Souvenir and Abstract Book

NATIONAL SEMINAR

ON

Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India

19-20th November, 2018

Compiled by:
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Organized by

Royal Association for Science-Led Socio-Cultural Advancement (RASSA), New Delhi
and
Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu
(SKUAST-J) Main Campus, Chatha, Jammu-180009 (J&K)

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राधा मोहन सिंह
Radha Mohan Singh

सत्यमेव जयते

कृषि एवं किसान कल्याण मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
& FARMERS WELFARE
GOVERNMENT OF INDIA

Message

It is a matter of immense pleasure to me that Royal Association for Science-Led Socio-Cultural Advancement (RASSA), New Delhi and Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu are jointly organizing a National Seminar on "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" during November 19-20, 2018, at Jammu.

Agriculture is susceptible to short term changes in weather and to seasonal, annual and long term variations in climate. Crop yield is the culmination of a diversified range of factors. Parameters like soil, seed, pest and disease, fertilizers and agronomic practices significantly influence crop yield. Burgeoning population, along with human-induced climate change and associated ecological problems are increasingly becoming a limited factor for enhancing farm productivity and ensuring food security for the rural poor. Achieving improved and sustainable agriculture production and productivity largely depends on the advancement of agricultural research and its effective application at farmers' field through transfer of technology.

I look forward to the Seminar with the anticipation that the discussions will culminate in a set of concrete recommendations to develop appropriate strategies for sustainable development in agriculture and poverty alleviation in the country.

I extend my warmest wishes and congratulations to the organizers for their endeavours in making this kind of academic interface possible.

Radha Mohan Singh
(RADHA MOHAN SINGH)

RASSA-2018

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D.O.No. PS/DDG(Edn.)/2018
Dated: 02 November, 2018

Message

I am glad that Royal Association for Science-Led Socio-Cultural Advancement (RASSA), New Delhi is organizing a National Seminar on "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" in collaboration with Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu at Jammu from November 19-20, 2018.

The theme chosen by the Royal Association for Science-led Socio-Cultural Advancement (RASSA) is topical and relevant in the context of present day's requirement for equitable and sustainable agricultural development. While India has made tremendous strides in all spheres of agricultural research and development thus paving the way for the great Indian green, white and blue revolutions, ensuring food and nutritional security to the nation, yet the degrading trend of rural resources and adverse climate change scenario have emerged as serious problems. The conservation and management of rural resources is essential to ensure sustainable development of future agriculture. This involves integration of social trade, environmental and ecological issues with efficient agricultural production. I hope, the deliberations and discussion during the Seminar would help to bring out meaningful suggestions and recommendations pertaining to the key area of information and communication management towards the development of smart agriculture.

I convey my best wishes to the organizers for the grand success of the National Seminar.

(N.S. Rathore)

RASSA-2018

डा. अशोक कुमार सिंह
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Message

I am delighted to learn that "Royal Association for Science-Led Socio-Cultural Advancement (RASSA)" is jointly organizing a National Seminar-2018 in collaboration with SKUAST-Jammu from 19-20th November, 2018.

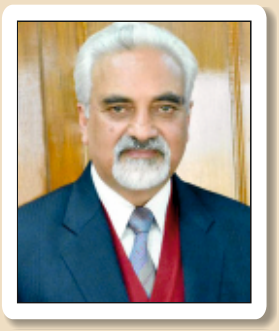
Indian agriculture is facing a big challenge to ensure food and nutritional security to meet the demand of ever increasing human population. Amidst this situation agriculture plays a pivotal role in the refurbishment of the green economy of our country to move towards a second green revolution but the emergence of large scale biotic and abiotic stresses, rampant degradation and depletion of natural resources put a question mark in the sustainability of the agriculture. The on-going effect of present climate change is further exacerbating the pressure. In this context, the agriculture scenario in hilly state of J&K is still lagging behind from the rest of the country. The factors like natural calamities spreading over various agro climatic situation of the region, large number of small holders, shifting land use pattern, low intensity of agri-inputs and negligible seed replacement rate are threatening the livelihood sustainability in the region.

In this context, the theme of the Seminar "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" is appropriate and need of the hour as we feel that there is a gap between technology generation and its use by the end users, especially the small and marginal farmers.

The organization of this Seminar is very timely and it will have a greater impact in catalyzing our commitment to reach the unreached for ensuring food and nutritional security to the ever increasing population without putting stress on natural resources.

(A.K. Singh)

RASSA-2018



Pradeep K. Sharma
Vice-Chancellor,
SKUAST of Jammu

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Message

I am pleased to learn that Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu is organizing National seminar on "Smart Technology to Boost Farm Profitability and Socio-Economic Status of Rural India" from 19-20th November, 2018 in collaboration with the Royal Association for Science-Led Socio-Cultural Advancement (RASSA), New Delhi. The seminar will serve as a platform for evolving broad consensus on use of smart technologies and development of future strategies. This will help in boosting farm profitability and socio economic status of farmers engaged in agriculture and allied sectors.

I hope that the deliberations of the seminar will result in a road map in support of holistic development agenda, demand driven research programme and their applications in the entire value chain with farmers and market occupying the central place

I extend my best wishes for the success of the seminar.

(Pradeep K. Sharma)

RASSA-2018

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"An institute for sustainable agriculture for food and nutritional security"

Dr. Jag Paul Sharma
Director Research

DIRECTORATE OF RESEARCH
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Message

It is the matter great pleasure that the Royal Association for Science-Led Socio-Cultural Advancement (RASSA), New Delhi in collaboration with Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu is organizing a National Seminar on "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" at Jammu from November 19-20, 2018. Effective risk management is crucial to increasing economic growth, improving food security and reducing poverty. Further, there has to be better assessment of climate risks, understand the interconnections between different types of risks and improve agricultural information strategies. There is a need for innovative extension approaches in the changing climatic conditions and international market situations so that Indian farmers could be empowered with smart technologies to boost farm profitability and socio-economic status of rural India.

I hope the deliberations and discussions on seminar theme would help to bring out suitable recommendations and plan for boosting farm profitability and enhancing socio-economic status of rural India in general and Jammu region in particular.

I wish the National Seminar a grand success.

I extend my warmest wishes and congratulation to the organizers for their endeavors in making this kind of academic interface possible.

JPSharma.

(Jag Paul Sharma)

RASSA-2018

Dr. K.S. Risam
Director Extension,
SKUAST Jammu

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Message

I am delighted to learn that RASSA-2018 National Seminar is being organizedjointly by Royal Association for Science-Led Socio-Cultural Advancement and Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu on the theme "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" from 19-20 November, 2018.

I hope that the seminar will identify the bottlenecks in the agriculture and allied sectors and suggest concrete measures to boost farm production /productivity and also formulate strategies for effective and speedy dissemination of technologies to the end users i.e. farmers. I congratulate the organizers for selecting the venue for the seminar at Jammu where farmers are key members for driving agriculture growth. I wish this seminar all success.

(K.S. Risam)
Director Extension SKUAST-J

RASSA-2018

Dr. D.P. Abrol
Dean
Faculty of Agriculture

FACULTY OF AGRICULTURE
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Message

I am pleased to hear that RASSA-2018 National Seminar is being organized jointly by Royal Association for Science-led Socio-Cultural Advancement, New Dehli and Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu. The theme entitled "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" has been rightly chosen keeping in view the present scenario of agriculture in the country.

Agriculture is the backbone of the Indian economy with the precise of bountiful of natural resources, wide biodiversity and varying agro climate situations of the country that offer a great scope for accelerating growth in the area of agriculture, horticulture, fishery and allied farm sectors. The purposed seminar is a noble effort to give a thrust in the agriculture development of the Jammu region in particular and the country in the general.

I compliment the organizers for selecting Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu as a venue of the seminar. I hope that outcome of the seminar will help in formulating strategy (ies) for effective transfer of research through extension to boost farm profitability and socio-economic status of rural India.

My best wishes for the success of the RASSA-2018 National Seminar.

(D.P. Abrol)

RASSA-2018

Awadhesh K. Singh
President

रायल विज्ञान–सेवित
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Registered Office
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F.No. RASSA/2016/Seminar/Jammu
Dated: November 06, 2018

Message

I am happy to know that RASSA is organizing two days National Seminar on "Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India" in collaboration with Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu on 19-20 November, 2018. The theme topics and subtopics identified for deliberations include almost all the important areas of Production, Protection and Processing Agricultural & Horticulture crops, Livestock. Food sciences and technologies, Agripreneurship and environment & sustainability, Capacity building and Competitivencess of Indian agriculture in global scenario.

Comprehensive deliberation planned in this seminar and development of appropriate action plan is very important to ensure end to end solution to the problems faced by Indian agriculture. The importance of such technologies has further increased in view of unpredictable and erratic climatic conditions observed every year during crop production seasons. Application of smart technologies will come handy for the farmers in salvaging the situation. Seminar on selected topics are timely, crucial, relevant and look like follow up of the resolve of RASSA to realize dream society consisting educated, competent, healthy, happy, progressive, prosperous and peaceful rural India adopted in its meeting held at Lucknow last year. All this can be possible only with increase in the income from the rural resources by inculcating the concept of Integrated Farming Systems with six "Fs" i.e. food, feed, fence, fuel, fertilizer and funds are managed to the fullest extent, utilizing byproduct of one operation as input in other operation with help of smart technologies in all the area to make farming not only sustainable but ever-growing with sustainability.

While I thank the organizers, the RASSA and SKUAST, for organizing such a relevant seminar from the land of goddess, I wish all the success for the seminar and pray for her blessings to make all the benefits flow to the rural India and Indian Agriculture to make this country strong and strong on all fronts.

(Awadhesh Kumar Singh)

RASSA-2018

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Dr. Poonam Parihar
Organizing Secretary
RASSA-2018

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Desk of Organizing Secretary

There is a tremendous technological development in agriculture and allied fields, but the outcome and benefits of all such advancements have not reached to the farming community. For this, several extension approaches have been tried and succeeded in various locations and community but no single approach could be claimed as the best for all situations and locations. Due to complexity of the social behavior of the farming community, there is always quest for the innovative approaches for food, nutrition and livelihood security in the rural areas. The enhanced production, processing and marketing in agriculture are vital for promoting remunerative rural employment and sustaining life support system livelihood security. There is a need to delve in length all the interrelated issues concerning agricultural growth agripreneurship development.

The theme of the National Seminar on "Smart Technology to Boost Farm Profitability and Socio-Economic Status of Rural India" is very relevant and timely in the context of rural prosperity. The seminar will cover all the important areas such as sustainable agriculture development, environmental and sustainability, technical advances and innovation in livestock and companion animals, agripreneurship, natural resources management, information and communication technologies, public private partnership and marketing. I hope the scientists, experts, entrepreneurs; extension personnel and industry partners attending this seminar shall deliberate on the above issues and come up with recommendation to mitigate the problem faced by the farmers. I think it is the high time to address the issues of rural development in meaning full manner.

I extend my sincere wishes for successful organization of the seminar.

(Poonam Parihar)

RASSA-2018

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ABOUT HOST INSTITUTE

Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu came into existence on 20th September 1999, and is a multi- campus university. It undoubtedly has grown leaps and bounds since its inception and has created an impact on education paradigm in the region.

ABOUT RASSA

Preamble: Innovations of Science do not reach the needy people timely. Science led interventions carry potential for development of people. Efforts from all responsible organizations and citizens including Government is needed to ensure that the potential of scientific innovations is realized for the benefit of the masses, to improve their income and living conditions. A group of like-mindedscientists, technocrats, business persons and other luminaries to facilitate the noble goal for overall advancement of the people and rural areas in a sustainable manner protecting natural resources and eco-systems.

Vision: To create a strong and coherent society sensitive to the social, cultural & educational needs to serve the society adopting science-led approaches.

Mission: To engage like-minded intellectuals in serving the society though science-led interventions.

Objectives

- To create a platform for like-minded people for the sustainable advancement of the society.
- To promote the educational and economic well-being of people by formulating plans and creating interest for entrepreneurial activities through skill development.
- To mentor and provide support to bright young individuals from less unprivileged section of the Society.
- To help to business professionals to setup and run their businesses in emerging field

ABOUT THE SEMINAR

The National Seminar of Royal Association for Science-led Socio-Cultural Advancement (RASSA), New Delhi- 2018 will be organized at Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu (SKUAST- Jammu), Main Campus, Chatha, Jammu-180009, J&K, India during 19th-20th November, 2018. The title of the seminar is “Smart Technologies to Boost Farm Profitability and Socio-Economic Status of Rural India”.

Contents

Relevance of Agriculture in Developing Entrepreneurship among Farmers- A Case Study

Rajesh Singh
Vice Chancellor
Purnea University, Purnia (Bihar)

Early agriculture research and education

Agricultural research and education encompasses the study of applied sciences (e.g., biology, chemistry, physics), and business management principles. One of the major purposes of agricultural research and education is to apply the knowledge and skills learned in several different disciplines.Agricultural research and education goes beyond knowledge and skills development in that students are able to develop an understanding of: 1) the significance of agriculture in a global society, through the application of scientific and business principles and problem solving strategies; and 2) the interdependency and relationships between the agricultural industry and other significant business interwoven with the entire economic and social structure of the community, state, nation, and world. The agricultural research and education focuses on the needs of individuals and groups and in developing individually satisfying and socially responsible knowledge, skills, and occupational values. Such a focus recognizes the value of, and relies heavily on, experiences as the context in which knowledge and skills are learned.Agricultural research and education focuses on, but is not limited to, study in horticulture, forestry, conservation, natural resources, agricultural products and processing, production of food and fiber, aquaculture and other agricultural products, mechanics, sales and service, economics, marketing, and leadership development. Of relevance to a general audience, agricultural research and education programs assist with providing lifelong learning opportunities in and about agriculture. Agricultural research and education provides opportunities to learn basic agricultural skills and knowledge, occupation training and retraining, and professional growth and development. Agriculture involves lots more than “plows and cows,”. Science has always played a very strong role in agriculture. It is important to take science and research and marry it with entrepreneurship and business to create a center that welcomes startup companies, growing companies, domestic and international partners, research institutes and academic and government labs—all interested in making their way in the growing field of agri-bioscience technology. Those companies may focus on anything, from bioenergy to sustainability to food and animal safety.It’s an exciting field, andis growing. Such companies are coming in, Energy, Food, Animal Health, Vaccines and Diagnostics for Animals, Poultry etc. We are looking to the companies that are in the areas we work in and we can provide technical support. So, before we try to explain how entrepreneurship in agriculture is influenced by research and education; we will like to focus on early research and education, which was structured to improve the skill of students and farmers to learn entrepreneurship in agriculture.

An early philosophy of agricultural education

At its onset agricultural research and education was part of a broad-based approach to rural education. The idea of making rural improvement a national issue. As early as 1906 the importance of relevant education was being discussed, as was the idea of rural-life development. For example, Liberty Hyde Bailey began his book *The Training of Farmers* (1909) with the lines: "The so-called rural problem is one of the great public questions of the day. It is the problem of how to develop a rural civilization that is permanently satisfying and worthy of the best desires" (p.3). In the preface to Aretas Nolan's *The Teaching of Agriculture* (1918), an author named Davenport wrote "That measure [success] is found in the performance of those who actually go to the land, live there, and succeed; for, after all, the fundamental purpose of our great system of agricultural research and education is to insure a better agriculture and make a country life as nearly perfect as possible" (p. vii).Good education depends on good teaching, which depends, in turn, on good teachers. The well-educated vocational agricultural teacher, according to Nolan, must be a thorough scientist and a technically trained agriculturalist. He should also have studied rural sociology, agricultural economics, public speaking and "other work to liberalize his general training" (p. 163), as well as having a thorough understanding of educational principles of pant system, psychology, and management. This is because the teacher's "influence and activities extend outside of the school to the rural life of the community" (p.163).In 1999 agricultural educators at the university, community college, and secondary school levels held a series of meetings to again look at where agricultural education is and where it needs to go. In their mission statement, this group explained that the mission of agricultural education was to provide a total dynamic educational system, to aspire to excellence, to serve people, and to inform the public about agriculture's needs, opportunities, and challenges. In attempting to accomplish this, the consortium listed the following objectives:

- To provide instruction in and about agriculture.
- To serve all populations.
- To develop the whole person.
- To respond to the needs of the market place.
- To advocate free enterprise.
- To function as a part of the total education system.
- To utilize a proven educational process, one which includes formal instruction, experiential learning, leadership, and personal development.

The future of agriculture research and education is bright. The food, fiber, and natural resource system requires the services of people well educated in the agricultural sciences. These people need experiential learning and personal leadership development training in the context of agriculture. Agricultural education programs can provide the education and training needed to serve the needs of the vast industry called agriculture.If we evaluated how agriculture research and education was formed, we can see agriculture is not only for increasing agriculture production and productivitybut also to improve whole society not only individual human being but whole population.

Our farmers are not getting best benefit of our well-planned research and education because we lack teaching them entrepreneurship in agriculture. Let us understand concept of entrepreneurship with special reference to the framers. How we can help farmers to become entrepreneurs?

Farmers becoming entrepreneurs

A lot is being said these days about farmers becoming 'entrepreneurs'. There are two parts to entrepreneurship. The first is the managerial skills needed to start and run a profitable farm business. The second is 'entrepreneurial spirit'.Both are important. Managerial skills can be taught, butan entrepreneurial spirit cannot be taught. Many farmersare already excellent managers and many also have some of the spirit of an entrepreneur. As 'price takers'many farmers have developed outstanding abilities tomake the most of their resources. But being 'price takers'suggests that these farmers are not innovative, do nottake risks, and lack the drive that is usually associatedwith an entrepreneurial spirit.

The purpose of this paper is to provide abetter understanding of the concept and practice ofentrepreneurship. With this understanding it is hoped that it will be better to help farmersdevelop the skills and spirit of an entrepreneur. This paper canhelp all of potential farmer-entrepreneurs. It is useful for them to understand what works and what doesn't.

What is entrepreneurship?

Entrepreneurship, value chains and market linkages are terms that are being used more and more when talking about agriculture and farming. Many small-scale farmers and extension organizations understand that there is little future for farmers unless they become more entrepreneurial in the way they run their farms. They must increasingly produce for markets and for profits. Becoming more entrepreneurial can be a challenge for small-scale farmers.

"An entrepreneur is someone who produces for the market. An entrepreneur is a determined and creative leader, always looking for opportunities to improve and expand his business. An entrepreneur likes to take calculated risks, and assumes responsibility for both profits and losses. An entrepreneur is passionate about growing his business and is constantly looking for new opportunities. Entrepreneurs are also innovators. They always look for better and more efficient and profitable ways to do things. Being innovative is an important quality for a farmer-entrepreneur, especially when the business faces strong competition or operates in a rapidly changing environment "

Farmers as entrepreneurs

Can small-scale farmers become entrepreneurs? Yes, Small-scale farmers all over the world have shown remarkable ability to adapt. They look for better ways to organize their farms. They try new crops and cultivars, better animals, and alternative technologies to increaseproductivity, diversify production, reduce risk – andto increase profits. They have become more marketorientedand have learned to take calculated risks toopen or create new markets for their products. Manysmall-scale farmers have many of the qualities of anentrepreneur.For small-scale farmers to become entrepreneursthey need all of these qualities and more. They needto be innovative and forward-looking. They need tomanage their businesses as long-term ventures with aview to making them sustainable. They need to be ableto identify opportunities and seize them.Some small-scale farmers do have these qualities,but they still focus on maintaining their traditional ways.

On the first rung of the ladder are farmers who farm exclusively for home consumption. If there is a surplus, they will sell it on the market, but this is very rare. Often these farmers are struggling with the basic survival of themselves and their families. They usually lack security in terms of health, water, food and shelter. They are rarely in the position to commit their minds and bodies to entrepreneurial tasks. While they may be entrepreneurial in spirit, they usually lack the opportunity to farm as entrepreneurs

On the second rung are farmers who have greater opportunities that allow them to produce beyond just surviving. These opportunities are still very limited. However, by changing their resource mix and overcoming access and risk issues, opportunities can be expanded. At this level the farmers are not 'entrepreneurs' in the true sense and neither are they truly market-oriented. They have a greater appreciation of the market and have expanded their survival farming to include some economic activities. The third rung represents farmers who understand the value of farming for the market, but are often limited by access to finance, labour or market information. The elements are all there, but they cannot risk family food requirements without greater certainty of income from cash crops. Farmers on the fourth rung are fully market oriented. Their primary reason for farming is to make profits by producing for the market. They are interested in profits, not food production. To be successful at market-oriented farming, the farmer needs greater farm management and entrepreneurial skills.

The entrepreneurial environment

For farmers to cope with the risks they will face in the complex world in which they compete, they need to develop an entrepreneurial spirit. A farmer with an entrepreneurial spirit energetically, enthusiastically and carefully makes many different decisions about his farm in the context of the value chain that influences the profits of the farm business. This is all happening in a dynamic, ever-changing and uncertain setting

Group entrepreneurship

Entrepreneurship can also occur among groups of farmers who want to form a business together. These farmers have similar goals and objectives and a willingness to share the benefits and risks. Ownership and control of the enterprise are divided among the group members. The group is the financial investor, employee and risktaker. Group entrepreneurship is particularly attractive among those farmers who would not be able to start an entrepreneurial business on their own. Often these are the poorest farmers in the community or the farmers with the weakest links to the economy. They seek security through group activities which allow them to pool their resources, share the risks and develop a social 'safety net'. To be successful, group enterprises must have the same entrepreneurial skills and spirit as individual entrepreneurs.

For group entrepreneurial we are using special plan in our this study that is " Farmers Producer Company" details of which has been explained in the case study by BHU Varanasi among eastern Uttar Pradesh farmers.

Barriers to entrepreneurship

It cannot be assumed that every enterprise will be successful. It needs the right environment. But often there are barriers outside the control of the farmer that limit success and make the environment hard for new businesses. This environment is affected by government policy and the level of investment in agriculture. The environment is different in every country; it varies greatlyeven within countries.

Lack of financial support: A major stumbling blockfor many farmers to expand production or diversify intonew high value enterprises is lack of access to finance.Farmers who are starting new enterprises often facedifficulty raising investment capital.

Social barriers: There is an also social barrierto entrepreneurship that farmers face. The conceptof entrepreneurship is not common to every culture orsociety. The fear of failure can be a barrier. Creativityand innovation are not always valued traits.

Lack of training facilities: To have a healthy farming sector, training facilities and support must beeasily available to farmers. Effective institutions need tobe developed to provide education and training at theright time, in the right place, and with the right balance oftechnical knowledge and practical skills.Lack of support services and trained extension staff. Farmers advancing through the five stages ofdevelopment will need information, advice and support, when running a farm business, production must always be linked to a market. Access to markets is often constrained by a number of factors. These include poor communications, infrastructure and marketing facilities, lack of reliable and timely market information, limited purchasing power and even negative attitudes of buyers

Challenges

A few examples of how farmer-entrepreneurs have grown their farm businesses have been discussed.These include increasing the area under productionand processing and packaging to add value. They alsoinclude handicrafts and agro- eco-tourism.However farmer-entrepreneurs have developedtheir farm businesses, they will face many challenges.Farmer-entrepreneurs need to be as ready as they canto meet these challenges. Some of the more significantchallenges are:

- Market-related risk
- Access to finance and credit
- Access to information
- Low bargaining power
- Vulnerability to economic shocks
- Access to training and related challenges

Whichever markets they use, farmers face substantial risks to reach them. Markets do not always function well; they are dynamic and diverse and they are not completely predictable. But increased market participation does offer many opportunities. The farmer-entrepreneur must weigh up the opportunities and risks and decide on the combination of markets to use. This is a key challenge for farmers. Access to finance and credit To change a home consumption farm into a marketoriented farm will require finance. There may be a need to upgrade equipment, hire transport to get to market, expand production or add processing. All of these require finance. The farmer can first check his own resources, but if he does not have sufficient funds of his own, he will need credit.

The Case Study: Banaras Hindu University

The Keeping above facts in mind we started working on a project, five years back (2011-12), how to bring farmers in entrepreneur mode. Initially we adopted some farmers of Chandulai and Mirzapur district to help them

produce foundation and certified seed of wheat, rice and pulses, so that they earn more. We provided them with breeder seed and helped them to produce seed for market. We also helped them in marketing by connecting them with government official to purchase their seed. But we faced problem due to several factor as they started getting depend on us for input and market. We started getting burden of running their business, which was practically not possible. So, we started working on the project how to make these famers real entrepreneur. This brought the concept of Farmers Producer Company.

Background of Concept of Farmer Producer Companies

The concept of Cooperatives initiated in milk programmes in Gujarat have shown its impact on State economy but many other states contributing significant percentage towards poverty are yet to realize impact of Cooperatives for political and other outside interference. The important States falling in this category include among others, Uttar Pradesh and Bihar. This has promoted the idea of formation of a "Producers Company" rather than a Cooperative. New concept of Producer Company was introduced in 2002 by incorporating new part XI A into the companies Act which enables incorporation of cooperatives in companies and conversion of existing cooperatives into companies, while exercising the unique elements of cooperative business with a regulatory frame work similar to that of companies. In a producer company only person engaged in an activity connected with or related to, primary produce can participate in the ownership. The members have necessarily to be primary producer. Several businesses have developed interest in model engagement with the farming community. It is farmers centered and farmers supported system of production and marketing that will make for durable arrangements. Farmers will need to be convinced that they could be owners of the means of production as well as partners in production and marketing methods, in a way that would benefit them. It is this trust that will trigger a chain of action for innovative production architecture. Such partnership also creates synergies through knowledge sharing, joint learning, and scale of economies, resource pooling and cost sharing.

Proposed Farmer Producer Company (PC)

The concept of producer company was introduced in 2002 by incorporating a new part IX A into the Companies Act based on the recommendations of an expert committee led by noted economist Y.K. Alagh, that was given the mandate to frame a legislation that would enable incorporation of cooperative as companies and conversion of existing cooperatives into companies while ensuring the unique elements of cooperative business with a regulatory frame work similar to that of companies.The objective of producer companies shall include one or more of the eleven items specified in the Act, the more important of these being:- Production, harvesting, procurement, grading, pooling, handling, marketing, selling, export of primary produce of members or import of goods or services for their benefit; Processing including preserving, drying, distilling, brewing, venting, canning and packaging of produce of its members and manufacture, sale or supply of machinery, equipment or consumable mainly to its members. The other objects include rendering technical or consultancy services, insurance, generation, transmission and distribution of power and revitalization of land and water resources; promoting techniques of mutually and mutual assistance, welfare measures and providing education on mutual assistance principles.

PC is a Producer Company of the farmers, by the farmers and for the farmers, financially facilitated by the government, but managed by professionals, leaving farmers to farm and on-farm activities. The concept visualizes to leave farmers to their area of expertise, farming and on farm activities, whilst the management of the 'cash to cash cycle' of the company will be taken over by the professionals staffing the PC. In today's competitive world, a farmer has to fend for everything right from finance, procuring inputs, farming for production and marketing for profitability. Each activity is an expert area and we cannot expect a farmer of limited resources and exposure, to be competitive. PC is proposed to take over all responsibilities from the farmers groups, leave them to farm, making them sustainable, where they remain stakeholders to the end. PC is not a co-operative society but is something between a co-operative society and a private limited company, minus external vested interests due to transparency, public audit and accountability. A PC as visualized should enable government, banks and financial institutions (eg. – NABAARD in India) to deliver of its programs, funds, etc, meant for farmers.

PC professionals would guide its members (employees of the PC would also be shareholders along with farmers and thus stakeholders to the end). Plans and budgets, macro for 3 years and micro, carved out of the macro, for one year, detailing the crops to be grown by the different members and on how much area, the price they will be paid on harvest, etc. This will be determined by factors such as (a) survey on needs of local community in the village, (b) contracts obtained (preferably in advance) from market (c) contracts from government programs etc. Each farmer will be paid price of his/her produce that was determined at the time of sowing. PC professionals will be accountable to the board of directos of the PC, which will include some farmers – general body of the farmers/members will have the ownership of the PC, through an annual business plan and budget, as done by a corporate company indicating production strategy, market strategy and the projected positive cash flow.

BHU model of farmers producer company

We decide to form different producer company for different districts of farmers and consequently a model was produced. The model was; each company will have 1000 famers as share holder. Each farmer will purchase 100 shares of Rs 10 each. Thus every company will collect about Rs Ten lacs (Rs 10, 00,000). As per guidelines of

Reserve Bank of India, we will get Rs Ten Lacs matching equity grant and Rs Ten Lacs is being provided by NABARD. So, literally these company will have Rs thirty lacs, if you have 1000 such share holders. After getting matching equity grant from SFAC, Minister of Agriculture and Farmers Welfare, Government of India, these companies are entitled for various subsides, grant, and low percentage loan by different Nationalized bank in India. We have a classic example of a company having turnover of Rs 1 crore to 10 crore in 3-5 years. This is a classic example of group entrepreneurship among the famers

Farmers producer company formed by BHU

Twelve Farmers Producer Companies were formed under a project by RKVY, whose PI is Dr Rajesh Singh (first author of this paper), with support of FAARD foundation, Varanasi. This initiative aims at developing a network of about 25000 farmers under one umbrella of a Master Company, which will work for promotion, and guidance of 12 companies. All these twelve companies have been registered under company act. Funds for their registration, CA fee and promotion were provided through a project, whose PI is Professor Rajesh Singh and funds for the project was obtained from Government of Uttar Pradesh, Government of India, RKVY etc. These companies are Badagaw Agro Producer, Company, Ltd. Vill- Gagkala Bhattha, Varanasi; Shivansh Krishak Producer, Company, Ltd. Susuwahi Karaudi, Varanasi; Amar-Beer Agro producer Company, Ltd. Odra, Dhanapur, Chandauli; Jaya Seeds Producer Company, Ltd, Jayapur Jakkhini, Varanasi-221305; Ishani Agro Producer Company, Ltd. Vill& Post- Imiliya, Vaya- Saiyadraja, Dist- Chandauli; Gramya Agro Producer Company, Ltd, Vill- Mahuawari, Post- Renda, Dist- Azamgarh; Barkachha Agro Producer Company, Ltd. Kamala Nagar Colony, Daulatpur, Pandeypur, Varanasi; Maa Vindhyavasini Agro Producer Company, Ltd. 474 New Colony, Arajibagh, Azamgarh; Punarutthan Agro Producer Company, Ltd, Vill& Post- Singhpur, Dist- Azamgarh; Jayashree Agro Producer Company, Ltd. Susuwahi Varanasi; MaaKalika Agro Producer Company, Ltd, Varanasi and JayashriHari Agro Producer Company, Ltd. Vill- Andokhar, Post- Shadiyabad, Dist- Ghazipur.

It has been planned that a project costing Rs 1.00 to 10.00 crores will be prepared for each of 12 companies,with the help of technical and financial expert for funding and smooth running of the companies. We have been able to bring about six thousand farmers under one umbrella. These companies have collected about Sixty Lacs from the farmers of Eastern Uttar Pradesh, which will attracted about Rs 60 lacs matching grant form SFAC, SFAC, Minister of Agriculture and Farmers Welfare, and sixty lacs by NABARD. This model is working on the concept of PM Mr Narendera Modi Ji desire of double the income in five year, we are tripling income in three years.

Livestock Production: A tool for nutritional security, socio-economic upliftment and rural empowerment

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Livestock rearing is an important component of the Indian agriculture with regards to its contribution to Gross National Product (GNP) as well as employment in the rural and peri-urban areas. Besides that, livestock sector plays an important role in ensuring food and nutritional security by eliminating hunger and widely spread malnutrition. It contributes to national economy and socio-economic development of the people by providing the way for livelihood security and essential nutrition through various products viz. milk, meat, eggs etc. The main objective of livestock production is to provide wholesome food with best quality protein for ever increasing human population. Livestock are also the source of wool, leather, fuel, draft power and fertilizer. This is the reason why 65% of the rural population is directly or indirectly attached with the livestock production system. Livestock is considered as the source of sustained rural economic growth as it reduces poverty much faster than agricultural crops. Even during the adverse climatic condition like drought and heavy rainfall, it helps in maintaining the economic condition of the rural family. Gender equity is more pronounced in livestock sector as about 70% participation is from women side as compared to 33% in agricultural farming.

Livestock Products and Sustainability

Pragmatic approaches for efficient livestock production and utilization are important to sustain livestock production activities. Sustainable animal production depends on feed supplies and costs, production efficiency and optimum utilization of produce. They further depend on hygienic production of milk and meat, value addition and diversification, better utilization of by products, cost efficient processing technology, creating sustained demand for the products, building positive image and innovative marketing approach.

Sustained livestock production to provide livelihood and ensure food and nutrition security to a large population is dependent on efficient utilization of livestock products. Processing of milk, meat, egg, wool and skin for the development of value-added products contribute to sustained demand for livestock and their products and efficient marketing of these products provides reasonable returns to the farmers. At present about 22% of milk and 2% percent of meat is processed into value-added products for trade while in developed countries it is above 90% and 60%, respectively.

Table 1: Share of Agriculture and Livestock sector in National GDP

Year	GDP total	GDP-Agriculture		GDP-livestock sector		% to agriculture
	(Rs in Billion)	(Rs in Billion)	% to total GDP	(Rs in Billion)	% to total GDP	
1980-81	1224	425	34.72	59	4.82	13.88
1990-91	4778	1352	28.30	308	6.45	22.78
2000-01	19250	4089	21.24	1047	5.44	25.61
2010-11	72489	11435	15.77	2858	3.94	24.99
2015-16	124586	13122	10.5	5606	4.5	25.8

Source: BAHS 2017 (AHS Series 18)

Table 2: Trends in production of major livestock products in India

Year	Milk	Eggs	Wool	Meat
	(Million tonnes)	(Million Nos.)	(Million Kgs.)	(Million tonnes)
1960-61	20.0	2881	28.7	-
1980-81	31.6	10060	32.0	-
2000-01	80.6	36632	48.4	1.9
2010-11	121.8	63024	43.0	4.8
2015-16	155.5	82929	43.6	7.0
2016-17	165.4	88139	43.5	7.4

Source: BAHS 2017 (AHS Series 18)

Table 3: Production and Per capita Availability of eggs in India during 1950-51 to 2016-17

Year	Egg Production (million nos.)	Human Population (million nos.)	Per Capita Availability (number/annum)
1950-51	1832	359	5
1960-61	1908	393	5
1968-69	5300	518	10
1980-81	10060	679	15
1990-91	21101	839	25

2000-01	36632	1019	36
2010-11	63024	1186	53
2014-15	78484	1244	63
2015-16	82929	1260	66
2016-17	88139	1275	69

Source: BAHS 2017 (AHS Series 18)

Table 4: Wool Production in J&K and Some other states during 2012-13 to 2016-17 (in 000 kg)

S.No.	State	2012-13	2013-14	2014-15	2015-1	2016-17
1.	J&K	7681	8710	8371	6866	7266
2.	Punjab	558	558	461	473	490
3.	Himachal Pradesh	1649	1655	1663	1409	1475
4.	Haryana	1370	1390	1429	702	691
5.	Rajasthan	14007	15027	14463	13415	14321
6.	Andhra Pradesh	5031	5037	778	789	792
7.	Telangana	-	-	4423	4562	4658
8.	Maharashtra					
9.	Karnataka	8020	7755	8821	8191	6588
10.	All India	46055	47909	48140	43581	43544

Source: BAHS 2017 (AHS Series 18)

Indian livestock production is unique with larger animal population of lower productivity distributed over variable agro-climatic zones. This situation compounds development of efficient and organized processing sectors. Further decrease in availability of land resources due to increase in human population demands a change in livestock production to meet the demand of domestic and export market.

Milk Production:

Milk is a whitish colloidal fluid produced by mammary glands, consisting of globules of milk fat suspended in an aqueous solution of lactose, protein, mineral salts and water soluble vitamins. Milk is a complete and balanced food gifted by mother nature to us. The nutritive value of milk is very high and it supplies high quality body-building proteins, bone forming minerals and essential vitamins as well as energy rich milk fat and milk sugar, lactose. All the nutrients present in milk are easily digestible and assimilable form. Milk is devoid of any antinutritional or toxic compounds in it. However, milk is a poor source of iron, vitamin C and dietary fibres. Milk as such is having a low shelf life due to the presence of rich nutrients as well as the high water content. This makes the storage, preservation and transport of raw milk more difficult. Thus the raw milk is value-added by processing and converted into processed products such as cheese, butter, yogurt, powder etc. Where milk is consumed as a liquid, it is increasingly made available in a wide variety of forms such as low-to full-fat, flavoured, with added vitamins and minerals. Traditional Indian Dairy products are those products which are known in this country for ages. Milk and milk products formed the main food of Vedic Indians. Khoa sweets have been the item of choice for centuries in India. The ancient medical literature states that the physical and mental happiness of individuals depend on the food they take.

India has become the largest producer of milk in the world. It produces more than 165 million tons of milk annually, as in the year 2016-17. Milk production in India is highly seasonal. The availability of milk is abundant after monsoons and all through the winter which is flush season, the quantity of milk in the summer declines which is lean season. It is happening over the centuries in our country. When we have too much production of any commodities without a matching demand, prices come down and that is where the indigenous dairy products play their balancing role. Surplus milk in the evening is boiled and converted into dahi, then to makkhan and finally to ghee which has a shelf life of about one year. In India only 5-6% of total milk is converted into western type of products in the organized sector. Nearly half of the milk produced in India (50-55%) is utilized for the manufacture of value-added milk products and approximately 45.7% is used as fluid milk. Only about 22% of the total milk produced is processed by the organized dairy sector. Collection of the entire surplus milk from about 5.8 lakh villages and its processing requires huge capital investment on equipments, buildings and other infrastructure. The milk that is supplied in the cities and towns is very expensive as a result of high costs of procurement, processing and packaging and due to losses because of souring of milk. Conversion of surplus milk into indigenous milk products in and around production areas is least expensive and more profitable. A large proportion of the milk is converted into indigenous dairy products.

Value addition to dairy products is an age-old practice in the world as well as in India. Besides of getting the economic benefits, these products are designed to play a significant role in the therapeutic and health promoting benefits. The most of our indigenous milk products especially sweets are value-added milk products such as burfi, sandesh, milk cake etc.

Table 5: Production and Per capita Availability of Milk in India during 1950-51 to 2016-17

Year	Milk Production (million tones)	Human Population (million nos.)	Per Capita Availability (g/day)
1950-51	17.0	359	130
1960-61	20.0	434	126
1968-69	21.2	518	112
1980-81	31.6	679	128
1990-91	53.9	839	176
2000-01	80.6	1019	217
2010-11	121.8	1186	281
2014-15	146.3	1244	322
2015-16	155.5	1260	337
2016-17	165.4	1275	355

Source: BAHS 2017 (AHS Series 18)

Table 6: Per Capita availability of milk in J&K and Some adjoining states during 2012-13 to 2016-17 (in g/day)

S.No.	State	2012-13	2013-14	2014-15	2015-1	2016-17
1.	J&K	316	302	352	395	400
2.	Punjab	961	980	1003	1032	1075
3.	Himachal Pradesh	460	461	466	505	521
4.	Haryana	767	800	839	877	930
5.	Rajasthan	555	572	655	704	785
6.	Gujrat	476	506	527	545	563
7.	All India	299	307	322	337	355

Source: BAHS 2017 (AHS Series 18)

Table 7: Statistics of milk production of Jammu and Kashmir during 2013-14 to 2016-17 (in 000 tonnes)

Region	2013-14	% Contri-bution at National level	2014-15	% Contri-bution at National level	2015-16	% Contri-bution at National level	2016-17	% Contri-bution at National level
J&K	1615	1.17	1951	1.33	2273	1.46	2376	1.44
All India	137686		146314		155491		165404	

Source: BAHS 2017 (AHS Series 18)

Meat Production:

Meat is an important source of protein and there is a growing awareness among the consumers about the nutritional attributes of meat. In India more than 70% of the persons are non vegetarian and the demand for meat is ever increasing with growing human population and income of the individuals. In India the main source of meat is goat, sheep, cattle, buffalo, pig and poultry, in addition duck, turkey, quail, rabbit are the emerging sources of meat. Recently rearing of emu and ostrich has been started in some states for meat production. To cater the need of huge non-vegetarian population, India is blessed with rich livestock wealth and is considered as one of the most important livestock rearing country in the world with the largest population of 512 million animals comprising of 191 million cattle, 109 million buffaloes, 135 million goats, 65 million sheep and 10.3 million pigs besides 729 million poultry (Livestock Census 2012). According to estimates of the Central Statistics Office (CSO), the value of output from livestock and fisheries sector at current prices for 2015-16 was Rs. 8,12,352 crore for livestock sector and Rs.1,47,687 crore for fisheries). During this period the contribution of milk and meat at current price was Rs 5,50,171 crore and Rs. 1,63,195 crore, respectively.

The annual meat production of India was 7.4 million tons during 2016-17 and it ranks 5th in the world in total meat production. It comprises buffalo meat 1.45 MT, beef 0.33 MT, chevon 1.04 MT, Mutton 0.56 MT, pork 0.47 MT and chicken 3.5 MT. At present the percent share of cattle, buffalo, goat, sheep, pig and chicken in total meat production of India is 5%, 20%, 14%, 7.5%, 6.5% and 47%, respectively. It is noticed that about 5% cattle, 10% buffaloes 38% goats, 33% sheep, 99% pigs and 220% poultry are slaughtered every year. During last two decades a significant growth has been noticed in meat production. New economic policies have created ample enterprise opportunities for trade and challenges for the researchers in meat and poultry sector in recent years. Certain multinational companies are actively engaged in meat and poultry business in India and they are channelizing their marketing outlets to the international markets. The scope for small and medium entrepreneurs is equally good to cater the needs of people in domestic market. New industrial policy has opened the windows to the international trade house to enter the Indian market.

Table 8: Meat Production in J&K and Some other states during 2012-13 to 2016-17 (in 000 tonnes)

S.No.	State	2012-13	2013-14	2014-15	2015-16	2016-17
1.	J&K	34.07	33.03	44.96	75.08	85.10
2.	Punjab	212.14	235.03	236.87	249.91	248.64
3.	Himachal Pradesh	4.00	3.99	4.00	4.01	4.40
4.	Haryana	347.61	366.61	381.40	402.80	427.48
5.	Rajasthan	151.72	174.89	180.59	179.93	180.10
6.	Andhra Pradesh	906.23	934.75	527.8	56.28	632.51
7.	Telangana	-	-	505.05	542.05	591.04
8.	Maharashtra	590.68	604.63	630.62	675.10	845.01
9.	Uttar Pradesh	1136.85	1221	1397.19	1417.88	1346.11
10.	All India	5948.17	6235.48	691.08	7019.96	7385.61

Source: BAHS 2017 (AHS Series 18)

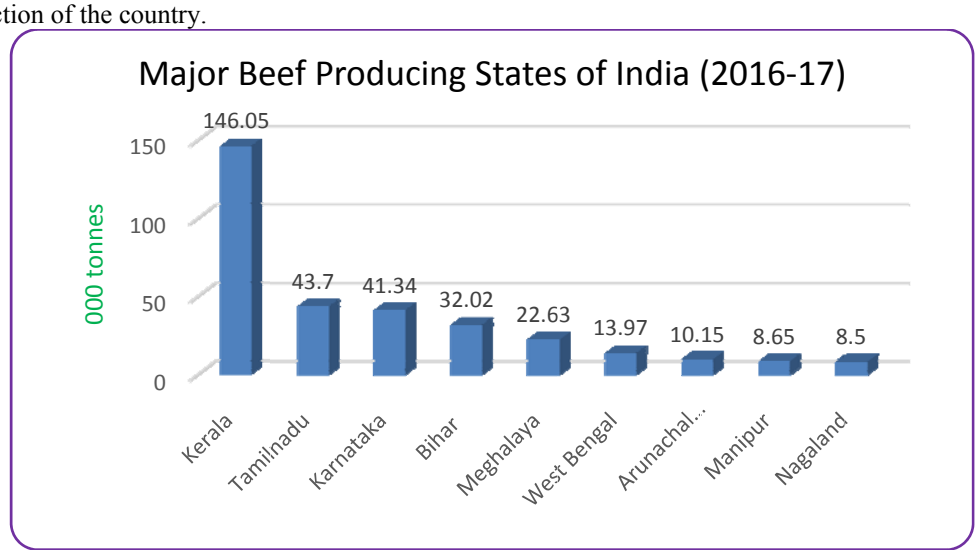
The importance of meat production in the country is evident from the fact that more than 70% of the human population is non-vegetarian by choice. However as against 11 kg per capita requirement of meat in the country, its availability from all sources is hardly 5.6 kg per capita indicating wide scope of improvement in production to meet the demand. In red meat production, the meat of choice is mutton and chevon whereas cattle and buffalo also contribute substantially to red meat production. Meat production is one of the fastest growing economies in the word. The production potential of meat animal has not been fully harvested in terms of its value addition and commercialization. There are many reasons for slow growth rate and meat processing industry in the country viz. negative attitude of public towards meat because of misinformation campaign and socio-religious-political considerations. The entrepreneurs who have resources to commercialize the production/trade avoid investing in the venture considering the trade unclean. Although a promising market exists in domestic sector and export to neighboring Middle Eastern and South East Asian region.

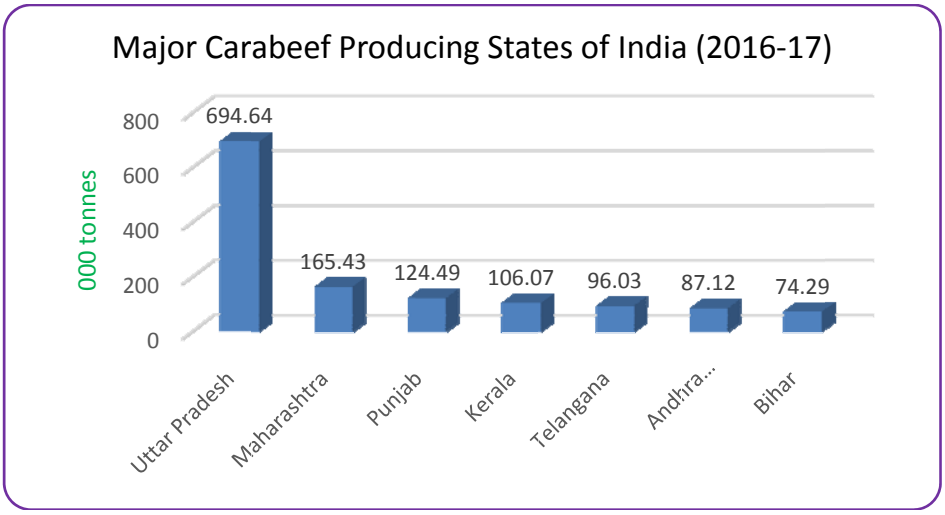
Table 9: Trends in meat production during 1960-2010

Quantity in million tonnes

Type	India			Asia			World		
	1961	2000	2010	1961	2000	2010	1961	2000	2010
Buffalo meat	0.55	1.26	1.46	0.98	2.56	3.08	1.07	2.85	3.41
Cattle meat	0.50	0.98	1.09	1.75	10.44	13.36	27.68	56.23	62.30
Goat meat	0.24	0.47	0.59	0.59	2.62	5.15	1.10	3.77	3.66
Sheep meat	0.12	0.22	0.29	0.85	3.52	4.37	4.93	7.66	8.53
Pig meat	0.15	0.47	0.33	2.90	48.01	61.96	24.80	90.01	109.26
Chicken meat	0.07	0.86	2.30	1.21	18.64	28.66	7.56	58.70	86.06

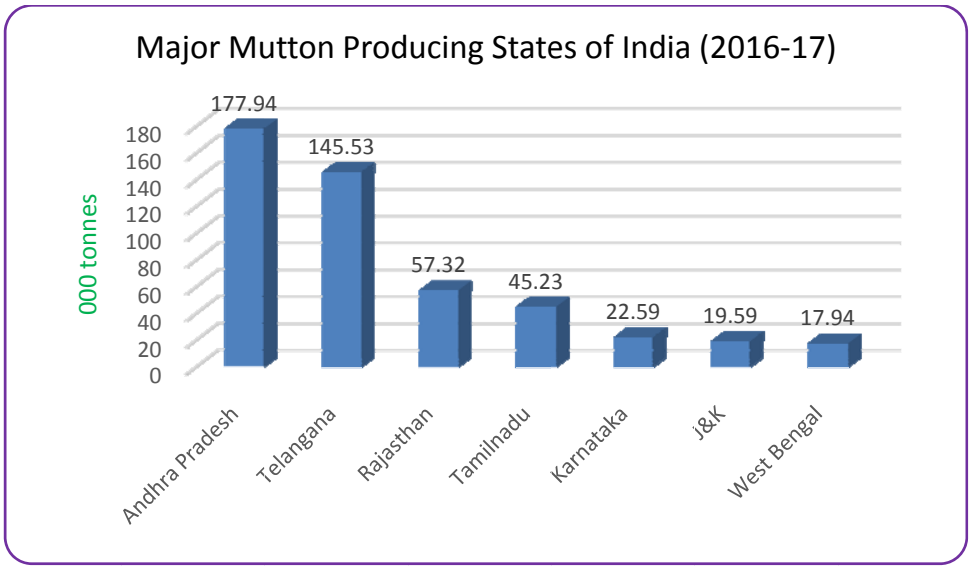
Bovine Meat: The major portion of the meat produced in our country is from large ruminants. In 2016-17, India produced 1.78 MT of bovine meat where 1.45 MT comes from the buffalo meat which is about 20% of the total meat production of the country.

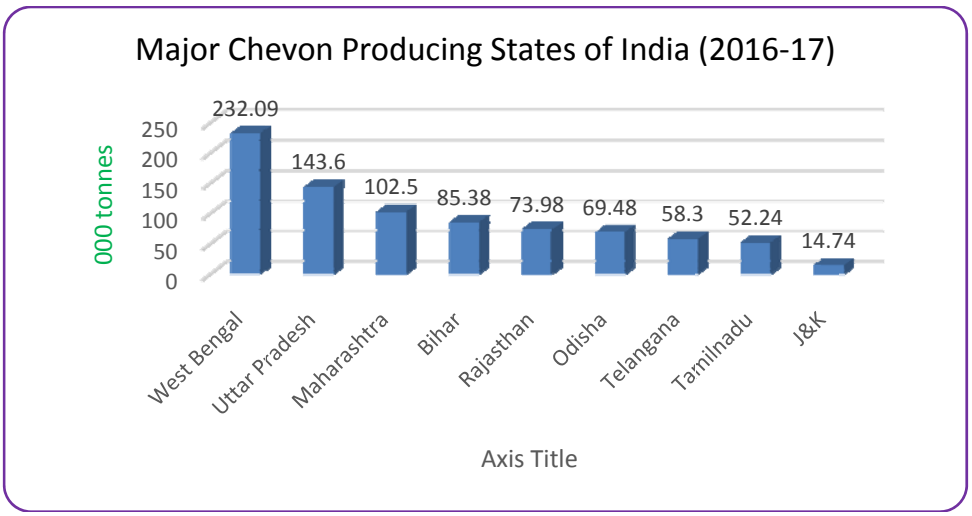




Most of the buffalo meat produced has export demand while meat from cattle is for domestic consumption only. Buffalo meat is preferred for its ability to retain moisture and its binding characteristics make it the choice meat for processing industry.

Sheep and Goat Meat: Sheep and goat meat is consumed by all the segment of the society without religious and social taboos hence serve as the main source of red meat consumption in the country. Goat meat is preferred in northern India whereas mutton is preferred in Southern India and Jammu and Kashmir. This group represents the costliest meat used for human consumption in India.





Pig Meat: In world largest contribution of meat is provided by pig as its production. China leads in production of pork. In India, pig meat production has increased at a faster rate as compared to meat production from other livestock species in the country. In India pig meat consumption has certain religious taboos and generally it is consumed by the weaker section of the society. The demand for pork is highest in the North – Eastern states in India. About 80% of the total pork is consumed by the NE persons while production is limited to areas of UP, MP, Jharkhand and Andhra Pradesh.

Demand of Livestock Products

Protein-energy malnutrition (PEM) is the most lethal form of malnutrition/hunger. It is basically a lack of calories and protein. Food is converted into energy by humans, and the energy contained in food is measured by calories. Protein is necessary for key body functions including provision of essential amino acids and development and maintenance of muscles. India has gained self-sufficiency in food grain production and is able to eliminate caloric hunger but till date it is not able to eliminate protein/nutritional hunger. The Global Hunger Index (GHI) is a multidimensional statistical tool used to describe the state of countries' hunger situation. In 2018, International Food Policy Research Institute calculated GHI for 119 developing countries and countries in transition. Out of these 119 countries, India has been ranked at 103rd position. It means that in developing world 102 countries are in better position than India with respect to hunger situation. The matter of concern is that India ranked below its South Asian neighours Nepal, Myanmar, Bangladesh, Sri Lanka and China in the GHI 2018. Myanmar ranked 68, China ranked 25, Nepal ranked 72 and Sri Lanka ranked 67 in the GHI. Livestock products being one of the important components of balanced diet, it warrants action on many fronts to increase their availability at affordable prizes.

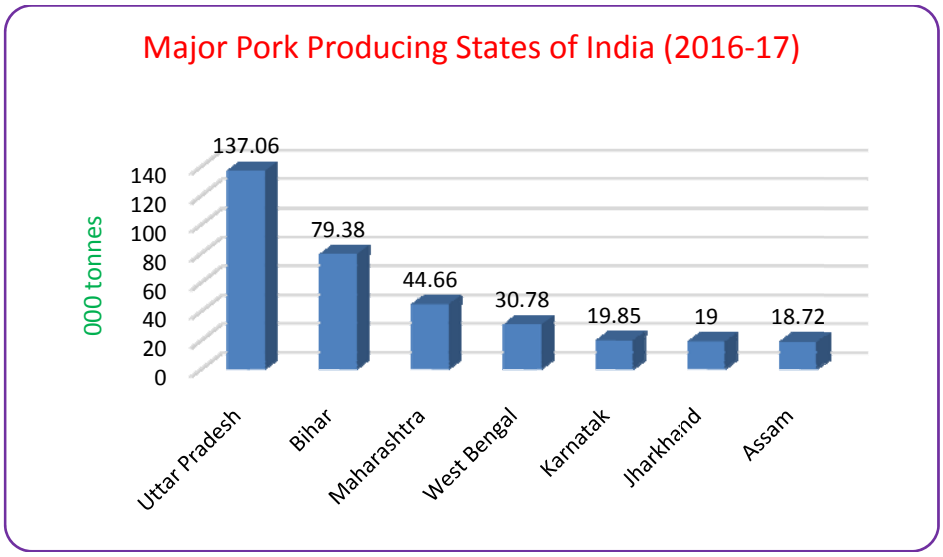


Table 10: Global Hunger Index scores 2018 showing situation of India and other adjoining countries

Country	Global Hunger Index (GHI)				
	2000	2005	2010	2018	Rank in 2018
Sri Lanka	22.3	21.2	17.9	17.9	67
Myanmar	44.4	36.4	25.9	20.1	68
Nepal	36.8	31.4	24.5	21.2	72
Indonesia	25.5	26.5	24.5	21.9	73
Bangladesh	36.0	30.8	30.3	26.1	86
Nigeria	40.9	34.8	29.2	31.1	103
India	38.8	38.8	32.2	31.1	103
Uganda	41.2	34.2	31.3	31.2	105
Pakistan	38.3	37.0	36.0	32.	106
Afghanistan	52.3	43.2	35.0	34.3	111

Countries with GHI≥30, between 20.0 and 29.9 and between 10.0 and 19.9 represents extremely alarming, alarming and serious hunger situation, respectively.
Source: IFPRI, GHI-2018

There is a large gap in the Indian animal protein consumption and ICMR recommendations, therefore there is an intense need to create awareness towards meat consumption in the developing counties both to utilize the available livestock as a food resource as well as to meet nutritional requirements. According to Nutritional Advisory Committee of ICMR the daily protein requirement of a healthy person is 1g per kg body weight. Average requirement of protein is 60 g per day per person with Net protein utilization (NPU) of 65. Out of this protein requirement about one third (20 g) we should get through animal protein to maintain the optimum balance of amino

acids. Average animal protein intake in developing countries is 15 g compared to 60 g in developed countries and for India it is 10 g compared to world average of 29 g. Ideally out of this 20 g, 50% requirement of animal protein should be met through milk, 20% from meat, 20% from fish and 10% from egg. Keeping in mind the present population growth, by 2020 the population of India would be 135 crore. It would be a big challenge to make animal protein availability at an affordable cost to all sections of society as the requirement will reach 170 MT of milk, 10.78 MT of meat, 10.78 MT of fish and 106 billion eggs. The triple effects of population increase, income growth and urbanization will fuel the growth in demand for animal products.

Table 11: Meat consumption trends

Region	Per capita consumption (kg/annum)
Developed countries	80.3
Developing countries	28.9
World average	39.8
India	5.6
Bovine meat	1.9
Sheep and goat	0.7
Pig	0.4
Poultry	2.3
Other meat	0.3

The gap between the expected demand and availability is likely to increase. Meeting the growing demand could be possible only through improving the productivity rather than number of livestock. Increasing productivity per unit time rather than their numbers is also important from environmental view point as livestock is considered as one of the important contributors of green house gases.

Export Potential of Livestock Products

India's international trade in livestock and livestock products is mainly in live animals, meat and edible meat offal, dairy and poultry products, feed and fooder and raw hide/skin and leather whose value in 2016-17 was Rs. 52,738, 27,20,919, 1,97,523, 7,47,739 and 5,96,430 lacs, respectively. India is the 1st and 5th largest producer of milk and meat out of total world milk and meat production, respectively.

Table 12: Export of livestock and livestock products during 2015-16 and 2016-17

Value: Rs. Lacs

Group	2015-16	2016-17
Livestock	46,598	52,738
Meat and edible meat offal	2,760,392	2,720,919
Dairy and Poultry Products and Honey	2,14,579	197,523
Animal feed and fodder	5,23,662	747,739
Raw hide and skin and leather	6,85,270	596,430
Raw wool and animal hair	1,16,532	108,367

Source: BAHS 2017 (AHS Series 18)

Table 13: Animal products exported from India Value in Rs Lacs

Qty in tonnes

Product	2015-16		2016-17		2017-18	
	Qty	Value	Qty	Value	Qty	Value
Buffalo meat	1314533.59	2668807.88	1323576.11	2616148.70	1350563.48	2603382.93
Sheep/goat meat	21635.70	83389.81	22008.58	86974.13	21906.51	83574.61
Poultry products	659304.17	76871.58	448724.74	53043.92	453966.53	55215.71
Processed meat	279.42	616.49	140.90	457.84	269.66	991.12
Swine meat	817.82	917.23	1117.95	1034.89	1115.34	1050.94
Animal casings	206.37	1702.44	173.23	1383.68	12424.66	32744.36
Dairy products	33442.55	75551.32	39166.98	90572.83	48039.45	119618.80
Natural Honey	38177.04	70587.11	45055.48	55779.03	51547.32	65357.58

Source: APEDA 2018

Table 14: Output from Livestock Sector at current Basic Prices (Rs. In Crores)

S.No.	Item	2011-12	2012-13	2013-14	2114-15	2015-16
1.	Milk Group	327767	372172	423146	495850	550171
2.	Meat Group	96219	114817	136311	154173	163195
3.	Eggs	16633	19658	22705	24404	26430
4.	Wool and Hair	496	539	584	578	571
5.	Dung	32599	37356	41741	44994	48094
6.	Silk Worm Cocoons and Honey	4326	4988	6448	6507	6541

Source: BAHS 2017

There is great demand of meat exported from India because of certain inherent merits such as its lean character, relative freedom from toxic Feed additive residues and near organic meat production. The major meat production centers in the country for exports are – Aurangabad, Nanded, Mumbai and Satara in Maharashtra; Goa; Medak and Zaherabad in Andhra Pradesh; Derabassi in Punjab; Barabanki, Unnao, Aligarh, Meerut, Saharanpur, Noida and Ghaziabad in UP; Mourigram in West Bengal and Gurgaon in Haryana. The major export of meat is from buffalo. Buffalo meat is exported in frozen boneless and deglanded form and is free from FMD virus due to its ageing for minimum of 24 hours at 2°C to bring down the meat pH below 6.0. The export of sheep and goat meat is very less and it has been decreased consistently during the last three years while export of buffalo meat has increased significantly in the last ten years. Since buffalo meat is not consumed on a large scale in India, it is processed and targeted for export. Currently India is exporting meat to more than 60 countries which is largely confined to Malaysia, Philippines, Mauritius, UAE and other gulf countries. A significant increase in sales to African countries has been noticed in recent years. There exist huge opportunities for India to develop its buffalo meat exports as existing leaders in industry like Europe and North America faces issues of reduction in agriculture subsidy and disease prone livestock.

Modern Technologies to boost Farmers' Income of Rural India with special reference to Mountain Agriculture

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In India, the growth and development of agriculture sector is utmost important and has to be done with pace of time to boost the farmers' income. Large and medium farmers of country have adopted some of the technologies to make the agriculture profitable. On the other hand, small and marginal farmers' comprising more than 80% still facing problems in agriculture due to high cost of input, poor knowledge and non availability of appropriate technologies. The Indian Himalayas cover an area of 53.7 million ha, which is 16.4 % of the total geographical area of the country. It has difficult terrain, wide variation in slopes and altitude, extreme cold winter. As a result adoption of improved farm implements and machines commercially available has been very difficult as such. Mountain farming is dominated by women using primitive tools and implements which are not ergonomically designed as per their physique and they have to work under the adverse conditions of drudgery. The trends indicate that the share of animate power has declined and the role of mechanical power enhanced in Indian agriculture during 1960-2015. For example, the power availability increased from 0.32 kW/ha in 1967 to 1.8 kW/ha in 2015 in India whereas mountains of Himachal Pradesh, Jammu and Kashmir and Uttranchal realised very little increase from 0.37 kW/ha to 0.90 kW/ha between 1977 to 2015. Mechanizing the mountain farm is a difficult task because of unique topography, small size plots and non availability of suitable equipment. While great strides have been made in agricultural mechanization in the country, the mountain regions have lagged far behind. At present, mountain agriculture is starved due to poor resources and infrastructures which forced the young rural generation to leave the farming. The modern techniques of crop production have not only created an impact on increasing productivity but also on reducing drudgery involved in farming operations, which directly or indirectly attract the farming community. In such condition, introduction and development of specific power source and equipment for agriculture so that farm power availability should be increased to about 2.0 kW/ha. This is possible only through development of appropriate machineries, introduction of custom hiring of modern and suitable power sources with matching equipment by proper training among the small and marginal farming community specifically young rural youths for enhancing the income as well as creating employment. However, there is an urgent need to establish directorate of Agricultural Engineering for sustainability to promote appropriate farm mechanization in mountain regions to attract the farmers.

A View of Agriculture

In India, the growth and development of agriculture sector is utmost important because agriculture is the backbone of Indian economy as it provides direct employment to more than 50 % of the working people. Being the largest source of employment and income to millions of people, it also provides a vast market for our industrial products and has to be done with pace of time to boost the farmers' income. The country has made a three-fold increase in food grain production from a level of about 55 million tonnes in 1970-71 to 272 million tonnes in 2016-17 and contributes about 28 % of gross domestic product. On the other hand, small and marginal farmers' comprising more than 80% still facing problems in agriculture due to high cost of input, poor knowledge and non availability of appropriate technologies. These farmers possess an area less than 2 hectare with poor resources at their command, especially in the dryland regions. Large and medium farmers of country have adopted some of the technologies to make the agriculture profitable.

Major mountain regions of India comprise of J and K, Himachal Pradesh and Uttarakhand that represent a wide diversity of micro-climates, habitats, soils, vegetation and livestock and terrace farming systems. Table 1 and 2 presents agro-ecological regions and livelihood of northern mountains. It covers a geographical area of 33.49 M ha with elevations ranging between 300-8611 m amsl. The annual rainfall is varied in the range of 350–3000 mm and mean temperature in the range of <1°C to 22°C in the region. Physio-graphically dominated by difficult terrain with varying soil types and slopes. Soils are generally shallow and medium loamy, red, yellow, lateritic, acidic to neutral with low-high organic matter. Total population 37.4 million with population density of 7.5/km^2 against a national average of 32.5/km^2. Net area sown is low 11.62% against a national average of 46.5%. Majority of the people are dependent on agriculture and land holdings are small and fragmented (Table 3). Rice, wheat, maize and minor millets are major cereals in the mountain region. However, region is food deficit particularly in pulses and oilseed. If post harvest losses and requirement of livestock are added deficits will be more than reported. However, region is surplus in fruits which is exported to plains earning substantial revenue. Arable land availability is low as a result horizontal expansion is not possible. Vertical expansion is only option for increasing productivity through infrastructural development and practicing precision farming where farm mechanization, land and water resources, agricultural structures and environment control, post harvest technology and value addition have tremendous role to play for self employment among rural youth.

Table 1: Agro-ecological regions and livelihood production systems in the Northern Hills

Region	Climate, altitude (m, amsl)	Livelihood production system	Parts of the State Covered		
			Jammu and Kashmir	Himachal Pradesh	Uttaranchal
Region I	Sub-tropical Sub-montane and Low Hills 200–800	Agri-livestock fish-horticulture	Jammu and plains of Udhampur district	Una, Bilaspur, Hamirpur Hills, parts of Sirmaur, Kangra, Solan and Chamba districts	Udhamsingh Nagar, Parts of Pauri Garhwal, Nainital, Dehra Dun, Almora and Pithoragarh
Region II	Sub-humid Mid Hills 801–1,800	Agri-horti-livestock-fish	Hilly areas of Doda, Udhampur, Rajauri and Punch districts	Kangra tehsils of Palampur and Shimla and parts of Mandi, Solan, Kullu, Chamba and Sirmaur	Parts of all districts
Region III	Temperate High Hills 1,801–2,200	Agri-horti-livestock-pasture-fish	Srinagar, Budgam, Anantnag, Pulwama, Baramula and Kupwara districts Leh and Kargil	Shimla district (except Rampur tehsil) and parts of Kullu, Solan, Chamba, Mandi, Kangra and Sirmaur districts	Major parts of Pithoragarh, Uttarkashi and small part of Chamoli and Tehri Garhwal
Region IV	Temperate dry Very High Hills >2,200	Livestock – silvipasture – agriculture	Leh and Kargil districts	Kinnaur, Lahaul and Spiti, Pangi and Bharmour tehsils of Chamba	Parts of Uttarkashi, Chamoli, Pithoragarh and Almora districts

Modern and Suitable Farm Technologies for Mountains

To mechanize the mountain farming, the technology available is quite scanty as well as not matching to the women folk involved in the various operations. Few studies carried out in mechanizing the mountain agriculture with the help of improved tools and equipment for reducing the drudgery of women are enumerated below:

a) **Power tiller rotavator:** The rotavator was found good for land preparation (Fig. 1) as well as very effective in puddling operation. By using rotavator, the 60 per cent time and 80 per cent labour can be saved with reduced drudgery to women folk. The other benefit of rotavator was better tilth and could also be used on custom hiring as entrepreneur.

b) **Seed drill/ paddy transplanter:** Manual drawn seed drills and multicrop planters (Fig. 2) were very good equipment for sowing maize, soybean, wheat etc. with precision and timeliness of operations. Similarly paddy transplanter could save labour and time with minimum drudgery. The results also indicated 10-15 per cent higher production by using seed drill /planter.

Table 2: Salient features of agro-ecological zones of the Northern Hills

	Attributes	Northern Hills			
		Overall	Cold arid region	Hot sub-humid region	Warm sub humid
1.	Name of district/ state	J&K, Himachal Pradesh and Uttarakhand	Ladakh and Gilgit of J&K, Parts of Lahual and Spiti region of HP	Shiwalik region of HP, Tarai of Uttarakhand, some parts of Punjab and Haryana	Rest of J &K, HP and Uttarakhand hills.
2.	Geographical area, m ha	33.49	15.6	1.7	17.7
3.	Climate	Dry and Cold	Cold arid	Hot sub humid	Warm sub humid and humid
4.	Latitude	29°31'-36°58'N	-	-	-
5.	Longitude	73°26'-83°30'E	-	-	-
6.	Elevation, mamsl	300-8611	> 2200	800-2200	< 800
7.	Annual rainfall, mm	350-3000	< 150	1000-1200	1600-2000
8.	Annual Temperature, °C	-8 to 22	-8	22	15-22
9.	Physiography	Steep slopes	Steep	steep	Mild
10.	Crop growing days	90-210	90	150-180	180-210
11.	Livelihood production system	Agri-Horti-livestock –fish	Livestock–silvipasture–agriculture	Agri-Horti-livestock–pasture -fish	Agri-Horti-livestock-fish

Fig. 1: *Power tiller in operation*

Table 3: Number, Size and Distribution of Agricultural Land holdings in Northern Hills.

Farm Groups	Northern Hills					
	J and K		HP		UK	
	H	A	H	A	H	A
<1 ha	1175(81.4)	429(44.6)	615(67.3)	252(25.7)	628(70.4)	243(28.8)
1-2 ha	179(12.4)	250(25.9)	174(19.0)	245(25.0)	158(17.7)	221(26.2)
2-4 ha	76(5.3)	202(21.0)	90(9.8)	243(24.8)	78(8.8)	212(25.1)
4-10 ha	13(0.9)	69(7.2)	31(3.4)	176(18.0)	24(2.7)	132(15.7)
>10 ha	1(0.07)	12(1.2)	4(0.4)	63(6.4)	1(0.11)	36(4.3)
Total	1443	962	914	979	891	843
Av. Size of land holding	0.67		1.06		0.95	

H= Number of Holdings (000), A= Area (000 ha), Percent in parentheses

Fig. 2: *Seed drill and paddy transplanter in operation*

c) **Wheel Hoe:** For inter-culture, wheel hoe was recommended for use in row crop i.e. wheat, soybean, maize by farm women as this implement can cover five times more areas with less drudgery as compared to *khuntee*.

d) **Sickle/cutter:** All serrated sickles and power operated cutter (Fig. 3) have 20-50 per cent higher capacity than local plain sickle for harvesting of crops. Serrated sickle manufactured by Falcon Tools was found best among all the available serrated sickles. For harvesting maize crop, a power operated bush cutter cum crop reaper has been found three times better than traditional harvesting. The capacity of bush cutter was 0.028 ha/h.

Fig. 4: *Manually operated various maize shellers*

Paddy thresher: Paddy threshing with the help of pedal operated paddy thresher has shown 50 per cent higher capacity as compared to beating method and requires minimum labour with less drudgery.

e) **Maize sheller:** Tubular maize sheller is a good tool for maize shelling. Farm women can easily adopt this tool because of low cost and high efficiency. However, the hand operated tubular maize sheller needs further modifications for firm grip mainly for use by the women. Horizontal and vertical cob shellers (Fig. 4) were also found 50 per cent higher efficiency compared to tubular maize sheller.

f) **Grain cleaner:** Hand and pedal operated grain cleaners developed by CIAE have been found good for cleaning of grain with 82 and 205 kg/h capacity, respectively. This equipment can save 80 per cent time of farm women.

Economics of farm Equipment for custom hiring

The total income earned by a farmer through hiring the power tiller is Rs 2,20,000/-annually at the present rate of hiring Rs 400/h for total 550 working hours of operation during the two seasons. The expenditure required to operate and maintain the power tiller was Rs 197/h. Thus, a farmers having power tiller will directly earn a profit of Rs 1,11,650/-annually without adding any additional income of yield etc. The impact of this technology was very encouraging in the mountain and number of farmers had purchased the power tiller for using on custom hiring basis. Not only this, many youths are also coming forward to adopt such technology as self employment.

Annual use of Power tiller: 500-600 hours

Farm equipment	Approx Cost, Rs	Expected Life, yr	Fixed Cost, Rs/h	Operating cost, Rs/h
Power Tiller with Seed drill, Reaper, Thresher and Trailer	320000	10	93	104

Profit to Entrepreneurs/farmers
Annual Expenditure : 197 X 550 = 1,08,350
Annual Income : 400 X 550 = 2,20,000
Net annual income, Rs = 1,11,650
Technology will help in self employment to rural youth.

Hence, it is concluded that, new initiatives with respect to modern agricultural engineering technology is the need of hour for further boosting the agriculture in the era of overall modernization. This will not only provide additional income but the farmers have sufficient time to do other profitable work in agriculture such as mushroom cultivation, bee keeping, cash crop cultivation, dairy, poultry etc due to faster operations. In view of the above, the following points are to be considered for strengthening the hill mechanization.

- Modernization of agriculture and horticulture by designing and developing need based suitable tools and equipments.
- Development of women friendly tools and equipments to reduce drudgery in various farm operations i.e. production to consumption.
- Introduction and popularization of micro irrigation and rain water harvesting for enhancing the net area under agriculture. .
- Design of low cost and suitable engineering techniques for protected cultivation.
- Introduction and development of suitable tools and devices for processing and value addition.
- Introduction of alternate energy sources and development of energy efficient gadgets for hill farming
- Proper repair and service facility with strong extension network.
- Development of entrepreneurs for custom hiring of farm machinery and small agro processing centre as self employment through proper training.
- Establishment of an Advanced Centre for Hill Mechanisation to meet out the challenges of this region.

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Entrepreneurship Development: A Tool for Rural Socio-Economic Development

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Entrepreneurship is getting importance as the current economic situation demand job providers to have a dominant role in nation's economy as India is struggling to provide job and income security to its citizens. Entrepreneurship provides significant role in the global as well as domestic economy by industrializing rural and backward areas, as a supplier of input to large industries, creating employment opportunities. It is key driver which transforms agriculture based economy to industry based which makes it even more important for India, as it's 68.84 per cent of population resides in rural areas which is devoid of basic amenities forcing people to migrate from rural areas to urban areas. Entrepreneurship is the social and economic hallmark of the present era. It is the key to economic growth and social change. Entrepreneurship has an important role in the context of a developing nation like India which is confronted with major socio-economic problems. Agriculture contributes to national economy in a major way and about 75% of our population is directly or indirectly engaged in agricultural pursuits. Hence, any improvement in agriculture will eventually lead to an improvement in the national economy. This can be achieved with the proper integration of agriculture and industry. The farm must be looked upon as a commercial enterprise unit. Mahatma Gandhi said, "If the villages perish, India will perish too. India will be no more India. Her own mission in the world will get lost." He gave much emphasis on village industries and visualized village as a self contained, independent and fully functional unit of Indian society. Fulfillment of his vision and much of the problems which have arisen because of lack of employment opportunities in rural areas can be tackled effectively if village industries are developed and agriculture moves from being just a way of life to agribusiness.

Agriculture should be integrated with village industries as to make use of agricultural produce by the industries at the village level itself. Also these can develop products which are to be used in agricultural processes. Therefore, a cycle can be developed where agro industries utilize the agricultural produce and also they can produce things which may be utilized by the farmers. This is the need of the hour also, when the country is going through the process of economic liberalization and globalization. Job seekers need to be converted into job creators or generators. For all this to happen there is a need to develop entrepreneurship among the farmers in particular and rural masses in general. To convert a farm into an enterprise, the identity of the person managing it must change from a farmer to that of farm business operator or entrepreneur (De, 1986). Any advancement in technology can never bring fruitful achievement until farmers become entrepreneurs. Agricultural advancement inspires farmers to be entrepreneurial, away from their conventional and hereditary vocational system. For example, Gujarat has achieved the

status of being a leader in bringing white revolution in the country because of the entrepreneurial behaviour of the farmers who shifted from traditional forms of managing dairies to new systematic procedures of dairy management and adopted new technologies of milk production and processing.

Entrepreneurship Development

To promote entrepreneurship among farmers' two important factors must be considered:

1. Development of the human factor – the entrepreneur himself and
2. Development of environment where entrepreneurial activities can flourish and grow.

The human factor includes his own motivation, attitude, his capabilities like decision making, moderate risk taking, persistent problem solving, innovativeness, ability to face failure and ambiguity, energy and driver, self confidence, goal setting etc. The environmental factors include social attitudes, values and support systems like markets, credit, family support etc.

Entrepreneur and Entrepreneurship

While promoting entrepreneurship amongst farmers, we must first understand who is an entrepreneur and what entrepreneurship is? The 'entrepreneur' is very much related to the term 'entrepreneurship.' Both these terms are used interchangeably. But they are conceptually different. The word 'Entrepreneur' is derived from the French word 'enterprendre' and the German word 'unternehmen' both meaning 'to undertake' or 'to do something.' In the early 16th century the Frenchmen who organized and led military expeditions were referred to as 'entrepreneurs.' After 1700, the term was applied to other types of adventures, mainly civil engineering like construction of roads, bridges and buildings. It was only in the beginning of the 18th century that the word was used to refer to economic aspects. Richard Cantillon, an Irish man living in France, was the first economist who introduced the term 'entrepreneur' referring to the risk taking function of establishing a new enterprise. Generally speaking, an entrepreneur is a person who establishes his own business or industrial undertaking with a view to making profit. In other words, we can say that an entrepreneur is a person who organizes, manages and takes the risk of running an

enterprise. An entrepreneur makes arrangement of various factors of production i.e. land, labour, money, people and machinery and directs them towards achievement of pre-determined goal.

Having studied the term 'entrepreneur', it is equally important to devote our attention to the term 'entrepreneurship' as well. While 'entrepreneur' refers to a person, 'entrepreneurship' refers to the function. Basically, entrepreneur is a business leader and the functions performed by him in relation to that business is entrepreneurship. Thus, entrepreneurship is a process involving various functions to be undertaken to establish an enterprise. Hence, entrepreneurship may be regarded as what entrepreneurs do.

Entrepreneurial Development

Meaning: Entrepreneurial development means to help a person in inculcating and strengthening his entrepreneurial skills, abilities and capabilities, so that he can achieve his entrepreneurial goals more efficiently and effectively.

Definition:

1. According to Joseph E. Steparek, "Intelligence, motivation, knowledge and opportunity are the pre requisites of entrepreneurial development".
2. According to Prof. C.B. Gupta and N.P. Srinivasan, "Entrepreneurial development is inculcating entrepreneurial traits into a person, imparting the required knowledge, developing the technical, financial, marketing and managerial skills and building the entrepreneurial attitude".

Entrepreneurial Development Programme (EDP)

Entrepreneurial development programme means a programme designed to facilitate a person in strengthening his entrepreneurial skills, motives, traits and capabilities which are necessary for playing his entrepreneurial role more efficiently. Entrepreneurial development programme is a process through which motivation, skills, traits and knowledge of potential entrepreneurs is enhanced. It helps entrepreneurs to develop their own ventures through the process of training and development. It has been recognised as an effective human resource development tool. It is mainly meant for the development of first generation entrepreneurs, who cannot perform business activities successfully with their own. Entrepreneurial development programme helps in achievement of desired results by injecting different qualities, traits and ultimately lead the country towards the progress.

The objective of EDPs is both short-term and long-term. The comprehensive objective of entrepreneurial development programme is promotion of small and medium size industries and encourage self employment. On the other hand up gradation of managerial skills for the potential entrepreneurs.

Objectives of Entrepreneurial Development Programmes

Entrepreneurial Development Programme has both short-term and long-term objectives. Short-term objectives are those which are fulfilled immediately after the completion of programme. Whereas long-term objectives are related with inculcating the various skills required for the successful establishment of a business venture.

Following are the objectives of Entrepreneurial Development Programme:

1. To develop and strengthen their entrepreneurial quality.
2. To analyse the environment related to small industry.
3. To select the appropriate project.
4. To formulate the effective and profitable projects.
5. To understand the process, procedure and rules and regulations for setting up the project.
6. To know the sources of help and incentives and subsidies available from government for launching the enterprise.
7. To acquire the basic managerial skills.
8. To know the problems and consequences of being entrepreneur.
9. To acquaint the needed entrepreneurial disciplines.

Some of the other objectives of EDP are discussed below:

1. To identify and train potential entrepreneurs is the foremost objective of an EDP. Training is imparted to the potential entrepreneurs so that they can do business effectively.
2. To generate employment by creating employment opportunities through starting new ventures and solves the problem of unemployment.
3. To reduce regional imbalances by developing industries in rural and backward areas.
4. To develop small and medium sized industries with less capital investments.
5. To prepare the entrepreneurs for bearing risk of business.

6. To enable the entrepreneur to take quick decision in difficult situations.
7. The EDP facilitates the entrepreneurs to prepare a team and with the co-ordinated efforts of team, fulfils the demands of consumers.
8. Precise, quick and effective communication is one of the important objectives of EDPs. Communication ability of entrepreneurs is developed through EDPs.

Stages of Entrepreneurship Development Programme (EDP) Training

There are three stages of Entrepreneurship Development Programme

A. Stimulatory phase

B. Support phase

C. Sustenance phase

A brief account of these is as follows:

A. Stimulatory phase

The stimulatory phase includes learning the basic skills required for the accomplishment of a job or activity. It also includes learning the basics of entrepreneurship. It involves all those activities that promote entrepreneurial awareness, entrepreneurial education and entrepreneurial spirit among the people. Now a days, we require much more information and a high level of motivation to succeed as entrepreneurs. So the identification of opportunities is the basic quality that must be developed in the potential entrepreneur. The ever changing environment keeps on throwing challenges and opportunities to us. So successful entrepreneurs are those who identify the opportunity and acquire benefit from these opportunities. Hence, the stimulatory activities help in the emergence of potential entrepreneurs in the society. It creates the environment where from people start looking for entrepreneurial pursuits. It generates the initial motivation, helps people perceive incentives and offer opportunities to acquire relevant information and skills. This stage includes:

1. Generating entrepreneurial awareness in the community through well planned publicity.
2. Identifying and selecting potential entrepreneurs.
3. Reinforcement of motivation through training.
4. Improving their knowledge and skills in modern management methods.
5. Developing technical competence relevant to the product or service selected.
6. Helping them to prepare project report.
7. Making available techno-economic information and project profiles.
8. Entrepreneurs to select new product.
9. Developing a data bank on new products and process available to the target group.
10. Evolving new products and processes relevant to local situation
11. Public recognition of entrepreneurial excellence.

B. Support Phase:

In this phase, the potential entrepreneurs are supported to translate their dreams into projects and launch enterprises. This includes activities such as identification of enterprise, preparing project proposals and organising resources for launching enterprise. These activities help the already stimulated entrepreneur to move ahead in achieving his immediate goal of setting up and running his enterprise. These activities also remove hurdles which are likely to cause sickness or discourage the new entrepreneurs and, hence, increase probability of success furthering encouragement and confidence of the new entrepreneurs. The activities in this phase may include:

1. Registration of the unit.
2. Assistance in getting finance.
3. Assistance in getting land, shed, electricity, water etc.
4. Help in selecting, buying and installing the new machines.
5. Getting licences and permits.
6. Getting NOCs (No Objection Certificate) from pollution control department and municipal corporations.
7. Arranging for raw material.
8. Granting tax relief and other type of subsidy.
9. Offering management consultancy.

10. Assisting in marketing the product.
11. Providing information related to industry.

C. Sustenance Phase:

Sustenance phase activities include all those efforts that help the entrepreneur in continuous, efficient and profitable running of his enterprise. This is the phase in which entrepreneurs are supported to continue their enterprise in efficient and profitable manner. The sustenance is provided by the promotional agencies, often through his project plans based on feedback, restructuring management and opting for alternative/growth opportunities.

Once the potential entrepreneur launches his enterprise, he needs support to sustain his effort and initial enthusiasm; because he may often face new challenges once he starts production. He may not be fully prepared for some of them. It may be non-profitable and non-viable due to many unforeseen and uncontrollable factors, as for example, lack of specific raw materials, unavailability of substitutes, change of skilled hands, major changes in government policies etc. These are the sustenance factors and in case these are timely and adequately attended, then it will lead to a well sustained and established enterprise. Besides, the entrepreneur should utilize contingency planning approach to overcome shocks, blocks and other problems.

The following activities are included in this stage:

1. Modernization, diversification and expansion or product substitution.
2. Additional financing for full capacity utilization.
3. Deferring repayment or interest depending on the situation.
4. Help and guidance in diagnosing the cause or failure or low production or profit.
5. Modification or change in legislation or policy affecting marketing.
6. Practical training through site visits and market survey in specific areas.
7. Consultancy services-marketing, finance, human resource development (HRD), technology management, crisis management etc. as and when required.
8. Awareness of environmental pollution and the remedies for it.
9. Social responsibility of the business.
10. Legal issues and their implications, tax liabilities etc.
11. Computer applications.

These were the three stages of EDP training. Among these, EDPs lay more emphasis on stimulating and supporting activities and does not pay attention to sustaining activities. It creates a situation of imbalances which will adversely affect entrepreneurial development. Therefore the organizers of EDPs must keep this thing in mind and organize an EDP which lays emphasis on all these three stages so that the objective of entrepreneurial development is achieved in proper manner.

Need for Entrepreneurship Development Programme

Entrepreneurship development programme helps in removal of various problems like unemployment, poverty, imbalanced regional growth, concentration of power etc. By removing these problems, EDPs helps in development of economy. The success of a nation depends upon the developed human resources. Therefore development of human resources in the right direction leads to development of any nation.

Need for EDPs can be best understood from the following points:

1. **Creation of employment opportunities**: Entrepreneurship development programmes helps to reduce unemployment which is the root cause of many problems in developing and underdeveloped countries. Unemployment can be reduced by enabling entrepreneurs to set their own establishments. As entrepreneurs set more and more units, job opportunities are created for the others. Thus problem of unemployment and poverty can be solved to a large extent with the help of EDPs.
2. **Balanced regional development**: EDPs helps in balanced regional development of a country. There are some industrially backward and remote areas in underdeveloped and developing countries. With the help of successful entrepreneurial development programmes, small scale units are set up in these remote and backward areas with limited financial resources. Central and state governments also provide concessions and subsidies to those entrepreneurs who set up their units in remote areas and hence promote balanced growth and in turn it also reduces concentration of power in few hands.
3. **Increase in per capita income**: Entrepreneurs put efforts joining other factors of production and these results in production of goods and services. With the help of EDPs more and more new enterprises are started which results in overall increase in the productivity which in turn leads to increase in national income and per capita income.

4. **Capital formation**: Establishing new venture requires an adequate and sufficient amount of capital. Entrepreneur organises various factors of production and employ his own and borrowed funds to set up his business enterprise. He mobilises idle savings of the society and employ these savings in productive uses and contributes in capital formation. There are various financial institutions and banks like-ICICI, IDBI, IFCI, SFCs which provides financial assistance to the entrepreneurs to develop their business. EDPs help in increasing capital formation which is a cushion for the development of a country.
5. **Use of local resources**: There are various resources available in local areas where the enterprise is established. The resources would be wasted if not exploited properly. An effective EDP play an active role in best utilisation of local resources by guiding, educating and imparting training to the entrepreneurs. Proper use of these resources will help in providing base for rapid growth of industry.
6. **Reducing social tension**: EDPs help in reducing social tension. Unemployed youth and educated people get frustrated when they fail to get employment. This results in social unrest. The unrest among the educated people can be defused by diverting them towards self employment. Self employment ultimately reduces social tension. EDPs can help in directing the unemployed young persons in the right direction. Through EDPs guidance, assistance and training is provided for setting up of their own establishments.
7. **Preventing industrial slums**: As most of the industries are located in urban areas, concentration of industries in cities leads to industrial slums. The industrial slums can be prevented by decentralisation of industries. This is possible through EDPs. These programmes have major contribution in solving the problem of industrial slum. Various incentives, concessions, subsidies are provided to the entrepreneurs to set up their units in the industrially backward areas. Infrastructural facilities are also provided in remote areas for the balanced industrial growth in all the regions. This would also be helpful in controlling pollution, overcrowding in urban areas and traffic congestion.
8. **Improvement in standard of living**: Entrepreneurs produces new goods and services by adopting innovative techniques. They supply variety of goods in the market at low prices. Consumers get their demands satisfied with variety of goods and at less prices, this leads to increase in their purchasing power. Increase in purchasing power means they can buy more goods with same level of income. This leads to high standard of living.
9. **Self reliance**: Entrepreneurs provides a country, variety of goods at large scale and at competitive prices. By adopting innovations we can substitute our imports. We can produce the substitute of those goods which are imported from other countries. Increased production creates export surplus. We can facilitate exports, after satisfying the domestic demands. In this way a country can earn foreign exchange also. A country will become economically independent and prevents dependence on foreign countries. Self reliance and self sufficiency in an economy can be achieved if the entrepreneurs are aware of latest developments and this becomes possible with the effective organisation of EDPs.
10. **Facilitating overall development**: EDPs helps in overall development. When an entrepreneur sets up a unit, it requires many other inputs, other units are developed simultaneously. For e.g. when an industry is to be started in a particular area, other facilities like transportation, communication, banking, insurance, input supplies are ultimately developed. This in turn leads to overall development of that area.

So, it is clear from the above that EDPs plays an important role in the growth and development of a country. The achievements like self reliance, improved standard of living, capital formation etc. clears the importance of entrepreneurial development programmes in an under developing and developed country.

Problems faced in conduct of EDPs:

There are various problems in the conduct of EDPs. A brief account of some of these is given below:

1. **No policy at national level:** For the successful implementation of EDPs every country requires a policy at national level. The national policy governs the entrepreneurs at various points. No doubt Indian government is aware about importance of EDPs, but we do not have a national policy on entrepreneurship.
2. **Problems at the pre training phase:** Problems at the pre training phase includes selection of potential entrepreneurs, selecting resource persons, finding business opportunities etc. These problems restrict the growth of entrepreneurship in India.
3. **Duration of EDPs:** Duration of EDPs ranges between 3-6 weeks. This is a very short period. It is not possible to acquaint the entrepreneurs with the problems they will face while setting up and running the business in these few days. So, to develop managerial skills and to impart practical training, time limit of EDP should be increased.
4. **Non availability of infrastructural facilities:** Infrastructural facilities like proper class room, adequate space for trainees, suitable guest speaker, boarding and lodging etc. in rural and backward areas creates problems in the successful implementation of EDPs.
5. **Poor methodology:** Methodology of EDPs is not proper. Even the trainers and organisers of EDPs are themselves not clear about the concept, which they want to discuss during training to the potential entrepreneurs. So, lack of proper methods of organising the programme became a cause for the failure of the same.

6. **Non availability of competent faculty:** Non availability of competent staff is a big problem. Sometimes competent teachers and resource persons are available but they refuse to take class in rural and backward areas.
7. **Poor response of financial institutions:** Financial institutions provide financial assistance to the entrepreneurs in the form of loans etc. These institutions demand securities for lending money. Those potential entrepreneurs who fail to fulfill the conditions laid down by these institutions cannot get financial assistance and their dreams to start their own ventures vanish.
8. **Mode of selection of participants:** The selection procedure is not standardised. EDPs are not designed for each and every entrepreneur. Those persons are selected who have a potential for doing business.
9. **Over estimation of trainees:** It is assumed that trainees have aptitude for self employment and business and training will motivate them and they will become able to set up their independent units. The agencies over estimate the potential of trainees and imparts training accordingly which does not satisfy the objective of EDP.
10. **Problems faced by women entrepreneurs:** Women entrepreneurs have to face many problems like:

(a) Stiff competition from male counterparts
(b) They have less risk bearing ability
(c) Family conflicts
(d) Marketing problems
(e) Shortage of raw material
(f) Social barriers
(g) Lack of information
(h) Lack of self confidence
(i) High cost of production
(j) Shortage of funds.

Extension Strategies to promote entrepreneurship

1. **Creating awareness:** Awakening of farm families to the possibilities of the easily accessible enterprises is the foremost task. The government, semi-government and non government organizations should create awareness among the most productive age group of farm families through various means like exhibitions, melas and campaigns. The printed and electronic media can be effectively put to use for the purpose.
2. **Motivating entrepreneurs:** Psychological stimulation is the prerequisite for putting any idea into action. For proper motivation of farm families, the economic, social, personal and political benefits of various possible enterprises should be highlighted. The use of farm visits, exposure visits, field trips, video film shows, dramas, puppet shows, group meeting etc. will help in motivating the potential group to become entrepreneurs.
3. **Expertise development:** After awakening and motivating the next step in development and success of an enterprise is the acquisition of knowledge and skill up-gradation and polishing of existing knowledge and skills are the basic requirements. Lectures, printed material, discussions, institutional and non institutional skill trainings for imparting first hand technical knowledge in procurement, processing, production and management should be provided to farm families who are interested or already engaged in various enterprises. Imparting knowledge in direct and indirect marketing of the produce and finance management should be in-built component of training programmes for rural folk.
4. **Continuous follow-up:** Constant follow-up should be ensured for sustainability of any enterprise. During this phase various constraints such as personal, social, economic, marketing etc. faced by entrepreneurs should be addressed. Possible help in the form of knowledge, technical skills and inputs should be provided to enable them to solve their problems.

Need for motivating rural families

Rural folk especially youth in the rural areas have little options. This is the reason that many of them either work at farm or migrate to urban land. The need is to set other options in the minds of rural youth and women. Entrepreneurship could be the best option. If planted and nurtured in the minds of farm families and youth, it could result in revolutionizing the Indian economy. It should be emphasized that the projects undertaken by these entrepreneurs should not be constrained by its location in rural area. It should enjoy all the advantages of the location. Following are the advantages of rural entrepreneurial projects:

1. Tax holidays and other tax advantages given to rural projects.
2. Abundance of labor at lower rates.
3. Advantage of local availability and regional resources in case the unit uses them as a raw material.
4. Prestige and respect among the local community
5. Live example for local youth for taking up entrepreneurial project
6. Support and motivation from local people
7. Competitive advantage over the big business due to the proximity to raw material and labor.
8. Employment generation for local people.

Advantages of entrepreneurship **among farm families**

Entrepreneurship not only enhances national productivity, generate employment but also help to develop economic independence, personal and social capabilities among farm families. Following are some of the personal and social capabilities, which will develop as a result of taking up enterprise.

i. Economic empowerment
ii. Improved standard of living
iii. Self confidence
iv. Awareness enhancement
v. Sense of achievement
vi. Increased social interaction
vii. Engagement in political activities
viii. Increased participation in gram sabha meeting
ix. Improvement in leadership qualities
x. Involvement in solving problems related to women and community
xi. Decision making capacity in family and community

Economic empowerment of farm families by entrepreneurship results in the empowerment in many aspects such as socio-economic, equal property rights, political representation, social equality, equal personal right, family development, market development, community development and national development.

Entrepreneurial behaviour

Behaviour, in simplest terms, means response of an individual to stimulus. Many people believe that entrepreneurs possess genetic talents. However, experts agree that most entrepreneurs are not born but they learn to become entrepreneurs. They change their behaviour. This entrepreneurial behaviour consists of following qualities in the entrepreneur:

1. He copes well or even thrives in uncertainty.
2. He is a creative problem solver.
3. He has strong human and organizational skills.
4. He understands the relationships between organization, strategies and environment.

On the basis of above observation the behaviour of the successful entrepreneurs in agriculture can be identified in the following lines:

1. **Cultivation**: Agro forestry, bee-keeping, crop, dairy, fish, flowers, fruits, fodder, goat, mushroom, ornamental plants, poultry, Rabbit, sericulture, vegetable etc.
2. **Inputs marketing**: Seeds, chemical fertilizers, bio-fertilizers, pesticides, weedicides, machineries, implements, animal feed, poultry hatchery, veterinary medicines, land-scaping, agricultural credit, custom service, bio-control units and bio-tech units etc.
3. **Product marketing**: Commission agent, consultancy, export, finance, retail, storage, transport and whole sale traders.
4. **Facilitative**: Research and development in agriculture and allied fields, marketing information, quality control, crop insurance, animal insurance, energy etc.
5. **Processing and value addition**: Brewery, cashew, cattle, coir, fruits, milk, paddy, poultry, sugarcane, tannery, vegetables, pulses, spices, bamboos etc.

Factors affecting the entrepreneurial behaviour of the farmers

In addition to the potential abilities of the entrepreneur, there are certain factors which limit the progress of the enterprise. Some of the factors which limit the agricultural enterprise are discussed here as under:

1. Money: The entrepreneurs constantly emphasize shortage of money and its effect on business and living. They see it as influencing business investment in three ways:

a. The supply of labour under their control.
b. The expenditure on farm requirement, particularly on commonly used items like seed and other inputs and
c. It prejudiced substantial long term investment because the farm people could not find the means to live till the fruits are to be achieved.

2. **Labour**: The farmers use less labour than they wish because their supplies of unpaid family labour and of cash to hire labour are limited. Shortage of farm labour is assuming an acute problem recently.
3. **Size of farm and size of farm business**: The size of farm in hectares is only one of several factors that determine the size of farm business it supports. The farmers face shortage of land as a preventing factor expanding their farm enterprise.
4. **Management**: The farmers work on the farm as well as manage the farm enterprise. In the factory production various jobs like buyer, mechanic, manager, book keeper and salesman are performed by different persons. However, most of the farmers perform all the functions alone. Many of them are not trained in performing these functions.

Inadequate irrigation facilities, natural calamities, uncertainty of production, unfriendly marketing network are few other factors that influence entrepreneurial behaviour of farmers adversely.

Factors affecting entrepreneurship

1. **Individual quality:** Entrepreneur is an individual having specific knowledge, skills and efficiency. Any new enterprise is created by an individual or group of individuals. The creativity of an individual encourages him to establish a new enterprise. Creativity consists of innovation, search and research. Such skills are not shown in all individuals. Personality, social conditions, supporting society, higher education, training and such other factors play important role in developing such skills. Thus characteristics affecting an individual like skills, motives, attitudes, social-cultural conditions etc. motivate an individual to become an entrepreneur.
2. **Industrial environment:** More suitable the industrial environment in a nation, more rapid development of entrepreneurship is shown. More favourable industrial environment is one, where transportation, communication, electricity, labour, water, raw materials etc. are easily available. Such industrial environments by and large affect entrepreneurship development.
3. **Social environment:** Better and more appropriate the social environment in a nation for entrepreneurship, more rapid development of entrepreneurship is observed. Social system plays vital role in providing certain type of social environment. As an individual is borne and developed in a family and society, social values, ethical standards, family structure, caste and religion, attitudes are part of social environment that affect entrepreneurship development.
4. **Economic environment:** The economy in which enough capital funds are available for establishing an enterprise and market incentives are also available encourages entrepreneurship development. Banking, education, industrial policy, economic policy, Exim policy, interest rate etc. are the factors of economic environment that affect entrepreneurship development. Thus economic soundness and free economy motivate entrepreneurship development positively.
5. **Technological environment:** Higher the technological development, more the entrepreneurship development is universally accepted. Due to technological development, new products, new production process, new raw materials, new researches are encouraged for modernization. So, it can be said that the country, in which technological environment is more suitable, affects remarkably the entrepreneurship development. Due to this reason, presently rapid entrepreneurship development has been reported in the countries like Japan, America and China.
6. **Political environment:** Government also plays an important role in entrepreneurship development. Due to globalization, Indian economy has adopted free industrial policy which has motivated many entrepreneurs to establish and to develop industries in Indian economy.
7. **Incentives:** Incentives are also one of the important factors affecting entrepreneurship. If motivating plans, policies, organizations are developed, it leads to rapid entrepreneurship development.
8. **Profit making:** It is the profit that induces the prospective entrepreneurs to get into the business and start new commercial activities. Therefore, profit is a factor which induces the entrepreneurs to organise and utilize the factors of production for development. It does not necessarily mean that the entrepreneur is concerned with profit only. He also satisfies many social needs.

How to develop Entrepreneurship among Farmers?

Establishing an enterprise and, thereby developing entrepreneurship is not one man activity. Infact, it involves multi-pronged activities. The following measures are suggested for developing entrepreneurship among the farmers:

1. Availability of finance at soft terms and conditions: Finance is considered as lubricant for setting up and running an enterprise. Funds, therefore, need to be made available on time at soft terms and conditions to the farmers.

2. Setting up agro – industries in the villages: In order to solve the problems of transportation costs as well as post harvest losses of perishable commodities, agro-industries need to be established and developed with modern infrastructural facilities in the villages. This would help in promoting export business, on one hand, and buyers and sellers in close interaction avoiding middleman in between them, on the other.

3. Imparting entrepreneurial education in state agriculture universities: Entrepreneurship development should be included in the graduate and post–graduate courses in the state agricultural universities so that later on while on the job, these graduates and post graduates may effectively implement government schemes and motivate rural people to take up entrepreneurial activities in agriculture. Even some of these graduates may opt for setting up of their own agro enterprises.

4. Disseminating self employment schemes among farmers: Prime Minister Rozgar Yojana (PMRY) is a major self employment scheme presently being run by the government through District Industries Centres (DIC_S) and finance is provided by the local bank. Exposure to entrepreneurship development should be given to agricultural finance officers in banks so that they can disseminate information about all what is available to provide the farmers to facilitate them in setting up an enterprise.

5. Availability of raw material: Raw material is must for any industry. Past experience shows that rural industries

with employment potential cannot be sustained for long unless a strong raw material base is created in rural areas itself. Therefore, a constructive policy is needed to strengthen the raw material base in rural areas.

6. Developing entrepreneurial attitude and competence among entrepreneurs: One of the problems of entrepreneurs is that most of them join their entrepreneurial career not by choice but by chance. Lack of aptitude and competency on the part of such entrepreneurs makes the units sick. Hence, there is a need to develop entrepreneurial attitude and competencies among the prospective entrepreneurs through the training interventions like Entrepreneurship Development Programmes (EDP), Women Entrepreneurship Development Programmes etc.

7. Training for orientation of entrepreneurs: To harness the local resources properly, proper provisions should be made to impart the institutional training to orient the entrepreneurs in specific products and trades.

8. Emphasis on applied science: Agriculture scientists should give emphasis on applied science in preference to basic science. They must give priority to development of technologies which can be adopted by farmers. Scientists should develop adaptable technological packages.

Potential benefits:

If entrepreneurship is developed among farmers, farm women and rural youth, following benefits will emerge:

1. It will stop migration to cities. Increasing population in cities can also be stopped and rural people will get employment in rural areas itself.
2. Employment opportunities in rural areas will be able to utilize the energies of rural youth and thereby lessen the social evils and mischiefs in the villages. Hence, it will pave the way for developing a healthy society in rural areas.
3. Enterprise in rural areas will improve their infrastructure and will have a boosting effects on other aspects like transports, roads, availability of products, economy etc. Thus, it will result in overall development of these areas.
4. This will help in shifting the economic power to rural areas and will be really a step towards decentralization of power. Rural manpower will be utilized by rural industries.
5. Agro industries can help in achieving a balanced growth and development which will be ecofriendly. Misuse and over exploitation of natural resources will be minimized.
6. Rural income can be increased which will pave the way for rural development to occur in rural areas. Exploitation of rural youth by traders and middlemen can thus be avoided.

Conclusion:

Human resource development is the critical factor for economic growth of villages and success of any government sponsored programme. However, due to ignorance and lack of intrinsic motivation of farmers, farm women and rural youth, they are unable to encash them. Moreover, farmers have also not perceived them as real opportunities for commercial exploitation. Even the development workers and field staff are not fully aware of the technological developments and the opportunities available for diversifying and commercializing agriculture into a viable enterprise. This may one of the reasons why they could not create an environment where farming community can reap the fruits of technological innovation and opportunities. Hence, there is a strong need to mobilize the farming community to take the advantage of the emerging opportunities. Farmers must become entrepreneurs and view their farm units as viable commercial units. Support and sustenance to enterprise in rural must be promoted through banks, training institutes and other exiting infrastructure. Keeping in view, the changing scenario, we need to equip extension professional with techniques of stimulating farmers, farm women and rural youth to initiate appropriate enterprise for meaningful self employment and income generating activities. Till date, agricultural development programmes have been emphasizing creation of infrastructure, developing technologies and disseminating them to farmer's field. But now the emphasis should be on the farmer himself. Thus, it can be said that entrepreneurship development in agriculture will help in economic prosperity of villages and in turn will result in healthier society and a healthier nation. This is the need of the hour of our country.

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Technology and Animal Rearing: A Journey from Domestication to Genomics

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Currently livestock is one of the fastest growing agricultural subsectors in the developing countries. Globally, livestock contributes about 40 percent to the agricultural gross domestic product (GDP) and constitutes about 30 percent of the agricultural GDP in the developing World. (FAO. 2010). By 2020, consumers in developing countries will eat 87% more meat and 75% more milk. About 3 billion new middle class consumers may emerge in the next 20 years and world Human population in 2050 is estimated to be 9.15 billion, with a range of 7.96-10.46 billion. Thus, there is no way to reach the millennium development goals of doubling of food production by 2050 without making livestock production more efficient. Over the span of three decades, India has transformed from a country of acute milk shortage to the world's leading milk producer, with production exceeding 163 million tonnes in 2017, accounting for more than 13% of worlds total milk production. Use of technology is one of the important advanced management tools that has significantly helped in achieving this goal. Many biotechnological innovations have an increasing scope for application in livestock industry viz vaccine and diagnostics development, manipulation of rumen microflora/feed, marker assisted selection for various economic traits like milk, disease resistance and twins/triplets and Assisted Reproductive Technologies (ART) like AI, induced multiple ovulation (superovulation), in-vitro fertilization, embryo sexing, embryo splitting, embryo transfer, gamete or embryo cryopreservation, stem cell production for regenerative medicine, Cloning (Somatic cell nuclear transfer), gene editing and transgenic animal production.

Technological interventions in farm animal species have taken a centre-stage in many developed and developing countries in order to enhance the productivity. Application of advanced reproductive technologies for propagation of superior germplasm are being used for improved production from livestock species, especially in India, in view of the limited availability of superior germplasm. Many reproductive technologies are currently in use but many of them need further standardization and efficiency enhancement. The application of cloning technology to milch animals holds a promise for the genetic improvement of cattle, buffaloes and goats. Artificial insemination, embryo transfer, *in vitro* fertilization, cloning, transgenics and genomics all are components of the tool box for present and future applications. Individually, these are powerful tools capable of providing significant improvements in productivity. Cloning through somatic cell nuclear transfer (SCNT) in buffalo has had a limited success. Using micromanipulator-based cloning procedure, blastocyst production rates ranging from 2.5% (Meena and Das, 2006) to 35% (Suteevun *et al.*, 2006) have been achieved. Based on the progress in scientific knowledge of endocrinology, reproductive physiology, cell biology and embryology during the last fifty years new biotechniques have been developed for and introduced into animal breeding and husbandry. Among them are oestrus synchronization/induction, artificial insemination, Multiple Ovulation Induction and Embryo Transfer (MOET), *in vitro* embryo production (IVP) and cloning by Nuclear Transfer (NT) (Sejian *et al.*, 2010).Flow cytometric technology is widely used for sexing sperm in mammalian species. Differences in DNA content have provided both a method to differentiate between these sex-determining gametes and a method to sort them that can be used for predetermining sex in mammals. (Garner, 2006). A very recent and most exciting development in this field is the establishment of reverse sex-sorting technology for the utilization of frozen ram and bull semen. Development of Radioimmunoassay (RIA) technology has paved way for estimation of almost all reproductive hormones which in turn depicts the reproductive status of the animals. RIA has made it possible to determine when animals are ready for breeding, diagnose pregnancy earlier than would be otherwise possible, check whether animals have been inseminated at the correct time, devise corrective measures for reproductive disorders and improve the efficiency of artificial insemination and embryo transfer programs.

Conservation of germplasm: The importance of Animal Data Banks for the collection of data on any aspect of life in a well-organized, meaningful and easily accessible way is also being realized. The data bank for animal genetic resources has a key role to play in listing and describing the breeds, in documenting the erosion of these resources and in highlighting the breeds that are likely to disappear in near future unless specific action is taken. India is one of the 17 mega Biodiversity countries of the world accounting about 7 to 8 percent of global recorded species. AGRI-IS; an Information System on Animal Genetic Resources of India (AGRI-IS) has been developed at National Bureau of Animal genetic Resources, Karnal, India. In view of lack of a systematic database on this information, ILRI has been developing the Domestic Animal Genetic Resources Information System (DAGRIS) as a web-based electronic source of information on selected indigenous farm animal genetic resources in Africa and selected Asian countries. International Livestock Research Institute (ILRI) films on research are helping Africa's small-scale livestock keepers better adapt to changing climates. Extensive efforts are being initiated at NBAGR (National Bureau of Animal Genetic Resources) and its several cooperating centers all over the country to characterize and document these diverse genetic resources both at phenotypic and genotypic levels to define their precise population

structure. Ex-situ conservation Germplasm repository at NBAGR preserves diversified form of germplasm (semen, embryos, DNA, epididymal sperms and somatic cells). A total of 1,09,200 frozen semen doses belonging to 277 breeding males (Bulls/Rams/Bucks/Stallions) from 37 breeds representing cattle, buffalo, sheep, goat, camel, yak and equine have been preserved at National Gene Bank. This would provide protection to the valuable animal genetic diversity and facilitate its access for genetic improvement of animal breeds.

Use of automation for farm operations: Automation, defined as the use of mechanical and electronic equipment to reduce the need for human labour (Evodarek, 2012), is a growing trend in the livestock industry and plays an important role in the future prospects. Many farms have also adopted automated feeding systems and climate control. Computer systems that recognize individual animals enable farmers to care for their animals more efficiently. The most salient characteristic of livestock farm automation systems is the opportunity to tailor operations to the needs of each individual animal. This is only possible if there are subsystems capable of recognizing the animals as they interact with the automated systems. The automatic systems most commonly used in animal production concern the various objectives which include automatic identification, drafting, feeding, milking, detection of estrus, detection of births and many other farm operations.-The electronic identification and monitoring of animals is mostly carried out by: a. Radio Frequency Identification system b. Global Positioning System c. Retinal Imaging and Muzzle Printometry

Automated oestrous detection: Numerous physiological and behavioural changes are associated with oestrus and various approaches to utilise these changes to automate oestrus detection have been explored. These include activity monitoring systems (pedometers or accelerometer technologies); mount detectors in which pressure-sensors are placed on the cow's tail head and that are stimulated each time the cow is mounted (Rorie *et al.*, 2002); changes in temperature and; vaginal mucus resistance and changes in hormones such as milk progesterone, lying behaviour and rumination time. Finally, combinations of these measures in the formulation of oestrus detection algorithms have been used to increase detection rates and reduce the number of false positive alerts. In New Zealand, the two main approaches that are commercially available are the activity monitoring systems (pedometer or accelerometer technologies that are either leg or collar mounted) and a camera-based system that automates the inspection of heat patches. Recently an electronic system for calving monitoring in dairy cows has been introduced on the market. This device is sutured at vulva lips in pregnant cows close to calving time and when it is activated by fetal membranes expulsion a radio wave signal is sent to a receiver installed in the calving barn. Through the use of the Global System for Mobile communication (GSM) technology, the receiver sends a short text message to the farmer's mobile phone warning him of the coming delivery. Other farm operations advocating automations include automatic barn cleaning, mist cooling or sprinkling, automatic egg collection systems, automatic exercisers/walkers, etc

Online herd management: Herd can be managed from anywhere now with the help of the online herd management system. Connected online with in-shed hardware it works as a single system to transfer data between the in-shed modules and online databases to provide the manager with real time data capture and management. The system is accessible wherever there is an internet connection giving a secure, 24/7 access to herd reporting and task management.

Advances in surgical operations: Laparoscopic and laser surgery provide less invasive procedures and shorter recovery time, while diagnostic imaging such as CT scan, ultrasound and MRI allow earlier diagnosis and provide baselines for before and after care. Diagnostic imaging offers more options for larger animals, too, including more in-depth looks into the head and digestive tract; potential use in neurologic, orthopedic and soft tissue treatment; and studying heart diseases.Since its introduction in the 1980s, strides in 3-D printing to make orthotics and prosthetics, to aid in surgical reconstruction and to make practice models also offer exciting new developments in education and surgery as the technology becomes less expensive. The practice of pet microchipping is growing, as well. Along with placing the implants, veterinarians record pet registration information in microchip manufacturer databases. Over the past two decades, advancements in the clinical understanding of wounds and their pathophysiology have commanded significant biomedical innovations in the treatment of acute, chronic, and other types of wounds.Various types of wound debridement techniques currently available in clinical practice are autolytic, enzymatic bio-debridement, mechanical, and conservative sharp and surgical. The term maintenance debridement describes the process of periodic removal of this recurrent slough and may involve application of one or more of the techniques.The advanced techniques of debridement include:

a. Low and high frequency ultrasound.
b. Hydrosurgery
c. Monofilament polyester fiber pad
d. Plasma-mediated Bipolar Radiofrequency Ablation (PBRA)

Laparoscopy (keyhole or minimally invasive surgery) allows a surgeon with the use of an instrument (laparoscope) inserted trans-abdominally to view, explore and manipulate inside of the abdomen and pelvis. Small portal incisions are associated with minimal tissue trauma and postoperative pain, shorter recovery periods, and decreased incidence of incision dehiscence. In addition to high pedagogic value, reduced hospitalization period and need for antibiotics and analgesics are the important advantages. Diagnostic laparoscopes used most frequently are suitable for a wide range of diagnostic and surgical procedures. Operating laparoscopes have an additional open

channel for the insertion of instruments (e.g. biopsy forceps). Using a single entry site, they are suitable for limited access techniques only. Use of laparoscopy in ruminants began with investigations related to their reproductive tract. During last one and half decades preventive as well as curative abomasopexy has become the most popular laparoscopic procedure in cattle. Laparoscopic splenectomy can be a safe and efficient procedure in ruminants. Laparoscopic technique for implantation of catheter into the urinary bladder is recommended. In prized animals, when preservation of fertility is essential, the laparoscopic herniorrhaphy and hernioplasty for correction of inguinal hernias can be successfully employed. By the use of minimally invasive theloscopy, substantial progress in teat surgery has now been made. In days to come, laparotomy for treatment of several abdominal diseases may be replaced by laparoscopy. Improvements in laparoscopic instruments and techniques may also permit more surgical procedures to be performed on an ambulatory basis, therefore setting a new trend in ruminant surgery.

New feeding innovations in poultry: In ovo feeding: In the quest for higher body weight gain, genetic selection along with improved nutritional status has significantly reduced the marketable age of broilers. As a result, more attention is being diverted towards the early development of chickens. The first few days after hatch are the critical period for the development and survival of commercial chickens. During this period, chicks make the metabolic and physiological transition from egg nutriture (i.e. yolk) to exogenous feed. In ovo feeding is technically feasible because *in ovo* administration of vaccines is already widely used in the broiler industry (Inovoject TM, Embrex, Inc., Raleigh, NC). Appropriate application of *in ovo* feeding has great potential to yield the following benefits for commercial poultry: Enhanced enteric development of the hatchling; Improved early growth performance (body weight gain and feed nutrient utilization efficiency); Improved health of hatchling due to improved resistance to enteric and metabolic disease, and reduced early mortality and morbidity; Improved resistance to stress associated with the hatching, handling, and transport to placement; and Modulate energy and protein metabolism and accelerate the development of the digestive, muscular, skeletal, circulatory, respiratory, and immune system (Bhanja *et al.,* 2015).

Advances in vaccinology and diagnostics: According to recent publications there are 105 biotechnology products licensed for animals. Most of these products are biologics, including veterinary vaccines and diagnostic kits. The animal health industry invests more than $400 million a year in research and development. Current sales of biotechnology-based products for use in animal health generate $2.8 billion. Biotechnology has yielded new and improved medicines for animals that help lower production costs and improve animal welfare by fighting devastating infectious diseases that affect animals worldwide. The advent of biotechnology has provided the means by which animal vaccines can be rationally designed for the specific control and eradication of diseases, including the implementation of DIVA (differentiating infected from vaccinated animals) strategies. Some viral proteins can spontaneously assemble into biological nanoparticles, so-called 'viruslike particles'.

Nanovaccines: VLPs mimic viral structures but cannot cause a productive infection and are readily recognised by the immune system, triggering an enhanced B and T cell immune response. (Rafiqi *et al.* 2017). Prominent examples of VLP-based vaccines are some baculovirus/insect cellexpressed veterinary vaccines against Porcine circovirus 2 (PCV2), Ingelvac CircoFLEX® for example. With the more frequent usage of recombinant vaccine antigens and the increasing emphasis on safety and tolerability of veterinary vaccines for the sake of animal welfare, those compounds are predicted to gain more importance in the future. Recent improvements in the understanding of virulence and pathogenicity combined with effective molecular biological methods have given way to rational design of vaccines, where virulence factors have selectively been eliminated or functionally silenced. This has led to vaccines that maintain the beneficial properties of live vaccines, while reducing the risk for a potential reversion of virulence. An example of this technology is a vaccine against Bovine viral diarrhoea virus (BVDV) recently introduced in the EU (Bovela®), where deletion and modification of two non-structural proteins allowed combining safety of an inactivated vaccine with the efficacy of a MLV.

Vector-based veterinary vaccines: Insertion of protective antigens into a live but apathogenic vector organism is a strategy that has been successfully applied to experimental and commercial vaccines. However, while vector-based veterinary vaccines are 'coming of age' for viral diseases, they are still only emerging for bacterial diseases. Besides conceptually combining the advantages of a live vaccine with its potent immune system stimulation with the high degree of safety of an avirulent carrier, they also allow for a potentially faster regulatory review. Additional advantages of some vector systems are their limited or even abortive replication competence in the host animal, substantially reducing the risk for shedding and recombination. some of the earliest vector-based vaccines in veterinary medicine, inducing a canarypox-vectored rabies vaccine for cats (Purevax®) and a herpes-based infectious bursal disease virus (vHVT-IBD) vaccine for chickens (Vaxxitek®) (Seidler *et al.*, 2017). Using DNA for vaccination represents a relatively new technology and its swift accessibility and well controlled production makes it a potentially interesting solution for the future. DNA vaccines currently suffer from some drawbacks, including: 1) relatively high costs; 2) strict requirements for intramuscular administration, which is a limitation in many domestic animal species; and 3) incompatibility with other classical vaccines leading to a barrier for the easy development of combination vaccines. Even higher expectations are on the use of RNA for vaccination; however, there are still technical hurdles to overcome before it will be widely used as vaccine, including the development of commercially viable formulations of mRNA. Both, DNA and RNA vaccines are able to broadly stimulate the immune system and are addressing the humoral and cellular immunity.

Advances in diagnostics: Biotechnology has also led to the development of rapid laboratory diagnostic tests to detect disease outbreaks early, a critical element in disease control. Importantly, biotechnology is enabling the development of diagnostic kits that can not only be used in the laboratory but pen-side tests that can be used in the field to make decisions about the exposure of animals during a disease outbreak. Recent advances in the development of technologies for personalised human medicine have motivated the development of prototype diagnostic tests for a wide selection of diseases of livestock. Biotechnology advancements in veterinary care continue to follow trends in human healthcare, including cancer vaccines and stem cell therapy. Current techniques employed to diagnose pathogens in livestock and poultry include classical plate-based methods and conventional biochemical methods as enzyme-linked immunosorbent assays (ELISA). Molecular techniques such as polymerase chain reaction (PCR) and real time PCR (RT-PCR) have also been used to diagnose and identify relevant infectious disease in animals (Bonkobara, 2016). However these DNA-based methodologies need isolated genetic materials and sophisticated instruments, being not suitable for in field analysis. Consequently, there is strong interest for developing new swift point-of-care biosensing systems for early detection of animal diseases with high sensitivity and specificity. Different sensing strategies based on DNA receptors, glycan, aptamers and antibodies are used (Vidic *et al.*, 2017). Besides devices validated according to standards of the World Organization for Animal Health are commercially available. Most of portable antibody-based methods for influenza virus diagnosis, including those being commercialized, are lateral flow tests. Advances in the development of the nucleic acid microarray have permitted automatization of the protocols and development of multiplex biochips for detection of various dairy pathogens. For instance, a biochip based on DNA amplification of genes characteristic for mastitis causing pathogens was shown to efficiently detect six other pathogens in addition to *M. bovis* in bovine milk with a limit of detection of 10^3 CFU/mL . Another example of a preliminary validated point-of-care test is a device that coupled reverse transcription loop-mediated isothermal amplification (RT-LAMP) with a lateral flow strips for foot-and-month disease diagnosis. The test provided diagnosis within less than 1 h with no requirement for instrumentation because the test line is visible by a naked eye. Techniques, such as optical, acoustic, electrochemical, microwire and localized surface plasmon resonance, have been proposed for traducing the hybridization with the specific target nucleic acid to the pathogen detection. For instance, an organic light emitting diode (OLED) biosensor can be employed for the detection of *Campylobacter* in poultry meat samples, using a DNA probe attached to a glass slide. The labelling of the secondary DNA probe with an Alexa Fluor fluorophore allowed reaching a sensitivity of 0.37 ng/µL DNA and 1.5×10^1 CFU/g of *Campylobacter* (Manzano *et al.*, 2015). In some areas, research is more advanced on pet health issues than in the food production animals sector. For example, symmetric dimethylarginine (SDMA)17, a form of amino acid excreted primarily from the kidneys, is now being used to diagnose chronic kidney disease (CKD) in cats and dogs. It has been found to permit identification of CKD on average nine months sooner in dogs and 17 months earlier in cats. Whether such technologies can transfer into the livestock sector will depend on the test cost relative to animal value.

Animal genomics in animal health: the next frontier: In the late 20th Century, a new window of opportunity has opened with a new area of research called genomics. As the 21st Century began and the human genome moved toward an initial draft sequence, additional technologies became available that allowed researchers to move into large-scale gene expression studies to visualise changes in levels of expression of hundreds of thousands of genes in specific tissues. The agricultural research community was able to capitalise on the infrastructure built by the human genome project by sequencing the chicken genome *(Gallus domesticus)* and the bovine genome *(Bos taurus).* The 2006 calendar year marked a major milestone in the history of agricultural animal research with the draft genome sequences completed for chickens and cattle and sequencing initiated for the porcine and equine genomes. The animal health research community now has in place a powerful toolbox for understanding the genetic variation associated with disease susceptibility, host-pathogen interactions, and complex phenotypes such as health traits.

Critical gaps in our understanding of gene structure and function in domestic animals must be filled before animal genomics can be successfully applied to animal health. Domestic animals provide a unique resource to study the primary biological mechanisms underlying gene structure and function, regulation of gene expression, and the genetic contribution to phenotypic variation because, unlike humans, domestic animals have been artificially selected to express or repress specific traits. Significant resources will be needed to support research and integrate two scientific disciplines that are not traditional partners: quantitative genetics and animal health. In support of that endeavour, the OIE has established an Ad hoc Group on Biotechnology. In this Group experts are working together to assess new technologies and develop scientific guidelines to enable their safe use in animal health research. Advances in animal genomics require interdisciplinary teams of scientists that address complex issues in animal diseases with state-ofthe-art equipment and approaches that include infectious diseases, pathology, physiology, immunology, and comparative microbial genomics. So far genomic studies on animal have been able to decipher:

a. quantitative population genetics studies to identify markers of health traits;
b. studies in functional genomics to assess host-pathogen interactions;
c. translating genomics information to discover innovative tools to control animal diseases;
d. integrated stakeholder support to advance the application of animal genomics for animal health.

Conclusion

In order to feed growing populations, it will be critical for the animal health sector in emerging markets to

make greater use of both new technologies and the latest science-based decision making on animal health. To some degree, this is already happening, for example with the use of biotechnology in animal feed, hormones for livestock, diagnostics and vaccines. However, often emerging markets lack access to animal health technologies and knowledge that are widely used in developed countries. Frequently, transfer of knowledge is much less costly than transfer of innovation, but transfer of knowledge in isolation does not necessarily help to provide solutions where infrastructure, technology and finance are lacking. Innovation must be appropriate to the needs of small-scale, resource-poor farmers. One key area where innovative developments may be within reach of such target groups is through mobile telephony, where inexpensive technology can be used more to provide farmers with knowledge and practical diagnostic assistance. Developments in mobile phone technology and software could be used, for example, to automate remote faecal egg counts or FAMACHA anaemia scores, leading to better targeted treatment. More research is required into the qualities of healthy animals, physiological and behavioural, and the implementation of management systems that foster the health of animals.

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Role of Protected Cultivation Technologies for Horticultural Crops in India

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Horticulture is the main source of numeration and livelihood to the farmer's in spite of small and scattered land holding. Since the spatial and temporal distribution of rain is erratic, scarcity of water does remain a problem during most of the period every year. Consequently, horticultural crops could not sustain due to deficit/ shortage of irrigation water or soil moisture during most of the crop period. Furthermore, the adverse climatic conditions such as snowfall, hail, sleet and abrupt reduction in temperature act as barrier in the growth of horticulture crops. All these circumstances largely hamper the horticulture based economy of farmers. Therefore, Plasticulture cum protected technologies along with harvesting of rainwater followed by storing in adequate capacity in low cost poly-tanks and precise use of this water through micro irrigation system in the horticultural crops grown under protected environment is the ultimate and sustainable solution of the horticulture based farming system. The demand for food is increasing day by day due to rapidly increasing population of the country. So in order to fulfill the food requirement of population there is a urgent need to increase the productivity of the crops. But, crop productivity is influenced by various factors such as cultivar, growing environment and management practices. The plant's environment is constituted by light, temperature, humidity, carbon dioxide and nutrients. In open field conditions, it is not possible to control the environmental factors such as extreme of light during summers, freezing temperature during winters, rains, frost, hails and drought condition. Sometimes, climatic fluctuations and adversities cause poor crop productivity or total crop failures. So, there is need of technologies in field of agriculture for feeding the rapidly increasing population and shortening the crop productivity gap of the country.

Protected cultivation is one of the leading technologies to meet the requirement of food especially in horticulture sector. Protechted cultivation is aimed to provide favourable environment for the sustained growth of plant so as to realize its maximum potential even in adverse climatic conditions. Production of crops under protected conditions has great potential in augmenting production and quality of vegetables, flowers and in some fruit crops in main and off-season and maximizing water and nutrient use efficiency under varied agro-climatic conditions of the country.

Current Scenario of Protected Cultivation

Presentably total area coverage in protected cultivation above 1.08 lakh ha in India which is in china is covered above 2.50lac hectare are in protected cultivation. This is the main reason of china is having Ist ranking in vegetable production. After the survey found leading state in India like, Maharashtra, Karnataka, Gujarat, Haryana, Rajsthan, J&K, HP and Uttarakhand**.**

Importance of Protected cultivation

The protected cultivation has following advantages in comparison to open field cultivation:

- Protect to the crops against abiotic stress during incidences
- Year-round, early, market demand and off-season cultivation is possible.
- Received higher quantity, quality, colour and storability for better export.
- Saving of water, fertilizer, moisture losses, nutrient leaching and soil erosion
- Minimized incidences of insect-pest, diseases and weeds.
- Enhance total crop duration from traditional.
- Increased employment or livelihood to the young youth.
- Beneficial for marginal or weaker section farmers of hill and peri-urban area
- Promote Hydro-ponics /Airo-ponics/Aqua-ponics technology.
- Very helping to the breeders and researchers

Structures or Features used under protected cultivation

Protected cultivation having various structures and features for using different crops and need based purpose *i.e*. Polyhouse, poly-tunnel, Shade-net-house, Insect-proof-net-house, mulching and anti-hail and Bird net-house.

Materials used for making protected structures

Various material are used in protected structures for installation and covering such as G.I. pipes, transparent film, shade net, insect-proof net, mulching sheet, pro-trays, plastic ropes, angel iron, GI. wire and drip irrigation system etc.

Crops grown in protected structures

Protected cultivation is generally recommended for growing high value and low volume cash crops. The commercially grown vegetables under protected structures are indeterminate tomato, coloured capsicum and parthenocarpic cucumbers. Other crops like summer squash, muskmelon, round melon, long melon, cucumber, bitter gourd and bottle ground can also be grown in plastic mulch, low and high tunnels. These cucurbits are ready to harvest one or one and half month early than the normal crop season and often command a greater price in the market.

Cultivation of Tomato, Capsicum, Cucumbers and Summer squash in protected structures

These crops can be grown nicely in polyhouse and Insect proof-net-house. The selection of structure depends upon the economic status of the person and crop to be grown. Protected cultivation technology of indeterminate tomato, coloured capsicum, parthenocarpic cucumber and summer squash are described below:

A. Tomato Crop in Polyhouse

Tomato is the first crop grown in polyhouse worldwide. It is relatively easy to grow as compared to capsicum and parthenocarpic cucumbers. In polyhouse and insect-proof-net-house, indeterminate tomato cultivars are generally grown; these cultivars produce flowers and fruit continuously along the main stem (signal stem) as it grows. As a result, these tomato plants may reach a length of 25 to 30 feet in 10-11 month duration of cultivation.

Soil and climatic requirements

The crops require loam or sandy-loam soil with good water holding capacity. But can be grown on wide range of soil types, as long as the soil is well-drained. Soil pH should be between 5.5 to 6.8 for successful cultivation. It is a warm season plant, so it cannot withstand severe frost conditions. It can be grown in a temperature and relative humidity range of 18-30 $^{\circ}$C and 60-70 % for good growth, yield and quality. The fruit set, pigmentation and nutritive value of the fruits greatly affected by temperature and light intensity.

Nursery rising in polyhouse

Mostly artificial soil-less media is used for raising healthy and vigorous seedlings in plastic pro-trays. Mainly three ingredients viz., coco-peat, vermiculite and perlite are used as root medium for raising the nursery. The coco-peat, vermiculite and perlite are filled in pro-trays in ratio of 3:1:1 as a root medium for raising the nursery in all type polyhouses. Seedlings are ready for transplanting in 28-30 days after sowing and it varies with season and crop.

Transplanting time and spacing

The suitable time of transplanting in plains is September-October and for hills, it is March-April. The spacing depends on cultivar, season, training and pruning system and management practices. The tomato is generally transplanted at a spacing of 50 x 50 cm under drip irrigation system.

Varieties

The tomato varieties suitable for polyhouse cultivation are Naveen, Nun 7711, GS-600, Arka Vardan, Arka Vishal, Avinash-2, Rakshita, Shnehlata, Himsona, Himshikhar and Rijuta. In cherry tomato, varieties are Pusa Charry-1 and NS 2.

Training and Pruning

The right time of training and pruning varies with the crop i.e. tomato crop require pruning after 20-25 days of transplanting. The training and pruning will continue at weekly interval during crop duration after transplanting. The different pruning methods for tomato crop are **s**ingle stem method, double branch method, triple branch method and four branch method.

Fertigation in polyhouse tomato

In polyouse conditions, application of fertilizer and irrigation water through drip system is essential to maintain healthy plant growth. The duration and amount of irrigation water required depends upon the growth stage of crop and surrounding climatic conditions. Fertigation is done an interval of 6-8 days from September to November and after that the interval of fertigation is again increased and it is done at an interval of 10-12 days. During May and June months, fertigation is done twice a week. Fertilizers solution of 5:3:6 ratio of N:P:K can be applied through drip irrigation @ 5-8 litres solution /m3 of water according to growth and season of the crop.

Pollination

Under polyhous crop requires pollination during flowering. So hand pollination is generally practiced with electronic vibrator or air blower. Bumble bee colony can also serve the purpose of pollination.

Harvesting and Yield

Under polyhouse conditions, harvesting starts 70-80th day after transplanting in tomato. In tomato harvesting duration is 200-230 days. The yield varies depending on the variety, type of polyhouse, training and pruning method, environmental control facilities and crop management practices. In tomato, a total of 15 to 20kg/m^2 big size tomatoes can be harvested under polyhouse cultivation.

B. Capsicum Crop in Polyhouse

Capsicum is an important vegetable crop with excellent prospectus for domestic and export market. It has very good potential as an alternative for polyhouse tomatoes. However, growing capsicum is harder and more laborious than growing tomatoes, but it fetches better price in the market.

Soil and climate requirements

The capsicum crop is more sensitive to environment as compared to tomato. The optimum night temperature for quality fruit production is 18-21°C. When temperature falls below 16°C for extended periods, growth and yields are usually decreased. It can tolerate daytime temperature over 30°C, as long as night temperature is within 21-24°C. It grows best in loam or sandy-loam soil with good water holding capacity. But it can be grown on many soil types, as long as the soil is well drained. Soil pH should be between 5.5 to 6.8 for successful cultivation.

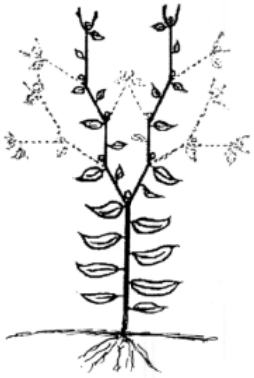
Transplanting time and spacing

The suitable time of transplanting in plains is September-October and for hills, it is March-April. The spacing depends on cultivar, season, training and pruning system and management practices. The capsicum is generally transplanted at a spacing of 50 x 50 cm without pruning and 50x30 cm with pruning methods.

Varieties

The varieties suitable for cultivation under protected conditions are Bharat, Mahabharat, (both green), Bomby (red), Orobellee (yellow), Indira (red), Swarna (Yellow) and Tanvi Plus (yellow).

Training and pruning



The capsicum crop require pruning after 25-30 days of transplanting, The training and pruning will continue at weekly interval during crop duration after transplanting. The capsicum is trained to different methods such as single stem pruning method, double branch pruning method, triple branch pruning method, four branch pruning method and multi branch pruning method.

Fertigation

As it is same as tomato crop. But drip fertigation ammonium nitrate, potassium nitrate and phosphoric acid are used as source of nitrogen, potash and phosphorus, respectively.

Harvesting and yield

Under greenhouse conditions, harvesting starts 70-80th day after transplanting. The harvesting duration is 180-210 days in case of capsicum. Yield varies depending on the variety, type of polyhouse, training and pruning method, environmental control facilities and crop management practices. On an average, capsicum varieties can produce 6 -7 Kg/m^{2}s of coloured fruits and 10 to 12 kg/m^2 of green fruits under polyhouse conditions. Average weight of quality coloured fruits is 200 to 250 gram/fruit with mostly four lobes.

C. Cucumber Crop in Polyhouse

Cucumbers are getting more popularity in the arbon and peri-arbon area. This crop grow very fast compared to tomatoes and also produce earlier and more fruits per plant. As a result, three crops of cucumber can be in a year under northern plain conditions of India for year round supply of high quality cucumber.

Soil and climate requirements

Cucumber can be grown on light to heavy soils. These do not perform well in heavy and poorly drained soils. It can tolerate strongly acidic soils but soil pH between 5.5 to 6.8 is best. Well drained soils are necessary for cucumber cultivation. It is a semi-tropical vegetable and grows best under condition of high light, temperature and moisture. However, it is more sensitive to temperature, which can cause reductions in both growth and yield. It cannot tolerate frost at growth stage. The optimum temperature for better development of fruits is 14°C to 20°C.

Transplanting time and spacing

The suitable time of transplanting in plains is September-October and for hills, it is March-April. But, however, cucumber transplanting in plains condition is done three times in a year i.e. first is July-August, second in November-December and third in February-March. The spacing depends on cultivar, season, training and pruning system and management practices. Cucumber is transplanted at a spacing of 30 x 50 cm under drip irrigation system.

Varieties

The varieties grown under polyhouse conditions also known as 'gynoecious' varieties. These varieties are parthenocarpic i.e. they produce fruit without the need of pollination. The fruits of these varieties require no peeling and lack bitterness. These varieties cannot be grown in open field to avoid pollination by non-parthenocarpic cucumbers because this will result in bitterness and the fruits becomes clubbed at the blossom and it also causes seed development. The varieties are Isatis (winter season), Kian, Hilton, Aviva and Asma (summer season).

Training and pruning

The cucumber crop requires training and pruning after 15-20 days of transplanting. The training and pruning will continue at weekly interval during crop duration after transplanting. The training methods for cucumber crop are single stem method, single stem with all main branches cut after one node, single stem with all main branches cut after two node, single stem with all main branches cut after three node.

Fertigation

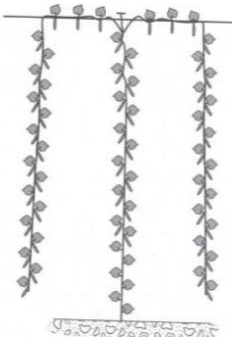
Cucumber requires a regular water supply for best quality and higher yields. The growth, flowering and fruit enlargement stages are most susceptible to irrigation deficit. The irrigation frequency depends on soil type and weather conditions. In general, fertilizers are also applied along with irrigation water according to the crop growth and season of cultivation. Cucumber crop has a higher fertilizer requirement; therefore, constant high levels of nutrients are required. The application of N,P and K @ 80,60, 100 ppm/m^3 is to be given at early stage of the crop and at the start of fruit picking stage N,P and K is applied @ 100, 80 and 120 ppm/m^3. During summer season fertigation is done twice a week, but during mild winter fertigation is done on 7 to 8 days interval. Fertigation during peak winter is usually done on an interval of 10 to 12 days, but it also depends upon soil type and growth of the crop.

Harvesting and yield

Under polyhouse conditions, harvesting starts from 30-35 days after transplanting in cucumber. The polyhouse cucumber completes a season in 90-100 days. So, three crops of cucumber can be taken in one year. The yield varies depending on the variety, type of polyhouse, training and pruning method, environmental control facilities and crop management practices. In cucumber, average yield varies from 15-20kg/m^2.

D. Summer Squash Crop in Lo-tunnels

Summer squash bushy or dwarf nature cross pollinated crop. So it generally used to grow in plastic low tunnels during off-season**.** Theses plastic low tunnels are flexible transparent covering that are installed over the rows or individual beds of transplanted vegetables to enhance plant growth by warming the air around the plants in the open field during winter season. These tunnels warm the soil and protect the plants from hails, cold wind injury and advance the crop by 30 to 45 days than the normal season. This technology is quite economical for growing off-season vegetables in peri-urban areas of the northern plains of our country. The varieties suitable for poly tunnel cultivation are Himanshu, Seole green, Dokato, Pusa Alankar and Australian green. Under northern Indian plains summer squash crop can be transplanted even in first to second week of December. Transplanting of the seedlings is done in a single row on each bed at a planting distance of 60-90 cm on drip system of irrigation. Distance between the rows is kept 1.5 to 1.6 meter. Transparent plastic (30-50 micron IR grade) is generally used for making low tunnels, which reflects infra-red radiation to keep the temperature of the low tunnels higher than open field. The plastic can be vented or slitted during the growing season as the temperature increase within the tunnels during the daytime. Generally, 3-4 cm size vents are made on eastern side of the tunnels just below the top on a distance of 2.5 to 3.0 m after transplanting and later on the size of the vents can be increased with rise in temperature and ultimately plastic is completely removed from the plants in month of February or March depending upon the crop, its growth and prevailing night temperature at that time.



Crop Care

All the recommended cultural practices (manuring, fertigation, weeding, and insect-pest and disease management etc.) are to be followed during the cropping period. Proper ventilation should be provided by opening curtains during day time and closing during night on daily basis. The ventilation area should be covered by 40-50 mesh insect-proofs net.

Shading Net House

Shading nets are the perforated plastic materials used to provide relief to the plants from the scorching sunlight, hot winds, direct rainfall as well as insects-pests. These shading nets are available in different shading intensities ranging from 25% to 75%. Theses shading nets are being used for raising nursery, indoor plants, hardening of tissue cultured plants and growing of vegetables. During high light intensities, leafy vegetables and ornamental greens are recommended to be grown under shade nets. This structure enhance 25-35% more yield as compared to traditional methods during peak summer season.

Insect proof net house

Shade house and Insect proof net house are often synonymously used but more correctly a net house is enclosed with perforated screen primarily to act as a barrier for the entry of insects and pests. .Insect-proof nylon nets are available in different intensities of perforations, ranging from 25 mesh to 60 mesh. Nets of 40 or higher mesh are effective means to control entry of most flying insects and save crop from diseases. These structures permit early planting of tomatoes and capsicum without the risk of vector. Higher mesh size, however, reduces the air exchange of the structure. UV-stabilized nets are now available which have a longer life. This structure enhance 25-35% more yield as compared to traditional methods during peak summer season.

Plastic Mulching

Mulching involves covering the soil around plant with an organic or inorganic material which makes condition more favourable for plant growth and development. Organic mulches, like leaves, straw, sawdust etc. add nutrients and humus to the soil as they decompose, improving its tilth and moisture holding capacity. Synthetic or plastic mulches have various beneficial effects on crop production. Plastic mulch accelerates plant growth by increasing soil temperature, conserving soil moisture, weed control, production of quality produce and reduction in leaching of fertilizer. The plastic mulch is available in different colours. Each colour has its own significance. Transparent polyethylene mulch raises the soil temperature. This effect derives mostly from the suppression of latent heat loss through evaporation. Black polyethylene film also gives effective weed control by cutting down solar radiation by more than 90%, resulting in etiolated growth and the eventual death of weeds under the film. The yellow plastic mulch attracts insects so it can be used to attract and kill insects. The silver-reflective type of plastic mulch associated with higher reflectance cause insect disorientation and repels aphids. Blue plastic mulch attracts thrips. The different types of mulches are reflective plastic mulches, infra-red transmitting mulches and biodegradable plastic mulches.

Nursery Raising Material

Plastic has wide variety of uses in nursery *viz*., for material glazing, seeder, trays and cell pack for propagation, container carrying trays, container for propagation and labels for proper identification, ground cover and packing of planting material for long distance transportation. Generally plastic trays or pro-trays having different cell sizes are used for raising vegetable seedlings. Mainly two kinds of plastic pro-trays are used in raising vegetable seedlings. One type of tray has cavities of 3.75 cm size, whereas the other type has cavities of 2.5 cm size. These trays helps in proper germination of seeds, provide independent area for each seed to germinate, reduces the mortality rate, maintain uniform and healthy growth of seedlings, are easy in handling and storing, reliable and economical in transportation. These plastic trays may be fixed in thermocol base trays having the same number and size of cavities before filling the media.

Packaging and Storage

In vegetable crops, around 30-35 % losses take place during harvesting, grading, packaging, transportation and marketing. The existing post-harvest loss of vegetables can be considerably reduced by adopting improved packaging, handling and efficient system of transport. Plastic is used for

packaging and storage of vegetable crops for extending storage life. The plastic bags, plastic sacks, plastic blow moulded containers are used for handling and storage. The cellulose film (cellophane), cellulose acetate, polyethylene (HDPE AND LDPE), polystyrene, ethyl cellulose, polypropylene, PVC, edible plastic are used for packaging of vegetables.

Drip irrigation

Drip irrigation is the best available technology for the judicious use of water for growing vegetable in large scale on sustainable basis. Drip irrigation is a low labour intensive and highly efficient system of irrigation, which is also amenable to use in difficult situations and problematic soils, even with poor quality water. Irrigation water savings ranging from 36-79% can be affected by adopting a suitable Drip irrigation system. In drip irrigation, water is supplied through a network of plastic pipes using dripper/emitters. Water is supplied at a regular interval and at a required time/ quantity. Productivity gains vary from 20 % to 50 % depending upon the crop. Drip irrigation works by applying water slowly, directly to the soil. Drip irrigation has high efficiency as there is no loss of water in form of evaporation or run-off and water is applied directly to the plant roots.

Rainwater harvesting

Protected cultivation is not possible without regular irrigation water under rain-fed condition in plain and hilly area. So water harvesting will be must for polyhouse structures. For this purpose we cane used the best option only poly-tanks in near by of Polyhouse structure. After development of poly-tanks we have collect all polyhouse roof water during rani season. This technology very beneficial to the hill farmers those are adapting contour farming because 80-90% hill farming depend on rain. The cot is calculated Rs. 110-120 per cubic meter for making poly-tanks.

Conclusions

The protected cultivation technology, due to higher yield per unit area along with export quality produce, can prove useful in raising the socio-economic status of small and marginal farmers of the country especially in hilly areas. It is also important in present scenario of shrinking cultivable land, depleting water and other natural resources. The high initial and operational cost of polyhouse, limited availability of material, mechanic and scientific staff, lack of awareness about the technology in rural areas are the main constrains in popularization of this technology among the farmers. So, there is urgent need to give emphasis on reducing the cost of installation of polyhouse, making available the technical manpower, easy availability of quality constructing material and strengthening the extension network. Keeping in view the increasing demand of off season and high value vegetables, fruits and flowers in metro-Politian cities of the country, there is urgent need for diversification from the traditional agriculture by production of high value horticultural crops under different protected structures for increasing their productivity and quality for getting high returns. Nursery raising under protected cultivation can be adopted as a agri-entrepreneur in major vegetable growing areas of the country by unemployed youths who are graduate in agriculture or post graduate in horticulture. Low cost protected technology like plastic low tunnels or walk in tunnels can be used for off season vegetable cultivation for getting high returns from off-season produce. Similarly insect-proof net houses can be used on a large scale for safe vegetable cultivation to minimize use of pesticides in vegetable cultivation and virus free crop production in large number of vegetables. Protected cultivation of horticultural crops is reasoned to be the next logical step to open field agriculture. One million hectare under protected vegetable cultivation can easily increase the production of vegetables by about 40 million tonnes. This will also permit the creation of about one million additional jobs in rural sector.

The field of protected cultivation is still evolving. Methods of more efficient input application are being devised. Better plant protection measures are being developed. More eco-friendly plastics are being produced by making the processes more efficient. As a result, protected cultivation could bring prosperity to vegetables growers in India and ensure nutritional and economical security for everyone.

Integrating Farmer led innovations and Agripreneurship for sustainable development and higher farm profitability: An overview of researches

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Farmers are creative and generate relevant local innovations which comes from a variety of sources including *intuition*, *dreams*, *experience at work*, *training*, *the ideas of friends*, *observations elsewhere*, *trouble/poverty* and *no way out*‘ *without being creative* (Critchley *et al* 1999). The identity of farmer innovators as those who have developed or are testing new ways of land husbandry that combine production with conservation is well established. Such innovations may be simple cultural measures or sophisticated structural designs combined with integrated production systems. The innovation may be an on-going experiment, or already proven and effective. It may even have become established as a local tradition. As such, farmers' innovation is 'A practice started and later improved by a farmer on her/his own initiative (problem oriented), without any external influence at all' (Critchley *et al* 1999a). Indian farmers have also been continuously improving available technologies for more efficient and cost effective farming, which resulted in numerous innovations over the generations and helped in improving farming practices ensuring better livelihood options. Promotions of farmers' innovations are also in priority agenda of the government now a day in the form of various programmes.

Farmer-led innovations are evolving under specific agro-climatic and socio-economic conditions and such innovations should be widely adopted and sustained. The farmers identified a number of new/indigenous traditional crops and developed varieties with enhanced productivity and better quality through selection. Farmers also developed low cost processing technologies for value addition, increased shelf-life and better marketability for various farm products. In addition, a number of farm implements and tools were designed and manufactured by the farmers to increase operational efficiency and productivity. Women farmers have contributed in diverse germplasm conservation, postharvest management and value addition which helped in enhancing the farm income. Most of the farming practices traditionally adopted by the farmers are those which were evolved after long experiences of the farmers and communities under specific agro-climatic and socio-economic conditions.

Farmer -led innovations, over generations, have neither been duly recognized nor documented. Also the Intellectual Property Rights (IPR) on the innovations made by farmers has often been ignored. Value of traditional knowledge and its documentation has often remained unnoticed by scientists. The innovations led by farmers have neither been institutionalized for their horizontal and vertical expansion nor properly recognized. As a result, many technologies developed by innovative farmers have not reached to other farmers. Although, the initiative in the form of protection of propriety rights of the farmer-led innovations by government and non-government bodies have been taken in recent past but at a limited scale. Farm Innovators could have effectively become consultants and entrepreneurs leading to off-farm income generation options but the lack of proper sustenance support, institutional requirements for up scaling and out scaling and related constraints hindered farmer to farmer extension, institutionalization of such innovations and their blending with the modern scientific knowledge for the benefit of farming community at large.

Connotation of Farmer led innovation

In July 1987, some 50 social and natural scientists of roughly equal numbers met at the *Institute of Development Studies(IDS) at the University of Sussex*, UK, for a workshop on 'Farmers and Agricultural Research: Complementary Methods', later more generally known as the 'Farmer First' workshop. That workshop brought together experiences from a diverse range of individuals and organisations and marked a key moment in the development of approaches to farmer participation in agricultural research and extension. The importance of traditional knowledge for the protection of biodiversity and the achievement of sustainable development started slowly being recognized internationally (Gadgil *et al.*, 1993). The motivating factor for developing innovation has always been curiosity followed by increased production in addition to the reduced cost of production (Bayer, 2013). The sustainability of livelihoods becomes a function of how men and women use asset portfolios on both a short- and long-term basis (Krantz, 2001). SRI was a 'farmer-first' innovation from the outset, truly farmer-centered in the experimentation and evaluation undertaken by Fr. Henri de Laulanié (1993, 2003) and it has been farmer-participatory in its further development. This reporting on farmer innovation reflects that fact that SRI is still a work in progress. Chapters of this story have been written in over two dozen countries already, through the efforts of NGO workers, researchers, teachers, administrators, and other motivated individuals (Uphoff, 2009). Tripps (2006) study of low external input technology (LEIT) showed that there are relatively few examples where LEIT projects have led to a significant amount of independent experimentation, while farmers' experimental capacities got

strengthened. Similarly, Sambodo (2007) mentioned that, farmers' decision rules can be distinguished according to their perceptions and attitudes, to their belief that they have the power to deal with problems and opportunities, as well as to the extent of socio-cultural influences. The innovators in general share certain distinctive characteristics like opportunism, tend to be curious, proud and willing to take risks, and they pick up ideas from here and there (CDCS, 1997), they respond to recognition (Gupta, 1998); they have latent skills and enthusiasm (Segeross, 1996), and triggered to innovate by various factors including problem solving and accidental or even playful discoveries (Roling, 1996) whereas the farm innovators depend on the land; pick up piecemeal advice and blend with their own experience; focus on intensification and integration of resources; typically concerned with resource management; demonstrate pride in their own achievements, driven by a financial motive as well as a general concern with production, stimuli to innovation are travel outside the area, and information from various sources (Critchley and Mosenene,1995).

The continuum of Farmer Innovation

The significance of farmers' innovation however ranges from being useful only to the individual farmer, to a wider range of farmers. Innovation involves the interaction of individuals and organizations possessing different types of knowledge within a particular social, political, policy, economic, and institutional context (World Bank 2006). Important dimension of the concept of "farmer innovation" is that it embraces not only technological innovation, but also new ways of managing livelihood in general (networking, communication, institution building, information management, marketing, planning, accessing resources, etc). As a conceptual understanding platform, Prolinnova-Ethiopia (2004) adopted the following schematic presentation to explain the conceptual framework of farmer innovation:

Local innovations have been extended in different scales, however, 70 percent of local innovations were extended beyond the village and 30 % were confined only in village. The effectiveness of local innovation was reflected through its area of coverage. Farming community has developed a number of valuable innovations, and has proved potential through the application of these innovations in fellow farmers' fields also (ICAR, 2010). As far as the impact of farmer led innovation is concerned increased production has been the major outcome of most of the farmers' innovations followed by increased satisfaction and knowledge (Tambo, 2014). Another important area of impact of farmer led innovations may be farmers' capacity to continue the process of innovation to address other challenges through strengthening individual capacities, such as confidence, knowledge and to handle experimentation and innovation (Wettasinha *et al.* 2014). Social networking of farm innovators has proved to be potential to construct knowledge. On the other hand the farm innovators require certain distinguishing capacities like foreseeing institutional requirements and linkages, comparative financial impact and success analysis ability in addition to analyse projected demand and required changes in socio cultural and infrastructural domain. FLIs having additional advantage over conventional innovations to tackle second generations' problems require different set of capacities on the part of farm innovators to scale their innovations in addition to be innovative, learning institutes for which are yet to be come into existence. (Nain *et al*, 2018). Farmer-Led Agricultural Innovation for Resilience (FLAIR) has achieved tremendous success in introducing SRI to a large number of small-scale farmers. In Cambodia and Vietnam, SRI adopters experienced significant positive impacts on food security and income with a coarse calculation giving a 13-fold return on investment (Pommier, 2014). Innovative ways to increase production, improve organisation, or reduce dependence on external inputs, farmer innovations were found having significant potential to improve the quality of life for farming families in Malawi and reduce their impact on the environment.. The farmer led innovations are driven by a range of interlinked factors: economic factors (the inability to afford external inputs or grow enough food to be food secure), environmental factors (the need to adapt to climate fluctuations or restore infertile soils which cannot be rested due to small landholdings), social factors(migration, HIV /AIDS, and scarce labour availability), cultural factors (need to use certain plants for ritual and other purposes), and political factors (availability of subsidized fertilizers and seeds as a form of political patronage by a neopatrimonial state) (FAO, 2012).

The major initiatives

The technological and institutional innovations are not two different departments of the same system, but it is often very common to see instances where technological innovations causing institutional changes or institutional innovation stimulating technological innovations. At international level, to develop mechanisms for local innovations to find their way into the formal research and development system, the Participatory Adaptation and Diffusion of Technologies for Rice-Based systems project initiated several activities to encourage their national partners to document, validate and disseminate local knowledge and innovations. This IFAD-funded project is coordinated by the African Rice Center (WARDA). The first phase of the project was implemented from 2000 to 2003 in Ghana, Guinea, The Gambia and cote d' Ivore. The Farm level Applied Research Methods for Eastern and South Africa(FARMESA) is a regional collaborative institute operating in five countries includingKenya, Tanzania, Uganda, Zambia and Zimbabwe with associate countries includingBotswana, Malawi, Mozambique and South Africa (FAO. 2008). African Highlands Initiative (AHI) in traduced numerous technologies to improve and enhance land productivity in a sustainable way within the intensive land-use systems of the highlands in eastern and central Africa while maintaining the quality of the natural resource base during 1998-99, where farmers modified some elements of the technologies in different ways and sometimes opposing some of researchers methodologies in their

fields according to their experiences with locally available alternatives resulting to a formal survey to trace such innovations and search out the motivating factors for innovation and its effects on adoption (Lyamchai*et al* 2005). The common activities for PROLINNOVA (Promoting Local Innovation) global programme are identification and documentation of local innovation, capacity building of different stakeholders, validation, promotion and up scaling of innovation which supports in livelihood of resource poor and low resource farmers. PROLLINNOVA Cambodia started up action research on so-called Local Innovation Support Funds (LISFs) in 2007 where farmers are given flexibility and independence in doing their own research relevant to local problems and conditions and facilitated the sharing of such innovations and experiences through a workshop. Promotion of farmer innovation and experimentation in Ethiopia (PROFIEET) Later named as PROLINNOVA-Ethiopia worked on the process and products of local innovation-based partnership between farmers, the formally trained researchers/experts, the private sector, policy people, extension workers and other factors". The global community of practices included 16 countries mainly from Africa, Latin, America and Asia (PRROLINOVA-Ethiopia, 2006). Promoting Farmer Innovation (PFI) is the key activity of a project in East Africa upto 2001. The methodology and early results of PFI sought to use local farmer innovation in the field of land husbandry as a stimulus to more appropriate research and extension systems in semiarid and marginal areas which led to documentation of selected innovations as one of the products. International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) in northern Malawi stressed and worked for convergence between informal innovation and formal research and development systems (Olivia, 2012).

In Indian context, NIF (National Innovation foundation) took up the mission of making India innovative (documenting, adding value, protecting the intellectual property rights of the contemporary unaided technological innovators, as well as of outstanding traditional knowledge holders) and a creative society since 2000 with the active support of Department of Science and Technology, Government of India. In this, it supplements the work done by the Honey Bee network over the years. The NIF seeks to create an innovation-driven society by giving awards to outstanding grassroots innovators, helping transform those innovations that have economic potential into products that can be commercially produced (either by the innovator himself or through licensing of the innovation to another commercial enterprise), and linking grassroots innovators to the formal science and technology system to get inputs to improve upon innovations wherever necessary and create a new model of innovation-driven entrepreneurship. To support individual innovators, the Technopreneur Promotion Programme (TePP) has been used to provide capital to several of the individual innovators. To support the commercialization activities of the NIF, the government created a Micro Venture and Innovation Fund of about $ 1million (to be operated by the NIF with the involvement of the Small Industries Development Bank of India) in 2002 and these funds are being used to scale-up innovations and facilitate the creation of viable enterprises . The Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI), a global NGO based in India was set up in 1993 to provide support to the honey bee network and to enhance global networking and do research on problems related to diffusion and protection of grassroots innovations. Grass Roots Innovation Augmentation Network (GIAN), Gujarat set up in 1997 is involved in documentation and validation of farmer innovations. It provides small amounts of funding for prototype development, links innovators to science and technology institutions, and identifies commercial enterprises interested in licensing product technologies from the grassroots innovators. ICAR organised a National farm innovators meet was organised at JSS Krishi Vigyan Kendra, Suttur, Mysore District, Karnataka and published Farm Innovators 2010. Intellectual Property and Technology Management cell (IP&TM) of ICAR oversees all matters related to intellectual properties and technology transfer/commercialization of new ideas. It is maintaining data base of successful innovative farmers for better dissemination. ICARs Zonal Technology Management and Business Planning and Development units (ZTM and BPD) main objective is to protect Intellectual Property Rights, showcasing, transferring and commercializing the ICAR institutes innovations. They also act as Agri Business incubator to Incubate new start up businesses. Almost all the State Agricultural Universities, state departments, KVKs, ATMAs are documenting the farmer led innovations at district level and recognizing them through kisanmelas, exhibitions, seminars, conferences etc. (ICAR report 2015). Technology Information, Forecasting and Assessment Council (TIFAC) set up in 1988 under the Department of Science and Technology to look ahead in technologies, assess the technology trajectories, and support technology innovation by network actions in selected technology areas of national importance is providing the technical and financial support in the form of filing patents, extending post patent support for technology refinement and marketing and to upscale through various programmes.Protection of Plant Varieties and Farmers Rights Authority (PPV&FRA**)** set up in 2005, is involved in documentation, indexing and cataloguing of farmers' varieties. National Bank for Agriculture and Rural Development (NABARD)set up a separate fund titled "Farm Innovation and Promotion Fund" (FIPF) to encourage specifically the innovations in the farm sector. The Fund has been created in NABARD with an initial corpus of 5 crores and it was operational with effect from 1 April 2005. It was initiated mainly to provide support on the analogy of venture capital for innovative ideas – technological and managerial (like supply chain management) in farm sector for further development (NABARD report 2010).National Research Development Corporation (NRDC) was established in 1953 is recognizing a large repository of wide range of technologies spread over almost all areas of industries, viz. Agriculture and Agro-processing, Chemicals including Pesticides, Drugs and Pharmaceuticals, Bio Technology, Metallurgy, Electronics etc. It has licensed the indigenous technology to more

than 4800 entrepreneurs and helped to establish a large number of small and medium scale industries. (NRDC annual report 2015)

Learning exchange through social networking

The growing importance of knowledge has led to the concept of knowledge management which is the process of capturing, developing, sharing, and effectively using knowledge. Extension manages knowledge in an agricultural innovation system to support the progress of farmers. In general, the uses of information technology communications tools support knowledge sharing (Eid and Nuhu, 2011). The SECI (Socialization, Externalization, Combination, Internalization) model is a knowledge management model that explains how the different forms of knowledge are transferred or combined in an organisation. Social network or negotiation communication model considers information overload or fatigue which implies different approach for different issues and facilitative knowledge exchange (interactive partnership to share knowledge and experiences for decision making). Low-cost information and communication technology (ICT) tools possess the ability to deliver timely, relevant, and actionable information to farmers at lower costs than traditional extension services (Aker,2011, Cole and Fernando, 2012, World Bank, 2016). Social media has proved to be an important platform for pluralistic extension, bringing together all the actors in Agriculture Information System (AIS) and making them shareholders in development (Narukae*t al*,2017). Study on social interactions between online communities in online learning through mobile device, has found social presence to be a principal factor influencing motivations to engage in social interactions for constructing and sharing knowledge (Cheung *et al*, 2008). Comparison of the use of blogs and Facebook for supporting knowledge management activities of creation, sharing, and application found that both tools generally support knowledge management but Facebook has more capabilities and potential than blogs in support of knowledge sharing (Cheung *et al*, 2013).

Farmer led innovations (FLIs) having advantage to tackle second generations' problems require different set of capacities on the part of farm innovators to scale their innovations in addition to be innovative (Nain *et al*, 2018). It can empower individual farmer and rural communities, strengthens link between farmers, extension worker and researcher in such a way that farmer experimentation directs the research agenda and the participatory technology development ensures sustainability of technology. Provision of comparative experiences through knowledge management systems, conflict management approaches, facilitation of multi stakeholder negotiations, building alliances with private sector, marketers and NGOs need to be stressed upon. Farmers need to initiate group action in production process, the mechanism for better remuneration need to be ensured for the extra efforts and the institutional arrangements for networking of stakeholders need to be devised to translate the challenges into opportunities.In order to enhance awareness of the innovative capacities of the farmers, to identify farmer-led innovations having potential to be adopted for larger impact and to share the experiences of farmers-led innovations in the field of agriculture and allied sector and to set the ground for networking of farm innovators, research institute and agricultural marketing agencies for dissemination of farmers' innovations as well as institutional innovations among larger population

Entrepreneurship development through and Farmer led innovation

There is proven nexus of entrepreneurship and innovationfor sustainable development and need of the day is to encourage 'entrepreneurial agriculture for human development and maximum farm profits'. Innovativeness has been found to be critical in entrepreneurial behavior. Farm Innovators could effectively become consultants and entrepreneurs leading to off-farm income generation options after getting training and support in certain distinguishing capacities like foreseeing institutional requirements and linkages, comparative financial impact and success analysis ability in addition to analyze projected demand and required changes in socio cultural and infrastructural domain (Nain *et al.,* 2018). On other hand according to social network theory, entrepreneurs' social ties influence their recognition of entrepreneurial opportunities and entrepreneurial pursuits (Hills *et al.*, 1997). The development of a rural entrepreneurial support system necessitates creating a supportive environment, or social networking, to flourish in an entrepreneurial climate through building partnerships (Dabson*et al*, 2003). Developing partnerships includes the coordinated efforts of central government, local governments, municipalities, academies and non-governmental organizations to help spur the entrepreneurial activity of that region (Kulawczuk, 1998). Partnership with institutions, academies and various organizations encourage rural community development and strengthen institutional support structures and well-built relations between the government and the private sector in new enterprise development in rural provinces. The strength of infrastructure development plays a crucial role in rural entrepreneurship development (FAO documents, 1997). Infrastructure development is highly correlated with the level of entrepreneurial activity across different countries (Zacharakis *et al.*, 1999). Since basic infrastructure development and availability of financing (Kulawczuk, 1998) are necessary for any entrepreneurial venture, it is assumed that a country's rate of the development of the national framework conditions may be a crucial link between a variety of other social, intellectual and environmental dimensions and rural opportunity recognition in a country. There is no proper appreciation of farmers as actors in the innovation system, little information provided about different sources of knowledge involved, or the flow of knowledge and little attention to long-term impacts on livelihoods (Brigidlett*yet al.*, 2012). Institutionalization of any farmer led innovation being a complex process requires capacity strengthening and change in individuals as well as change in organizations. Fuentes *et al.* (2013)

suggested that private players should assist in the commercialization of farmer-led innovations. Farmers should play a key role in planning the process of scaling out in their area to develop ownership and commitment to improving livelihoods. Supporting organizations need to facilitate the scaling out process beyond short term research or development projects (Miller and Connell, 2009).

Summing up

Diminishing returns from Agriculture have put the whole rural economy under severe stress which paved the way to accelerate the diversification of rural livelihoods in order to have adequate viable and sustainable means and opportunities. Institutional mechanism and human mobilization for networking and resource optimization, collectivization, technologies and methodologies of secondary agriculture are the keys for maximizing farm income. Human resources base in rural ecosystem in general is lacking in social processes of group and enterprise management skills along with marketing and communication skills. The capacity building interventions not only have the potential for changing entrepreneurial competencies but broadening the horizon of the participants to launch their own income generating activities. The backward and forward linkages in the form of advisory services, input supply, marketing of the produce, financial backstopping and the support and convergence of various stakeholders like banks, NGOs, research institution, state line department may bring positive impact in the form of initiation of income generating activities out of their own innovations. Screening for scalability of farmers' innovations and efforts for their institutionalization pre-requires creation of platform for exchange of information and experiences, developing and disseminating theme-based knowledge products and undertake analysis of partner institutions to assess their potential as participants and building capacity of partner institutions. The framework for agri-entreprise development for maximizing farm profitability may be conceived as the function of entrepreneurial competencies, entrepreneurial climate, and farmers' innovations. To encourage Entrepreneurial Agriculture for Human Development and maximum farm profits, farmers need to harness all their skillsso that they will be able to withstand harsh conditions which are as a result of environmental changes or social compulsion driven. Agricultural productivity is believed to be enhanced by the incorporation of strategic entrepreneurship skills. Also, farmer led innovations generated for immediate problem solving or creative application have helped in optimizing farm profits and managing agricultural activities conveniently. Innovativeness has been found to be critical in entrepreneurial behaviour.

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Soil management strategies for livelihood security in changing climate scenario

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Soils are the most vital and precious natural resource for existence of mankind. But the pressure on this vital resource has increased and soil quality has declined to a greater extent. Climatic variation has also contributed to decreasing soil quality. The increase in temperature, erratic rainfall and indiscriminate use of agro-chemicals leads to less available soil water, less biomass and less soil organic matter content and hence to decrease in soil physical, chemical and biological properties. Interactions between climate change and soil degradation are believed to be primary cause of more frequent droughts and floods. Soil quality can however be improved by following simple soil management practices and modest improvements in soil quality can have a drastic positive effect on sustainable crop productivity, food security and the environment quality.

Introduction

Agriculture over the years is losing ground to other professions, which are considered more attractive by the younger generation. Decrease in agricultural productivity with climate change and shrinking of land availability is the biggest challenge to feed increasing population. To have a natural and ecological balance we need 30% land under forest cover. The challenges before us are daunting. The future approach shall have to be more sustainable so that while we increase productivity, on one side, we do not degrade the environment and ecology on other side. Healthy soils provide the largest store of terrestrial carbon. When managed sustainably, soils can play an important role in climate change mitigation by storing carbon (carbon sequestration) and decreasing greenhouse gas emissions in the atmosphere. Conversely, if soils are managed poorly or cultivated through unsustainable agricultural practices, soil carbon can be released into the atmosphere in the form of carbon dioxide (CO2), which can contribute to climate change. The steady conversion of grassland and forestland to cropland and grazing lands over the past several centuries has resulted in historic losses of soil carbon worldwide. However, by restoring degraded soils and adopting soil conservation practices, there is major potential to decrease the emission of greenhouse gases from agriculture, enhance carbon sequestration and build resilience to climate change. Climate change is affecting India in a big way and its impacts are many and serious-erratic monsoon, migration of agricultural zones, spread of tropical diseases, sea level rise, change in availability of fresh water, floods, droughts, heat waves, storms, hurricanes etc. Abrupt climate change could make large areas of the country uninhabitable.

There is a direct link between the rise in global temperature and damage to eco-systems. About 130 million hectares land is undergoing different levels of degradation, namely water erosion (32.8 M ha), wind erosion (10.8 M ha), desertification (68.1 M ha), salinization (7.0 M ha), water logging (8.5M ha) and nutrient depletion (3.2 M ha). It could have serious repercussions on agricultural productivity, if preventive steps are not taken. Other effects of climate change are more. For instance, rise in sea levels, say about a meter by the next century, may displace millions of people. Sea level rise would lead to ingress of saline water and salination of ground water and surface water in coastal areas. Almost 50 percent of flora and fauna could be affected by global warming. At the present warming rate, 1/4th of earth's species including birds may become extinct by 2050. Rising water temperatures and more intense hurricanes would affect the sea life. Increasing desertification is a serious problem. Arid and semi-arid conditions make India more prone to desertification. Depletion of natural vegetation and cultivation on sand dunes and marginal lands accentuate soil erosion. Trends indicate that agricultural productivity will decline up to 25 percent which could be as much as 50 percent in rainfed agriculture. Climate change will have an adverse impact on food security. Food cost will increase as food availability (cereals, livestock products, fish) will decrease. Disadvantaged regions and socially and economically backward people will be affected more. Food security would be further exacerbated by loss of cultivable land and nursery areas for fisheries, by inundation and coastal erosion in low lying areas. Predictions based on modeling studies indicate that substantial losses are likely in rain-fed wheat in South and South – East Asia. A 0.5 degree Celsius rise in winter temperature would reduce wheat yield by 0.45 tones per hectare.

Expected Climate by 2060

- Several degrees warmer, on average (3 to5°C)
- Generally higher expected rainfall along the East Coast
- Greater rainfall extremes
  - More floods
  - More droughts
- Possibly lower rainfall in some areas
- Increase in sea levels by up to 60 cm
- Likely impact on C sources and sinks

Impact of climate change on Soil Quality/Soil Health

Assessing the impacts of climate change on soil process is more complex. While there is extensive scientific

debate about the nature of the underlying driving forces, there is clear evidence of changing temporal and spatial patterns of climate phenomenon that impact soil processes. Changes in temperature, moisture, increased CO_2 concentration and enhance atmospheric deposition impact several soil processes especially related to C and N dynamics and storage in soil. Climate change is the shift in the climatic conditions form what we perceive now as normal. Furthermore, the climatic conditions have a strong bearing upon the type of activity occurring within the soils.

Of the climatic parameters temperature and precipitation are perhaps the most important. Climate change is occurring, both in terms of air temperature and precipitation. Among the potentially most important characteristics of expected climate change in relation to agriculture, are changes in climate extremes, warming of high latitudes, shift of monsoon rainfall areas toward the poles, and reduction in soil humidity. Climatic change may alter the hydrologic cycle and, consequently, it will impact the available water resources, thus resulting in frequent floods in some case and drought conditions in other. Either way the agricultural productivity will be impacted. With the changing climate will come many challenges as soil process will alter. The variations in the soil conditions can occur in many ways.

Soil quality' is generally used more by soil scientists but farmers prefer the term 'soil health' as it portrays soil as a living, dynamic system whose functions are mediated by a diversity of living organisms that require management and conservation. However, soil quality is the capacity of soils within landscapes to sustain biological productivity, maintain environmental quality, and promote plant and animal health. It is the interactions of measurable chemical, physical and microbiological properties of a particular soil.

There are several definitions of soil quality. However, The Soil Science Society of America defines soil quality as "the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation.

Organic carbon and nitrogen found in soils are subject to a range of biological processes capable of generating or consuming greenhouse gases (CO_2, N_2O and CH_4). In response to the strong impact that agricultural management can have on the amount of organic carbon and nitrogen stored in soil and their rates of biological cycling, soils have the potential to reduce or enhance concentrations of greenhouse gases in the atmosphere. Concern also exists over the potential positive feedback that a changing climate may have on rates of greenhouse gas emission from soil. Since emissions of greenhouse gases from soil derive from biological processes that are sensitive to soil temperature and water content, climate change may impact significantly on future emissions. The diversity of climate, soil types, and agricultural practices in place across the country will make it difficult to define generic scenarios for greenhouse gas emissions.

Summary of expected effects of individual climate change variables on soil processes

Increasing temperature	Loss of soil organic matter Reduction in labile pool of SOM Reduction in moisture content Increase in mineralization rate Loss of soil structure Increase in soil respiration rate
Increasing CO_2 concentration	Increase in soil organic matter Increase in water use efficiency More availability of carbon to soil microorganisms Accelerated nutrient cycling.
Increasing rainfall	Increase in soil moisture or soil wetness Enhanced surface runoff and erosion Increase in soil organic matter Nutrient leaching Increased reduction of Fe and nitrates Increased volatilization loss of nitrogen Increase in productivity in arid regions
Reduction in rainfall	Reduction in soil organic matter Soil salinization Reduction in nutrient availability

Indicators of soil Quality

Indicators of soil quality can be categorized into four general groups

1. Visual indicators
2. Physical indicators
3. Chemical indicators
4. Biological indicators

1. Visual indicators

These are visual observations and photographic interpretations. Exposure of subsoil, change in soil colour, ephemeral gullies, ponding, runoff, plant response, weed species, are few examples of potential locally determined indicators.

2. Physical indicators

Physical indicators provide information about soil hydrologic characteristics, such as water entry and retention that influences availability to plants. Some indicators are related to nutrient availability by their influence on rooting volume and aeration status. Other measures tell us about erosional status. Indicators include measures of:

- Aggregate Stability
- Available Water holding Capacity
- Bulk Density
- Infiltration
- Soil Crusts
- Soil Structure

3. Chemical indicators

Chemical indicators provides information about the equilibrium between soil solution (soil water and nutrients) and exchange sites (clay particles, organic matter); plant health; the nutritional requirements of plant and soil and levels of soil contaminants and their availability for uptake by plants. Indicators include measures of:

- Soil Reaction (pH)
- Electrical Conductivity
- Cation exchange capacity
- Organic matter
- Potential contaminant elements (heavy metals, radioactive compounds etc.)

4. Biological indicators

These indicators provide information about the micro and macro-organisms, their activity, or by-products that form the soil food web that are responsible for decomposition of organic matter and nutrient cycling. Earthworms, nematodes, or termites populations have been suggested for use in some parts of the country. Farmers can measure the status of either the total community of microorganisms or specific members of that community or species that performs similar jobs or niches. Indicators include measures of:

- Earthworms
- Potentially Mineralizable Nitrogen
- Soil Respiration
- Microbial biomass C

Selected indicators of soil Quality and some processes they impact

Measurement	**Processes affected**
Organic matter	Nutrient cycling, Pesticide and water retention
Infiltration	Runoff and leaching potential, Plant and water use efficiency, erosion potential
Aggregation	Soil structure, erosion resistance, crop emergence, infiltration
Microbial biomass	Biological activity, nutrient cycling, capacity to degrade pesticides
Forms of N	Availability to crops, leaching potential, mineralization and immobilization rates
Bulk density	Plant root penetration, water and air filled pore space, biological activity
Topsoil depth	Rooting volume for crop production, water and nutrient availability
Conductivity or salinity	Water infiltration, crop growth, soil structure
Available nutrients	Capacity to support crop growth, environmental hazard
Soil surface	Erosion, Crusting, Sealing, infiltration

Karlen *et al*., 1997

Threats to soil quality/health due to climate change

The burning of fossil fuels by industry, households and vehicles releases gaseous emissions of sulphur dioxide and oxides of nitrogen that can travel hundreds of miles in the atmosphere. These gases can be dissolved in rainwater to form sulphuric and nitric acids. These will subsequently be deposited on soil and result in soil

Soil quality is at risk from a number of threats driven by a range of man-made and natural pressures including climate change, land use change and land management practices. Human activities have changed the character and quality of soils over time. Soil quality is degrading due to destruction of protective vegetation cover and by keeping the soil bare for long periods of time. Active nutrient and pesticides addition to soils is there. All of these activities

can impair, or even destroy, the ability of soil to carry out its essential functions. There is a direct relationship between soil quality, soil functions and productivity. Once soil is damaged or contaminated it can be extremely difficult, if not impossible, to restore. Climate change is affecting numerous soil quality issues such as:

Strategies for maintaining Soil Quality

To protect the soils against any negative effect of climate change, or against other extremes in external circumstances such as nutrient depletion or excess (pollution), or drought or high-intensity rains, the best management practices are:

Use of cover crops

Management of soils to give them maximum physical resilience through a stable, heterogeneous pore system by maintaining a closed ground cover as much as possible is one of the most important strategies for maintaining soil quality. Various pulse crops behaves as cover crops and helps in maintaining soil quality. Nitrogen is the major limiting nutrient for most crops and it can be supplemented by incorporating a legume of some type in the cropping system. Before green revolution, various pulse crops regularly found a place in crop rotations but in order to meet the food requirements of increasing population, there has been a paradigm shift in crop production system in India being biased towards cereal-cereal rotations. However, symbiotic association of the legumes with different species of Rhizobium has proved useful in sequestrating significant amounts of atmospheric N_2 in the soil plant system to the extent that 25-50% of the chemically fixed N requirement of the succeeding cereal crop can be met by the atmospheric N fixed by the legumes.

Carbon sequestration

The sequestration of carbon helps off-set emissions from fossil fuel combustion and other carbon-emitting activities while enhancing soil quality and long term agronomic productivity. Soil carbon sequestration is the process of transferring carbon dioxide from atmosphere into the soil through crop residues and other organic solids, and in a form that is not immediately reemitted. Biochar is proposed as a new form of soil carbon sequestration, in which fine-ground charcoal is applied to the soil. Biochar is produced by the combustion of biomass under oxygen-limited conditions. International Biochar Initiative (IBI) argues that applying charcoal to soils would create a reliable and permanent carbon sink, and would mitigate climate change, as well as making soils more fertile and water retentive. This has a positive impact on environmental, agricultural and biodiversity aspects of ecosystems.

Carbon sequestration potential of horticultural crops

Horticultural crops have the ability to capture atmospheric CO2 and through the process of photosynthesis, metabolize it to produce sugars and other compounds that are necessary for the plants normal development. The carbon sequestered by plants is the results of the difference between CO2 absorbed from the atmosphere during the process of photosynthesis and the CO2 released to the atmosphere during respiration. This difference is converted into biomass. Therefore, whilst CO2 levels are high, both natural vegetation and agricultural plants including vegetable crops act as a source of sequestered carbon. When this is taken into account, vegetable cultivation also become one of the most effective means in mitigating the increase of atmospheric CO2.

Integrated plant nutrient management system

Using an integrated plant nutrient management system to balance the input and offtake of nutrients over a cropping cycle or over the years is most essential for maintaining deteriorating soil quality. The IPNS encompassing adequate and balanced use of nutrients in an integrated manner employing chemical, organic and biofertilizers and is the most ideal system of nutrient management. The supply of nutrients in the form of organic manures helps in retaining more moisture, thereby enhancing the water and nutrient use efficiencies.

Application of organics along with fertilizers not only increased the crop productivity but also improves the physical chemical and biological properties of the soil. Besides, organic sources of nutrient acts as slow release fertilizers as it synchronizes the nutrient demand set by plants, both in time and space, with supply of the nutrients from the labile soil and applied nutrient pools.

Site-specific nutrient management

Site-specific nutrient management (SSNM) can be prescriptive, corrective or a combination of both. SSNM has potential to mitigate adverse effects of climate change. SSNM approach follows the principles of participatory soil sampling and development of soil health cards, which is very helpful for recommendation of nutrients. Based on the expected crop demand, targeted yield, soil test data, fertilizer efficiency and crop grown in each field, SSNM sheet could be developed in each farmer's field. With this, farmers will invest only on deficient nutrients and omit nutrient application which was in sufficient range in soils. Thus, it reduces the input cost and improves the use efficiency of nutrients significantly. Nitrogen content of the standing crop is measured by employing certain diagnostic tools such as chlorophyll meter and leaf colour chart, which helps in deciding the most suitable time for application of nitrogen during period of crop growth. Various benefits of SSNM practice include lowering input cost, higher nutrient use efficiency, higher water use efficiency and reducing GHGs particularly N_2O .

Balanced fertilization

One of the major constraints to decreasing soil quality and less fertilizer use efficiency in Asia is an imbalance of

applied nutrients. Nitrogen (N) applications tend to be too high in relation to the amount of potassium (K) and phosphate (PO_4) used. The use of micronutrient is very limited. This is partly the result of a difference in cost of different nutrients, and partly due to the lack of knowledge among farmers about the need for balanced fertilizer applications. The imbalances in fertilizer use have therefore led to emergence of multi-nutrient deficiencies in the Indian soils. At the country level, nutrient deficiencies have increased to the order of 89, 80, 50, 41, 49, 33, 12, 5 and 3 % for nitrogen, phosphorus, potassium, sulphur, zinc, boron, molybdenum, iron and manganese, respectively. This depletion of nutrient reserves from the soil is often a hidden form of land degradation.

Thus this gap between nutrients required by the crops and amounts expected to be made available from soil nutrient application has to be bridged through external nutrient application. Balanced and efficient use of fertilizers results in lower unit production costs, higher economic returns and minimal environmental impact. Fertilizer use on soil test basis can ensure the balance among nutrients and lead to increased yields and profits and helps in maintaining sustainability.

Promoting Microbial inoculation for plant and Soil health

Seed and Soil inoculation with a group of bacteria called plant growth promoting rhizobateria (PGPR) or plant health promoting rhizobacteria improves the health of soils. These have several polyfunctional abilities like fixing atmospheric nitrogen, solubilizing phosphorus and other nutrients from insoluble sources, producing growth hormones and suppressing the activities of pathogens through production of antibiotics, ammonia, HCN etc.

In-situ nutrient recycling

Recycling of crop residues/biomass helps in enhancing the soil organic matter and availability of micronutrients and thus maintains soil quality. The farmers, generally, burn crop residues to avoid inconvenience during tiling and seeding operations in the subsequent crop. However, the crop residues are resources with readily available carrier of nutrients and organic matter. Leaving crop residues on the soil surface or incorporation provides a favourable environment for soil and surface dwelling organisms because of reduced water loss, amelioration of temperature extremes, fluctuations, and the presence of a relatively continuous substrate for decomposers. Implements are available to help in simultaneous mulching rice straw while sowing wheat.

Also the practice of green manuring for improving soil fertility, biological health and supplying a part of nutrient requirement of crop/ cropping system is an age-old practice.

Crop diversification

Crop diversification is a concept where in more than one type of crops are raised to mitigate the risks of crop failure and price fluctuation of one crop. It is intended to give wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops in the hope of increasing overall productivity and marketability. Diversification ensures certain income to the farmer from other crop. It helps in reversing the process of system degradation and can deliver many agronomic and ecological benefits simultaneously. Crop rotations lead to an increase in species richness and overall density and thus also improves various physical, chemical and biological properties of soil. Crop substitution and shift are also taking place in the areas with distinct soil problems e.g growing of rice in high water table areas replacing oilseeds, pulses etc.

Conservation of soil moisture

Conventional soil moisture methodologies like mulching are useful in view of future water scarcity. Mulching influences soil moisture and influences NUE and WUE of crops, by affecting the hydrothermal regime of soil, which may enhance root and shoot growth. Soil moisture greatly influences nutrient transformation and release from organic forms, their uptake by roots and subsequent translocation and utilization by plants. Low cost efficient and location based technologies are very much available and there is need to adopt it.

Rainwater harvesting

There is variability in rainfall. Some season will get more rain and some will less. This is going to hamper the location-specific conventional crop growing. Creation of suitable on farm reservoirs wherever possible can serve the purpose of water scarcity and helps in retaining soil moisture.

Organic Farming

Organic farming is a holistic production management system, which promotes sustainable agriculture and enhances agro-ecosystem health. It ensures qualitative development of soil, water and environment on sustainable basis. The experimental evidences could prove that a holistic soil and crop management had similar productivity as compared to conventional agriculture and often higher yields in the regions of the world where the production environment is much fragile and tough (rainfed and hilly areas). On this note, organic agriculture may prove to be an alternating strategy to avert climate change with basic principles with regard to mitigation of climate change, and it include to:

- Encourage and enhance biological cycles within the farming system
- Maintain and increase long-term fertility in soils
- Use as far as possible, renewable resources in locally organized production systems
- Minimize all forms of pollution

Beside this, organic agriculture give priority to the optimal (recycled and reuse) use of inputs with an aim to achieve maximum output.

Agroforestry

It includes both traditional and modern land-use system where trees are managed together with crops and/or animal production systems in agricultural setting. Agroforestry systems buffer farmers against climate variability, and reduce atmospheric loads of greenhouse gases. Agroforestry can both sequester carbon and produce a range of economic, environmental, and socio-economic benefits. For example, trees in agroforestry systems improve soil fertility through control of erosion, maintenance of soil organic matter and physical properties, increased nitrogen aeration, extraction of nutrients from deep soil horizons, and promotion of more closed nutrient cycling. In India, reducing emissions from deforestation and forest degradation is a major event that needs to evaluate to rectify it.

Fruit based agroforestry system

The fruits based agroforestry system is a self-sustainable system where solar energy can be harvested at different heights, soil resources can be efficiency used and cropping intensity is increased. The system consists of three main components viz., main crop, filler crop and inter crops which occupy three different tiers in space of the production system.

Tank Silt Application

Community tanks and taals may be used to collect rain water along with nutrient-rich top soil eroded from catchment areas. This tanks' silt can supply organic carbon and several nutrients besides improving soil physical, chemical and biological properties, if applied in the field.

Mulching-cum-manuring

In permanent cropping system, soil organic carbon improves by use of organic manures added through plant residues, mixed cropping, legume based crop rotations, or agroforestry. On the opposite side, sole use of synthetic nitrogen fertilizer application increases oxidation of organic matter, thereby reducing organic carbon from the soil. It improves soil surface conditions to increase infiltration, and water holding capacity, and reduce evaporation losses from the field. Beside this, it also provides additional nitrogen into the soil thereby improving soil health. It reduces temperature fluctuation in the soil and lowered down the canopy temperature at reproductive stage in many crops giving higher yield and test weight levels. It can be done through the use of crop residues, green manure crops, green leaf manure crops, brown manuring etc.

Mitigating N_2O emission from soils

N_2O emission contributes about 38% of agricultural GHGs emissions of which 1% as direct N_2O emission from applied nitrogenous fertilizers. These emissions can be reduced by adding catch or cover crops that have the capacity to extract stored nitrogen from the soil that was not used by the previous crops. However, study suggests higher N_2O emission after manure application compared to mineral fertilizer application due to higher oxygen consumption for decomposition of organic matter. These can be reduced by improving soil aeration either by lowering bulk density, rescue incorporation of legumes, and increase tillage practices (as no-tillage cause low aeration with more release of N_2O gas).

Biomass recycling

Indian agriculture produce around 500 550 million tonnes (Mt) of crop residues annually, which can be used as animal feed, soil mulch, manure, thatching for rural homes and fuel for domestic and industrial purposes. However, large portion of around 90-140 Mt residues burnt on-farm annually to clear the field for the next succeeding crop. Burning causes release of smoke, deleterious particles, emission of green house gases, and loss of plant nutrients like N, P, K, S, and carbon from the soil, which are beneficial for soil health.

Application of biochar

The current availability of biomass in India is estimated at about 600 million ton/ year. Studies sponsored by the Ministry of New and Renewable Energy, Govt. of India have estimated surplus biomass availability of about 180-200 million ton/annum. Of this, about 93 million ton of crop residues are burnt each year. Generation of crop residues is highest in Uttar Pradesh (60 million ton) followed by Punjab (50 million ton). Efficient utilization of this biomass by converting it as a valuable source of soil amendment is one approach to manage soil quality, fertility, mitigate GHGs emission and increase carbon sequestration. Biochar is a fine-grained, carbon-rich, porous product remaining after plant biomass has been subjected to thermo-chemical conversion process (pyrolysis) at low temperatures (~350–600°C) in an environment with little or no oxygen. Biochar is not a pure carbon, but rather mix of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S) and ash in different proportions. Biochar is a fine-grained charcoal high in organic carbon and largely resistant to decomposition. It is produced from pyrolysis of plant and waste feed stocks. As a soil amendment, biochar creates a recalcitrant soil carbon pool that is carbon-negative, serving as a net withdrawal of atmospheric carbon dioxide stored in highly recalcitrant soil carbon stocks. Char-amended soils have shown 50-80 percent reductions in nitrous oxide emissions and reduced runoff of phosphorus into surface waters and leaching of nitrogen into groundwater. As a soil amendment, biochar significantly increases the efficiency of and reduces the need for traditional chemical fertilizers, while greatly

enhancing crop yields. The carbon in biochar resists degradation and can hold carbon in soils for hundreds to thousands of years.

Resource Conservation Based Technologies

The key resource conservation-based technologies are in situ moisture conservation, rainwater harvesting and recycling, efficient use of irrigation water, conservation agriculture, energy efficiency in crop production and irrigation and use of poor quality water. Other strategies include characterization of bio-physical and socio-economic resources utilizing GIS and remote sensing; integrated watershed development; developing strategies for improving rainwater use efficiency through rainwater harvesting, storage, and reuse; contingency crop planning to minimize loss of production during drought / flood years.

Integrated Nutrient Management (INM) and Site-Specific Nutrient Management (SSNM) techniques have the potential to mitigate effects of climate change by reducing carbon dioxide emissions and improving crop yield. One of the key emerging technologies to reduce GHG emissions from paddy fields is the use of zymogenic bacteria, acetic acid and hydrogen-producers, methanogens, methane oxidizers, and nitrifiers and denitrifiers in rice paddies which help in maintain the soil redox potential in a range where both nitrous oxide and methane emissions are low. The application of urease inhibitor, hydroquinone (HQ), and a nitrification inhibitor, dicyandiamide (DCD) together with urea also is an effective technology for reducing nitrous oxide and methane from paddy fields. Use of neem-coated urea is another simple and cost effective technology.

With the increasing organic matter under conservation agriculture, soil can retain carbon from carbon dioxide and act as a carbon repository for longer time period fighting climate change problem. It provides small-scale farmers with diversification opportunities, reduced labour requirements for tillage, land preparation and weeding. More time availability offers real opportunities for diversification options such as for example poultry farming or on-farm sales of produce, or other off-farm small enterprise developments.

Conservation agriculture lowers farm power. Reduced requirements for farm power and energy for field production by up to 60% compared to conventional farming. Additionally equipment investment, particularly the number and size of tractors, is significantly reduced. Zero tillage reduces soil compaction causing more carbon to retain in the soil, thereby improving soil health.

Watershed Approach

The conservation measures of soil and water in the lower catchment areas are prone to be damaged due to excessive runoff from the upper areas. Therefore, it is essential to protect the upper catchment areas through the watershed approach.

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Chronological outlook of Seed Potato Production Scenario in India

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Seed constitutes a major and important input in potato (Solanum tuberosum L.) cultivation. On account of vegetative propagation, the requirement of seed potatoes (tubers) is voluminous and accounts for 40-50% of the total production. Potato productivity in India is low in comparison to developed countries due to the non-availability of quality seed in required amounts. Seed potato production involving micro-propagation (tissue culture) techniques can overcome many of the problems associated with theconventional multiplication system. The everlasting shortage of seed potatoes in most of the potato growing nations can be overcome through hi-tech seed production system including micro-propagation and aeroponic techniques on account of faster rate of multiplication. Besides, rapid multiplication, disease freedom on account of multiplication of disease free mother stocks under controlled conditions followed by reduced number of field exposures as compared to conventional multiplication system is an added advantage of seed potato production through these techniques. For expanding quality seeds, the entire seed framework needs to be reviewed. The present review will be an endeavor to outline the historical background of seed potato production, issues and challenges faced towards seed potato production, supply frameworks and policy implications with respect to seed potato production in India.

Keywords: *Seed, health status, virus indexing, seed plot technique, meristem culture, hi-tech system*

Seed is the basic and vital input in agriculture, its timely availability in adequate quantity that decides the strength and health of agricultural economy in the country. Seed has played a very important role in India's green revolution and shall continue to be the vital component for the days to come (Naik and Buckseth, 2018). There is a saying "as you sow, so shall you reap", which traditionally relate to the quality of seed determining the production, has been the wisdom of our fore fathers. The experience in the country side indicated that farmers who save their own seed, generally select fields which are free from diseases and pests and then select only those plants which are healthy, well filled for seed purpose, harvest them separately, clean, cure and then store in proper containers and inspect regularly for any kind of damage or get good quality seed from other seed farmers on barter basis, indicating thereby the importance of seed in their production system. There is limited accessibility of quality material in case of vegetatively propagated plants in India. Generally tubers are used as Seed in case of potatoes (Ranali, 1997) overwhelming various problems like low multiplication rates, increased production cost various seed borne diseases befitting the risk of degeneration over years. Such tubers when planted yield low and diseased plants in adjacent generations. This was coined as 'degeneration' or selenity by the Dutch workers in 1972. This acts as a major constraint in producing clean potatoes (Badoni and Chauhan, 2010). Potato production is constrained by various factors that include availability of suitable varieties, agro-techniques, quality seed and storage infrastructure, especially in tropics and sub-tropics. But most important being the availability of quality seed as it has a direct bearing on crop yield (Singh and Sharma, 2018). Potato seed is bulky and the rate of multiplication is slow (5-6 times), this poses a unique challenge to seed production and seed supplying agencies (Young, 1990). Since the crop is multiplied vegetatively using tuber as seed, it gets degenerated very fast necessitating replacement of the seed every year (ideally) or after every two years (Naik and Buckseth, 2018). Further the seed is either unavailable or out of the reach of farmers due to high price. The seed related issues are further aggravated because of restricted accessibility of reasonable seed producing regionsQuality seeds can alone add to the increased yield by 15-20% (BADC, 2012).

Seed Potato in India

The simple first endeavor to maintain healthy standards of potato seed stocks was made in 1933 in UP (Uttar Pradesh) by Agriculture Department. They attempted to increase the pathogen free seed supplies of Dunbar Cavalier and Majestic cultivars imported from England. This aided in anchoring around 100 quintals of Majestic and 250 quintals of the other assortment i.e. Dunbar Cavalier at Almora and Nainital hills of Garhwal district.To conquer the issue of dormancy, a secondround of multiplication was done in the mid hills of Bhawali. But this resulted in degeneration of stocks due to occurrence of bacterial brown rot disease in seed tubers and thus the scheme failed. In 1935, a thought was envisioned to establish anundeniable research foundation in India.This provoked the opening of a Potato Breeding Institute in Shimla and two seed creation farms at Bhowali (Kumar slopes, UP) and Kufri (Shimla Hills) as a piece of Indian Agricultural Research Institute, Delhi.Taking a look at the issue of seed degeneration, a research plan under the Indian (Imperial) Council of Agricultural Research was developed in 1941. It surveyed the various diseases affecting potatoes(Vasudeva and Azad, 1952). Potato cyst nematode, popularly known as golden nematode is a 'major constraint to potato production throughout the world and this quarantine pest is restricted to Nilgiri hills of South India. It was first detected in1961 at Ootacamund and brisk execution of isolate estimates confined its further spread to other potato developing areas.

Hills-Ideal for Seed Potato Production

A project with the name 'Production of partially disease free potatoes' was set up. The fundamental approach was to clean up all the seed crops present in fields which could be obviously distinguished for viral infection. It

brought about threefold increase in the yield of Darjelling Red Round variety. But it was soon realized that potato seed generation on a huge scale requires production and development of India's own varieties. As the climatic conditions in India were entirely different from North America and Europe from where the potatoes were imported in.The experience additionally brought the acceptancethat an association which is specialized in science and excels in the craft of seed production was required for commercial production of potato. An overview was portrait by Devis in 1934 on the different reasons for seed potato degeneracy and it were the aphids particularly *Myzus persicae* which was observed to be the fundamental driver. Additionally, with the advancements winning around then, hills were observed to be the perfect location for seed potato production which was pathogen free. According to the guidelines provided by him for the location and maintenance of seed potatoes in hilly areas, the principal seed production station for potatoes was built up in the high hills of Kufri, H.P. It satisfied the states of lower temperature in summers (underneath 20 degree Celcius) with the inability of aphid migrants to alight the potato crops and their colonization. It was additionally risky to grow potato crops for seed purpose when aphid population transcends above 20 in 100 leaves.Till 1935, the seed potato was being imported from various European countries on yearly basis, but during Second World War, European countries put a blanket ban on the export of potato seed to India.

Foundation of CPRI:

European varieties were imported to Indiaand endeavors were made to acclimatize them to the agro-climatic conditions prevailing in India. But soon deterioration of seed stock took place due to absence of any seed potato production program. With this, it was realizedthat India can't relyon exotic varieties alone and therefore, needs to have its own program for research and development of potato. In 1945, a scheme for developing Central Potato Research Institute was advanced by Sir Herbert Steward, then Agricultural Advisor of Government of India. The planwas implemented by Dr. S. Ramanujam in 1946 and it was the first occasion when that scientific orientation was given to the seed potato production. In 1946-1947, 1072 mounds of seed potatoes of three varieties-*Arran consue, up-to-date and Kerrs pink* were distributed to local farmers.However, it took three years for the entire scheme to attain a concentrated shape in the form of CPRI, Patna with its first Director Dr. S Ramanujam. The three units functioning independently were (i) Potato Breeding Station, Shimla (ii) Seed Certification Station, Kufri (iii) Potato Multiplication Station, Bhowali were now converged into CPRI.The administration of Himachal Pradesh developed a research scheme for producing disease free seed tubers.This venture effectively delivered clones of 'Up-to-Date" which was imported from Northern Ireland. As hills were the only source of pathogen free seed, in 1956 the headquarters were shifted to Shimla. With the course of time trade was successfully established between the hills and plains. In between, 1956 to 1983, a few local research stations were built up in various potato developing zones of the nation to address local issues of potato development. The organization has seven territorial research stations situated at Jalandhar (Punjab), Patna (Bihar), Modipuram (Uttar Pradesh), Kufri (Himachal Pradesh), Gwalior (Madhya Pradesh),Shillong (Meghalaya) and Ootacamund (Tamil Nadu). Potato seed creation was confined to high slopes till mid 1960's.

Seed Act, 1966

The seed requires a synchronized flow starting from breeder's seed up-to certified seed. To maintain this continuous stream, The Seed Act was passed. The required amount and quality of breeder seed is obtained by multiplying the seed at four different stages viz., Stage I, Stage-II, Stage-III and stage IV under stringent conditions to prevent any onset of diseases. The foundation seed so developed needs to further undergo two stages of multiplication –Foundation Seed I and Foundation Seed II. Once it is confirmed to be genetically pure and disease free this stock is maintained as nucleus seed. Further its health will be maintained through indexing.

Overdependence on Hill Seeds

Viruses are transmitted by vectors known as aphids, consequently potato seed started to be produced in the high hills which almost lacked aphid during the potato cropping period . This increased the strain on the indigenous seed multiplication systems being practised in the hills. Subsequently, after 22 years in 1966 another research station was setup in Fagu, H.P. As all hilly areas have not been found to be reasonable for production and maintenance of healthy seed potatoes which can meet the standards.The issue of rapid degeneration had made the plains fully reliant on the hills in order to satisfy their prerequisite for seed Thus the entire pressure was laid onto the hills for quality seed potato production which offered ascend to an extensive no. of issues, for example:

(i) Limited areas having elevation of 750 m or above which are technologically suitable for seed production.
(ii) Seeds produced in hills cannot be utilized in plains for sowing in October due to dormancy.
(iii) Limited means of transporting the freshly harvested but dormant seed tubers over long distances resulting in delay in planting.
(iv) Crop conditions due to irrigation practices

In the Indian hills viz., Kashmirvalley, Kinnaur and Lahul Spiti potato planting takes place during the summer seasons followed by harvesting towards the end of monsoons. However, there was no uniform distribution of rainfall which is critical for the growth of plant. Therefore in case of scanty rainfall, the much required irrigation is difficult to provide due to highly uneven topography, exceptionally porous nature and non availability of ground

water. Another factor which adds is limited area for cultivation and the seed not being of the right physiological age to be immediately used in plains.

Also, a high rate of degeneration makes the seed break down after a couple of multiplications. Since the eastern, north-eastern, Deccan and South western parts of the nation, having hotter climatic conditions, were not reasonable for customary quality seed production. To conquer these issues it was important to fabricate another framework for seed production as well as certification in plains which could limit the reliance on slopes. In 1971, an undertaking under the name All India Coordinated Potato Improvement Project (AICPIP) with its headquarters in CPRI, Shimla was set up.

Development of Seed Plot Technique for Plains

Till mid-1960's the seed potato cultivation was constrained to high hills only as it had low aphid population during cropping season. Potato was cultivated as a spring crop in the Indo-Gangetic plains which was totally exhibited to aphids bringing about degenerated seeds. Different analyses were led by CPRI for seed potato creation in various agro-climatic areas. A noteworthy achievement underway of value potato seed was culminated through the introduction of " Seed Plot Technique' in 1965. This made India, the only nation in South Asia with its own breeding program for potato. This aided in beating seed decline because of aphids as the seed crops could be grown during very little or no aphid population in the plains of Northern India. Due to the advancement of Seed Plot Technique, the significant production of disease free seed moved from the slopes to the fields in plains. Despite the fact that potato was presented as a late spring crop in temperate hills, it at last turned into a noteworthy winter crop for the plains. The vast stretch of fertile belt reaches out from Punjab to Assam. The seed produced through seed plot method gave 30-40% higher yields as well as was free from many soil and tuber borne diseases (B.P. Singh and Rajesh, Rana 2014). It was adequate for producing enough breeder seed for the nation every year.

Seed Plot Technique benefitted Indian agriculturists as well as aided in sparing expansive measure of cash which generally was spent on the import of foreign seeds. The primary guideline of this technique relied on developing healthy seed potato utilizing low aphid period in between October and starting of January incorporated with coordinated pest and disease management. Though, roguing and dehaulming of the seed crop needed to be completed by the last week of December or mid of January before the aphids reach the critical level. This strategy opened a window in sub-tropical plains forproduction of quality seed. The seed production could be taken up in bigger zones under sub-tropical plains including, U.P, Bihar, Punjab, Haryana and parts of Madhya Pradesh. Farmers could undoubtedly receiveseed of right physiological age at the exact time of planting, with no issue of dormancy.

The selection of seed plot system prompted enormous development in cold stores for storing the produce which in the following season could be used for autumn planting. As a result of the advancement of seed plot method, potato tuber moth (PTM) got eliminated and seed rottage diminished. Thus seed plot technique met the seed prerequisite as well as prompted higher productivity with minimum losses (P .M. Govindakrishnan, S.S. Lal and M.K. Jatav Central Potato Research Institute, Shimla-171001 (HP)

Virus Indexing

Exploiting the seed plot framework, a proficient consistent strategy for outfitting the quality of healthy seed stocks was envisioned after 1970 through clonal choice, tuber indexing and stage-wise field multiplication of healthy tubers. Indexed tubers concept for production of disease free potato seed took shape once diagnostic methods were developed for major potato viruses (Singh and Sharma, 2018). In this method, tubers are selected from storage/ growing crop that are uniform in type, free from detectable diseases, and within an acceptable size range. Each tuber is coded for identification, and an eye, preferably from the stolon end, is removed and planted in the greenhouse. Resultant plants are evaluated for vigour and viral diseases. The tubers which are free from all the viruses are used for production of disease free seed by multiplying them in the field for four (Stage 1, 2, 3, 4) generations (Crissman and Mc Arthur, 1993; Singh, 2003). This has been made feasible utilizing ELISA (Enzyme Linked Immune Sorbent Assay) with its first use in 1984, by CPRI. In this method, tubers are first screened against different infections like PVX, PVA, PVY PVS, PLRV, PVM, PVY^N and PVY^Cusing ELISA. Tuber indexing is a system of testing the picked tubers to be free from any disease by growing up their eye plugs in net houses. Another essential technique grasped for virus detection and elimination is Immunospecific Electron Microscopy which is in used since 1987. Scotland pioneered this concept which has since been used world over for potato seed production, including India (Koehnke and Shaughnessy, 1942; Upreti, 1977). The new diagnostics developed over the years have improved the efficiency of the system.

Seed Potato Production Systems

Conventional system

The conventional method of seed potato production is to repeatedly propagate a sample which has been proved to be free ofpathogens in a system called clonal multiplication (Bryan, 1981;Struik and Wiersema, 1999). The clonal multiplication system hasbeen practiced effectively in the Netherlands, South Africa, Kenya(Crissman and Mc Arthur, 1993) and India (Upreti, 1977). Thispotato seed production system is laborious, expensive and timeconsuming. Because of a low multiplication rate (usually 1:6), ittakes many years to produce significant

quantities of seed to meetthe demand of potato industry. Another constraint is the degeneration of seed stocks from one generation to another due toaccumulation of bacteria, fungi, viruses and viroids. Modern seedprogrammes tend to minimize the use of clonal systems or use acombination of clonal and rapid multiplication systems.The production of potato seed under conventional system hasnot been effective in avoiding or reducing the buildup of pathogensand has consequently led to reduced quality potato seed andlow crop yields. In this system, seed potato growers select better quality tubersfor seed and discard those of poor quality. The diseased and healthyplants are identified and separated and the healthy tubers areused for the next season's production. If the mother potato plantbecomes infected with a disease during the growing season, eachof the new daughter tubers is likely to be infected as well. Duringthe growing season, growers check seed fields visually for signs ofdisease and remove infected plants through the process of rouging. However, visual inspection, particularly for primary infection,is unreliable, time consuming and requires a well experienced eye(Lapierre and Signoret, 2004; Phytocultures Ltd., 2008). Inevitably,the quality of seed potato produced in subsequent generation'sdeclines substantially. The conventional method of propagation isone of the slowest methods of seed multiplication. This method hasalso shown to be done at certain time of the year specific particularly in tropical and sub-tropical regions where potato is a wintercrop (Burton, 1989). In addition, the method requires a seed producer to have enough land if he has to enter into commercial seedproduction. This however, is associated with high labour cost in managing big fields.

Thus, the only way-out to overcome the above said limitations is augmentation of seed potato production through hi-tech seed production system to improve the quality and to reduce the field exposure.

Hi-tech system

The virus-indexed and pathogen-free mericlones are subjected to a rapid tissue culture plant propagation method to generate abundant clean (pathogen-free) cultures. Several facets of the generic science of plant tissue culture have both current and potential future applications (Naik and Karihaloo, 2007). These include micropropagation, i.e. clonal propagation through axillary shoot proliferation using explants (isolated plant tissues, e.g. leaf sections or stem internodes used in in vitro culture) containing pre-existing meristems, de novo shoot production following the induction of adventitious meristems by the application of plant growth regulators and somatic embryogenesis, which is the process of embryo initiation and development from vegetative or non-gametic cells (Millam and Sharma, 2007). All these processes hold significant applications in potato biotechnology. The widespread introduction of plant tissue culture to seed potato production during the 1970s enabled the rapid multiplication of disease free seed material and resulted in more productive seed stock. Micropropagation now underpins many seed potato production systems and specifically provides the nuclear stock material, in the form of microplants (plants derived through in vitro axillary bud proliferation) or micro-tubers (in vitro produced tubers) for their subsequent use in a chain of potato seed production programmes (Millam and Sahrma, 2007; Chindi *et al.*, 2014).

Micropropagation involving in vitro asexual multiplication allows quick and round-the-year production of disease-free good quality pre-basic seed and thus is a way out to supplement the ever high requirement of quality seed. The use of micropropagation in pre-basic seed production has resulted into mass production of potato plants in a very short period of time (Naik *et al.*, 2000). Seed potato production through micropropagation is mostly based on the production of in vitro plantlets or microtubers, and on the subsequent production of minitubers as first ex vitro generation (Fig 1) (Ranalli, 1997). Minitubers can be produced from plantlets planted at high densities in the greenhouse in beds (Wiersema *et al.*, 1987) or in containers (Jones, 1988) using different substrate mixtures, or even in hydroponic culture (Muro *et al.*, 1997). Lommen (1995) presented alternative production techniques for minitubers using very high plant densities and non-destructive, repeated harvesting of minitubers by lifting plants carefully from the soil mixture and replanting them after harvest. These techniques allowed minitubers of ideal size to be produced, the number of tubers could beincreased considerably, while total yield was reduced. Many seed programmes prefer to use minitubers, defined as the small tubers, (usually 5–25 mm), that can be produced throughout the year under semi in vitro conditions in glasshouse and screen-houses using in vitro propagated plantlets, planted at high density. Hydroponic and aeroponic techniques have been evaluated and proved suitable for minituber production in greenhouse (Nugaliyadde *et al.*, 2005); hydroponic culture in inert aerated substrate (such as wood, perlite, vermiculite), in which film culture, i.e. hydroponic systems in which roots grow directly in either a pure circulating nutrient solution or in a circulating nutrient solution system with very little substrate (Struik and Wiersema, 1999).

Figure 1: Integration of tissue culture in potato seed production. (a) Rapid micropropagation of virus-free mericlones on semi-solid medium. (b) Multiplication of micropropagated plants in liquid medium for production of microtubers. (c) Potato microtubers developed under dark in MS medium supplemented with 10 mg l^{-1} BA plus 80 g l^{-1} sucrose. (d) Harvested microtubers. (e) Pathogen-free high-density potato crop raised either from in vitro plants or microtubers in net house. (f) Harvested minitubers from high-density net house crop. (g) Healthy field crop raised from minitubers harvested in previous season.

Recently hydroponic/aeroponic systems have been developed for production of minitubers from *in vitro* plants. In addition to reducing the cost of production, these systems facilitate round the year production and adoption of phytosanitary standards. Production of minitubers using aeroponics is an alternate soil-less culture technology. This technology consists in enclosing the root system in a dark chamber and spraying a nutrient solution on roots with a mist device. The modified device consists of aeroponic chamber, pump, spraying tube, timer and nutrient solution reservoir. Production and utilization of minitubers using aeroponics have been reviewed by Buckseth *et al.* (2016).

The multiplication rate of potatoes is very low compared to other crops, from between four to six times under optimal conditions. For this reason, a large portion of crop area is devoted to the production of seed tubers and it takes a considerable time to build up a sufficient amount of commercial tubers. With every field multiplication the build-up and transfer of pathogens can increase, leading to seed degeneration. Therefore it is essential to investigate methods of increasing the number of minitubers (G0) produced from disease free in-vitro plantlets (Tshisola, 2014). Therefore, aeroponic technique offers many interesting opportunities for developing enhanced production systems, mainly for mini-tubers. Although requiring a degree of technical sophistication to design, establish and run, the benefits offered are sufficient for such systems to have been widely adopted by seed production companies worldwide (Millam and Sharma, 2014).

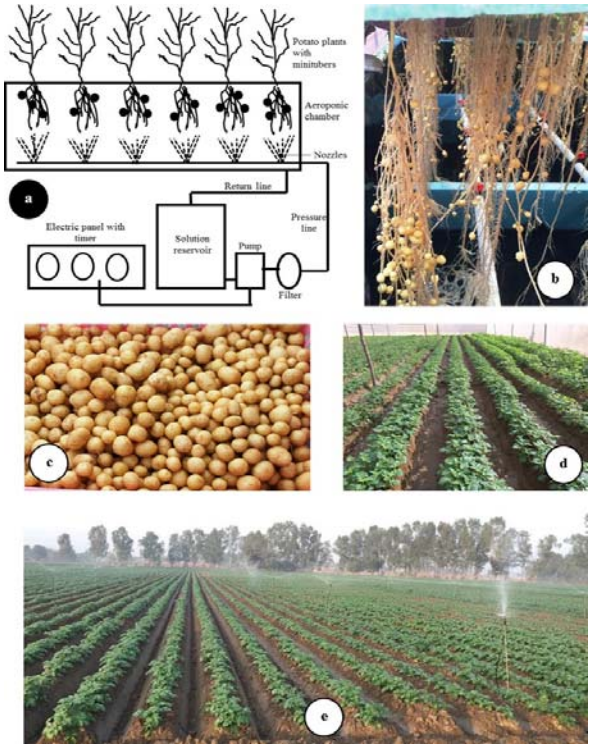

Figure 2. Aeroponics in potato. (a) Diagrammatic presentation of aeroponic system. (b) Minitubers developed in aeroponic chamber. (c) Harvested minitubers. (d) Minituber crop in net house, and (e) Minituber crop in the field.

Aeroponics seems to have lot of scope for augmenting existing seed production in the country. Being a relatively new technique for seed potato production in India, optimization of several factors in seed production through aeroponics need to be addressed (Bucksesth *et al.*, 2016).

The minitubers ("Nucleus Seed" or G-0 stage), thus, produced are cold stored and used for field planting in next season. The pathogen-free nuclear seed is multiplied 2 times (G-1 and G-2 stages) under strict sanitary and phytosanitary conditions on research farms to produce "Basic Seed" (produce of G-2 stage). This basic seed is further multiplied by registered growers and other seed producing agencies for 3 more years (G-3, G-4 and G-5 stages) to produce "Certified Seed" (produce of G-5 stage) as per minimum seed certification standards (Indian Minimum Seed Standards, DAC 2013). In all these multiplications, limited generation system wherein the planting of each seed class is limited as per the eligibility by compliance with established disease tolerance levels and the number of field multiplications in particular country is followed. During potato production, the plant is constantly exposed to sources of contamination. The probability of a seed tuber or seed lot becoming infected with pathogens progressively increases every year. To minimize this, seed certification agencies have enacted regulations to basically restrict or limit the number of years the seed lot can be eligible for the seed certification process. A generalized potato seed production system using tissue culture as proposed by Naik and Khurana (2003) is shown in figure-3.

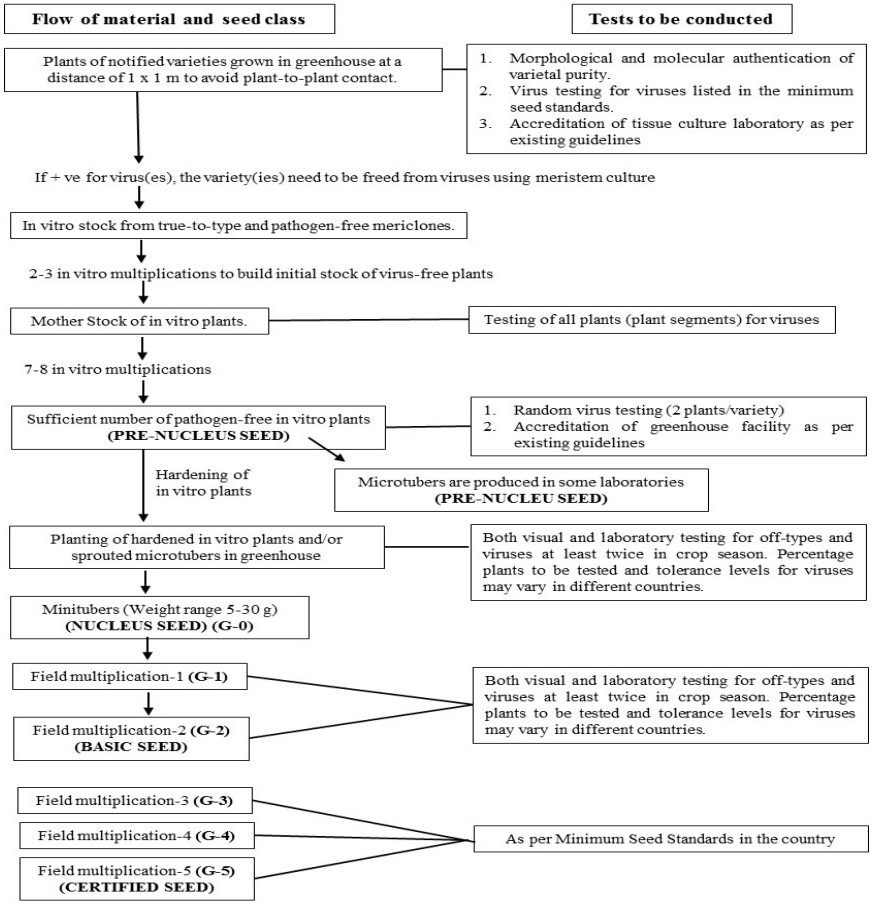

Figure 3: *Integration of tissue culture in quality potato seed production.*

Future Prospects

In mitigating the problem of shortage of good quality seeds, strategies to rapidly multiply the seed tubers such as tissue culture in conjunction with aeroponic systems have been tried. These technologies needs to be given serious thought and should be promoted in most developing countries so as to increase potato yields. In areas having high disease pressure, the new system of seed potato production based on micro-propagation and aeroponics has the advantage of better health status of seed stocks due to the reduced number of field multiplications over the conventional (clonal multiplication) system. In terms of the need for a greater efficiency of seed potato production and for a reduced energy input, research into soil-free techniques will continue to be the subject of focus in both established and developing potato-producing areas, in the near and distant future. Advances in engineering technology will also assist in the development of more automated and controlled seed propagation systems. However, there are also options for simplifying the seed potato production systems for adaptation to low-technology situations, which has greater scope and relevance towards the increasing trends of potato production in developing countries.

Speed Breeding: A Promising Tool for New Green Revolution

Akarsh Parihar
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The interest for higher yield is escalating because of a blasting human population, and the world needs to produce 60-80% more food by 2050 to sustain its nine billion people, however, yield development in numerous zones is stagnating due, to a limited extent, to an unpredictable climate change. To give the fundamental yield progression, more efficient breeding schemes that increase the rate of genetic gain and create stable, drought tolerant, and disease tolerant cultivars are required. This could be accomplished through reconciliation of numerous, cutting edge advances that encourage a speedier, more productive, breeding cycles. Speed Breeding is a new technique that uses extended photo-periods and controlled temperature regimes, enabling rapid generation advancement in glasshouses with sodium vapour lamps (SVL) or growth chambers fitted with a mixture of metal halide and light-emitting diode (LED) lighting with single seed descent breeding strategy to achieve rapid generation cycling in fully enclosed growth rooms or glasshouses for large-scale application in crop breeding programs. Australian scientists have developed the world's first 'speed breeding' technique that can boost the production of the crop by up to three times. For most crop plants, the breeding of new, advanced cultivars takes several years. Following crossing of selected parent lines, 4–6 generations of inbreeding are typically required to develop genetically stable lines for evaluation of agronomic traits and yield. This is particularly time consuming for field-grown crops that are often limited to only 1–2 generations per year. The scientists have used the technique to develop the new 'DS Faraday' wheat variety due for release to industry this year. DS Faraday is a high protein, milling wheat with tolerance to pre harvest sprouting. Modern crop breeding and advances in management practices have contributed substantially to the annual gain of 0.8–1.2% in crop productivity. Achieving linear progress to aim for 2% genetic gain is a huge challenge when crop yields have plateaued in some regions, due to the narrow genetic base and lack of potential to increase harvest index within elite breeding stocks. Sustained yield increases will also be hampered by extreme weather and the occurrence of more aggressive strains of pests and pathogens. In essence, genetic gain in a crop breeding program is determined by the following equation: $\Delta G = I\ h\ \sigma_A/L$; where i is the selection intensity, h is the square root of the heritability in the narrow sense, σ_A is the square root of the additive genetic variance, and L is the length of breeding cycle interval or generation.

1. Methods of speed breeding

1. Speed breeding I – Controlled environment chamber conditions
2. Speed breeding II-Glasshouse conditions
3. Speed breeding III – Low cost homemade growth room design

Table 1: Comparison of basic requirement and condition in speed breeding I, II and III

SB	I	II	III	Control
Chamber/ **Glasshouse/** Room	A Conviron BDW chamber (**Conviron**, Canada)	**Glasshouse**	Room 3 m × 3 m × 3 m with insulated sandwich panelling (low cost homemade growth room design)	Same
Photoperiod/ Temperature	22-hr (22 °C) 2-hr (17°C)	22-hr (22 °C) 2-hr (17°C)	• 12-hr photoperiod (12-hr dark for 4 weeks then increased to an 18-hr photoperiod (6hr darkness). • Air-conditioner was set to run at 18°C in darkness and 21°C when the LED lights were on.	**12-hr photoperod/ 12-hr dark**
Lighting	LED bars	High Pressure Sodium (HPS) vapour lights	LED lights	**No supplemental lighting**
Compost mix	Med. Grade Peat (40%), Sterilised Soil (40%), Horti. Grit (20%)	Composted pine bark (0-5mm) 70%, Coco peat 30%	N/A	

4. Advantages of speed breeding

1. Multiple generations in one year
2. Fast way to obtain fixed homozygous lines
3. Phenotypic selection in early segregating generations
4. Rapidly generate fixed populations through SSD

5. Rapid introgression of genes into elite lines using MAS
6. Allows study of plant-pathogen interactions, flowering time etc.
7. Multi-environmental trials across years
8. Integrated with genomic selection, genome editing etc.
9. High-throughput phenotypic screens for multiple traits
10. Exploit gene bank accessions and mutant collections for an rapid gene discovery

Table 2: An estimate of costs involved in setting-up and maintaining speed breeding conditions I, II and III

SB	Type of lighting	Maintenance (cost per annum)	Energy Use (Kwh per calendar month per M^2)			
			Heating	Cooling	Lighting	Humidity
I	White LED bars (6 units), far red LED lamps (12 units) and metal HQI lamps (32 units) in a **7.6 m^2 area**	2,78,519.10 Rs	71	17	1323	28
II	12 High Pressure Sodium (HPS) vapour lights in a **30 m^2 area**	51,077.43 Rs [HPS light bulbs: 2128.23 Rs replaced biannually]	Minimal use	Summer: 144 Winter: 72	105	N/A
III	7 LB-8 LED lights (Grow Candy) with rating of 400W each, in a **9 m^2 area**	None so far LED Lifespan: 50,000 Hours Warranty: 2 Years	None	93	156	74
			Low-cost speed breeding growth room design, light exclusively by LEDs to reduce the operational cost of lighting and cooling.			

5. Advantages of speed breeding

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18. Integrated with genomic selection, genome editing etc.
19. High-throughput phenotypic screens for multiple traits
20. Exploit gene bank accessions and mutant collections for an rapid gene discovery

6. Global status of work done under speed breeding: Speed breeding is a powerful tool to accelerate crop research and breeding.

Watson *et al.* (2018) reported that speed breeding can be used to achieve up to 6 generations per year for spring wheat, durum wheat, barley, chickpea and pea and 4 generations for canola instead of 2–3 under normal glasshouse conditions. They demonstrated that speed breeding in fully enclosed and controlled environment growth chambers can accelerate plant development for research purposes, including phenotyping of adult plant traits, mutant studies and transformation. The use of supplemental lighting in a glasshouse environment allows rapid generation cycling through single seed descent (SSD) and potential for adaptation to larger-scale crop improvement programs.

Speed Breeding 1: Controlled environment chamber conditions

Wheat, barley and *Brachypodium* seeds **stratified at 4°C for 3 days** and then germinated at room temperature for 2 days before sowing in pots (one seed/ pot) with compost mix (peat 40% + Grit 20%). Seeds were **harvested ~2.5-3 weeks post anthesis**. Plants were not watered in the last week leading up to harvest in order to accelerate the grain ripening. Harvested spikes were kept in paper bags and **dried at 28-30 °C for 3-5 days** to reduce the moisture content.Seeds were stratified at 4 °C for 3 days and then placed at room temperature, with periodic rehydration of the filter paper lining to maintain moisture levels.

2: Speed breeding for multiple quantitative traits in durum wheat

Alahmad *et al.* (2018) deployed speed breeding in durum wheat (*Triticum durum* Desf.) by integrating selection for multiple quantitative traits, including above and below ground traits on the same set of plants. Transgressive segregation was observed for all assayed traits in the Outrob4/Caparoi F_2 population. Application of the selection index successfully shifted the population mean for four traits, as determined by a significant mean difference between 'selected' and 'unselected' F_3 families for crown rot tolerance, leaf rust resistance, seminal root angle and seminal root number. No significant shift for plant height was observed.

Experimental Methods:

To evaluate this multi-trait screening approach, we applied selection to a large segregating F2 population (n = 1000)

derived from a bi-parental cross (Outrob4/Caparoi). A weighted selection index (SI) was developed and applied. The gain for each trait was determined by evaluating F_3 progeny derived from 100 'selected' and 100 'unselected' F_2 individuals

Table 1: Development stages (GS) of crops grown under speed breeding condition II (SB) and glasshouse (GH) conditions with no supplementary light.

Crop	Developmental stage				Average reduction in anthesis (Days)
	SH	GH	SH	GH	
T. aestivum	**3rd leaf emergence**		**Anthesis**		
	15.7±0.6	18.1±1.0	43.0±0.0	71.0±3.5	**22±2 days**
H. vulgare	**3rd leaf emergence**		**Awn peep**		
	10.0±1.7	17.0±0.0	22.7±1.5	101.5±19.1	**64±8 days**
B. napus	**Green buds visible**		**First flower opens**		
	36.7±1.2	119.0±0.6	44.0±1.0	158.0±15.6	**73±9 days**
C. arietinum	**Early bloom (first flower opens)**				
	31.4±1.1	63.4±4.6	28.6±0.5	67.8±7.4	**33±2 days**

Table 2: Summary of generation time and yield measurements of wheat, barley, canola and chickpea grown in individual pots under speed breeding condition II (SB) and glasshouse (GH) conditions with no supplementary light.

		Days to anthesis	Days to seed sampling1	Total generation time	Mean yield/plant (g/plant)	Gen./year
Wheat	SB	41.4±1.7	14	65.4	3.5±1.2	**5.6**
	GH	63.1±2.8	14	87.1	2.5±1.0	**4.2**
Barley	SB	30.4±1.4	28	68.4	5.9±1.4	**5.3**
	GH	94.0±14.4	28	132.0	9.4±4.8	**2.8**
Canola	SB	46.2±2.2	42	98.2	8.3±2.2	**3.7**
	GH	119.1±15.3	42	171.1	9.2±2.4	**2.1**
Chickpea	SB	30.1±0.7	42	82.1	1.9±1.3	**4.5**
	GH	62.6±3.7	42	114.6	2.4±1.7	**3.2**

Speed breeding in conjunction with genetic transformation-Seeds of barley (*H. vulgare* cv. Golden Promise) were sown and immature embryos harvested and transformed.

Table 3: Transformation data of barley (*H. vulgare)* under SB I and control conditions.

Experiment Number	Time of embryo harvesting (days post sowing)		Number of immature embryos		Number of transformed plants		Transformation efficiency	
	SB	Control	SB	Control	SB	Control	SB	Control
1	60	92	25	75	7	19	**28%**	25%
2	66	92	50	50	13	18	**26%**	36%

Control conditions were 16-hr photoperiod with 15°C/12°C 80% RH and at the mature plant

Multi-trait phenotyping procedure for F_2 and F_3 under speed breeding condition

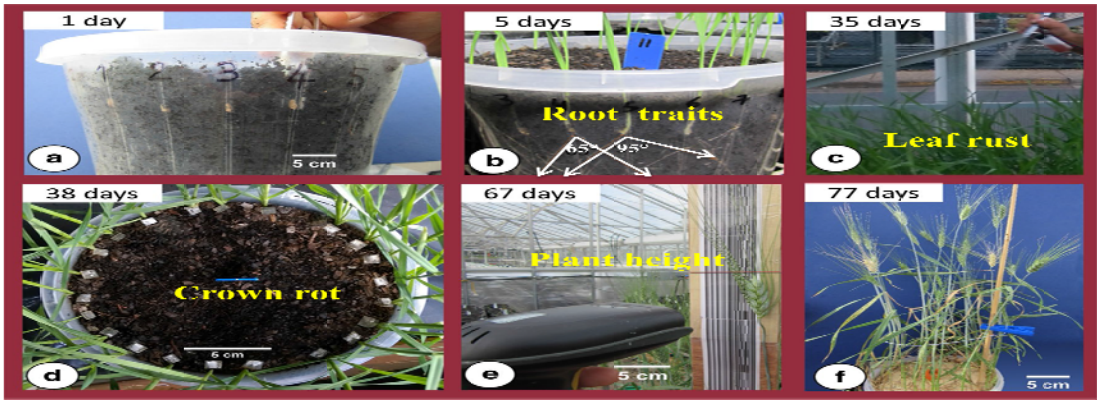

***Fig. 2. Visual summary of a generation from sowing to harvest using the multi-trait phenotyping procedure: a** seeds sown in the clear-pot, **b** seminal root image analysis, **c** plants inoculated with leaf rust using airbrush method, **d** plants inoculated with Fusarium crown rot, **e** plant height measured using a barcode reader, and **f** whole-pot view at the time of crown rot assessment during the grain filling stage*

Phenotyping

- Seminal Root Angle (RA), Seminal Root Number (RN), Tolerance To Crown Rot (CR), Resistance To Leaf Rust (LR) and Plant Height (PH).
- Plants were grown initially in the glasshouse under constant T-(17±2°C)
- 10 DAS (SB)T-22/17 °C

Implementing multi-trait selection

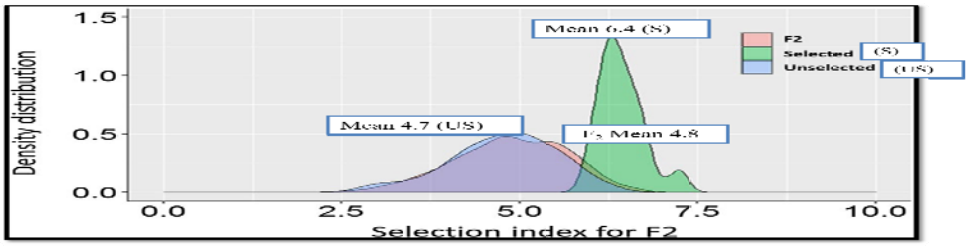

Fig. 1. Density distribution of the weighted selection index values *for selected, unselected and the entire F_2 generation (F_2). Selection index values are representative of the sum of all traits simultaneously (RN, RA, LR, CR and PH)*

Weights

35% crown rot, 30% for root angle, 15% LR, 10% root number, 10% for PH

- Selection of the top 10% of F_2 individuals -mean SI of 6.4 for the 'selected' set.
- Distribution of SI in this 'unselected' set overlapped with the distribution of the entire F_2 population, thus was considered representative of a truly random population.

3: Speed breeding for multiple disease resistance in barley

Hickey *et al.* (2017) applied novel methodology for rapid trait introgression to the European two-rowed barley cultivar Scarlett. Scarlett is widely-grown in Argentina and is preferred for malting and brewing, yet lacks adequate disease resistance. They used four donor lines combining multiple disease resistance (i.e. leaf rust, net and spot forms of net blotch and spot blotch) in a modified backcross strategy, which included both multi-trait phenotypic screens and the rapid generation advance technology 'speed breeding', to develop 87 $BC_1F_{3:4}$ Scarlett introgression lines (ILs) within two years. Phenotyping this set of lines in disease nurseries located in Australia and Uruguay revealed the ILs had high levels of multiple disease resistance.

Objective: Rapidly transfer multiple disease resistance into the Scarlett genetic background

Background:-

- Rapid trait introgression to the European two-rowed barley cultivar Scarlett.
- Scarlett is widely-grown in Argentina and is preferred for malting and brewing, yet lacks adequate disease resistance to a number of foliar diseases.

1. Leaf rust (LR) caused by *Puccinia hordei*, Powdery mildew (PM) caused by *Blumeria graminis* f. sp. *hordei*, Net form of net blotch (NFNB) caused by *Pyrenophora teres* f. *teres*, Spot form of net blotch (SFNB) caused by P. *teres* f. sp. *maculata* and Spot blotch (SB) caused by *Cochliobolus sativus*.

Experimental Methods:

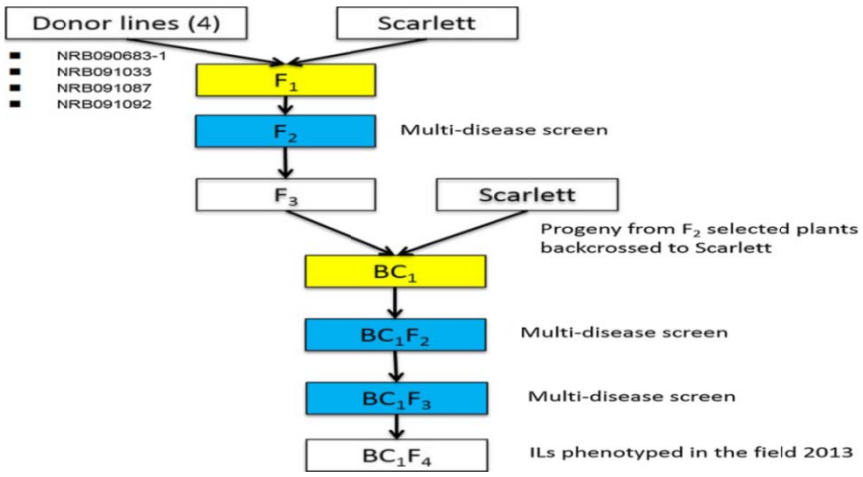

Fig. 1. Breeding strategy employed for transferring multiple disease resistance into the Scarlett genetic background, which was implemented within 2 years to develop backcross derived introgression lines (ILs).

- The F_1 plants were grown in a temperature controlled glasshouse fitted with sodium vapour lamps. Constant light and temperature (22˚C) were used to provide 'speed breeding' conditions and effectively accelerate plant development.

Results:

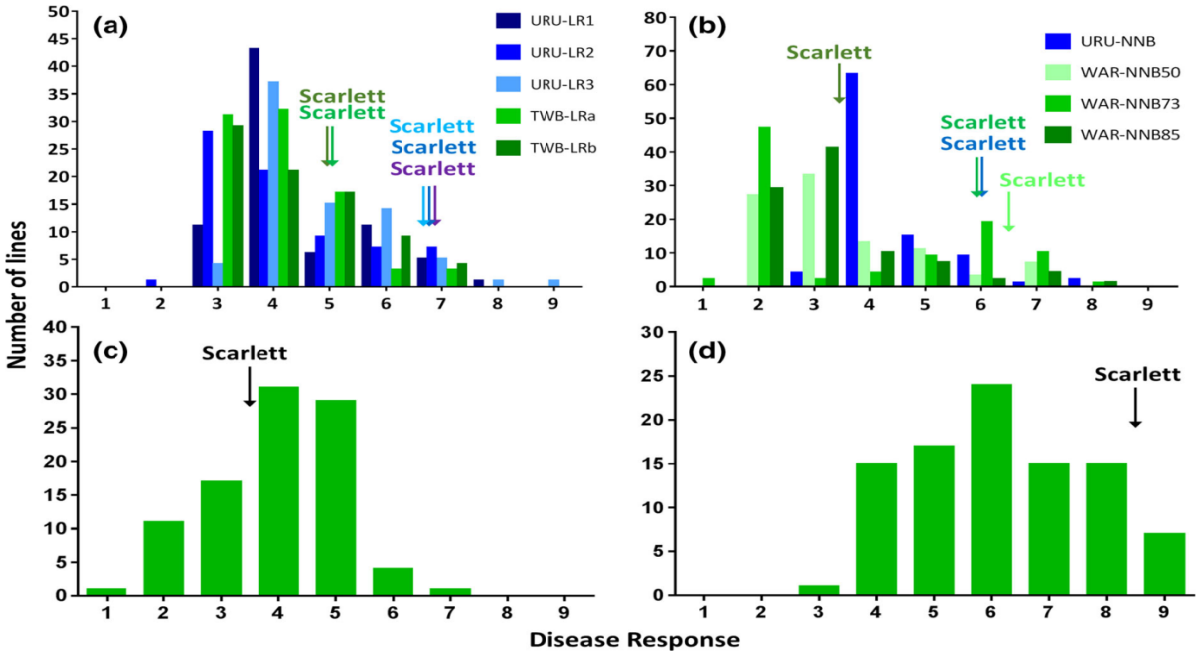

Fig. 2. Distribution of disease response in the backcross derived Scarlett introgression line population (a LR evaluated in three field screening nurseries at Uruguay and Australia **b NFNB** in three field screening nurseries in Warwick, Australia using three different pathotypes and natural infection at Uruguay **c Spot form of net blotch** in a field screening nursery at Warwick, Australia and **d** Spot Blotch evaluated in a nursery at Australia.)

4: Development and application of speed breeding technologies in a commercial peanut breeding program

Connor *et al.* (2013) described a new speed breeding technique, which combined controlled environment conditions, continuous light in conjunction with optimal temperature, and a single seed descent breeding strategy in a greenhouse environment. Speed breeding was successful in reducing generation time of full-season maturity cultivars of peanut from 145 to 89 days and could rapidly progress the inbreeding of F_2, F_3 and F_4 generations in less than 12 months, and potentially accelerate the development of first cross to commercial release in around six to seven years.

Objective:

1. Reducing the release time of new peanut varieties is a key objective of peanut breeding programs.
2. To assess the potential use of speed breeding techniques in a peanut breeding system.

Results:

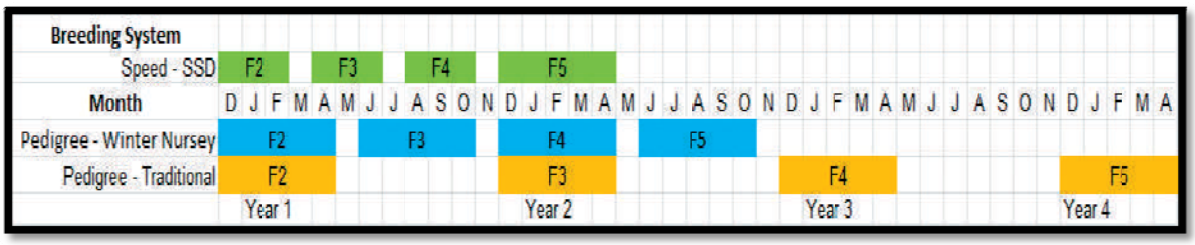

Fig. 1. Comparison of timeline required to develop F_6 fixed lines using strategy 1, 2 and 3.

- **Inbreeding development F_2 to F_5**

1. **Speed breeding / SSD-17 months** 2. Pedigree –Winter nursery-around 23 months 3. Conventional-42 months

Speed breeding was successful in reducing generation time of full-season maturity cultivars from 145 to 89 days. Speed breeding can rapidly progress the inbreeding of **F_2**, **F_3** and **F_4** generations in less than 12 months.

Summary of speed breeding conditions and crops used.

Speed breeding protocol	Species and cultivars/accessions	Generation/ year
I-Conviron Chamber Protocol (John Innes Centre, UK)	(i) *T. aestivum cvs. Paragon,* Chinese Spring	6
	(ii) *H. vulgare cvs. Braemar*, Golden Promise	6
	(iii) *B. distachyon*	4.5
	(iv) *M. truncatula*	4
	(v) *P. sativum* accession JI 2822	6
II-Glasshouse Protocol (University of Queensland, Australia)	(i) *T. aestivum*	6
	(ii) *H. vulgare*	6
	(iii) *C. arietinum*	6
	(iv) *B. napus*	4
	(v) *A. hypogea*	4
III-LED Protocol (University of Sydney, Australia)	(i) *T. aestivum cvs.* Morocco, AvocetR	6
	(ii) H. vulgare cvs. Gus, Baudin	6
	(iii) *Avena sativa cv.* Swan	6
	(iv) *Triticosecale cvs.* Jackie, Coorong	6

2. Limitations of speed breeding

i. Extended photoperiods may cause injury in some crops.

ii. Unlikely to be successful in short-day crops such as maize or rice.

iii. Disease outbreaks using controlled environment conditions.

iv. Plant losses in SSD during greenhouse condition.

v. Increased monetary costs.

vi. Incorporation of relatively simple inherited traits

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Organic Livestock Farming: A Step towards Sustainable Organic World

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21st century is a century of fast growth and dependence on machines. From early morning to the time to sleep, we are totally depended on machines. In such a fast life, we often forget about one of very essentiality of our life i.e. food. Yes, food. It is not produced by machines but by plants and animals. If we don't bother about what we eat, certainly we are not bothered about its composition. We gained huge momentum in production of food through green revolution, white revolution, pink revolution, yellow revolution but at the same time incorporated many such chemicals and drugs in our food chain which have very deleterious effects on our health. Day by day, the use of such chemicals is increasing both in crop production and in livestock production as well. Pesticides in crop production and antibiotics and hormones in livestock production though had made us world leaders in food production giving food security to nation but along with such progress, it had endowed our body with many ailments due to bio-accumulation of those chemicals. The produce treated with such chemicals serves as a slow poison for humans which are slowly killing our health. So, all around the world, the major producers are reverting back to chemical-free farming i.e. organic farming.

Status of organic production

World scenario

As per the survey supported by the Swiss State Secretariat for Economic Affairs (SECO), the International Trade Centre (ITC), and Nürnberg Messe, the organizers of the BIOFACH fair consumer demand for organic products is increasing, more farmers cultivate organically, more land is certified organic, and 178 countries report organic farming activities.

The market research company Ecovia Intelligence estimated that the global market for organic food reached 89.7 billion US dollars in 2016 (more than 80 billion euros). The United States is the leading market with 38.9 billion euros, followed by Germany (9.5 billion euros), France (6.7 billion euros), and China (5.9 billion euros). In 2016, most of the major markets continued to show double-digit growth rates, and the French organic market grew by 22 percent. The highest per capita spending was in Switzerland (274 Euros), and Denmark had the highest organic market share (9.7 percent of the total food market).

In 2016, 2.7 million organic producers were reported worldwide. India continues to be the country with the highest number of producers (835,200), followed by Uganda (210,352), and Mexico (210,000). A total of 57.8 million hectares were organically managed at the end of 2016, representing a growth of 7.5 million hectares over 2015, the largest growth ever recorded. Australia is the country with the largest organic agricultural area (27.2 million hectares), followed by Argentina (3 million hectares), and China (2.3 million hectares). Almost haft of the global organic agricultural land is in Oceania (27.3 million hectares), followed by Europe (23 percent; 13.5 million hectares), and Latin America (12 percent; 7.1 million hectares).

Indian scenario

Organic farming is becoming very popular worldwide and being practised in 178 countries. In India too, the cultivated area under certified organic farming is increasing year by year. Organic farming in India has taken shape for three reasons. First, organic farming has emerged in areas of low-input where organic farming is a way of life and where one could say smallholders have practiced organic farming as a tradition. Second, farmers started practicing organic farming in response to the ill effects of the Green Revolution. Third, smallholders have recognized the benefits due to high market demand and premium prices of growing organic foods. As a result, the total area under certified organic farming (organic and in the process of converting to organic) has increased exponentially over a decade from 0.04 million hectares in 2003-04 to 5.71 million hectares in 2015-16.

According to the Agricultural and Processed Foods Products Export Development Authority (APEDA), 50% of the world's certified organic producers, or about 597,873 smallholder farms, reside in India. Additionally, India exported about 69,837 metric tons of organic agricultural products in 2012 to various destinations in the Gulf countries, Germany, Switzerland, the United Kingdom, Netherlands, Japan, and the United States.

India is blessed with numerous agro-climatic zones which aids in the cultivation of majority of crops and other agricultural products. The total area under organic certification is **5.71 million Hectare** (2015-16). This includes 26% cultivable area with 1.49 million Hectare and rest 74% (4.22 million Hectare) forest and wild area for collection of minor forest produces. India produced around **1.35 million MT (**2015-16) of certified organic products

which includes all varieties of food products namely Sugarcane, Oil Seeds, Cereals and Millets, Cotton, Pulses, Medicinal Plants, Tea, Fruits, Spices, Dry Fruits, Vegetables, Coffee etc. The total volume of export during 2015-16 was **263687 MT.** The organic food export realization was around **298 million USD.** Organic products are exported to European Union, US, Canada, Switzerland, Korea, Australia, New Zealand, South East Asian countries, Middle East, South Africa etc. Oil seeds (50%) lead among the products exported followed by processed food products (25%), cereals and millets (17%), tea (2%), pulses (2%), spices (1%), dry fruits (1%), and others.

Organic Livestock Farming

The livestock sector is of great importance for the sustainability of rural economies and many ecosystems; however, it also has a high environmental impact. Due to the growing demand for animal products, there is a need to design new livestock production systems that allow the combination of food security and sustainability. Organic animal husbandry or organic livestock farming may be defined as a system of livestock production that promotes the use of organic and biodegradable inputs from the ecosystem in terms of animal nutrition, animal's health, animal housing and breeding. It deliberately avoids use of synthetic inputs such as drugs, feed additives and genetically engineered breeding inputs, while ensuring the welfare of animals. Organic farming is based on closed agricultural systems and minimal use of non-renewable energy sources (e.g. artificial fertilizers). Livestock, particularly ruminants, play an important role in maintaining the fertility of crop and grasslands.

The basic principles of organic livestock production can be summarized as-

- Land-based activity (homegrown feed; manure returned to the same land that produces the feed)
- Good animal health and welfare (outdoor, free-range, maximum access to pasture etc.)
- Optimization rather than maximization of production (breeding for traits other than yield or growth rate, feeding species-specific diets etc.)
- Lower stocking densities and production levels than that in conventional systems.

Importance of Organic Livestock Farming

Organic farming is becoming very popular worldwide and being practised in 179 countries. In India too, the cultivated area under certified organic farming has increased exponentially over a decade from 0.04 million hectares in 2003-04 to 5.71 million hectares in 2015-16. In 2015, 2.4 million organic producers were reported worldwide and India continues to be the country with highest number of producers (0.59 million) followed by Ethiopia and Mexico (FiBL-Research Institute of Organic Agriculture survey 2017). Alongside cereals, spices, cotton, tea etc, the Government of India is now keen to promote organic animal husbandry through focused attention on native breeds and local practices. In XII plan, the GOI has launched *Paramparagat Krishi Vikas Yojana*, under which Rs. 300 crores (Union Budget 2015-16) have been allocated to promote organic agriculture including organic animal husbandry. The organic livestock and poultry standards have also been notified for implementation (APEDA, 2015 Agriculture and Processed Food products Export Development Agency) since 1st June, 2015, which, however, are not yet known to the stakeholders indicating the need to fill this gap. Organic production systems are knowledge and skill intensive, where the producers are expected to be knowledgeable about production norms, standards and practices for production and processing prescribed under approved standards by the designated authorities viz APEDA, BIS, FSSAI etc. It is expected from the organic producers that they are not only familiar with organic livestock standards, but also well versed in good agricultural/livestock production practices, animal welfare standards, regulatory requirements as applicable to livestock and food production in general.

Animals part of organic farming systems

According to the basic principles of organic agriculture, livestock are kept as a part of the farming system and their nutrition has to be based on home-grown feeds. Therefore, both the sustainability and the productivity of the farming system depend on the internal flow of nutrients as represented by feed and manure, which implicates that health and welfare of organic livestock, cannot be seen isolated from the whole system. The importance of livestock to the success of organic farming is often a source of major discussion which essentially revolves around whether grass/ arable systems are seen as critical for generating nitrogen in the farm system or whether a truly stockless system based on green manures and grain legumes is possible.

In the arable system, livestock, particularly ruminant livestock are certainly necessary for their role in utilizing the grass, and are also important as a source of manure for transferring fertility to crops around the farm. Livestock also fulfill an additional role through their utilization of arable crop residues. In most situations, a system involving grassland and livestock is likely to be the most sustainable system of organic production. In any case, the climate, soil and topography in many parts of India are suitable for grassland and livestock production. In the past, conventional livestock farming has been impressively successful in its ability to improve the performance of farm animals and to decrease production costs. Animal farming systems are now expected to meet a number of objectives: to produce milk, meat, eggs and fibre, but also to minimize environmental damage and to improve animal welfare, biodiversity and environmental goods.

The agricultural cycle is incomplete without the input of domesticated animals that play a predominant part in the cycle under the organic management of livestock. Livestock is often the central point around which the organic

farm operates and a major factor contributing to its success. Animal husbandry is important to organic agriculture, since it stabilizes the agro-ecological system and makes this more productive.

Principles of Organic Livestock Production

- Organic livestock farming is a land based activity. In order to avoid environmental pollution, particularly natural sources such as the soil and water, organic production of livestock must in principle provide for a close relationship between such production and the land.
- Livestock must have access to free range exercise area and / or grazing apart from specified exemptions.
- Biological diversity should be encouraged and preference should be given to breeds adaptable to local conditions. Genetically modified organisms and products derived are not compatible with organic production.
- Organic livestock should be fed on organically produced grass, fodder and other feed stuffs, apart from some specifications (for ruminants 10% of DM of specified components may come from conventional origin).
- Animal health management should be mainly based on prevention (appropriate breeds, a balanced high-quality diet and a favorable environment in terms of stocking density and husbandry practices). The preventive use of chemically synthesized medication (allopathic medicines) is not permitted, but sick and injured animals must be treated immediately as well being of the animal is more important (although this may affect their status with regards to organic certification).
- Housing should satisfy the needs of the animals concerned. Adequate ventilation, light, space and comfort should be provided to permit ample freedom of movement to develop the animal's natural social behavior.

Benefits of Organic Livestock

There is a growing market for organic meat and organic livestock production can contribute to animal welfare and environmental protection. Although livestock are usually the last part of the farm to be certified organic, they are often central to the farm and can contribute to its success. Livestock play an even more critical role on organic farms than they do on conventional farms. Livestock on an organic farm play a key role in:

- **Nutrient cycling**-a process in which nutrients are returned to the soil through manure and compost. Amending soils with animal manures can increase microbial biomass, enzymatic activity and alter the structure of the microbial community
- Incorporation of feed crops, such as alfalfa or grasses into crop rotations helps to **build soil organic matter**
- Increasing cropping options, **adding diversity** to the agro-ecosystem
- **Weed control**-feed crops can be used to suppress and control weeds and animals can be used to graze out weeds on crops or pastures
- **Preparing the ground for cropping**. Livestock such as pigs can 'plough' rough or new land before planting vegetables or grains, reducing tillage and weed control costs
- **Interrupting insect and disease cycles** by taking land out of cropping
- **Adding value** to grass-lands and promoting the use of green manures
- **Reducing the financial risks** of farming by converting lower quality grain crops and screenings into profit and spreading income more evenly over the year

Organic livestock Vs Conventional livestock farming

- Organic livestock farming is more ethical and welfare concerned and is strongly related to the environment in which it operates, whereas, conventional system is production oriented.
- Organic farming differs from conventional farming in many ways. Organic farming is primarily knowledge intensive, whereas, conventional farming is more chemical and capital intensive.
- Organic production involves less intensive livestock farming practices than in conventional ones. Synthetic fertilizers and pesticide sprays are prohibited in animal feed and fodder production and animals are kept at lower stocking rates, which in turn decrease the pollution risk.
- Differ in aspects relating to natural/ biological and economic, but primarily on the support of natural processes in their production systems. Therefore, sustainability, diversity, renewability and integrity are important aspects.
- In contrast to conventional agriculture, the farm is considered as a farm organism, where the integrative and holistic aspects were placed into the fore. Organic agriculture has clear benefits in reducing environmental pollution in comparison to conventional agriculture.
- The basic standards of organic farming provides suitable tools to minimize environmental pollution and nutrient losses on the farm level, which seem to be more effective measures than in conventional production.
- Regulations concerning housing conditions serve as preventive measures against conflict behavior and the incidence of injuries and claw disorders.
- Certification of organic production system, assures the consumer the quality of the products

Organic livestock farming maintains sustainability

Sustainable agriculture is a way of raising food that is healthy for consumers and animals, does not harm the environment, is humane for workers and animals, and provides a fair wage to the farmer. The characteristics of this type agriculture include:

- **Conservation and Preservation:** what is taken out of the environment is put back in, so land and resources such as water, soil and air can be replenished and are available to future generations. The waste from sustainable farming stays within the farm's ecosystem and cannot cause or build up pollution. In addition sustainable agriculture seeks to minimize transportation costs and fossil fuel use, and is as locally-based as possible.
- **Biodiversity:** farms raise different types of plants and animals, which are rotated around the fields to enrich the soil and help prevent disease and pest out-breaks. Chemical pesticides are used minimally and only when necessary; most sustainable forms don't use any form of chemicals.
- **Animal welfare:** animals treated humanely and with respect, and are well cared for. They are permitted to carry out their natural behaviors, such as grazing, rooting or pecking and are fed a natural diet appropriate for their species.
- **Economically viable:** farmers are paid a fair wage and are not dependant on subsidies from the government. Sustainable farmers help strengthen the rural communities.
- **Socially just:** workers are treated fairly and paid competitive wages and benefits. They work in a safe environment and are offered proper living conditions and food.

The concept of organic livestock farming can only fulfill the criteria for sustainability if all requirements on animal health and welfare, together with product quality and ecological soundness, are strongly considered and controlled. Sustainability lies at the heart of organic farming and is one of the major factors determining the acceptability or otherwise specific production practices".

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Information System on Organic Livestock Farming http://www.ivri.nic.in

Organic Animal Husbandry Development in Sikkim: The Road Map

Strategies and Road Map for Doubling Farmers Income by 2022-23

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In India, in the past decades the main focus was on the increase in raising agriculture output by introducing better technologies and varieties. Increase in the use of quality seeds, fertilizer, irrigation, agro-chemicals, providing subsidies on farm inputs all these measures were leads to green revolution in India and has made the India not only self-sufficient, but also a net food exporting country. The main focus was only on to increase the agriculture productivity but did not focus on the farmers' welfare, how to increase the farmers' income. Past experiences shows that in some cases, growth in output brings similar increase in farmers' income but in many cases farmers' income did not grow with the increase in output. Thus the farmers' income remains low, which is evident from many studies. The NSSO data on consumption Expenditure Survey for year 2011-12 showed that more than one fifth of rural households with self-employment in agriculture as their principal occupation were having income less than poverty line. Farmers' income also remain low in relation to income of those who are working in the non-farm sector. Thus low level income of farmers constitutes an important reason for the emergence of agrarian distress in the country. The country also witnesses a sharp increase in the number of farmers' suicides due to losses from farming. This causes detrimental effect on the interest in farming and forcing more and more farmers especially younger farmers to leave farming. This leads to serious adverse effect on the future of agriculture in the country.

Thus, there is a need to pay special attention towards the raising the farmers' income and to promote farmers' welfare. In this context, Hon'ble Prime Minister of India Sh. Narinder Modi set goals for doubling the farmers' income by 2022-23. Unless farmers' income increases substantially, distress cannot be tackled (Chand, 2016a). National Commission on Farmers under the chairmanship of Dr. M.S. Swaminathan has addressed the issue of distress and farmers' welfare through a series of recommendations.Several scholars notably Swaminathan (2016), Kurian (2016), Chand (2016 b) and Satyasai and Bharti (2016) argued that doubling of farmers' income is possible. The major constraints, for doubling of income within 6 years are low and unrealisable Minimum Support Price (MSP), non-remunerative price in the market, low share of farmers in final price, poor penetration of crop insurance, high and increasing input cost and absence of market infrastructure.

The concept and time frame:

Clarity on the following points is important to assess the possibility of doubling the income of the farmers. The substantive points are:

1. What is the period and targeted year for doubling the farm income
2. What is to be doubled, is it output, value added or income earned by farmers from agricultural activities.
3. Whether nominal income is to be doubled or real income is to be doubled; and
4. Whether the targeted income includes only income derived from the agricultural activities or would it also include income of farmers from other sources.
5. It is obvious that the targeted year to double the current income of the farmers or income for the agricultural year 2015-16 is by agricultural year 2022-23, which is seven years away from the base year 2015-16. And if anything is to be doubled by the year 2022-23, it will require an annual growth rate of 10.41 percent.
6. Again, it is important to clarify what is sought to be doubled. Is it the income of framers, or the output or the income of the sector or the value added or GDP of agriculture sector? If technology, input prices, wages and labour use could result in per cost savings then the farmers' income would rise at much higher rate than the output. In nominal terms, the output became 2.65 times while farmers' income tripled in the seven years period. Therefore, doubling of the framers income should not be view ideas same as doubling of farm output.
7. It is obvious that if inflation in agricultural prices is high farmers income in nominal terms will double in much shorter period. In a situation where non agricultural prices do not rise, or rise at very small rate, the growth in farmers income at real prices tends to be almost the same as the nominal prices. The government's intention seems to be to double the income of farmers from the farming in real terms.
8. It is pertinent to mention that the latest data on number of cultivars is available only up to the year 2011-12. Therefore, while calculating per cultivator income, it is assumed that farm workers would continue their withdrawal from the agriculture at the rate observed during 2004-05 to 2011-12. Presently, per cultivator income has been estimated as Rs. 1,20,193 at current market prices.

Sources of Growth in Farmers Income:

Doubling real income of framers till 2022-23 over the base year of 2105-16, requires annual growth of 10.41 per cent in farmers income. This implies that the ongoing and previously achieved rate of growth in farmers income has to be sharply accelerated. Therefore, strong measures will be needed to harness all possible sources of growth in farmers' income within as well as outside agriculture sector.

A. The Major Sources of Growth Operating within Agriculture Sector are:

i. Improvement in productivity
ii. Resources use efficiency or saving in cost of production
iii. Increase in cropping intensity
iv. Diversification towards high value crops

B. The Sources Outside Agriculture include:

i. Shifting cultivators from farm to non-farm occupations and
ii. Improvement in terms of trade for farmers or real prices received by the farmers.

❖ **Recommendation of M.S. Swaminathan's Report:**

1. Irrigation:

i. Enable farmers to have sustained and equitable access to water.
ii. Increase water supply through rain water harvesting and recharge of the aquifer. (Million Wells Recharge Programme.)

2. Agricultural productivity:

i. Substantial increase in public investment in agriculture related infrastructure particularly in irrigation, drainage, land development, water conservation, research development and road connectivity.
ii. A national network of advanced soil testing laboratories with facilities for detection of micro nutrient deficiencies.

3. Credit and insurance:

i. Expand the outreach of the formal credit system to reach the really poor and needy .
ii. Issue Kisan Credit Cards to women farmers, with joint pattas as collateral.
iii. Expand crop insurance cover to cover the entire country and all crops, with reduced premiums.
iv. Competitiveness of farmers
v. Improvement in implementation of Minimum Support Price (MSP). Arrangements for MSP need to be in place for crops other than paddy and wheat. Also, millets and other nutritious cereals should be permanently included in the PDS.
vi. MSP should be at least 50% more than the weighted average cost of production.

Strategy for Improving Farmers Income:

The sources of growth in output and income can be put in four categories.

i. Development initiatives including infrastructure
ii. Technology
iii. Policies and
iv. Institutional mechanisms

Increasing Income by Improving Productivity:

i. Biotechnology is set to play critical role in crop and livestock production by enhancing yields, nutritional profile, stress tolerance and crop protection. In India must have a clear vision of the GM crops? The policy support accordingly be provided for the development of the seed and biotech industry in the country. As per studies BT cotton alone has contributed more than 80,000 crores of additional output value to the farmers. Similar potential many other crops may have for Indian agriculture and towards enhancing farmer's profitability.
ii. Improving agricultural productivity in rain fed regions of India, which constitutes more than 50% of the country's arable land. Besides watershed management, constructing check dams and farm ponds should be taken up in a mission mode for providing life saving irrigation for the crops. Chandrababu Naidu Committee report (2003) need to be revalidated and implemented for bringing 69 million hectare area under Micro irrigation to save water and input costs, increase productivity and improve quality of output. The area expansion and subsidy to the states must be linked with the adoption of precision agriculture model.
iii. Bridging yield gaps among the states is important in improving national productivity i.e. the gap in rice yields almost 3 times between Punjab and Chhattisgarh. There is urgent need for developing a strategy document for assessing the present trends of crop productivity vis-a-vis the potential yield of a major crop systems, so that specific action plans can be taken up for bridging the yield gaps which in turn will contribute to enhanced productivity of bridging the yield gaps which in turn will contribute to enhanced the productivity of the

farming systems. Increased Budget on the farmers' Interstate exposure visits and training scheme of MOA. This is a powerful scheme towards helping farmers bridge the yield gap.

Water and Inputs:

i. Fertiliser subsidy and rationalising the NPK pricing for maintaining NPK ratio in the soil and better application technologies to improve efficiency and reduce fertilizer subsidy by 25,000-30,000 crores annually. Policy on promoting crop specific speciality fertilisers and fertigation, besides setting standards and regulating bio fertilisers under the Soil Health Mission is needed. Since the year 2010, NP/ NPK fertiliser has been widening. Therefore, unless corrections are made in fertiliser policies the benefit of the soil health card will not be realised. And desired increase in yields in major crops will continue to delude the nation.

ii. Crop losses in India are huge and estimates range from Rs. 90,000 to Rs. 1.50 lakh crores annually. Pesticides play an important role not only in protecting crops from pests and disease but also in crop productivity, cost reduction and quality improvement. The cost benefit ratio in using pesticides is heavily in favour of farmers. The Government however needs to check flood of spurious pesticides in market by fly by night operators by regulating registrations, strengthening quality enforcement and tackling corruption through provisions of joint testing of samples.

iii. Farm mechanisation in India has been story of tractorisation. Time has come to promoting efficient equipments and tools and small engine driven tractors to address small farm requirements adequately. Through a mix of specialised custom hiring centres and with State Agros, cooperatives and input dealers. Developing and custom hiring facility in farm mechanisation should be given high focus.

iv. There is a need for integrated water use policy. India should critically examine several ongoing initiatives and develop its country –wide system for judicious and integrated use and management of water. A national commission on efficient water use in agriculture should be established to assess the various issues, regulatory concerns, water laws and legislations, research, technology development and community involvement. This will especially help resource poor farmers in the rainfed ecosystems who practice less –intensive agriculture.

v. Farmers however needed to be educated on water usage systems to drift them away from flood irrigation systems, which affect productivity and waste water. The most important part is the crops planning, which needs to be done keeping water resources of a region and the water intake by various crops in mind. For example, high water consuming crops like paddy and sugarcane should be grown in high rainfall areas.

Road MAP and Action Plan:

The quantitative framework for doubling farmers income has identified seven sources of growth. These are:

1) The first step is to increase productivity. It means focussing on irrigation and that is why we have increased the irrigation budget. India has 142 million hectares agriculture land, out of which only 48% is under institutional irrigation. With the objective of providing water to every field. Pradhan Mantri Krishi Sinchai Yojana was launched on July 1, 2015 and to provide an end to end solution in irrigation supply chains, water resources, network distribution as well as farm level application. We have adopted a comprehensive approach, one that combines irrigation with the water preservation. The objective is More Crop Per Drop. In addition, the aim is to complete pending medium and large irrigation projects on a priority basis in the next four years. Water harvesting, management, and watershed development projects have been put on the fast track.
2) The second factor is effective use of inputs, which means increasing production through improved seeds, quality planting materials, organic farming, soil health card and other schemes. For the first time a scheme has been launched for organic farming. Similarly, the government has curbed illegal use of urea and ensured its adequate supply through Neem Coated Urea scheme. In addition, the Soil Health Card scheme has helped reduce cultivation cost and increase production by curbing misuse of fertilisers. Farmers are also getting timely information and advisory services through new technologies such as space technology and online and telecom facilities via Kisan Call Centre and Kisan Suvidha App.
3) The next critical factor is reducing post-harvest losses. One of the biggest problems of farmers is storage after harvesting; as a result; they are forced to sell their products at a lower cost. Therefore, the government is encouraging farmers to use warehouses and avoid distress sales. Loans against negotiable warehouse receipts are being provided with interest subvention benefits. The focus is on storage facilities and integrated cold chains in rural areas.
4) Value addition is being encouraged as a critical factor for augmenting income. The government has launched the Pradhan Mantri Kisan Sampada Yojana. Under this, food processing capabilities will be developed by working on the forward and backward linkages of agro-processing, benefitting 20 lakh farmers and creating employment opportunities for about 5 lakh.
5) In agriculture marketing, the electronic –National Agriculture Market (e-NAM) has been launched with three reforms and so far 455 mandis have been linked to it. Online trading has begun on various mandis. In addition, a model APMC act has been circulated, which includes private market yards and direct marketing . Farmers are also being organised as Farmer Producer Organizations (FPOs) . This helps them achieve economy of scale and increase bargaining power.
6) The Pradhan Mantri Fasal Bima Yojana (PMFBY) helps reduce the possible risks. The lowest rate has been fixed for kharif and rabi crops. Maximum rate is 2 per cent and 1.5 per cent respectively. The scheme covers

standing crops as well as pre-sowing to post-harvesting losses and 25 % of the claim, is settled immediately online. Under PMFBY, many states are using remote sensing technology and drones to estimate losses and settle claims. To reduce climate change impact, various tolerant species and animal species have been developed. Contingency plans for affected districts have also been prepared.

7) Focus on agri-allied activities is critical. Horticulture, dairy, poultry, bee-keeping, fisheries, white revolution, blue revolution, agro-forestry, integrated farming and rural backyard poultry development have been focussed and promoted to increase the income of the farmers. Farmers have been encouraged to utilise uncultivated areas for peripheral and boundary plantation to grow trees for wood and to produce solar cells.

Special measures:

1. Structural reforms in agriculture pertaining to land leasing and market restrictions need to be addressed. The market regulation on movement and procurements by private players is hampering market growth and prices realisation by farmers. Similarly, due to land leasing policies of the State Governments, the concept of the contract farming is not successful. The experiments of contract farming are based on 'win all', bringing value to all partners in operations. This needs to be encouraged on large scale.
2. Through a nationwide crops competitiveness study, States' profiling of crops and animal resources should be done, indexing them against national and global benchmark on cost, quality and productivity parameters and their short, medium and long run term strategic advantages . Based on this national indexing and estimation of market demands in short, medium and log terms national crop planning needs to be done . If India has to succeed in global market on a long term basis, this task is unavoidable.
3. Agriculture to be brought to the concurrent list; bringing the entire gamut of post production activities in agriculture, such as Post Harvest Management, marketing, processing, infrastructure, agribusiness etc. Under the concurrent list of the constitution for better central planning, as the business of food and agriculture is globalizing and role of central Government is increasing in making laws and policies, especially in post harvest, trade and agribusiness, where MNCs and corporate sector is involved in big way.
4. Review of the current scenario of the farm credit and subsidy disbursement system. All financial benefits, mainly the subsidies in different forms, should be provided and transferred directly to farmers account through e-governance through which tracking of farmers' application, status and approval of all schemes is available online. Gradually phase out all subsidies including fertiliser and only transfer money to farmers, calculating aggregate measure of the support. This improves efficiency of government investments.
5. Implementing ambitious Agribusiness Hubs Model, operating on a national platform and establishing 2.40 lac multi functional Agribusiness hubs in all the Gram Panchayats of the country . This will revolutionize the farm economy and create jobs.
6. ICT-based agricultural extension brings incredible opportunities and has the potential of enabling the empowerment of farming communities. Information technology can support better crop, fertilizer and pesticide use planning as well as disease monitoring and prevention, both in crops and animal husbandry, besides improving farmers' operational and financial management and to effectively connect them with the markets for better price realisation.
7. Diversification of agriculture in the First Green Revolution areas such as Punjab, Haryana and Western U.P. seems need of the hour. To promote diversification on ecological principles, will require making monetary equivalence (profit margin) between the replaced crop/commodity and enterprise with the ones planned to be introduced. Farmer is mainly concerned with the profit he gets from a particular crop or commodity. Crops like maize, soybean, pulses, oilseeds, fruits and vegetables have the potential to replace rice and wheat in this area. Upward push in MSP in favour of proposed diversification crops will be practical option to achieve this objective.
8. Integrating all central and state subsidies, instead of reducing costs of inputs, need to be targeted to empower farmers through infrastructure development in rural areas to promote agribusiness, food processing, water management, soil health enhancement, seed production and processing, custom hiring, plant protection, dairy, poultry, fisheries and enterprises etc. This will boost up agriculture sustainability and farm profitability.
9. Strengthening organic food programme for India. Major parts of India such as NER, HP, J&K, Uttarakhand, MP, Chhatisgarh, Jharkhand, which are organic by default, must be made organic by process for the producers to get advantage of market value.
10. Establishing Special Agriculture Zones (SAZ) by selecting export oriented and industrial use crops. Promoting certification, formation of Global Commodity Boards, on the pattern of California Walnuts, Washington Apples etc., can help double in 5 years the current level of 1.70 lac crores of agri exports, which will benefit farmers significantly.
11. Promoting scientific agriculture micro-irrigation on a very large scale. Micro irrigation along with the nutrient application can be highly efficient and priority should be given to empower farmers with micro-irrigation. Advanced concept of precision agriculture need to be promoted on a large scale, emulating the success of TN Precision Farming Project. A National Project on Precision Agriculture on the pattern of TNPFP should be launched with integrated approach from advance production technologies to formation of FPOs and linking them with the markets.

12. Provide affordable health insurance and revitalize primary healthcare centres. The National Rural Health Mission should be extended to suicide hotspot locations on priority basis.
13. Set up State level Farmers' Commission with representation of farmers for ensuring dynamic government response to farmers' problems.
14. Restructure microfinance policies to serve as Livelihood Finance, i.e. credit coupled with support services in the areas of technology, management and markets.
15. Cover all crops by crop insurance with the village and not block as the unit for assessment.
16. Provide for a social security net with provision for old age support and health insurance.
17. Promote aquifer recharge and rain water conservation. Decentralise water use planning and every village should aim at Jal Swaraj with Gram Sabhas serving as Pani Panchayats.
18. Ensure availability of quality seed and other inputs at affordable costs and at the right time and place.
19. Recommend low risk and low cost technologies which can help to provide maximum income.
20. Need swift action on import duties to protect farmers from international price.
21. Set up Village Knowledge Centres (VKCs) or Gyan Chaupals in the farmers' distress hotspots. These can provide dynamic and demand driven information on all aspects of agricultural and non-farm livelihoods and also serve as guidance centres.
22. Research institutes should come with technological breakthroughs for shifting production frontiers and raising efficiency in use of inputs. It is important to adopt Good Agricultural Practices (GAP), agronomic practices like precision farming and IFS models to raise production and income of farmers substantially. Similarly, modern machinery such as laser land leveller, precision seeder and planter and practices like SRI (System of Rice Intensification), direct seeded rice, zero tillage, raised bed plantation and ridge plantation would allow technically highly efficient farming. R&D institutions should include in their packages grassroot level innovations and traditional practices which are resilient, sustainable and income enhancing.

Conclusion:

The low level of farmers' income and year to year fluctuations in it are a major source of agrarian distress. This distress is spreading and getting severe over time impacting almost half of the population of the country that is dependent on farming for livelihood. Persistent low level of farmers' income can also cause serious adverse effect on the future of agriculture in the country. To secure future of agriculture and to improve livelihood of half of India's population, adequate attention needs to be given to improve the welfare of farmers and raise agricultural income. Achieving this goal will reduce persistent disparity between farm and non-farm income, alleviate agrarian distress, promote inclusive growth and infuse dynamism in the agriculture sector. Respectable income in farm sector also attract youth towards farming profession and ease the pressure on non-farm jobs, which are not growing as per the expectations.

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THEMATIC AREAS & SUB- THEMES

Theme 1: Invigorating Transformation of Farm Extension Towards Sustainable Development: Futuristic Challenges and Prospects

- Sustainable Extension approaches for Technology Delivery
- Stocktaking of Extension Research
- Strengthening Extension Education
- ICT and technology delivery
- Gender and rural youth for sustainable development
- Futuristic challenges and prospects in sustainable Agricultural Extension

Theme 2: Advances in Crop Production Technologies and Natural Resource Management

- Sustainable technologies for enhancing crop productivity
- Organic farming: challenges and current senerio
- Soil quality and capacity for crop production
- Climate change and natural resource management

Theme 3: Crop Improvement and Protection Technology

- Breeding system modifications for sustaining agriculture
- Innovation in plant breeding for food security and nutrition
- Biotic and abiotic stress management
- Plant health
- Integrated pest and disease management (IPDM)

Theme 4: Recent Developments in Horticulture

- Horticulture to ensure food and nutritional security
- Technological advancement in horticulture

Theme 5: Food Science and Technology: Sustainable Food Processing

- Innovation in food processing
- Nutraceutical and nutrition security
- Food and health defence

Theme 6: Agripreneurship

- Capacity building, opportunities and micro-enterprise development
- Entrepreneurship development models and institutional innovations
- Gender issues and success stories
- Challenges faced by entrepreneurs

Theme 7: Technical advances and Innovations in Livestock and Companion Animals

- Livestock production: recent trends, future prospects
- Biotechnology options for improving livestock production
- Innovations in animal health
- Advances in animal health technology
- Enhancement of livestock productivity
- Biotechnological interventions in veterinary sciences
- Poultry Farming

Theme 8: Promoting the competitiveness of Indian agriculture in a weakened global economy

- Economic education and research for promoting competitiveness in agriculture
- Agricultural policy: implications for food security and self-sufficiency
- Trade policy and the competitiveness of Indian agriculture
- Promoting competitiveness through improving farmer access to markets.

Theme 9: Environment & Sustainability

- Green energy, green economy, green business and green computing
- Sustainable agriculture and food security
- Industrialisation vs. environment
- Sustainable business
- Renewable energy for sustainability

Theme 10: Extension system and Policy Issues

- Demand driven extension and market led extension
- Contract farming and public private partnership Invigorating transformation of farm extension towards sustainable development futuristic challenges and prospects

OP 1: Impact of Front Line Demonstration (FLDS) on paddy growing farmers of Jammu and Kathua Districts of J&K

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In order to increase the productivity of crops per unit area and get the feedback of farmers on the performance of new varieties and technologies the Front Line Demonstration (FLDs) programmes was designed and launched. Keeping in view of an effective extension approach of FLDs, an impact assessment was conducted in Jammu and Kathua Districts of the state where FLDs were given to the farmers by the respective KVKs. The impact was based on the comparison of beneficiary and non-beneficiary respondents with reference to their socio-personal profile, knowledge level, extent of adoption of improved paddy production and benefit-cost ratio. Based on random number sampling total sample of 80 respondents (40 beneficiaries and 40 non-beneficiaries) were interviewed using a structured interview schedule. The results showed that one third of the respondents (37.50%) were noticed to fall under age interval 36-50 years and majority of the respondents have marginal land holding (40.00%) and main source of irrigation was canal. KVK act as the main source of information to the beneficiaries while non-beneficiaries were mainly dependent upon the input dealers for information. In paddy majority (72.50%) of the respondents possessed high level of knowledge in case of beneficiaries while only 57.50% of respondents possessed high level knowledge in case of non-beneficiaries. A significant difference was found between beneficiaries and non-beneficiaries related to the adoption of recommended seed rate, seed treatment, use of DAP in nursery, fertilizer usage in main field and diseases management of rice and the results of linear regression showed that none of the selected variables had significant contribution with the adoption of various practices in paddy. By calculating the benefit-cost ratio of both beneficiaries and non-beneficiaries, it was found that the beneficiaries achieved more returns on their investments as compared to non-beneficiaries in case of rice.
Keywords: Front Line Demonstration, Knowledge, Adoption.

OP 2: Empowering Women for Sustainable Development

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History of human development to present 21st century, witnesses that work done by women has always been unrecognized. In developed countries efforts of women are assimilated and integrated into nation mainstream however, in developing countries their efforts are recognized as dismal. In India, women constitute 48.46% of the total population, devotes 75% of their work hours with 81% rural women engaged in agricultural production but only 17% of their contribution is recognized in the national GDP, thereby, limiting the potential growth rate to merely half of the developed countries. Rural women in India are still under-privileged in all social, economic, and political sectors that acts as a constraints in militating towards the fullest attainment of women empowerment in the country. Women empowerment can be prime driver for attainment of sustainable development. Sustainable development is a key objective for all national policies which aims continuous improvement of the quality of life on earth for both current and future generations. It is to secure dynamic economy with high level of employment and education, health protection, social and territorial cohesion and of environmental protection in a peaceful and secure world respecting cultural diversity. Reproductive health, environmental and agricultural stewardship, education and economic empowerment of rural women are few issue areas to consider when discussing women and sustainability. Contribution of women in sustainable development has been recognized by the world leaders while setting the 2030 agenda for sustainable development and also by the policy makers in the 12th five year plan. Women have a strong role in education and socializing their children, which promotes futuristic development of the society. More should be done to increase women's voice in environmental decision making and to enable women to seize opportunities in the "green economy". More capacity building program and training tailored to the needs of rural women are needed. Their access to financial resources and information is needed. In order to build rural women as catalyst for sustainable development, their role in family, community and society at large has to be free from socio-cultural and religious traditions that prevent women participation.

OP 3: Livestock development by bridging the extension gap through satellite applications

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Although livestock production is in hands of masses, still India has prospered as pioneer in milk production, meat production, egg production and their value added products. Enhancement in animal productivity was not achieved in a day or in decade but accomplished after rigorous research work and widespread extension efforts throughout the length and breadth of the country. Still there are millions to cater, with varied information needs, knowledge level and opinion about emerging husbandry practices. Word of mouth and traditional extension methods have brought a considerate success but due to increase in scale of production and engagement of large number of people in livestock business, there arises a gap between what the farmers know and what they should know. Information and Communication Technologies (ICT) have been playing an elite role in information dissemination. Due to extensive network coverage, affordable internet service and cheaper mobile handsets, ICT is spearheading the information revolution in the country. As far as satellite communication and its applications are concerned, it acts as a backbone to ICT utilization. Without satellite applications, majority of the advanced ICT initiatives cannot work as they rely on satellite communication. Television and satellite based radio communication are classical applications of satellite which has in the past revolutionized extension and advisory systems all across the globe. With operationalization of commercial ventures related to livestock development, there is wider scope of utilization of newly emerged satellite applications like Geographical Information System (GIS), Global Positioning System (GPS), General Packet Radio Service (GPRS) and Remote Sensing (RS). The emerging field of geoinformatics holds the potential to converge satellite applications for better extension delivery and mass reach. Satellite applications are being utilized for almost all the livestock managerial aspects, studying the behavioral and physiological aspects, tracking animal movements, monitoring health and diseases, disease surveillance, livestock surveys and census, monitoring vectors and their control, grassland and fodder management, etc. It can be said that satellite communication has a promising future for strengthening extension delivery and hence livestock development.

Keywords: Extension, GIS, GPS, GPRS, Livestock, Remote Sensing, Satellite Applications

OP 4: Strengthening Extension Education

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India is an agriculture based country and about one third population of the country depend on agriculture directly or indirectly but decline in the growth rates of agricultural production and productivity is a serious issue. It is said that the fundamental problem of agricultural growth is lack of education. There is a need of education for the rural development, in general, and agricultural development, in particular. The education has two components: a) research in agriculture to develop new technologies and b) educating farmers to improve their skills, abilities, attitude etc. Because Improvement in agricultural production, productivity and sustainability will largely depend on farmers willingness and access to new technology, extension education play an important role in addressing this challenge. Extension has been defined as a system that facilitate the access of farmers to information and technologies and assist them to develop their own technical, management skills and practices. Strong extension education system is the key to the desired change to meet the present day challenges in agriculture, to work with farmers within a climate and economic environment by providing suitable technologies to widen their horizon, enriching knowledge and upgrade abilities to improve better handling of natural farm resources and production technologies to achieve production goal, But the weak extension system therefore limit the ability for potentially beneficial agricultural innovations and market opportunities to reach small farmers. The goal of Strengthening Extension education is to strengthen the capacity of Government and farmers to mobilize and work with other service providers to deliver agricultural extension services more effectively and with better coordination. The aim is to improve farmers access to better and improved information about new technologies and practices so that farm-level productivity is increased, more income is generated from agricultural activities. Extension education has an important role to play in empowering farmers and other partners to overcome the emerging challenges.

Keywords: Extension, Education system, Agriculture, Technologies

OP 5: Technology Resource Centre: A sustainable extension approach for technology delivery for drudgery reduction of Indian women farmers

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Agriculture is main source of livelihood for majority of population in India. Though much development has taken place in agriculture, the work that women do has not been altered. Women do not have proper awareness and knowledge about improved tools and equipment that can reduce their drudgery. The women don't have access to tools and machines to ease their hard manual labour. Since women's contribution in agriculture is significant to economy, improving their work efficiency is of concern and needs to be given high priority. These concerns of women farmers have been addressed through a project entitled, 'Mitigating hardship of Indian women farmers through technology intervention', initiated by IEA for funding through John Deere Foundation of US. Under the project a Technology Resource Centrewas established for easy access/availability of technologies to reduce their drudgery. The women could take different tools and technologies from this centre on custom-hiring basis. Participatory approach involving Self-help groups was used in the project for sustainability. The technology Resource Centre acted as a single-window approach for various activities related to farming. The capacity building training as well as field demonstrations of technologies transformed lives of women farmers full of drudgery to that of ease and comfort improving efficiency and output in agriculture work. Additionally, the time saved through use of improved tools and technologies can be transformed to money by initiating various agro and non-agro enterprises.

Keywords: Drudgery, Technology, Women farmers, Improved tools

OP 6: Surface Covered Cultivation: Boost Farm Profitability and Socio-Economic Status of Women Farmers in Hilly Region of India

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The farming in hills suffers from scattered traced land, erratic climate, rainfed conditions. Majority of (75%) male migrate from hills to metro city in search of employment. Therefore, the hill farming is largely dependent on women. Women are also involved in other responsibilities, as a house wife, mother, farming and social activities, with all these commitments, women workers are very hard pressed which affect their health. Therefore, there is an urgent need for women friendly technologies which could save their time and energy. To alleviate the situation, we conducted 20 trials/FLDs on plastics mulch technology (UV stabilized 40-50 micron thick black colour) for off-season high value vegetable crops (Solanaceae, Cole group and Cucurbits) and compared with traditional farming system at different village level during 2006-2009 at Champawat district of Uttarakhand through Research and Extension Center (KVK), Lohaghat under the administrative control of GBPUA&T, Pantnagar. All GAP, INM, IPM protocols were used under study and it revealed that plastics mulch technology saved 90% time of labour spent on weeding, 25% fertilizer, 50% irrigation/water or moisture losses through evapo-transpiration, 50% soil fertility erosion, 50% expenditures, 60% crop mortality. This technology has enhanced 50% more qualitative yield and return per unit area per unit time as compared to traditional farming methods during all the years. Mulching technology also saved forest pruning ensuring environment security, risk of life hazard, time and money. Plastics mulch technology as compared to traditional farming save 50% time of women farmers which they can utilize in other activities. Mulching technology, a part of protected technology was found to be very cost effective (Rs.5/m^2), easy adoptable in field. This technology can play a key-role in organic mode of vegetable production, drudgery reduction, and livelihood security of women in hills. This is a proven technology especially for hills easy to adopt where limited resources of man power is available for agricultural operations and it give a higher return in many of horticultural crops under small land holding for poor resource woman farmer community.

OP 7: Impact of MNREGS on Women Empowerment in Kangra district of H.P

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A majority of the poor in rural areas of the country depend mainly on the wages they earn through unskilled and casual labour. Welfare programmes have been an important interventions in the cotext of poverty and unemployment as these programmes provide unskilled manual workers with short-term employment. Mahatma Gandhi National Rural Employment Guarantee Act is an important step towards realization of the right to work with a great potential for increasing the volume of employment among rural unemployed and under-employed as

well as the capacity to tap the under-utilized labour of women in developing rural India. The Act came into force on February 2, 2006 with the aim of enhancing livelihood security of households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work, with equal wage rate for both male and female workers. The Act also mandates 33 per cent participation for women. The state of Himachal Pradesh has been exalted for implementation of MNREGA as it tops in providing employment to women under MNREGS. Therefore, an attempt was made to examine the impact of MNREGS on empowerment of women through the man days generated in Chandropa panchayat of Panchrukhi block in Kangra district of Himachal Pradesh for which the data was collected from 90 households (60 beneficiaries and 30 non-beneficiaries) selected randomly from the list of households obtained from office of Chandropa panchayat. The findings of the study revealed that the women participation rate was 100 per cent which was much higher than the provision of employment for women (33 per cent) under the scheme. Further the results indicated that the scheme generated 84 person days in the Panchayat which was much higher than the national average (35 days, 2013-14) as well as the person days generated in the state (41 days, 2013-14). So it can be concluded that the scheme has a positive impact on employment generation especially with respect to women thus empowering them socially, economically and politically.

Keywords: MNREGS, person days, women participation, empowerment

OP 8: Knowledge level of farmers' about NFSM interventions in Jammu district of J&K state

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The present study was conducted in purposively selected Jammu district of Jammu and Kashmir to find out the knowledge of farmers' about NFSM interventions. Jammu district comprise of four agriculture sub-divisions namely R.S. Pura, Marh, Dansal and Akhnoor. Out of these four agriculture sub-divisions, two sub-divisions namely R.S. Pura and Marh were selected because maximum number of rice growing farmers have been covered under NFSM in these two sub-divisions. From each sub-division, 6 villages were randomly selected thereby, selecting a total of 12 villages for the present study. Quasi-Experimental research design was employed for conducting the present study. 60 NFSM beneficiaries from each sub-division were selected by without replacement random sampling method, thus making a total sample of 120 NFSM beneficiaries. Similarly, 24 non-beneficiaries were also selected from each sub-division belonging to NFSM villages, thus making a total sample of 168 respondents (120 beneficiaries and 48 non-beneficiaries) for the present study. Data were collected from the selected respondents with the help of semi-structured interview schedule by using the personal interview method. The analysis of information collected by personal interview method revealed that respondents had good knowledge about varieties of Basmati and hybrids, methods of nursery raising, insect-pests, diseases and weeds of rice crop, herbicides, timing of application of herbicides, functions of motor pumps and knap sack sprayers. Only 13.33 per cent NFSM farmers had knowledge about name of seed treating chemicals whereas 10.41 per cent of non-NFSM farmers had knowledge about name of seed treating chemicals. 53.33 per cent NFSM farmers knew about field demonstration whereas none of the non-NFSM farmers had any idea about the same. Hundred per cent NFSM and non-NFSM farmers identified weeds, insect-pests and diseases of rice crop. Only 8.33 per cent NFSM and 4.16 non-NFSM farmers knew the name of fungicides. Overall 84.16 per cent NFSM farmers and 60.41 percent non-NFSM farmers had knowledge about critical stages of irrigation in rice crop. 67.5 per cent and 55 per cent NFSM farmers had knowledge about recommended dosage of urea and DAP respectively but on the contrary only 54.16 per cent and 39.58 per cent non-NFSM farmers had knowledge about recommended dosage of urea and DAP respectively. Hundred per cent NFSM and non-NFSM farmers had knowledge about function of motor pump and knap sack sprayer. Only 6.66 per cent NFSM farmers and none of the non-NFSM had knowledge about function of conoweeder. 70.8 per cent NFSM farmers and 43.8 percent non-NFSM farmers had knowledge about Farmers' Field School.

Keywords: NFSM; Knowledge; Interventions

OP 9: Extent of Technological and Extension Yield Gaps in relation to Maize Crop Under Rainfed Condition in Rajouri District of Jammu and Kashmir State

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Maize (*Zea mays L.*) is one of the most important crops in world agricultural economy grown over an area of 177 million hectares with a production of 967 million tonnes (KPMG, 2014). India ranks fourth in area and sixth in production of maize. Maize is the major crop of hilly districts of J&K State and plays an important role in

the livelihood of the people. In J&K maize is predominantly grown as rainfed crop during kharif season and forms a staple food of vast majority of rural households, beside its use as livestock feed and fodder. In J&K, future increases in maize production to meet domestic demand will have to rely on improvements in yield per hectare rather than on the expansion of maize production area. In the Jammu region 75 per cent cultivated area is rainfed (DES, 2011). The productivity of maize at the national level for 2014-15 was 2.56 tonnes / ha whereas for the same period it was 1.49 t / ha in J&K state (AICRP on Maize, 2016). To boost the production and productivity of maize crop in the district, Krishi Vigyan Kendra(KVK) Rajouri is conducting front line demonstrations (FLDs) on maize crop. The main objective of the FLDs is to demonstrate and popularise the improved production technologies among the farmers. A study was conducted on 412 front line demonstrations on maize crop for five consecutive years (2013-14 to2017-18) in district Rajouri. There was a wide yield gap between the potential, demonstration and farmers yields in maize mainly due to technology and extension gaps. The results of the study revealed that the average yield of demonstration plots and farmers plot (check) were 24.48 q/ha and 17.92 q/ha respectively. On overall average bases 36.86 % higher grain yield was recorded under demonstration plots than farmers' plot. The technological yield gap and extension yield gap during the study period varied to the extent of 19.70 to 48.20 q/ha and 1.58 to 10.30 q/ha respectively. The overall technology gap, extension gap, and technology index in maize crop were 35.35 q/ha, 6.55 q/ha and 58.80% respectively.

OP 10: Farmers' Access to Information and Communication Technologies under Front Line Demonstrations

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Extension is a communication intervention and to meet out this, farmers' access to information and communication technologies has become quite imperative. Wide extension functionary-farmer gap all over the world has remained an impediment in the smooth delivery of extension services including extension messages to the door steps of the farmer clients. Traditional extension approaches have however been effective in the past but in the present context of changing role of extension in the new economic, market led and farmer led extension regime, the role of extension has been drastically changed and in order to meet the emerging challenges arising out of the new extension era, Information and Communication Technologies (ICTs) have a crucial role to play. The present investigation was carried out to study the ICTs access and their usages by 280 farmers on whose fields Front Line Demonstrations (FLDs) on production, protection and management technologies of different crops enterprises were laid out by the KVK in 14 different villages of the district during the year 2017-18. It has been found that 94.25 percent of the respondents had access to mobile phones and 22.25 percent had access to smart phones. Besides, 16.35 percent had been found using internet and social media platforms. However their usage regarding agriculture technologies and their access through Internet has been found to be quite low i.e 2.75 percent. 32.67 percent of the farmers were found using voice calls to enquire about seed availability, time and method of sowing and pest and disease incidence from the extension specialists. Access to television and radio has been found to be 98.28 and 95.85 percent, however their usage has been found to 43.35 and 32.89 percent respectively.

OP 11: Impact of Integrated Farming System under Farmer FIRST Programme

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As the country heads for 2022, all eyes are on whether the target of doubling the farm income will be achieved or not. The Indian Council of Agricultural Research (ICAR) has also launched Farmer 'FIRST' programme (FFP). By FFP the ICAR aims to move beyond production and productivity to privilege the smallholder agriculture and complex, diverse and risk prone realities of the majority of the farmers through enhancing farmers' scientist interface. Farmer here plays a central role of a partner in identification of research problem, prioritization, conduct of experiments and management in farmer field conditions. The FFP moves beyond increasing productivity to enhance farmer's income by incorporating suitable different modules. In the state of Jammu and Kashmir, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu has implemented the Farmer First Programme in a cluster of 12 rainfed villages in Samba district. The demonstration of recommended 0.5 hectare Integrated Farming System model for rainfed area is one of the essential mandates of the project covering modules including crop, livestock, mushroom and vermicompost etc. The difference in net returns and employment days generated from an area of 0.5 hectares under recommended IFS model were Rs. 161196/-and 130 days more than the existing farming system. The efforts are need to scale down the coverage under different modules, keeping in view the marginal size of land holdings in the selected village cluster under the Farmer FIRST Project.

Keywords: Integrated Farming System, Impact, Economics, Farmer FIRST Programme

OP 12: Impact of maize FLDs on productivity and income distribution under NICRA Project

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KrishiVigyan Kendra Kathua under the administrative control of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K) has implemented National Innovations in Climate Resilient Agriculture (NICRA) project, sponsored by Indian Council of Agricultural Research, New Delhi. The project was implemented in 2011 in Said and Sohalvillages of NICRA project and over the last seven years, all available recommended rainfed technologies have been implemented in the selected villages through organization of OFTs, FLDs, extension activities and trainings. The focus was also on demonstrations of technologies that can mitigate the effect of climate change, besides providing higher income to the farmers. Maize, being the principal crop of rainfed areas, remain the prime focus for demonstration of latest technologies. The recommended package of practices for maize crop is being implemented on farmers' fields which has resulted not only in increased income at farm level but has also helped in achieving equitable distribution of income among rural households.
Keywords: NICRA Project, Rainfed areas, Income distribution

PP 1: Women Empowerment- Key to Social and Economic Growth

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Women are the real architects of society. This phrase is an everlasting principle of the universe. The unique reason behind this is that, if we consider any personality there must be a direct or indirect influence of woman for his/her achievement. Agriculture is the back bone of our country. More than 70 percent of the people engaged in agriculture and it is the livelihood occupation for majority of the people. But from the period known, the role of women is always in a dependent position in spite of her strong support or impact on men. Women shoulder almost all responsibility for meeting basic needs of the family, yet are systematically ignored for utilization of the resources, information and freedom of action required for them to fulfill this responsibility. Several studies revealed that, when the women are involved, supported and empowered in the society then entire society will flourish and the communities become more resilient. The role of women in this field is highly substantial. More than eighty percent of the work has to be performed by women. They are working as labourers in involved in different agricultural operations. Women belong in all places where decisions are being made .It shouldn't be that women are the exception. Education is going to play a crucial role to utilize science and technology in a proficient manner. Hence there is an indispensable need to focus on women education for their empowerment. Keeping in view the past and the present status of the women in agriculture and also the growth and development of science and technology in the field of agriculture, There are two ways of empowering women in agriculture *i.e.* Employment and entrepreneurship. When women participate in the economy, everyone benefits. Women have a bright future in the field of agriculture as it is the evergreen profession and involves much scope for future. Science and technology in agriculture is of very noteworthy dimension and will strengthen the women in performing agriculture
Keywords: Agriculture; Economy ; Women employment; Entrepreneurship; labourers

PP 2: Farmers' Innovation: Needs and Challenges

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The growth and development of India relies on agriculture and allied enterprises, reason being its huge contribution to national GDP as well as this sector constitutes massive workforce participation. Agriculture sector depends on technologies or innovations because these provide the foundation for the growth and development of this sector. The creativity, wisdom and innovation of farmers have essential roles to play in agriculture, reason being its applicability as well as its affordability to tackle field situation. Due to discontinuance of centralized innovations in agriculture, focus of agriculture is shifted from research station innovations to farmers' innovation. Farmers' innovation is no doubt a good source of solving location specific problems but a number of challenges are associated to it. Farmers' innovations are not well documented and validated. These innovations are evaluated on the basis of scientific parameters and criticized for being unscientific. Farmers' face a number of constraints while developing and commercializing innovations. Considering these pertinent issues the present paper is an attempt to highlight the current status of farmers' innovation with special reference to needs of these innovations and challenges associated to it.
Keywords: Farmers' innovation, Need, Challenges, Status

PP 3: KVK: An Option for Sustainable Extension Approaches for Technology Delivery

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Krishi Vigyan Kendra is farm science centre that function at grass-root level to promote agriculture and technologies for rural development. The KVKs are to disseminate agriculture technologies and provide services for capacity building of persons those are interested or involved in agriculture. They also train officials responsible to promote agriculture and allied areas for development. We need to integrate the aspect of smart technologies to boost farm profitability and socio economic life of farmers. Farmers are at the user end of the technologies and services being provide through various channels like Research Station/Universities/KVK/State Govt. etc. Farmers can enhance their production/income only they act upon and utilize the technologies available, participate in the various government policies/programme and benefit from it. Today in the age of technology and information there are a wide range of technologies from which they can get access to information on agriculture and allied areas like animal and poultry rearing, Fish farming, Bee Keeping, Mushroom cultivation and other diversified areas. The farmers get expert advice and information from agriculture related through KVK. Farmers can enhance their inome by –

i) Enhancing their gross income by growth in production, gaining high price for their produce and involvement in diversified farming and non farming ventures like value addition, custom hirring etc.
ii) Reducing cost by purchase of high quality inputs at a better cost, optimal use of inputs for maximised output and saving in input
iii) Stablising their income through coping mechanism and risk mitigation

The KVKs have potential for such achievements. The training, Demonstration and extension activities have a several examples of the farmers. At Sultanpur the farmers started smart technologies to boost farm profitability and socio economic after getting vocational training at KVK, Sultanpur in the thematic area of Diversified farming integrated poultry cum fish culture, Staking in Tomato, Vegetables through Machan system, Spacing management in early cauliflower, Intercropping of Lentil and Mustard with sugarcane, integrated improved dairy farming, Feed production of fish and poultry, RCT as self employment for rural family.

PP 4: Futuristic Issues and Distress in Indian Agriculture: A threat to sustainability

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Scientific agriculture interventions in India are being adopted gradually .Although, food grain production has increased since the Green Revolution era of the mid-sixties. During the last one decade, production of maize and cotton has doubled. The growth rates in horticulture, livestock,poultry and fishery sectors have increased and have significantly contributed towards agricultural gross domestic product (AgGDP). The average agriculture sector growth over the last three years has remained around 4.7%.The stagnant growth of agriculture may be due to some challenges which are emerging from different spheres. It appears that the Indian agriculture, being at the cross-roads, is currently facing both unprecedented challenges and unparalleled opportunities. The key challenges to be addressed are: (i) weakening of public extension system (ii) increasing risk in agriculture due to erratic weather, (iii)Lack of interest on the part of rural youth to continue in the farming(,iv) small, and fragmented holdings; (v) limited employment opportunities in non-farm sector(vi) migration to urban areas,(vii)low market price and(viii)suicide by farmers. These challenges can have serious implications on the farm income and the future of Indian agriculture. Neglecting these challenges at this juncture could adversely affect the national food and livelihood security, especially for the resource poor farmers. In the past some years, the weather patterns have been changing. The situation does not become any better even when there is normal rainfall. 56% of the country depends on snow-fed rivers for its water. Floods and erratic rainfall destroy crops at their harvesting stage. The wet conditions and humidity result in spread of diseases in crops affecting its yields. There is a wide array of factors that has led to the increasing spate of farmer suicides in India. The lands are not as productive as before, the markets are failing, the debts are piling up, and the pests cannot be kept at bay. Crop insurance is not being implemented properly. Lack of knowledge about Kissan Credit Card hinders farmers about its use. All problems have solution but it needs will and commitment from the implementing agencies to exonerate farmers from the distressed farming to a stable and sustainable farming

Keywords: Challenges in Agriculture, Food security, Farmers distress

PP 5: Indigenous Technical Knowledge (ITK) practices adopted by the farmers in NICRA village of KVK, Kathua

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In the emerging global knowledge economy a country's ability to build and mobilize knowledge capital, is equally essential for sustainable development as the availability of physical and financial capital. The basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of the people, applied to maintain and improve their livelihood. Indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generation to generation and closely interwoven with people's cultural values. Ingenious technical knowledge is also the social capital of the poor, their main asset to invest in the struggles for survival, to produce food, to provide shelter or to achieve control of their own lives. However, the knowledge system is yet to become familiar to many laboratory and extension scientists to be accepted as forms of social and cultural resources for innovation. The older peoples in the society are the best sources to provide information on ITK practices adopted by the farmers. The information was collected from the selected farmers of NICRA village through personal interview and focused group discussion. The objective of the study was to know the different types of ITK practices followed by the farmers. Indigenous knowledge is the systematic body of knowledge acquired by local people through accumulation of experiences, informal experiments and intimate understanding of environment in a given culture. Indigenous knowledge is not only economically viable but also locally feasible. Indigenous technologies in agriculture are low cost, organic and eco friendly in nature. They do not cause any damage to the air, water and soil, safe to human beings and free from environmental pollution. But Indigenous Technology is diminishing day by day due to modern technology. So an attempt was made to integrate the indigenous knowledge with modern scientific knowledge for the betterment of farmers.
Keywords: Perceptions, ITK, Practices

PP 6: Krishi vigyan Kendra: a hub of knowledge dissemination

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KVK is an integral part of the National Agricultural Research System (NARS) aims at assessment of location specific technology modules in agriculture and allied enterprises, through technology assessment, refinement and demonstrations. KVKs are playing a proactive role in transferring new technology at field level with beneficial impacts towards farming community. They have an edge in technology transfer over other service providers by virtue of their having better technical expertise and demonstration units. KVKs have been functioning as Knowledge and Resource Centre of agricultural technology supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district and are linking the NARS with extension system and farmers. With the intervention by KVKs, about 80 percent of the farmers have modified their agricultural practices which were related to diversification of crops and changes in cropping pattern, use of fertilizers and pesticides, seed planting technique, changes in machinery used and in water use pattern. To realize their true potential, farmers must have information of the state-of-the-art technologies, necessary inputs and related information. In this context, the Government of India has established a large network of 645 Krishi Vigyan Kendras (KVKs) across the country with an aim to conduct technology assessment and refinement, knowledge dissemination and provide critical input support for the farmers with a multidisciplinary approach. KVK's are providing not only technical knowledge but also knowledge on different schemes running by the government, like Rashtriya krishi vikas yojna, Rashtriya kaushal vikas yojna and Attracting and Retaining Youth in Agriculture (ARYA) Scheme. Other than skill development programme KVK's are participating in organization of different social events like Swachhta Hi Sewa, Sankalp Se Siddhi, World Soil Day, Krishi Unnati Mela etc. Rural peoples comes to KVK's to gather information about different rural development schemes like National Rural Employment Programme (NREP), Jawahar Rozgar Yojana (JRY), Mahatma Gandhi National Rural Employment Guarantee Scheme, Bharat Nirman Yojana, National Rural Health Mission, National Rural Livelihood Mission, National Food Security Scheme. It is expected that in due course of time KVKs would play an increasingly important role in transforming agriculture, a key ingredient to transform India.
Key words: KVK, technology transfer, rural development

PP 7: KVK-Catalyzing rural women towards sustainable agriculture

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In the current scenario, women play a multi dimensional role in agriculture. Within the agriculture sector, the wage workers working on the basis of socio-economic status and regional factors, working on their own land and also in management of various aspects of agricultural production, women play important roles. According to FAO, women's contribution to Indian agriculture is about 32% while in some states (Such as hills, Northeast and Kerala), contribution of women to agriculture and rural economy is more than men. Women are involved in 48% agriculture related employment where as 7.5 crore women are playing significant roles in Milk production and livestock management. To strengthen women's participation in agriculture and allied activities and improve their access to land, loans and other facilities, the government has policy provisions like joint leasing of land for both domestic and agricultural land under national policy for farmers. In order to ensure that women contribute effectively in agricultural production, and productivity and get better livelihood opportunities proper structural, functional and institutional measures are being promoted to empower women to build their abilities and increase their access to input technology and other agricultural resources. Keeping in view the key role of women in agriculture, KVK Jammu has introduced women farmers to various techniques and women friendly technologies with an objective to create awareness, encouraging women to take up different income generating activities in agriculture and allied sectors and recognizing their invaluable contribution in Indian Agriculture and Economy.

PP 8: Information and Communication Technologies: A Catalyst for Sustainable Development

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ICT concept involves transfer and use of all kinds of information. It affects all aspects of life as we know that with it or without it, life would be virtually unimaginable. Information and Communication Technologies (ICTs) have been making considerable impact on the society due to their universal application and appeal. While the businesses and urban communities have seen the positive contribution of ICTs in several dimensions like increases in efficiencies, communications and information on anytime-anywhere basis, the same cannot be said of the rural areas, especially in the context of the developing countries. There are many ways in which Information Technology can be used to exchange the information rather effective communication like information kiosks which provide not only the basic services like email, but helps in education, health services, Agriculture and Irrigation, online trading, community services etc. Across the past twenty years, the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavour within business and governance. Education is a very socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees of personal contact with learners. The use of ICT in education lends itself to more student-centered learning settings. But with the world moving rapidly into digital media and information, the role of ICT in education is becoming more and more important and this importance will continue to grow and develop in the coming century. FAO has been promoting the use of ICTs in agriculture and has focused on ICT innovation for improving agricultural production and enhancing value chains. Expert systems (Artificial Intelligence) helps in determining marketing alternatives and optimal strategies for producers, integrated crop management systems for different crops, Farm-level Intelligent Decision Support system developed to assist in determining optimal machinery management practices for farm-level system, etc. and in this way, Information technology helps to predicts the results related to the agriculture. A large number of initiatives have been made-and are being made-in different parts of India, to deploy ICTs in a manner that can create an impact on the society. However the successes are few and far between-especially considering the large size of the country and of the population that needs services relevant to their lives.

PP 9: Impact of Krishi Vigyan Kendra Activities in Ensuring Livelihood Security of Tribal Farmers in Rajouri District of Jammu and Kashmir

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Rajouri district of Jammu and Kashmir is predominantly a hilly district with 36 per cent Tribals who are primarily engaged in cattle farming and sheep and goat rearing along with practicing crop farming. In the district, Budhal block is having maximum population of tribals which account for 56 per cent of total population.

Krishi Vigyan Kendra, Rajouri implemented various extension programmes for the tribal farmers of Budhal like trainings and FLDs on cereal crops, fodder crops, animal feed, backyard poultry, grafted fruit plants, small tools and implements, farm mechanization and improved storage structures. Results of various activities reveal that cropping intensity in most of the demonstration villages increased to 200 per cent thereby giving additional income to the tribal farmers. There was about 47 per cent and 28 per cent increase in productivity of maize and paddy crops, which are their staple food. With the introduction of dual purpose improved statins of backyard poultry, the egg production increased from 60 to 158 eggs per year giving an additional income of Rs. 12500/-per year. Moreover, after the intervention of KVK, on an average there was an increase of 5 litres of milk with the balance ration feeding and health management of milch animals. Introduction of small tools and implements helped in drudgery reduction by on an average 2 hours per man per day. Post activity PRA of the adopted villages revealed that with the intervention of KVK, Rajouri there was improvement in socio-economic status of tribal farmers.

PP 10: Future challenges before agriculture extension for sustainable development of agriculture

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Indian agriculture at present is facing numerous challenges. At present food grain production of India is 283mt and this requirement will further rise to feed its ever growing population. The main challenge at present is not about to increase the quantity but also quality of production to meet nutritional requirement and changing dietary pattern of the people. Accelerating the adoption of climate smart technologies by the farming community especially resource poor farmers will be a big challenge for extension personals for minimizing the adverse effects of changing climate on agricultural productivity. Attracting and retaining rural youths including farm women towards the profession of agriculture is a big challenge before policy makers. The profession of agriculture needs to make more remunerative so that it may attract rural youth as prosperous career avenue. The other major challenges the Indian agriculture facing includes shrinking size of land holding, increasing number of marginal and small farmers, increasing the productivity of rain fed area, enhancing farm diversification, creating proper marketing facilities, providing proper cost of the produce to the farmers, optimizing the use of different agro-chemicals for environmental sustainability, increasing mechanized power in agriculture, promoting traditional technology with scientific, enhancing participatory approach etc. Multi-prolonged approach involving all stakeholders is required to address all these challenges actively for making Indian agriculture evergreen. Role of field level extension personals is of utmost importance in mitigating these challenges for achieving the sustainable development of agriculture .

Key words: Challenges, climate change, productivity, sustainability, farm diversification

PP 11: Feeding the Future: Sustainable Agriculture

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The goal of sustainable agriculture is to meet society's food and textile needs in the present without compromising the ability of future generations to meet their own needs. There is a need to increase productivity of resource efficient farming that can adapt to climate change and mitigate its worst impacts, equitable, sustainable access to natural resources is crucial, as is managing them well. Focusing on smallholder farmers, particularly women, who are likely to be the main agents of change, Promoting research in sustainable agriculture, which needs to be scaled up and advocating sustainable agriculture. Both public and private investment in sustainable agriculture needs to be optimized. With the population exceeding 6.7 billion and growing by over 6 million a month, the need to protect agricultural land and to increase food production has become critical. Meeting the needs of the present without compromising the ability of future generations to meet their own needs is the key principle behind the concept of sustainability. If natural resources such as soil, nutrients and water are used up at a rate faster than they are replenished then the farming system is unsustainable. Sustainability is also dependent on maintaining a high level of biodiversity, especially in the soil and the surrounding environment. Some of the biggest threats to sustainable agriculture are loss of biodiversity, dryland salinity, acid soils and pests and weeds. Farmers, scientists and agricultural authorities are working together on approaches to deal with them. Sustainable agriculture is a simple concept that embraces a complex web of scientific and economic issues. Developments in information technology will play a key role in managing the complexity. To achieve sustainable agriculture we must deal both with issues involving environmental impacts and productivity of the land.

PP 12: Perception of Rural Youth of Jammu District towards Agriculture as an Occupation

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India is an agriculturally dominated country. Primary occupation of villagers is still agriculture and its allied ventures. India is a young country and rural youth constitutes about 41% of total population of India. In the present scenario the interest of rural youth is declining towards agriculture. In the coming years, one of the biggest challenges for Indian agriculture would be retaining its youth in agriculture. Hence, the present study was conducted to know the perception of rural youth towards farming and to analyze the problems encountered while practicing agriculture. A sample comprised of 100 rural youth (below the age of 35 years) were randomly selected from the five operational villages of KVK Jammu viz. Raipur sajdan, Suchetgarh, Sagoon, Kattalbatal and Chak Sheikhan of Jammu district. Data was collected with the help of structured interview schedule and analysis was carried out using descriptive tools namely frequency and percentage. The results of the study showed that majority 72% of the respondents are graduate, about 18% have passed higher secondary and only 10% of the rural youth were under matric. About 78% of the farming youth accepted that poor income and poor living standard are the main cause of rural youth luring to non-farm sector and they don't want to adopt agriculture as an occupation. Due to lack of other income options leads 22% of the rural youth to practice the farming as occupation. Majority 50% of the respondents faced problems related to landholding size and low produce of crops and they like to prepare their children for non-farm sector. About 35% are in view that agriculture needs lots of hard work and high productivity costs and inputs. Very less 15% opined that agriculture is beneficial if innovations and technology adopted by the farmers but poor income hinder them to invest on technology and innovations. It can be concluded from the results that educated youth are deviating from the agriculture to some other occupations, they found difficult to support themselves and their family due to poor income. Poor living standard and low production of crops also lure to next generation fore away from farming, therefore children and youth dislike farming or not paying attention in adopting high cost agricultural technology and innovations in their farm. Thus youth losses their faith that they can change the face of agriculture.

Key words: Perception, Rural youth. Occupation, Technology and Innovations

PP 13: Constraints faced by the Gujjars and Bakerwals of Jammu Division for availing the benefits of tribal developmental schemes

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Jammu and Kashmir is the northern most state of India. It is home to 1, 25, 41302 people belonging to diverse culture. Of them, Gujjar and Bakerwal, the nomadic tribe, forms more than 20 percent of the total population. They are scattered in all the three regions of Jammu and Kashmir, with highest concentration in Poonch and Rajouri. (Census, 2011). Since our independence various policies, strategies, approaches and models to tribal development have been conceived. From the very beginning of the 1st five years plan a numbers of programmes of tribal development have been formulated and implemented. Billions and billions of rupees have been spent in the name of tribal development. But most of the programmes have been either failed or could not yield result up to the expectation. In order to find out the constraints faced by Gujjars and Bakerwals for availing the benefits of different tribal developmental programmes, a study was conducted in Jammu division of Jammu and Kashmir state. Multi-stage sampling technique was employed for the selection of districts, blocks, villages and ultimate respondents. The total sample size was 112. Pretested interview schedule was used for collection of data. The constraints reported by the *Gujjars* and *Bakerwals* for availing the benefits of the Government interventions are generalized for the study and ranked accordingly .The major constraint faced by Gujjars and Bakerwals was lack of awareness about different welfare schemes (68%), followed by lack of knowledge of government interventions (66%), lack of adequate fund from different development department of government (41%), lack of communication with government agencies (40%), illiteracy of the respondents (38%), irresponsibility of government employees (30%), lack of proper information (29%), benefits directed towards known person only (26%), no proper management and government developmental offices are far away from respondents' residence (22%), lack of proper utilization of funds (17%), plan is not prepared timely (12%), lack of training programmes for respondents (7%) and a employee's selective nature towards people while providing benefits (2%).

Keyword: Gujjars, Bakerwals, development programmes, interventions, communication and benefits.

PP 14: Extension approaches for sustainable agricultural development

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India is an agrarian country where 70 per cent of the population is directly or indirectly involved in agriculture and allied sectors. People depend on agriculture for their livelihood. Thus there is a need for a well articulated and comprehensive agricultural extension policy, to develop agricultural extension systems. Agricultural extension as a source of information plays an important role for the achievement of sustainable agricultural development. The public sector extension approach is the dominant extension model throughout the world and it has usually been run by the Ministry of Agriculture. It functions at two levels: the ministry or national level and the implementation level in states, districts and villages. The effective agricultural extension approaches are the most important includes the approaches like the participatory approach; farmers' field school approach and the public-private extension approaches. Also, agricultural universities and research institutes have to play an active role in development activities by providing training courses for employees and farmers focusing on sustainable agricultural development through field schools. Conducting training and offering agricultural extension programmes that meet local standards are crucial for sustainable agricultural development, for example to prepare and train newly graduated agricultural employees and to rehabilitate them scientifically and professionally for sustainable agricultural development. Other intervention measures include providing effective information dissemination to farmers, improvement in technology delivery mechanisms and increasing outreach such as making technology component farmer specific. Others are decentralization of agricultural technology delivery institutions, enhancing farmer's managerial ability especially through farmers' organizations and reforming agricultural markets to stabilize income of farmers. In addition, regular networks should be established to facilitate the exchange of knowledge between farmers under the extension agents.

PP 15: Role of Information and Communication Technologies (ICT) in Indian Agriculture

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The application of information and communication technology (ICT) in agriculture is increasingly important. E-Agriculture is an emerging field focusing on the enhancement of the agriculture and rural development through improved information and communication process. More specially e-agriculture involves the conceptualization, design, development, evaluation and application of innovative way to use information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture. ICT promises a fundamental change in all aspects of our lives, including knowledge dissemination, social interaction, economic and business practices, political engagement, media, education, health and entertainment. ICTs are most natural allies to facilitate the outreach of the agriculture extension system in the country. Despite large, well educated, well trained and well organised extension manpower and around 60% of farmers in the country still remain un-reached, not served by any extension agency and functionary. Information is vital to tackle climate change effects. For this reason,a shift is needed in the agriculture sector to disseminate appropriate knowledge at the right time to the one who are at the frontline in the battle i.e. the farmers, in both developed and developing countries. At the same time, information per se is not enough, but appropriate communication system are needed to ensure that information come to farmers in an effective, accurate and clear way. Through ICT, farmers have been empowered to exchange their opinions, experiences and ideas. It has given farmers more exposure and allowed them to use science that looks at agriculture from an integrated perspective. Information and Communication Technologies will initiate new agricultural and rural business like e-commerce, reality business for satellite offices, rural business, and virtual corporation of small-scale farms. It will support analysis on optimum farm production, disaster management, agroenvironmental resource management etc. It will improve farm management and farming technologies by economical farm management, risk management, effective data or data transfer etc., realizing competitive and property farming with safe product. It will facilitate rural activities and supply softer and safe rural life with equivalent services to those within the urban areas, like provision of distance education, telemedicine, remote public services, remote diversion etc.

PP16: Socio-Economic Survey: A Case Study of Manigam Village of Ganderbal District of J&K

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The research study on socio economic status of Manigam village of Ganderbal district has been conducted on the socio economic conditions and infrastructure availability. A socio-economic survey is regarded as one of the most significant source of statistical data on domestic spending and income as well as other data on the status of housing, individual and household characteristics and living conditions. The present paper is an attempt to focus on the socio economic conditions and the infrastructure availability in the village (Manigam).

Advances in crop production technologies and natural resource management

OP 1: Smart technologies to improve land and water productivity in South-Asia

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Wheat-rice cropping system in South-Asia has taken a toll on the natural resources of air, water and soil as this proves to be labour-, water-, capital-and energy-intensive, and become less profitable under the current scenario of climate change. Adverse effects will be further intensified under changing climate, declining underground water table, deteriorated soil structure. The frequency of droughts, heavy rain falls and heat waves increased under the scenario of climate change which results in higher grain production instability. Further, number of rainy days, rainfall events, postpone of monsoons, mid-season droughts etc. have observed in recent years, affecting the land and water productivity. For enhancing the profitability, productivity and sustainability of this system-a paradigm shift is required. To improve declining land and water productivity under the prevailing climate change, scientists developed several resource conservation technologies (RCTs) viz. direct seeded rice, irrigation based on soil matric potential, zero tillage in wheat and mechanical transplanting of rice under different tillage conditions, being advocated in the region, have been studied under isolated conditions for individual crops. A single RCT might not be solve the purpose of improved land and water productivity, therefore an integrated approach with agronomic and soil manipulations depending on the location, soil textural class and agro-climatic condition is the need of the hour. The delineated lower WP at the farmers' fields compared to well-managed experimental plots indicates the need for a scope to improve it. However, these technologies need to be studied for complete wheat-rice cropping system in the region as a whole including the intervening periods. However, these technologies are site specific and before selecting any particular RCT for a particular region, soil texture and agro-climatic conditions must be considered. Further, a single RCT would not be effective therefore, an integrated approach is required. In this chapter, an attempt was made to discuss different scientific interventions and their different integrated approaches which might be used to improve land and water productivity under the climate change scenario for improving the productivity, profitability and sustainability of RWCS in the region. But, after adopting any RCT or a set of RCTs, their residual effects need to be delineated not only during succeeding or proceeding crops but also on the soil moisture dynamics during intervening periods for finally improving the livelihoods of the poor farmers of South-Asia under the scenario of climate change.

Keywords: Climate smart agriculture-land and water productivity-South-Asia-RCTs

OP 2: Development of Tractor Operated Offset-Disc type weeder for orchards

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Horticulture production is surpassing the food grain production in the country wherever mechanization of orchards is in nascent stage. Appropriate machinery to do the various orchard farm operations is not available. Orchardist prefers ploughing the orchard with tractor implements, the easiest method to control weeds, but often the implements or body of the tractor may hit and bruise the tree trunks/ shoots. Intercultural operations particularly under the canopy and in between trees are not available. Some efforts have been made by side shifting capability of the rotavators for intercultural operation under the canopy. Using this option, the tractor hood height restricts its reach. Keeping this in view, an offset weeder was designed and developed to interculture in between successive trees and under canopy of tractor able orchards using hydraulic sensor. Hydraulic sensor is planned to avoid trunk of trees from any damage as well it gives signal to equipment for going back to its original position. The main frame length was 2.00 m. A gang of 4 discs was mounted in such a way that angle can be varied from 32-45^0 for operation. The disc spacing was 230 mm. Offset weeding of approx. 1.0 m length between successive trees is possible. Functionality of developed prototype was assessed by varying angle manually with mechanical hinges. Tractor was operated in 1st low and 2nd low gear. The coverage of this offset weeder is 1.0 m. Due to its 500mm offset; it reached near to trunk of trees. The tractor operated offset weeder is having potential to reduce burden on manual labour with increased overall productivity.

OP3: Assessing the Level of Knowledge of Agro-ecological Bases of Contemporary Water Management Innovations (CWMI) a smart technology to boost farm profitability and socioeconomic condition of farmers in Dryland Agro-Ecosystem

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CWMI are those belonging to or occurring in the present living times or occurring at the same time as new integrated technology and practices developed by farmers and few researchers. (Like water harvesting, water sharing, water saving or protective irrigation and community mobilization, etc. Farmers need to understand the scientific problem solving approaches behind the contemporary water management innovations that they have evolved during agro-ecological crises. Some of the technological innovations and institutional innovations developed by few research institutes supporting farmers at the time of crisis. So even under this distressed condition, farmers will be able to survive although at a subsistence level. The efficacy of these CWMI were assessed and analysed. The major finding were: All the farmers shared the agro-ecological principles and rationale behind the community participation and community management of common property resources of rain water, through rain water harvesting, saving, sharing and using judiciously through micro-irrigation systems. All the farmers have comprehensively understood the agro-ecology behind hydrological cycle of water harvesting and water saving for future contingencies. As the farmers have had undergone great stress periods during times of agro-ecological crisis, they were all appreciating the value of scarce water resources for their livelihood security.

OP 4: Role of vermi compost in organic farming for sustainable Agriculture

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Soil fertility is crucial for survival of humanity at the planet earth. Plant obtains nutrients from soil, atmosphere and water act as medium for their availability. Conventional agriculture is based on fossil and imported source of energy which is dwindling and becoming extensive. The indiscriminate use of chemicals in modern intensive agriculture concerns the contamination of food with agro-chemicals and also pollution of environment, soil and water. At present the soil are tired, overworked, depleted, sick, poisoned by synthetic chemicals. Production and quality of food has suffered and so as the health. This made us to about alternate forms of agriculture to produce food devoid of contaminants. Besides, in the present era of global warming and climate change, the face of agriculture has to be more environment friendly, hence the main emphasis should be for development of production technologies which are sustainable in long run. Organic agriculture is one among the broad spectrum of production methods in which utilization of organic composts like vermicompost is the major part of production methods that are supportive of the environment and restricts the use of synthetic inputs. The utilization of vermicompost has gaining popularity and is in great demand because of its eco-friendly nature and low cost. It can be prepared easily and plays a major role in improving the growth and yield of different field crops, vegetables, flowers, seedling preparations and ornamental plants; it can be used at any stage of the crop development.

Keywords: organic farming, vermin compost, chemical fertilizer, agro-chemical

OP 5: Development of Battery Assisted Spinach-cum-Coriander Seeder for small farmers

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Amongst vegetables, Spinach (*Spinacia oleraceae*) and Coriander (*Coriandrum sativum*) leaves are being used in most of the household as these are good source of vitamins, large amounts iron, calcium, and minerals. The introduction of the seed drill made sowing of the common food grain seeds in a line which proved to be much more economical and efficient. Traditional method of sowing the Spinach and Coriander does not allow use of mechanical weeders for removing/ trampling the weeds even cutting operation too. Tractor operated pneumatic sowing machines are used for sowing all sorts of fine seeds at exact intervals and at exact depths but not for coriander too**.** One to seven row manual operated seeder is also available for vegetable at a high cost [Rs. 56720/ (709 €) for one row and Rs. 56880 (711€) for additional rows] but not for both crops. In fact there is no manual operated seeder for sowing Spinach and Coriander. The manual operated seed drill consumes power that restricted its day-long work with a worker/ workers. Attempt is made to provide a type of manual operated seeder for vegetable growing farmers which can reduce the workload of farmers with increased output. A battery-assisted two-row seeder has been developed for sowing Spinach and Coriander in line at varying row spacing of 21 to 45 cm. Seeder consisted of trapezium shaped hopper, metering unit on drive lugged wheel shaft and boot type furrow opener. Two independent seeder equipped with lugs (drive) wheel is mounted on left and right sides of main square

shaft enabling row spacing. The weight of battery-assisted two-row seeder is 35 kg. The hopper volume of each seeder is 2.0 litre. The seeding depth is 25-35mm for spinach and Coriander which can be adjusted. The area covered was 0.0454 ha/h and 0.0648 ha/h at row spacing of 215 mm and 300 mm, respectively. The speed of operation was 2.16 km/h. The power consumption varied from 100W to 175W due to varying tilth levels. The two row developed seeder is eco-friendly and helpful in reducing workload of farmers.

OP 6: A Study on Post-Harvest Management Practices among the Mango Growers in Jammu District of Jammu and Kashmir

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Mango occupies a pre-eminent place amongst the sub-tropical fruits grown in Jammu region and is extensively grown in Jammu district. To find out the post harvest management practices adopted by the farmers in Jammu district a study entitled "A Study on Post-Harvest Management Practices among the Mango Growers in Jammu District of Jammu And Kashmir" was conducted. Based on proportionate random sampling the selected 80 mango growers were interviewed using a structured interview schedule. The results showed that one-third (37.50%) of respondents were noticed to fall under medium age interval (59 -70 yrs) and 47.50 per cent of the respondents were having small landholdings. Rain water was the main source of irrigation as 48.75 percent of the respondents were found relying on it. Average area under mango orchards was 1.23 ha. 38.75 per cent of the respondents possessed medium level of knowledge about post-harvest management practices. The detailed analysis of individual management practices indicated that a cent per cent of respondents had knowledge of duration taken for fruit maturity, identifying maturity of fruits, method of harvesting, storage techniques, packing material and importance of grading and packing, a high percent of respondent possessed knowledge about use of fruits pickers for harvesting (88.75%) and causes of post harvest losses (56.25%) while, only a small percentage of respondents possessed knowledge of ideal time for harvesting (25.00%). The analysis of the adoption of post-harvest management practices showed that cent per cent of respondents adopted Dasheri variety, followed by hand picking as a method of harvesting (57.50%) and time of harvesting (25.00%). But, none of the respondents had adopted the washing of the fruit. The results of binary regression showed that adoption of post-harvest management practices like storage facility were significantly determined by landholdings, number of trees, distance from market and artificial ripening were significantly determined by education, distance of market and extension contact. A cent percentage of respondents expressed the constraints of lack of processing unit followed by marketing problems (88.75%) and lack of technical knowledge and guidelines (86.25%).
Keywords: adoption, post harvest management

OP 7: Climate Smart Agriculture-An Option for Sustainable Food and Sugar Security

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Climate change is expected to have important impacts on agriculture, especially in developing countries because of relatively low adaptive capacity, highly vulnerable to natural risks, poor forecasting technologies and mitigating policies. It has been estimated that over the next few decades, especially from developing countries, billions of people, will face scarcity of water and food and higher risks to health and life because of climate change. Food grain and sugar production in India has increased significantly over the years, but its sustainability is variable due to the dependence on monsoons and other local situations. However, to meet the future demand for food grain and sugar by the year 2050, the annual food grain and sugar production needs to grow to the level of 333 and 51 million tonnes, respectively. Farmers are regularly face adverse weather and environmental conditions that spell disaster for their produce. Extreme situations such as flooding and droughts constantly plague our farming community. Climate change may affect agriculture production by change in temperature, precipitation, carbon di oxide concentration, water availability, frequency of extreme climatic events etc. Sugarcane (*Saccharum officinarum* L.) is an important crop for sugar and bioenergy and its production may have been negatively affected and will continue to be considerably affected by increases in the frequency and intensity of extreme environmental condition due to climate change. The degree of climate change impact on sugarcane is depend on the geographic location and adaptive capacity. Sustainability depends on the principles that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Climate Smart Agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support sustainable food security under the new realities of climate change.This concept reflects an ambition to improve the integration of agriculture development and climate responsiveness.CSA initiatives sustainably increase productivity, enhance resilience, reduce greenhouse gases (GHGs) emission, and require planning to address tradeoffs and synergies between these three factors: productivity, adaptation, and mitigation. As there is need for significant increase in the agricultural

crop productivity levels to meet this demand, CSA can help to achieve this target.In this paper, we briefly reviewed agricultural crops response to climate change eventsand application of CSA practices for better understand for improving and sustaining food grains and sugarcane productivity and profitability.

Key words: Climate change, vulnerability, CSA, food and sugar security, adaptation and mitigation.

OP 8: Conservation Agriculture: Sustainable Technologies for Enhancing Crop Productivity

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In agriculture the main challenge is to encourage farmers in the use of ecologically-appropriate technologies and practices and to ensure that knowledge about sustainable production practices is increasingly accepted, applied and innovated upon by farmers. There is a large but underutilized potential to integrate farmers' local knowledge with science-based formal knowledge. A comprehensive effort should also be under taken to different stages of the innovation system, including technological adoption, adaptation and diffusion at the farm level, and to investigate the impact of agricultural policies on technological change, technical efficiency and production intensification. Conservation agriculture (CA) technologies involve minimum soil disturbance, permanent soil cover through crop residues or cover crops, and crop rotations for achieving higher productivity. In our country, efforts to develop, refine and disseminate conservation-based agricultural technologies have been underway and made significant progress since then even though there are several constraints that affect adoption of CA. The technologies of CA provide opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources, and benefit the environment. Conservation agriculture (CA) is a method for resource-saving agricultural crop production whose aim is to achieve profits together with high and sustained production with preserving the environment. Conservation agriculture basically relies on three principles, which are linked and must be considered together for appropriate design, planning and implementation processes. These are following:

i) Continuous minimum mechanical soil disturbance and no-till direct seeding
ii) Permanent organic soil cover with crop residues and cover crops
iii) Crop diversification with crop rotations and associations in case of annual crops or plant associations in case of perennial crops.

Therefore, benefit of conservation agriculture is several folds. Conservation agriculture, leads to sustainable improvements in efficient use of water and nutrients by improving nutrient balance and availability, Reduced cost of cultivation through savings in labour, Reduced field preparation costs, Climate change mitigation, Time and Farm Power, Improved use deficiency resulting in reduced use of inputs, infiltration and retention by the soil, reducing water loss due to evaporation and improving the quality and availability of ground and surface water. The nature of production systems has been transforming from high-disturbance production systems with a high environmental impact to low-disturbance agro-ecological systems where production technologies and practices are more in harmony with the ecosystem process and where both productivity and environmental services can be harnessed.

OP 9: Assessment of combining ability for yield and its contributing traits in Rice (*Oryza sativa* L.) under sodic soils

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The present investigation entitled "Studies on genetic variability, combining ability and hrterosis in aromatic and non-aromatic rice (*Oryza sativa* L.) uner sodic soil". The present study was based on two related experiments, namely, Germplasm evaluation (Experiment-I) and Combining ability (Experiment-II). These experiments were conducted at Main experimental farm, of the N.D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad., during *Kharif,* 2015 and 2016. The combining ability experiment was based on evaluation of a line x tester set of 69 hybrids (F_1's) and their 26 parents along with two checks for seven characters under sodic soil condition in randomized complete block design with three replications during *Kharif*, 2016. The 69 F_1's were generated by crossing 23 lines with 3 testers during *Kharif*, 2015. Analysis of variance for combining ability revealed non-significant mean squares due to testers and lines for all the characters under study except significant mean squares observed for testers for plant height. This indicated less importance of general combining ability and additive gene effects in expression of out of 7 characters. The mean squares due to lines x testers interactions, indicating importance of specific combining ability and non-additive gene effects, were found to be highly significant for all the seven characters under study. Twenty-three out of sixty-nine crosses emerged with positive

and significant sca effects for grain yield/plant. The five best crosses were Pusa Bas.-1 x Jaya, NDRK-50046 x Jaya, NDRK-50055 x Jaya, NDRK-50054 x CSR-10 and NDRK-50063 x CSR-10 which showed significant and positive sca effects for grain yield/plant as well as some other yield components.

Key words: Rice, combining ability, general and specific combining ability

OP 10: Interventions for improving farm's productivity and profitability in Lahaul valley

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Lahaul and Spiti is the largest district of Himachal Pradesh in terms of geographical area accounting nearly for one-fourth of the total geographical area of the state. It falls in the dry temperate zone where there is a great diversity of climate due to variation in altitude, topography and geographical location. The climate is extremely cold and heavy snowfall occurs during winter which spans from November to March. Most parts of the zone remain cut off from the world during this period. There is only one cropping season starting from April to September or early October when the mean minimum and maximum temperatures range approximately between 12 to 24° C; though occasionally it ranges from as low as 5°C to 30°C. The average annual rainfall of the zone is 250 mm. Agriculture is the main source of livelihood in Lahaul valley. Itplays a key role in improving socio-economic conditions of tribal farmers. Garden pea and potato are the main cash crops in the valley. Cauliflower is fast emerging as a new cash crop alternative. Rajmash, buckwheat, toria, kuth and manu are the other crops grown in the valley. Poor soil fertility, dominance of single crop variety (pea and potato), occurrence of weeds, diseases and insect-pest incidence and huge technological gaps in crop cultivation are major factors for poor productivity and profitability of tribal farms. Interventions including high yielding and disease resistant varieties, integrated disease, insect-pest and weed management, integrated nutrient management, micro-irrigation system and power tiller may be helpful in improving farm's productivity and profitability in the valley.

OP 11: Organic Seed Production in Okra

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Okra, *Abelmoschus esculentus* (L.) Moench, is a vegetable crop found to be a rich source of vitamins A and C, thiamine, riboflavin, calcium and iron. The area under cultivation of this crop in India is about 4, 32,000 hectares and production is about 45, 28,000 metric tonnes. The continuous use of chemical fertilizers has resulted in creating a potential threat of environmental pollution and causing a deterioration of the nutrient status. There is an urgent need to optimize nutrition recycling to sustain crop production without affecting soil health and protecting environment from pollution by shifting towards organic farming. An experimental trial of Organic Seed Production of Okra (*Abelmoschus esculentus* L.) var. Seli Special was laid down at Organic Farming Research Centre, Chatha. The size of the experimental plot was 15m x26 m with seed rate of 20-25 Kg/ha, spacing of 45x30 cms,FYM 20—25 t/ha, Vermicompost 4-6t/ha, Trichoderma for seed treatment @ 2gms/Kg and neemcake 16 q/ha. Before sowing an*in vitro*seed germination was done and it was calculated to about 70 %. The Date of Sowing was 08/03/2018. Days to 30 % germination was 09 days, days to 50 %germination was 11 days and days to 90 % germination was 23/02/2018 15 days. The range of days to 50% flowering was36 days to 43days. The first green pod picking was doneto boost the health of Okra plants for further strengthening seed production. Its range was from 51 days to 56 days. Total five pickings of mature pods were done from 91 days to 110 days. Organic plant protection measures were taken to ensure the crop protected from diseases and inspect/pests attack. The total seed produced was about 110.0 quintals/ ha.

OP 12: Impact of Cluster Front Line Demonstration in Increasing Production and Productivity of Oilseeds in Dhanbad

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Oilseed crops are the second most important determinant of agricultural economy, next only to cereals. India is the largest producer of oilseeds in the world and accounts for about 14 per cent of the global oilseeds area, 7% of the total vegetable oils production, and 10 % of the total edible oils consumption. The growth in per capita consumption is attributable to both rising income levels and living standards. However, the current per capita consumption of 14.3 kg/year in 2012-13 in India is considerably lower than the global average of 24 kg/year. Cluster Front Line Demonstrations (CFLDs) is a unique approach to provide direct interface between researcher and

farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and get direct feedback from the farmers' field about the crops. The Cluster frontline demonstration was conducted by Krishi Vigyan Kendra, Dhanbad on Mustard, linseed, groundnut and sesame in 2015-16 and 2017-18. The average yield of the mustard increased from 5.0q/h to 12.50 q/h. and the average yield of the linseed has been increased from 5.8q/h to 9.20 q/h. The yield of the groundnut has been increased from 5.0 q/h to 15.04 q/h while the yield of the sesame has been increased subsequently from 2.5 q/h to 4.0 q/h in last two years. Thus the productivity and production of oilseeds has been increased through demonstration substantially.

Keywords: Cluster Front Line Demonstration. Mustard, Groundnut

PP 13: Technological Interventions in Irrigation Sector for Enhancing Farmers Income

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In India, still only about 49% of the gross cropped area is under assured irrigation and rest of the 51% cropped area dependent upon the seasonal rainfall. There are spatial and temporal variation of water availability in India as rainfall occurs in 4 months during rainy season. India has the largest irrigated area in the world and about 68 million hectare area (2013-14) irrigated by canals (26%), tubewells (45%), wells(19%), tanks (3%) and other sources (7%). Micro irrigation is having higher irrigation efficiency by judicious use of water and helps to improve water saving. It is a suitable option to increase the water productivity and quality of the food. This technology will help to save water and due to this, area under irrigation can be increased by diverting the same water to other non irrigated areas. Advanced pumping solutions in micro irrigation consumes less power and improves power use efficiency by 30-50%. Moisture sensors ensures optimum availability of water to the plants as and when required. Digital SIM based services facilitates farmers to know the power availability on real time basis and remotely operates the irrigation pumps. Another new technology in irrigation sector is solar pump irrigation. It is promoted to ensure assured and timely irrigation where electricity is not available particularly in interior villages. Solar pump irrigation cooperative enterprises (SPICE) in Gujarat is one of the practical model in this sector. Laser land levelling, zero tillage, aerobic rice and system of rice intensification are very useful new initiatives and adopted by progressive farmer as these techniques can help in saving irrigation water up to 15-25%, farm energy up to 20% and crop yield improved up to 20-25%.

Keywords: Micro irrigation, Moisture sensor, Laser leveller, Zero tillage.

OP 14: Resource Conservation Agricultural Machineries for Rainfed Areas

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Conservation Agriculture is soil management practices that reduce erosion and degradation and include better crop management practices. It includes direct sowing, minimum or no-tillage, reduced tillage and incorporation of crop residues. Rainfed agriculture constitutes 55% of total net cultivable area in India. The rainfed agriculture witnesses climate constraints like long dry spells, erratic rainfall frequency, high losses of moisture due to evaporation, soil degradation, etc. The present level of land productivity in rainfed agriculture in India is about 1 t/ha, however, globally it varies from 1-2 t/ha (FAO, 2002b). Proper tillage and seeding practice for precise placement of seed and fertilizers in the moist zone are challenging task. Suitable implements have been designed and recommended for dryland areas to conserve the moisture and soil amendments. Agricultural mechanization helps in increasing productivity and utilization efficiency of agricultural inputs with reduce drudgery and timely farm operations. Machinery for mechanical weeding and inter-culture operations in dryland crops and placement of seeds and fertilizers below the soil surface, leading to improved fertilizer use efficiency are very important. Rotavator, Happy seeder, Roto till drill, Slit till drill, Strip till drill, laser land leveller are useful conservation machineries. Crop stubble slasher, knife rollers and chopping rollers maintains a permanent organic soil cover in the field.

Keywords: Resource Conservation, Rainfed Agriculture, Conservation Agriculture

OP 15: Vermicompost-A boon to Organic Agriculture

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Vermicomposting is a biological technique of converting organic wastes in to a rich soil amendment. Earth worm selection is the most important part of vermicompost production. *Eisenia fetida* named as tiger worm is the most common type of earthworm used for vermicomposting. It has rapid rate of growth and easy handling nature it is most preferred for vermicomposting *Dendrobae naveneta* named as European night crawler is used for industrial vermicomposting given its large structure. But it has low reproduction and maturity rates compared *E. fetida, P. excavatus* and *E. eugeniae*. *Dendrobaena rubida* is not commonly used for vermicomposting citing its preference for organic soil. This species can also be used in vermicomposting. *Lumbricus rubellus* is found in moist surfaces. It takes more time to mature and less rate of reproduction therefore, this is not suitable for vermicomposting and *Perionyx excavatus* is found in tropical zones. It is used in vermicomposting given its advantage of breaking up of organic matter under high range of temperatures. For feeding Materials Food waste, cow dung and Bio-degradable waste can be used. Bedding plays a crucial role in vermicomposting by maintaining a proper amount of oxygen and to facilitate these considerations non-toxic, light material must be considered. The selected bedding material must be shredded so as to minimize the oxygen blockage. Selected bedding material should be of dry leaves, Animal manure because it provides appropriate nutrients required for the earthworms. The Optimum Temperature Range is 15 to 30 C, Optimum moisture range is 70-80% and the Optimum pH Range is 6.5 to 7.5. The design of the worm pit depends on the organic waste generated. Earthworms are surface dwellers and their activity is mostly confined to the top surface of the soil and hence, more depth reduces their level of activity. Materials Used for construction of pit consists of Bricks and concrete. Mostly *Eisenia fetida* is used for vermicomposting with1 0.25 to 0.4 gworm weight of earthworm, length of 2.5 to 5 cm. Method of vermicomposting is Heap Method Duration having 90 days. The entire material will be turned in to a rich soil amendment. This output is dried, sieved and packed as organic fertilizer for varying utilities.

OP 16: Design and development of weeding-cum-earthing-up equipment

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Every year in INDIA, an average of 1980 Cr of rupees is wasted due to weeds. Our country faces the total loss of 33% of its economy from Weeds. Shrinking farm lands, acute labour shortage, decreasing income per acre of cultivation, and economic frustration are some of the key factors hurting a farmer's confidence in continuing farming. Weeding control is done by: mechanical weeding, thermal weeding: flaming, biological control, chemical control, and by farming pattern. It has always been a problem to successfully and completely remove weeds and other innocuous plants and also earthing-up the crop. In order to overcome these problems weeding-cum-earthing-up equipment is developed This work involved the design and construction of low cost weeding-cum-earthing-up equipment, which consists of two main units viz. first weeding unit and second soil cutting and earthing-up unit. A serrated blade and two discs were selected for weeding and earthing-up operations respectively. The weeding efficiency and cutting width of developed equipment was found 90.7% and 35cm respectively.

Keywords: Weeding, Earthing-up, working width, and weeding efficiency

OP 17: Napier growing for achieving self-reliance in fodder

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The availability of fodder is major issue in Poonch district as majority of the farmers are rearing dairy animals for their subsistence. Farmers are in practice of providing green maize fodder during *kharif* to feed the cattle. Apart from green fodder, the stubbles of maize are stored to meet the demand of milching animals as fodder is not in sufficient quantity in the district. Maize is the main *kharif* season crop of Poonch district cultivated in an area of 26,000 hectares and maize stubbles contribute significantly to meet fooder requirement. MP cherri is also grown in a limited area during *kharif* months.In Poonch and Rajouri districts, the farmers during *Assu month* are also engaged in cutting and saving grass from forest areas and dhoks for the fodder deficient months. In rabi, large area in the district is also put under Oats cultivation to meet the requirement of fodder. Crop residues of wheat also act as source of fodder which occupies approximate 14 thousand hectares of area during *rabi* season. Similarly rice residues and crops residues of other crops are also saved for feeding cattle. Apart from small dairy farmers who are rearing 3-4 animals for their subsistence, Animal Husbandry is a major enterprise and provides livelihood to

nomadic and migratory families who have large number of milching animals besides sheep and goats. The tribal population constitutes about 47.5% of the population of the district and animal husbandry is their primary or secondary occupation. Farmers have small land holdings and availability of arable land for fodder cultivation is limited. There are areas on dhoks, along the bunds, weed infested areas, waste lands, fallow land where Napier grass can grow well. Napier also known as elephant grass is a popular fodder crop. It is a fast growing, deeply rooted, perennial grass growing up to 4 metres tall. It grows well in high rainfall areas and can survive well from amsl upto 2000m. 12 front line demonstrations on Napier Hybrid (NB37) were laid out by KVK Poonch during 2016-17.The napier root slips were grown in waste lands and dhoks in the month of July at a spacing of 75 cm X 50 cm. The grass performed well in all the demonstrations. First grass cut was recorded at 75 days after sowing and subsequent cuts were taken on 35 days interval. Average Green fodder yield from 100 square meter area was recorded to the tune of 6.5 to 9 quintals in different demonstrations thus enhancing fodder availability for the fodder deficient area.

OP 18: Traditional Methods of Storing Vegetables: Exploring Indigenous Technical Knowledge from the Cold Desert of Ladakh, India

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Situated between 32°N to 36°S latitude and 75°E to 80°E longitude in the trans-Himalaya and surrounded spectacularly by arid mountains, the cold desert of Ladakh is unique in its own ways. One of the most sparsely populated region of Jammu and Kashmir (J&K) state with a population of 274289 (according to 2011 census), the people of Ladakh are close to their roots. In order to get acquainted with the indigenous technical knowledge (ITK) of storing vegetables, extensive surveys in the villages of Stakmo, Ranbirpur, Thiksey, Saboo, Naang, Phey, Umla of Leh district were conducted. The methodology was to meet the elderly and experienced farmers of these villages and record the information related to the storing of vegetables during the harsh winters when temperature dips to minus in this region. The ITK recorded during the survey included *Tsothbang* (vegetable cellar) which is a rectangular structure prepared in the ground with a dimensions of 12 × 10 × 6 m^3(L × W × H). The cellar has a small outdoor entrance and a ventilator and is used to store cabbage and root crops like potato, radish, carrot, turnip etc. during winter. The *tsotbang* helps to keep vegetables fresh for 5 to 6 months. Another ITK recorded was *Chulta*which is a traditional onion seed production practice. Here in onion bulbs along with the greens are harvested during the month of Septemberand stored in *charches*until the first week of May when the temperature is conducive for the onion to sprout again and develop seeds. The study pressed upon the fact that the ITKof farmers has to be integrated with scientific knowledge and technological advancements of today in order for farmers to improve their traditional ways of doing things.

Keywords: Indigenous Technical Knowledge, Ladakh, Traditional, Vegetables.

OP 19: Role of agroforestry in natural resource conservation and sustainable development

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The earths natural resources include air, water, soil, minerals, fuels, plants and animals. Conservation is the practice of caring for these resources so that all the living things can benefit from them now and in the future. All these living things we need to survive, such as food, water, air and shelter come from natural resources. It is now widely accepted that future of food, livelihood and environmental security depends upon the attention paid to conservation, sustainable development and management of natural resources. Agroforestry offers an acceptable alternative for resource conservation and sustainable production. This paper reviews the resource conservation benefits of Agroforestry which includes reduced soil and water erosion, maintenance of soil health, improved biodiversitry, livelihood security, amelioration of microclimate, insurance against risks caused by adverse weather and sustainable production.

Keywords: Resources, shelter, sustainable, biodiversity and amelioration.

PP 1: Socio-economic Factors Affecting Apple Production in Chenab Valley of Jammu province

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An attempt had been made in this study to identify the socio-economic constraints faced by the apple growers which stall its production and growth in the study area. The present study was carried out in the Jammu region of Jammu and Kashmir state with special emphasis on selected districts viz., Doda, Kishtwar and Rambam, as these regions had the highest area and production under apple crop. Apple is one of the key fruits with potential to generate income and employment in the high mountainous districts of Jammu, especially with road constructions gaining pace in these areas. The primary data from 180 respondents has been collected by survey method by interviewing the apple growers as well as different market functionaries directly through an especially prepared and pre-tested schedule. The identified socio-economic factors of the sample farmers in apple production has been ranked by making use of the Garrett's Ranking Technique. The analysis of the study revealed large number of factors affecting apple production in the study area, out of which high labour cost, lack of latest technical knowledge, high cost of transportation, Lack of transportation facilities and costly packing material has been identified as the major problems. In consequence, to solve the production problems of the study area apple producers should be organized as federation, cooperative, and union. The study calls for all government and non-governmental organizations to work together to expand and improve apple production and establish apple marketing hub for tackling the bottlenecks in the expansion of apple crop in the study area.
Keywords: Socio-economic, Constraints, Production, Apple, Jammu.

PP 2: Organic Farming in Relation with Sustainable Mulberry Cultivation

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Sericulture is one of the oldest agro-based industry in India and the success and failure of this industry fully dependents on the production of quality mulberry leaves. Though the chemical based inputs are much preferred by the farmers because of short term results and economy. But residues of the chemicals (fertilizers / weedicides / insecticides / fungicides) used in the mulberry cultivation pose a potential risk of environmental pollution besides adverse effects on the users, silkworms, natural enemy complex, beneficial micro-organisms etc. It has been now being realized that the use of organic manures such as FYM, compost, vermin-compost and bio-fertilizers etc. with other nutrient combinations may help to maintain the soil health for sustaining the mulberry sericulture. Therefore, promotion of organic farming is need of the hour in sericulture to avoid indiscriminate use of chemicals in mulberry garden. The awareness on the harmful effect of toxic chemicals and the need for an eco-friendly sericultural, industrial and agricultural management with natural resources have been deeply felt which can only provide a new shape of the life style of the human being. Experiencing the ill effects of various chemicals in soil, declining the organic matter in the soil and ecological, environmental and social hazards, a new thrust on organic farming has been developed which is expected to be substantially better and potential to improve the sericulture industry in the way of improvement in leaf, cocoon as well as silk production and quality.
Keywords: Sericulture, mulberry cultivation, organic farming and agricultural management

PP 3: Polymorphism for grain size on A genome of Indian cultivars of bread wheat

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Bread Wheat (*Triticum aestivum.L*) is one of the most indispensable cereal crop worldwide. However, food insecurity is increasing at fast pace and to meet this demand, wheat yields need to increase by 50%, by the year 2050. Thus, in order to achieve higher grain yield of wheat, studying yield parameters is most essential. Wheat yield is a polygenic trait having additive and epistatic effects showing increasing interaction with the environment. Larger grains are directly related with higher yield and are having favorable effects on seedling vigor and early growth, thereby promoting and stabilizing yielding ability. Large grain size has been an important trait and is measured by thousand grain weight (TGW). TGW, mainly determined by grain length, grainwidth and grain thickness is a complex trait and a more detailed knowledge of its genetic control is useful for breeding programs and breeding efficiency worldwide. In the present study, molecular characterization of 56 Indian wheat cultivars was conducted using TaGS5 3A CAPS marker identified to be associated with grain size.DNA from all the genotypes was extracted, PCR was conducted and the amplified PCR product was digested with a restriction enzyme sat1. The results revealed the presence of two alleles viz Allele T and Allele G in our germplasm responsible for enhanced and decreased grain size. Among 56 genotypes, 26 genotypes were possessing T alleles and 21 genotypes were

carrying G allele while rest 9 genotypes were heterozygous. The study suggests the rich diversity and polymorphism of grain size on A genome of Indian wheat cultivars which will help in improving the grain yield traits of bread wheat.

Keywords: wheat, grain size, grain yield, TaGS5, CAPS, PCR, sat1 enzyme

PP 4: Organic Farming: Key to Sustainability and Cimate Change

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The word 'organic' means 'living', 'earth friendly' or 'of plant or animal origin'. Organic farming (OF) is a unique production management system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal, farm wastes and aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco friendly pollution free environment. OF is an age old practice in India. Organic manure has been prepared and applied in farming since Vedic period. The prime requisite is the promotion of a healthy soil-plant-environment system to reduce Land degradation and abuse of the inputs. With large land area and climate diversity, India has a considerable potential to contribute to C-sequestration. The soil organic carbon (SOC) in cultivated soils is less than 5 mg g-1 compared to 15-20 mg g-1 in uncultivated soils. This available potential of 10-15 mg g-1 soil–C sink could balance net emission from fossil fuel combustion .The modern system of farming is becoming unsustainable as evidenced by declining crop and factor productivity, damage to environment and increasing chemical contaminations etc. As the main focus being to increase production, product quality was neglected. As a result, biological diversity is lost, soil productivity is diminished, water resources are overused and polluted and climate changes have occurred and environmental problems overtook the first place in global context. Both the organic and conventional farmers perceived with high intensity the constraints like "Inadequate availability of inputs like vermicompost, biofertilizers and organic manures", "Lack of skill about improved methods of composting,Lack of awareness about the concentration, time and local market for organic produce and poor access to guidelines, certification and input costs and method of biofertilizer application. An integrated effort is needed from government and nongovernment agencies to encourage farmers to adopt OF as a solution to climate change, health and sustainability issue.

Keywords: Soil organic carbon(SOC) ; Sustainability ; C-sequestration; Biofertilizers

PP 5: Impact of organic and inorganic sources of nitrogen application on Economics of wheat (*Triticumaestivum* L.)

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The field experiment was conducted during winter season of 2015-16 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad. The experiment consisting of six treatments *viz*, T_1 (recommended dose of nitrogen through inorganic source), T_2 (recommended dose of nitrogen through organic source), T_3 (50% of recommended dose of nitrogen through inorganic source + 50% of recommended dose of nitrogen through organic source), T_4 (25% of recommended dose of nitrogen through inorganic source + 75% of recommended dose of nitrogen through organic sources, T_5 (75% of recommended dose of nitrogen through inorganic source + 25% of recommended dose of nitrogen through organic source), T_6 (dose of nitrogen through Urea based on soil test) were laid out in randomized block design with four replications. Highest gross returns were obtained with recommended dose of nitrogen through 75% of recommended dose of nitrogen through inorganic source + 25% of recommended dose of nitrogen through organic source followed by T_6.The highest B:C ratio (2.05) were calculated with T_5 followed by T_6 (1.98) and lowest T_2 due to high yield and low cost of cultivation obtained by T5 treatment compression to T6 and T1.

Keywords: Nitrogen; FYM; Economics, Urea; Gross returns

PP 6: Performance of Oats genotypes for fodder and grain yield under cold arid conditions of Leh, Ladakh

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To find the performance of Oat Genotypes for fodder yield under Ladakh conditions, the research was conducted at high mountain arid agriculture research institute, Leh SKUAST-KASHMIR during kharif season 2017-2018. The experiment consists of six genotypes including check (SKO-90, JHO-851, JHO-996, SKO-108, SKO-20 and Sabzar) laid in Randomized Block Design (RBD) with three replications. The plot size of 2×2 meter was used in this experiment. These high yielding varieties of fodder suitable for cold arid region of Ladakh shall be of great

significance to the local farmers for livestock. Among all the genotypes Sabzar showed maximum fodder yield (6.53 kg) followed by SKO-20 (5.93kg) as compared to other genotypes tested during the present experiment. Maximum grain yield was observed in variety Sabzar (1366.6 kg ha-1) followed by SKO-20 (1276.6 kg ha-1).
Keywords: Genotypes, Fodder, Oats, grain and Yield.

PP 7: Need of battery-operated planter for selected seed spices in India

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Seed spices are grown in about 16.4 lakh ha area with a total production of 13.14 lakh tonnes annually in the country. The major area covered under different seed spices is 6.62 lakh ha in coriander, 7.60 lakh ha in cumin and 2.18 lakh ha in fenugreek, respectively with their corresponding production of 6.09, 4.85 and 2.2 lakh tons. Presently the seed spices are mostly grown by marginal to sub-marginal farmers in the country by traditional methods. The area possesses by this category of farmers is very less which does not allow having high cost machines due to size and shape of land and economic conditions. The options available for mechanizing the sowing operation to increase productivity are manual operated machine. The average power requirement in operation of various manual operated farm equipment varied from 50 to 70W which clearly indicates the use of varied muscle power (load) by human being. This energy expenditure can be reduced if major load is shared with auxiliary power source which will enhance machine performance and operator's productivity as compared to manual operation. The potential of Eco-friendly power source can be an option for developing such machine for small farmers. Battery Electric Powered Vehicles (BEPVs) are commonly being used in commercial sectors. Such technology can be tried in agriculture sector, particularly for such operations which considered as light draft requirement activities (sowing, weeding, spraying etc). Battery can easily be charged with suitable solar power pack. A battery-operated spice planter for selected seeds will share major workload of operator for providing ease in sowing operation with reduced drudgery. This will help in seed spice mechanisation of marginal and small farmers in the country.

PP 8: Foliar Nutrition on Pulses in Rainfed areas-An Approach towards a Hunger Free Society

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Rapid population growth reduced per capita availability of food in our country. To cope up this food insecurity growing of short duration, highly nutritious crops with wider adaptability to present climate change is proved to be an ideal strategy. Pulses being short duration crops with cheap source of protein attracting attention of many researchers in rainfed areas. Even though pulses are adaptable to rainfed situations but their nutritional quality and yield are very low than those growing in irrigated ecology. In rainfed areas efficiency of soil applied fertilizers depends on rainfall which determines available soil moisture and lack of evenly distributed rainfall during critical stages of pulse crops reduces their competitive ability both qualitatively and quantitatively. Foliar spray has an advantage of quick absorption and utilization of applied nutrient correcting the nutrient deficiencies and providing a lime light towards improvement of yield and quality of pulses at lower rates of nutrient application. Foliar spray also helps pulse crops to revive from effect of long dry spells occurred during crop growing season and in case of *rabi* pulses this spray helps in tolerating frost. Many trending researches in rainfed areas showing better growth, yield and quality of pulses providing a scope for achieving qualitative stable yields similar to that in irrigated agriculture thereby making our country self-sufficient with enriched pulses production combating with major evils of a society like hunger and malnutrition.

PP 9: Pulses for Sustainable Livelihood and Nutritional Security in India

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Pulses keep an utmost position in our dietary pattern for nutritional security. Pulse crops have been an integral part of human diet for millennia and today are an important crop not only for food security, but also for combating malnutrition, alleviating poverty, improving human health and enhancing agricultural sustainability. These staple crops when eaten with cereals, can help to increase the protein quality of the meal. Protein helps in the repair of body tissue, synthesis of enzymes and hormones and also in the supply of energy. Current per capita availability of pulses is 37 g/day and Indian Council of Medical Research recommendation is 52 g/day. Global per

capita consumption of pulses is around 7kg/person/year (2016 data, FAO). The advances of the Green Revolution led to massive gains in both yield and production of many basic foodstuffs through the industrialization of farming, while pulses expanded comparatively very little over the same time frame. The present production of pulses in our country hovers around 19 million tonnes. This shortfall in pulses is mainly due to near stagnation in production during the last decade (1999-2009) on account of abrupt climatic changes complex disease pest syndrome, emergence of new pests and pathogens and declining total factor productivity. In order to narrow down the demand supply gap of pulse, the total requirement of the pulses in the country is projected at 39 million tonnes by the year 2050 which necessitates an annual growth rate of 2.2 percent (Vision document -2050 of Indian Institute of Pulses Research 2015). This requires a paradigm shift in research, technology generation and dissemination regarding pulses production. To meet the ever increasing demand for pulses at national and state level, all stakeholders are making concerted efforts to accept the challenge by adopting various interventions / new techniques of pulse production, increasing the efficiency of pulse supply chains, creating more effective public–private institutional arrangements for innovation, and establishing policies, regulations, and investments that are nutrition sensitive.
Keywords: pulse production, new techniques, interventions and industrialization of farming

PP 10: Crop diversification for livelihood security and resilience to climate variability

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Enhancing the resilience of Indian Agriculture to cope with climatic change is imperative to the livelihood security of millions of small and marginal farmers in the country. Devising appropriate adoption strategies will enable farmers to cope with various climate risk, promote efficient use of natural resources to bring sustainability to farm production and stability to their incomes. The Indian Council of Agricultural Research (ICAR) has responded to this challenge of climate change on Indian Agriculture and launched National Innovations on Climate Resilient Agriculture (NICRA) in 2011. The project has major aim of evolving climate resilient agricultural technologies to address the concerns of projected climate change scenarios in the country and also to demonstrate the best bet practices that can help farmers to cope with current climatic variability. In scare rainfall areas of the district Kathua, the practice of sole cropping is predominant but is risky and often results in low yields or sometimes even in crop failure due to erratic monsoon rainfall and skewed distribution. In such areas intercropping is a feasible option to minimize risk in crop production, ensure reasonable returns at least from the intercrop and also improves the soil fertility with a legume intercrop. Demonstration on crop diversification by inclusion of HYVs of black gram, sesamum, Gobhi Sarson, gram, lentil, Toria and okra were conducted in Said-Sohal village in Kathua district of Jammu and Kashmir. In NICRA village results of demonstrations on high yielding Varieties (HYVs) of maize showed 65.4 percent increase over traditional cultivar. Demonstration on crop diversification by inclusion of High Yielding Varieties of black gram, sesamum, Gobhi Sarson, gram, lentil, Toria and okra resulted in yield increase to the tune of 62.5, 62.8, 51.3,68.6, 76.5, 88.4 and 38.1 percent respectively over traditionally grown varieties. In Maize + Cowpea intercropping, due to synergy existing between two crops, an yield enhancement of 72.5 percent in maize and 24.6 percent cowpea was observed over the traditional system with a net return of Rs 24,200/ha. in maize and Rs 32400/ha. in cowpea. Net return in case of cowpea was more because no additional input other than seed was applied to the cowpea crop.
Keywords: Crop, Climate, livelihood, resilience

PP 11: Organic plant breeding: An approach towards sustainable agriculture

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Organic plant breeding is a holistic approach which respects natural crossing barriers and is based on fertile plants that can establish a viable relationship with the living soil. It is a new challenge for organic agriculture. At the present time, organic farmers have to grow crops using conventional varieties. In the next few years, some of these varieties will be available as organic seeds. But in the long term, organic farming cannot progress without organic varieties that are specially bred for organic production. The change to organic varieties needs a new way of thinking and a new approach to breeding research. Breeding for organic farming could also trigger a new burst of creativity. Biodiversity is inherited from the past. It is the result of human activities. Organic farming is already a manifestation of diversity and would also create new biodiversity. Further experimentation is needed in mixing species as is deeper investigation of the rhizosphere. A pluridisciplinary approach will be required to improve the ecological quality of the variety. Breeding cannot take place without considering the ecosystem of the field. Biodiversity has to be enhanced above and below the ground, taking into account both auxiliary fauna and the rhizosphere. Variety mixtures can help to overcome a number of the deficiencies of these varieties such as pest, disease and weed suppression. The increased genetic diversity provided by mixtures can also help to buffer against environmental variation thus stabilizing yield. Population breeding approaches are one means of introducing this

diversity into the organic production system. The ultimate goal of a growing number of organic seed producers and plant breeders is to develop crop varieties that are adapted to organic production systems. Traits associated with superior performance in organic systems include insect pest and disease resistance, weed tolerance, adaptation to biologically mediated nutrient availability, and tolerance to climatic and environmental stresses, such as cold or wet soils (which is typically managed with fungicide seed treatments in conventional systems). Varieties developed for these systems will ideally have the ability to outgrow weed pressure, have vigorous seedling growth even at low temperatures, and have greater nutrient use efficiency in soils where macronutrient availability is limited due to mineralization of organic matter. While resistance to insects and disease is important for all crops, it is especially important in organic systems as external inputs of crop protection chemicals are much less likely to be used. Changes to plant architecture may also be advantageous for organic production methods. Genetic selection for increased root growth, root density, or rooting vigor may translate to heightened nutrient scavenging ability. Large spreading leaf canopies may allow certain crop varieties to reach above and shade weed competition. By breeding under the challenges of environmental stresses in low input systems it is possible to breed genetically diverse, heterogeneous varieties with greater adaptive advantage to the environmental variables and cultural practices of organic farming.

PP 12: Organic Agriculture in India-A transitional Phase

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India is having 30 per cent of the total organic producers in the world. According to the World of Organic Agriculture 2018report out of the total organic cultivation area of 57.8 million hectares India is having1.5 million hectares of organic cultivation. But, according to a study by the Associated Chambers of Commerce and Industry of India (ASSOCHAM), still most of the organic farmers are struggling due to poor policy measures, rising input costs and limited market. The increased need of organic manure cannot be fulfilled by immediate elimination of chemicals and chemical fertilizers. Farmers also complain of low productivity and pest attack during the transition from conventional chemical farming to organic farming,. No doubt, the farmers are aware of ecological hazards of conventional chemical-based farming, but the fear of decline in production and unavailability of free flow of organic inputs in the market discourage them from adopting organic farming. As reported by ICAR, during the transition there is an average dip by 6.7 per cent in the first year, and the government needs to have a plan in place to support farmers. The report given by Ashok Dalwai committee on Doubling of Farmers' Income also claim up to 30 per cent drop in yields when shifting to organic farming. It is extremely difficult to access the market for small and mid-sized farmers located in hilly regions and tribal belts. The rise in expenses of the organic products to consumer is also another discouraging factor. According to the ASSOCHAM report, post-harvest handling of relatively small quantities of organic foods also results in higher costs because of the mandatory segregation of organic and conventional produce, especially for processing and transportation. The existing certification systems for organic food is also not only cumbersome and time-consuming, but also expensive. The government, meanwhile, has not done enough to address the hurdles. The main hurdles are Supply-Demand Disparity of Organic Food, Shortage of organic seeds and inputs, confused certification framework andthe high price of organic produce in a price-sensitive nation. The absence of a policy on organic farming is cited as the primary factor impeding its growth notwithstanding the numerous accounts of success, the concept of organic farming suffers from a lack of incremental growth. Chronic issues plaguing the farm sector are likely to hamper its growth. For example, the growing fragmentation in land-holdings risks making it infeasible. To overcome these hurdles in organic farming, GOI started Paramparagat Krishi VikasYojana(PKVY). It is the Centre's free certification programme for organic farmers. A 2018 report on the implementation of PKVY highlights that all states, except Tripura, Odisha and Karnataka, have failed to utilise even 50 per cent of their funds under the scheme. While the Centre has increased allocation for the scheme by 44 per cent for the current year. One of the most important step is to ensure marketing of organic produce, connecting farmers with the domestic and global supply chain and othercorrective measures are needed to ensure that the states become responsible and contribute toward "organic India" To encourage farmers in J&K to cultivate scientifically tested and commercially beneficial aromatic and medicinal plants organically in the state of Jammu and Kashmir, GOI has started Jammu Kashmir Arogya Gram Yojna'. Council for Scientific and Industrial Research (CSIR) will help the farmers with expert guidance and provide them saplings of as many as nine varieties of medicinal and aromatic plants. The plant varieties, selected for J&K are lemon grass, Rose, Mint, Ashwagandha and Phalsa. Initially, 1000 villages of Kathua, Jammu and Udhampur in the state will be covered under the scheme. Different CSIR institutions like Indian Institute of Integrative Medicine (IIIM), Institute of Himalayan Bioresource Technology (IHBT), Central Institute of Medicinal and Aromatic Plants, National Botanical Research Institute (NBRI) and North Eastern Institute of Science and Technology (NEIST) has associated with the implementation of the scheme, first in Jammu and Kashmir and then in other states.

PP 13: Soil and Water Conservation Measures for Rainfed Area of Jammu District

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The global scenario of the rain fed regions account for 1.75 billion hectares and this area is about 5 to 6 times the irrigated areas of the world. Agriculture in India is practiced under a wide variety of agro-climatic zones and rainfall pattern. In India out of total net cultivated area of 142 million hectares about 81.8 million hectares (57.6 per cent) is rain fed. This rain fed area has a vital role to play for food security of the country. Nearly 44 per cent of food requirement comes from the rain fed regions besides support to 40 per cent of human population and 60 percent of livestock population. Increased population pressure and smaller land holdings have promoted deforestation leading to unabated soil loss, thereby reducing the productivity of these lands, which in turn affects the economic condition of the farmers luring them to other sources of employment and the cycle continues. The challenge lies in protecting the limited land resources from further soil erosion, improving productivity of land and eroding poverty in rainfed area of Jammu district. The study was conducted regarding awareness of soil-water conservation measures among farmers of *Kandi* Panchayat, Akhnoor Tehsil of Jammu District. A random survey of three villages namely Gargal, Kandi and Godhan of *Kandi* Panchayat of Jammu District was conducted. Total 100 farmers were considered from all three villages out of which 25 farmers from Gargal, 25 farmers from kandi and 55 farmers from Godhan were interacted. A questionnaire related to awareness of soil and water resources and agriculture engineering technology was used to examine the level of awareness. It was found that only 23 percent of the farmers of the selected villages were aware about the soil-water conservation measures. The majority of the farmers were not having knowledge about the different soil and water conservation technologies suitable for rainfed areas. The study reveals that there is a urgent need to organize training programmes and on farm demonstration of soil and water conservation measures to encourage their participation for natural resource management of the region.

PP 14: Effect of Exogenous Application of Phytohormones and Fungicides on Yield, Quality Storability and Economics of Garlic (*Allium Sativum* L.)

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Phyto-hormone may be defined as an organic substance other than a nutrient active in very minute amounts which is formed in certain parts of all plants and is usually translocated to other sites, where it evokes specific biochemical, physiological and morphological responses. They help in increasing the yield by manipulating source-sink relationships. Their role, as a growth inhibitor, has long been recognized, and utilized as a tool in suppressing post harvest activities responsible for physiological weight in loss, rotting, sprouting etc in long stored crop like garlic. Fungicides, on the other hand are well known for their role in checking of disease inoculums, both at field as well as during storage. Therefore, the present study highlights the various parameters of growth, yield and storability of garlic as influenced by the pre-harvest application of phyto-hormones and fungicides.

Key words: Exogenous application, phytohormones, fungicides, yield, quality, storability, economics, *Allium sativum* L

PP 15: Vegetable intercrops: A pathway for sustainable agriculture

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The demand of vegetables is increasing day by day among people due to high income and awareness about benefits of vegetables being rich source of nutrients, vitamins, minerals, antioxidents, fibres,carbohydrates etc .presently, availability of vegetables per day per capita is about 200 g below the required quantity of vegetables(300 g per head per day). Land holding is decreasing day by day due to urbanization, high population growth and industrialization across the country. Hence, the challenges are to produce more vegetables per unit area to fetch up the demand. Therefore, strategies should be to produce higher quantity of vegetables from less land with optimum use of water, fertilizers and by adopting agronomical management practices. Cropping system like intercropping can be followed for higher production in per unit area. Intercropping refers to growing two or more dissimilar crops simultaneously on the same piece of land. Crop intensification is in both time and space dimensions. It also helps the farmers for getting stable production and maintaining the soil fertility level. Intercropping system results in yield advantage because the component crop differ in their use of growth resources which results in higher farm income. When they are grown in combination, they are able to complement each other and per se make better overall use of resources than when grown separately. Many studies have indicated that intercropping with different vegetable was

more productive and profitable than sole cropping because of complementary effects of intercrop. The strategy should be to produce more less use of land so that our natural resources can be used in an efficient manner which will leads toward the sustainability of agriculture.

PP 16: Organic Farming in Mulberry a move towards sustainable sericulture

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Sericulture is an agro-based industry depending mostly on a perennial tree mulberry(morus alba). Silk productivity mainly depends upon quality of mulberry leaves. Residues of chemical inputs used in mulberry not only causes potential risks to environment but also have negative impact on leaf yield, quality and cocoon productivity. Therefore promotion of organic mulberry cultivation is considered as need of an hour in sericulture to avoid indiscriminate use of chemicals and step towards sustainable sericulture. Adoption of this alternative strategies like use of FYM, poultry manure, sheep manure, bio-fertilizers and other organic amendments to substitute chemical inputs plays a long term role in enhancing soil health,biological properties,improves water holding capacity in light textured soils, infilteration in heavy soils, activates beneficial micro organisms thereby increasing nutrient supply to the mulberry plant.

PP 17: Integrated nutrient management in tomato crop production

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Vegetables are one of the important aspects of horticulture sector in particular and of agricultural sector in general. India ranks second in area as well as production of tomato. Keeping in view the importance of this crop, the on farm trials were conducted in the farmer's fields in the years 2017-18 and 2018-19 under the aegis of Krishi Vigyan Kendra Doda SKUAST-Jammu to assess the role of integrated nutrient management in tomato crop variety Sonali. The response of Farmer's practice T1 (use of FYM only) was compared with T2 (vermicompost @ 5 q/ha broadcasting during final land preparation + recommended NPK) and T3 (T2 + Azotobacter @ 800 g/ha as seedling root dip treatment for two hours). The observations were made on growth parameters and the yield. The results revealed that treatment T3 (T2 + Azotobacter @ 800g/ha as seedling root dip for two hours) recorded highest yield of 228q/ha with B:C ratio of 1: 2.85 as compared to treatments T1 and T2.

Keywords Tomato, vermicompost, azotobacter

PP 18: Enhancing the pulse production with improved varieties in district Doda

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Doda is a hilly district of Jammu and Kashmir state with an average elevation of 1107 metres and average annual rainfall of 982mm. Among several critical inputs of crop production, the improved variety is one of the important constituent to increase the production and quality of produce. Blackgram and Rajmash are the major pulse crops of kharif season in district Doda. From economic point of view mash crop is a good source of income for the farmers. But the farmers are obtaining very low yield of blackgram due to lack of high yielding varieties, poor nutrient management and lack of knowledge of integrated pest and disease management. Keeping in view its importance in the district, the frontline demonstrations were conducted in the villages viz. Gwari, Dhara, Khallu and Rounda of district Doda in the year 2016-17 and 2017-18 with blackgram variety Him mash-1. The average yield obtained with blackgram variety Him mash-1 was 4.11 q/ha as compared to local check which yielded only 3.18 q/ha which was about 29.24% increase in yield over the check. Therefore, it can be suggested that this crop variety in the region is important for increasing the income, productivity and also to raise the standard of living of the farmers.

Keywords: Blackgram, mash, productivity and yield

PP 19: A review on current scenario and issues of organic farming in India

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Organic farming system in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes and other biological materials along with beneficial microbes

(biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution-free environment. India holds a unique position among 172 countries practicing organic agriculture: it has 6,50,000 organic producers, 699 processors, 669 exporters and 7,20,000 hectares under cultivation. But, with merely 0.4 per cent of total agricultural land under organic cultivation, the industry has a long journey ahead (Bordolo, 2016). India produced around 1.35 million MT (2015-16) of certified organic products which includes all varieties of food products namely sugarcane, oil seeds, cereals and millets, cotton, pulses, medicinal plants, tea, fruits, spices, vegetables, coffee etc. With the increase in population, our compulsion would be not only to stabilize agricultural production but to increase it further in sustainable manner. The scientists have realized that the 'Green Revolution' with high input use has reached a plateau and is now sustained with diminishing return of falling dividends. Thus, a natural balance needs to be maintained at all cost for existence of life and property. The obvious choice for that would be more relevant in the present era, when these agrochemicals which are produced from fossil fuel and are not renewable and are diminishing in availability. There is neither subsidy for organic cultivators nor incentives to practice organic cultivation. There are many areas in India where farmers use crop residues, manures, legumes and neem to grow their crops. They rely on crop rotation and interplanting, to do their job. These farmers practice, farming through organic inputs. Now it is the high time to make attempts to classify these practices accordingly. If this is done, the poor farmers will get a premium price for their low yields. This will also go a long way in alleviating poverty and raising the living standards of the poor villagers. Most of the agriculture in backward and tribal areas especially in the hills of northern, eastern and northeastern region could be safely classified as organic. We must take advantage of this opportunity by arranging a market for these products both for domestic and export market.

PP 20: Effect of conservation modules on water quality of the adopted village ponds in the lower Shivaliks of Jammu

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The water resource in the lower Shivalik region of Jammu is facing daunting challenges due to urbanization, industrialization and huge demand for agricultural activities. The potential for augmentation of water availability is limited, water tables are receding day by day and water quality issues have been increased. Mere 25 % plain area is covered under different canal command areas, whereas 75% is rain fed spread over the span of ten districts of Jammu region. The study was conducted to assess the impact of water conservation modules on water quality of four adopted ponds at village Merth, Sahar and Uttri of district Kathua respectively. The participatory rural appraisal report of each village has been formulated to understand location as well as present resource potential of the district. The adopted ponds have been redesigned in such a manner that most part of the runoff from adjoining rivulets should be trapped in these ponds. The conservation modules which were adopted for improving the water quality of ponds are Digital Elevation Model (DEM) mapping of watershed area, bunding, contour bunding, promoting terrace farming to reduce soil loss, diversion of sewage water, constructing channels to divert rain water into ponds and promoting rain water harvesting. Various water physico-chemical and biological parameters were assessed using standard procedures before and after adopting conservation modules. The water parameters which were assessed are pH, dissolved oxygen (DO), biological oxygen demand (BOD), electrical conductivity (EC), temperature, turbidity, total coli forms, nitrate and total dissolved solids (TDS). The overall Water Quality Index (WQI) value on the scale of 0-100 for the four adopted village ponds before adopting conservation module was 50.0 (Medium) for Merth first pond, 21.0 (Very Bad) for Merth second pond, 42.0 (Bad) for Sahar pond and 40.0 (Bad) for Uttri pond. After adopting conservation modules the WQI value of adopted village ponds was 78.0 (Good) for Merth first pond, 52.0 (Good) for Merth second pond, 74.0 (Good) for Sahar pond and 72.0 (Good) for Uttri pond. The study thus revealed that there is an improvement in water quality of adopted ponds and which can be further improved by sustaining these conservation modules. The trainings and awareness given to farmers and local residents of village also played an important role as they will help in participatory approach for the conservation of these ponds.
Keywords: Water Quality Index, Digital Elevation Model. Conservation modules, ponds

PP 21: Climate Change: Its Consequences on Agriculture

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Climate change has become a buzz word in general and particular to agriculture and food security. The climate change is related to changes in the concentration of the greenhouse gases (water vapours, CO_2, CH_4, N_2O, and CFCs), which trap infrared radiations from the earth's surface and thus cause the greenhouse effect (Central European University, 1999). As the world population grows to a projected 9 billion by 2050, agricultural production

must also increase by an estimated 70 percent (FAO, 2016). Climate volatility, more frequent extreme weather events and temperature changes increasingly threaten the viability of agriculture and forestry sectors and rural infrastructure throughout the world. Globally, agriculture directly accounts for 13.5 % of greenhouse gas emissions and indirectly for another 17% due to deforestation and land-use change (Chibongas, 2016). The sector holds a large mitigation potential, mainly through reduced deforestation, soil management and increased productivity. Agriculture is therefore a part of the problem and a part of the solution to Climate Change. Every 1 degree Celsius increase in temperature reduces wheat production by 4-5 million tons. Cereal productivity to decrease by 10-40% by 2100 (Farooq, 2016). Recent example such as flood damage by heavy rainfall in 2014 and dry weather in 2016 in the J&K resulted in the destruction of major crops like, apple, pear, walnut, saffron, cherry etc. and caused loss of over 14.25 billion rupees. In the context of India, especially Jammu and Kashmir, which nestles in fragile Himalayan Ecosystem; the indicators of climate change are evident now. Irrigated rice, wheat and mustard productions may be reduced by 6%, 4% and 4%, respectively (Anonymous, 2016). The huge chunk of paddy land have been converted into rain-fed dry land in the districts of Anantnag, Baramulla, Bandipora, Badgam, Pulwama, Kulgam and Shopian in recent years. Some Climate change mitigation and adaptive measures have been suggested such as weather forecasting and awareness among the farmers, use of best practices for water conservation like sprinkle irrigation etc, adoption of organic farming and reintroduction of non-polluting traditional methods, introduction of drought and pest resistant crops.

Keywords: Climate Change, agriculture, deforestation, organic farming.

PP 22: Impact of conservation agriculture and nutrient management practices on sugarcane productivity

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A field experiment was initiated to study the effect of conservation agriculture pratices on sugarcane cultivation. An experiment with 03 main plot treatment combinations of tillage and nutrient scheduling and application methods viz., M1: laser land leveling (LLL) + conventional tillage (CT) + 10 % of recommended dose of fertilizers (RDF; 250:120:120; N:P:K; kg ha-1) applied as basal and remaining 90 % doses of fertilizers applied through fertigation, M2: LLL + reduced tillage (RT) by excluding deep tillage + 10 % of RDF as basal and 90 % through fertigation and M3: LLL + RT + 10 % of RDF as basal, 40 % through band placement and remaining 50 % through fertigation. In M3 treatment, 40 % of RDF was band placed with Stubble shaving, Off barring, Root pruning and Fertilizer placement (SORF) machine developed at ICAR-NIASM rather than broadcasting in standing crop at 60 days after planting of sugarcane. The fertigation was done at 15 days interval started at 15 days after planting as per the treatments. Two treatment of soil surface cover management practices viz., T1: Residue; covering of soil surface with a live mulch of mungbean followed by retention of mungbean residue and trash as mulch and T2: without residue were accommodated in sub-plots. An absolute control with CT without LLL, recommended nutrient and surface irrigation management practices was also maintained to compare the treatment effects. The results revealed that there was no significant difference in cane yields (var. MS 10001) under conventional tillage (M1) and reduced tillage practices (M2) practices. It indicated that reduced tillage could be adopted without compromising with the cane yield. Furthermore, application of 40 % of RDF through band placement and 50 % of RDF through fertigation (M3) improved the cane yield significantly over the application 90 % of RDF through fertigation (Fig. 2.35). The yield improvement with M3 over M1, M2 and conventional sugarcane management practices (M4) treatments was 8, 10 and 23 %, respectively. This might be due to that band placement of 40 % of RDF provided the initial boost to the crop growth and remaining 50 % applied through drip fertigation helped in sustaining the crop growth during the grand growth stage through synchronized supply of nutrients. Laser land leveling and drip irrigation practices not only saved the irrigation water but also improved the cane yield to the tune of 11 %. Furthermore, covering of soil surface with live mulch of mungbean followed by retention of mungbean residue and trash in the field improved the cane yield on an average by 10 % as compared to without residue. Moreover, growing of mungbean with sugarcane as live mulch not only served the purpose of soil surface cover but also provided the economic seed yield and crop residues. The maximum seed yield of mungbean was recorded under M3 treatment (RT+RDF applied with SORF (40%) and fertigation (50%)) which was 4 and 8 % higher than M1 and M2 treatments, respectively.

PP 23: Organic Farming in Mulberry Production

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Sericulture is an agro-based industry depending mostly on a perennial tree mulberry (*Morus alba*). Silk productivity mainly depends upon the quality of mulberry leaves. A residue of chemical inputs used in mulberry not only causes potential risks to the environment but also have a negative impact on leaf yield, quality and cocoon

productivity. Therefore promotion of organic mulberry cultivation is considered as need of an hour in sericulture to avoid indiscriminate use of chemicals and step towards sustainable sericulture. Adoption of these alternative strategies like use of farm yard manure, poultry manure, sheep manure, bio-fertilizers and other organic amendments to substitute chemical inputs plays a long-term role in enhancing soil health, biological properties, improves water holding capacity in light textured soils, infiltration in heavy soils, activates beneficial microorganisms thereby increasing nutrient supply to the mulberry plant.

Keywords: Biofertilizer, *Morus alba*, organic farming, sericulture.

PP 24: Increasing Farm Profitability through Climate-Smart Agriculture

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There is no denying the fact that present world is grappled with the problem of climate change owing to the emission of green house gases to which the agriculture contributes 13% globally. However, with the rise of population, we cannot afford to cut back on agricultural production so as to slow down the effects of climate change. Thus, a need arises to grow more but we have to grow it smarter. In order to encourage the farmers to adopt the climate-smart agriculture, it is important to identify and promote approaches that are not just green but are easy to adopt and provide an immediate financial benefit to farmers. Prompting the farmers to plant trees on farm bunds shall not only hold the flow of ground water during the monsoon, absorb carbon, combat soil erosion but will generate the additional income from tree's fruit and timber in future. Climate-smart agriculture has the potential of creating the business opportunities by discouraging farmers to purchase costly chemical fertilizers and encouraging them to learn how to make organic fertilizers and pesticides using local leaves and herbs. Owing to the varying climatic conditions in different regions of the state of Jammu and Kashmir and keeping in the land holding capability of farmers which technically hampers the cultivation of different crops profitably, adoption of climate-smart technology offers the best way out to increase farm income especially on small farms where farm mechanization is a major constraint. Dissemination of climate-smart technology especially in far-flung areas through the help of farmer's participatory mode shall in reality help the farmers of these areas to utilize the meagre resources efficiently, thereby reducing the cost of cultivation and increasing the production efficiently. Climate-smart technology promises a more sustainable food system that protects the environment and increase farm profitability.

Keywords: Climate, Technologies, Profitability.

PP 25: Physico Chemical Properties and Available Nutrient Content of Soils of KVK Doda at Bhaderwah in District Doda (J&K), India

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Present investigations were carried out to study the physico chemical properties and available nutrient status of Gwari farm soils of KVK Doda of SKUAST-Jammu at Bhaderwah during the year 2017-18. Representative soil samples were drawn from 12 sites being managed under different land uses. The samples were processed and analysed in the laboratory for important physico chemical characteristics and available nutrients using standard procedures. These soils were found to contain high amounts of clay with pH, EC and OC varying from 5.42 to 7.14, 0.04 to 0.3 dS/m and 0.58 to 1.76 per cent respectively. Contents of available N and K varied from 263.2 to 557.9 kg/ha and 63.57 to 286.72 kg/ha respectively. Studies revealed that these heavy textured soils, strongly acidic to neutral in reaction, containing medium to high amounts of OC are within safe limits of soil salinity and contain low to high contents of available N and K.

Keywords: Physico chemical, Available nutrients, Land use, Bhaderwah, Doda

PP 26: Physico Chemical Properties and Available Nutrient Content of Soils of Regional Horticultural Research Sub Station Bhaderwah, District Doda (J&K), India

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Present investigations were carried out to study the physico chemical properties and available nutrient status of Sartingal farm soils of Regional Horticultural Research Sub Station of SKUAST-Jammu at Bhaderwah during the year 2017-18. Representative soil samples were drawn from 10 sites being managed under different land uses. The samples were processed and analysed in the laboratory for important physico chemical characteristics and available nutrients using standard procedures. Majority of the soils were found to be of loamy texture with pH, EC and OC varying from 5.30 to 5.74, 0.04 to 0.15 dS/m and 1.52 to 2.15 per cent respectively. Contents of available N

and K varied from 496.8 to 663.6 kg/ha and 119.91 to 364.0 kg/ha respectively. Studies revealed that these soils are rich in OC, strongly acidic to moderately acidic in reaction, are within safe limits of soil salinity and contain medium to high contents of available N and K.

Keywords: Land use, Physico chemical, Available nutrients, Bhaderwah, Doda

PP 27: Spatial variability of soil physcio-chemical properties and available macro-nutrients under different land uses in temperate zone of Doda district of J&K

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The area under study located at longitude 32°17° to 32°40°E North and latitude 74°35° to 75°10° East from mean sea level. The 236 composite soil samples from different depth *viz.,* 0-20, 20-40, 40-60, 60-100 covering agriculture, horticulture, forest, grassland, eroded and barren land use systems by using global positioning system to assess the "spatial variability of available macro-nutrients and to establish their relationship between soil physcio-chemical properties". The mean values of pH, EC, CEC,BD WHC, sand, silt and clay were 6.34, 6.28, 5.30, 6.33,6.62, 6.36;0.23, 0.37,0.21, 0.19, 0.22, 0.10;18.06, 18.95, 23.30, 21.35,9.05, 13.50, 1.45, 1.41,1.36, 1.49, 1.55, 1.53; 30.88, 35.61, 36.45, 36.34,24.88, 32.83, 51.25, 62.56, 50.07, 56.64, 66.74, 64.25;15.28, 17.83, 18.32, 17.58,22.48, 19.99; 21.39, 25.77,30.16, 28.57, 10.77, 14.77;17.38 for corresponding of agriculture, horticulture, forest, grass, eroded, and barren land use systems. The pH of the soils were slightly acidic to neutral in nature and dominant textural classes were sandy loam followed by sandy clay loam in all land use systems. The mean values of available macronutrients viz NPKS in surface soils were 266.60, 276.02, 301.40, 284.78, 195.20, 216.00 ; 13.50, 13.30 ; 16.85, 14.25, 9.00, 10.60 ; 259.6, 226.80, 273.90, 270.90, 199.25, 209.95 ; 3.95, 3.71 ; 5.85: 4.65, 2.60, 3.25 in agriculture, horticulture forest, grass, barren and eroded land use systems respectively. The available N was medium to low, available P was high to medium and available S was medium to low in surface soil under all land use systems and decreased with increasing depth. The available macro nutrient N, P, K, S holds a positive relationship with pH, EC, silt and clay at surface as well as subsurface depth. The results indicated that available macro nutrients (N, P, K, S) and clay, CEC, WHC, contents were highest in forest land use system and lowest in eroded land use system followed the trend: forest land use system, grass land use system, horticulture land use system, agriculture land use system, barren land use system and eroded land use system.

Keywords: GPS, land use systems, textural classes, physico chemical properties and soil available macro nutrients.

PP 28: Variability of soil available micro-nutrients and physico-chemical properties under different land uses in hilly zone of Doda district of J&K

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The area under study located at longitude 32°17° to 32°40°E North and latitude 74°35° to 75°10° East from mean sea level. The 236 composite soil samples from different depth viz., 0-20, 20-40, 40-60, 60-100 covering agriculture, horticulture, forest, grassland, eroded and barren land use systems by using global positioning system to assess the "variability of soil micro-nutrients and to establish their relationship between physico-chemical properties". The mean values of pH, EC, CEC,BD WHC, sand, silt and clay were 6.34, 6.28, 5.30, 6.33,6.62, 6.36;0.23, 0.37,0.21, 0.19, 0.22, 0.10;18.06, 18.95, 23.30, 21.35,9.05, 13.50, 1.45, 1.41,1.36, 1.49, 1.55, 1.53; 30.88, 35.61, 36.45, 36.34,24.88, 32.83, 51.25, 62.56, 50.07, 56.64, 66.74, 64.25;15.28, 17.83, 18.32, 17.58,22.48, 19.99; 21.39, 25.77,30.16, 28.57, 10.77, 14.77;17.38 for corresponding of agriculture, horticulture, forest, grass, eroded, and barren land use systems. The pH of the soils were slightly acidic to neutral in nature and dominant textural classes were sandy loam followed by sandy clay loam in all land use systems. The mean values of available micronutrient viz., iron, copper, zinc and manganese in surface soil under agriculture, horticulture, forest, grass, eroded, and barren land use systems were 37.55, 41.71, 51.76, 47.27,21.14, 27.36, 2.85, 3.19,3.59, 3.26, 1.55, 2.82; 1.09, 0.92, 1.01, 0.85, 0.77; 0.87, 18.64, 20.75, 25.88, 21.68, 11.32, 12.81. The available Fe and Cu were high to medium in range and available Zn and Mn were sufficient and moderate in all land use system. The available micronutrients including Fe, Cu, Zn and Mn were positively correlated with pH, EC, silt, clay, CEC. The results indicated that available micro nutrients (Fe Cu, Zinc and Mn) and clay, CEC, WHC and $CaCO_3$ contents were highest in forest land use system and lowest in eroded land use system followed the trend: forest land use system, grass land use system, horticulture land use system, agriculture land use system, barren land use system and eroded land use system.

Key Words: Global positioning systems, land use systems, textural classes, physico chemical properties and soil available micro-nutrients.

PP 29: Organic Farming in India: Technological Break Through

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Vicious cycle of chemical farming is now exposed in the increasing crop un-sustainability, higher input requirement, poor soil quality as well as recurrent pest and disease infestation. Moreover, in the pretext of climate change yield interference has become quite predictable under the unpredictable weather conditions vis-a-vis hike in biotic potential. The excess/indiscriminate use of pesticides and fertilizers has led to the entry of harmful compounds into food chain, death of natural enemies and deterioration of surrounding ecology. Organic farming can solve many of these problems as this system helps to maintain soil productivity and effectively control pest by enhancing natural processes and cycles in harmony with environment. Today, it is clear to the agricultural community that organic farming is the best option for not only protecting/sustaining soil-plant–ecological relationship but to mitigate the adverse effect of climate change. However dearth of proper technological advancement is the major hindrance towards achieving the true objectives of organic farming. In this background, an Indian organic farming practice called Inhana Rational Farming (IRF) Technology has demonstrated some promising results that have brought bring forth the relevance of organic farming in today's agricultural scenario. IRF technology was first introduced as a complete organic package of practice in 2001 in tea and aims at developing Healthy Plants through: (i) Energization of soil system i.e., enabling the soil to function naturally as an effective growth medium for plants and (ii) Energization of plant system i.e., enabling higher NUE alongside better bio-chemical functions that leads to activation of the plants' host defense mechanism.

PP 30: Scope and Limiting Factors in Pulses Production in Rainfed Areas of Jammu District

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Pulses are the the prime source of protein and balanced diet for majority of Indians. With the increase in population, pulses production also have to be increased proportionately for the vegetarian Indian society. With the increasing awareness about vegetarian as well as vegan food, stress on production on different types of pulses is gaining impetus. For increasing production of pulses, various initiatives are being taken by government which include: area expansion and productivity enhancement of pulse crops, creating additional employment opportunities and enhancing farm level economy to restore confidence of farmers. One of the intervention namely Cluster Frontline Demonstations (CFLD) on pulses is being sponsored by central government for promotion and extension of improved technologies i.e., Seed, Integrated Nutrient Manangement (INM), Integrated Pest Management (IPM) and capacity building of farmers. Constant monitoring and concurrent evaluation are being conducted to assess the impact of the interventions for a result oriented approach. Krishi Vigyan Kendra, Jammu is conducting on CFLDs on pulses since 2016-17. A study was conducted to assess the impact of CFLD programme in area expension and productivity enhancement of Urdbean and Chickpea in Jammu district. The results revealed that CFLD programme helped in increasing the productivity of these crops thereby improving the socio economic status of the farmers which has led in restoring farmers confidence in the cultivation of these crops. But, there were some bottlenecks that are being reported by the beneficery farmers. The respondents reported that eractic rainfall, decline in the prices of pulses in the market in the last two years and monkey menace are some of the factors that lower the morale of the farmers in adoption of new age cultivation practices of pulses.

Keywords: Pulses, productivity, CFLD

PP 31: Effect of different organic sources on growth and yield of maize under subalpine conditions of Bhadarwah

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A field experiment was conducted during *kharif* 2014 and 2015 at Sartangal farm of Regional Horticulture Research Sub-Station, Bhadarwah, Sher-e-Kashmir University of Agriculture Sciences and Technology of Jammu. In Bhadarwah the average annual temperature is 16.3 °C and the average rainfall is 1206 mm. Climate of Bhadarwah was warm and temperate. Bhaderwah is a city with a significant rainfall. Even in the driest month there is a lot of rain under sandy clay loam soil having slightly acidic in nature, high in organic carbon, (0.81), medium in available nitrogen (310 kg/ha) and potassium (115kg/ha) and high in available phosphorous (35 kg/ha) to study the "Effect of different organic sources on productivity of maize under subalpine conditions of Bhadarwah" to evaluate

nine different combinations of organic sources in RBD design with three replications.. It has been observed that maximum yield of maize were observed in T_7 where 100% recommended N was applied through 1.25 t/ha through FYM + 1.25 t/ha through vermicompost + 1.25 t/ha through neem cake + 1.25 + pine needle and significantly superior over recommended dose of fertilizers after completion of second year. There is no significant difference were observed among the yield attributing character of maize.

Key Words:-FYM, vermicompost, rock phosphate, phosphorous soluble bacteria, maize

PP 32: Impact of climate change on agriculture

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Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions or the distribution of events around that average (e.g., more or fewer extreme weather events). Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Despite technological advances, such as improved varieties, genetically modified organisms, and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities. The effect of climate on agriculture is related to variability's in local climates rather than in global climate patterns. The Earth's average surface temperature has increased by 1 °F (−17 °C) in just over the last century. The Intergovernmental Panel on Climate Change (IPCC) has produced several reports that have assessed the scientific literature on climate change. The IPCC Third Assessment Report, published in 2001, concluded that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect pest incidence. In Africa and Latin America many rainfed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century are projected. Marine life and the fishing industry will also be severely affected in some places. Climate change induced by increasing greenhouse gases is likely to affect crops differently from region to region. For example, average crop yield is expected to drop down to 50% in Pakistan according to the UKMO scenario whereas corn production in Europe is expected to grow up to 25% in optimum hydrologic conditions. In the long run, the climatic change could affect agriculture in several ways likewise *productivity*, *agricultural practices*, *environmental effects*, *rural space* and *adaptation.* Most agronomists believe that agricultural production will be mostly affected by the severity and pace of climate change, not so much by gradual trends in climate. If change is gradual, there may be enough time for biota adjustment. Rapid climate change, however, could harm agriculture in many countries, especially those that are already suffering from rather poor soil and climate conditions, because there is less time for optimum natural selection and adaption.

PP 33: Spatial Variability of Soil Organic Carbon in the Foothill Himalayas

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Organic carbon has been designated as the most reliable indicator of soil quality. However, there are wide variations in the soil organic carbon over short distances within among different land covers for obvious reasons as well as within similar land uses owing to management practices, topography, etc.GIS (Geographical information system) technique is now widely used to delineate variation in soil properties as well as their mapping for a more site specific approach. A study was, therefore, carried out to assess the spatial variability of soil organic carbon (SOC)on watershed basis in the Shivaliks of Jammu. Soil samples were collected from two different watersheds representing shivalik hills of Jammu. Shivaliks is a dry semi hilly belt deeply affected by soil erosion. The samples were air dried and processed. These samples were analysed in the laboratory using standard procedure. The data was subjected to geo-statistical analysis and semivariogram was constructed with the help of Surfer (demo software). Soil carbon maps were generated using interpolation technique with the help of ArcGIS. Preliminary studies revealed that topography, vegetation and management practices seem to be the major factors contributing to their variability. Soil organic maps provide clear picture of the distribution of soil organic carbon within the watersheds. Interesting variations with respect to SOC content were observed. Based on the limits for OC ie. low (<0.50 %), medium (0.50-0.75 %) and high (> 0.75 %), the soils were in general low to medium in organic carbon content in the cultivated agricultural fields based on the initial values obtained. The forest areas of the watershed had relatively higher organic carbon often falling in the high range.

Keywords: Soil mapping, spatial variability, Organic carbon, Soil health, watershed

PP 34: Influence of Organic Nutrient Management Practices on Productivity and Quality of Groundnut and Finger millet in Groundnut (*Arachis hypogaea* L.) –Finger Millet (*Eleusine coracana* L.) Cropping System

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The results of the field experiments conducted during *kharif* 2015 and *kharif* 2016 in farmers' field of Chokkahalli village of Chintamani taluk, Chikkaballapura district coming under eastern dry zone Karnataka to study the effect of bio-digested liquid manures on productivity and quality of groundnut (*Arachis hypogaea* L.) and finger millet (*Eleusine coracana*) revealed that there was significant increase in grain and straw yield of finger millet and kernel and haulm yield of groundnut with the application of different combinations of organic sources. Application of enriched biodigested liquid organic manure (EBDLM) at 50 kg N equivalent ha^{-1} + 3 sprays of panchagavya (PG) at 3 % produced significantly higher grain yield, straw yield, productive tillers $plant^{-1}$, finger length and 1000 grain weight (3695 kg ha^{-1}, 5169 kg ha^{-1}, 7.33, 9.28 cm and 3.95 g, respectively) in finger millet and significantly higher pod yield, kernel yield, number of pods $plant^{-1}$, 100 kernal weight and shelling per cent (2231.5 kg ha^{-1}, 1608.2 kg ha^{-1}, 35.9 g $plant^{-1}$, 43.12 g, 72.0 %, respectively) in groundnut. Further, higher iron, calcium and protein content of finger millet (4.86, 345.43 mg 100 g^{-1}) and higher protein and oil yield of groundnut (430.55 kg ha^{-1} and 799.64 kg ha^{-1}) was recorded with EBDLM at 50 kg N equivalent ha^{-1} with 3 sprays of PG at 3 per cent as compared to other treatments.

Key words: Yield, Quality, Groundnut, Finger millet, Organic Nutrient Management

Crop Improvement and Production Technology

OP 1: Flower-Visiting Insect Pollinators of Mustard (*Brassica napus*) in Jammu Region

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The present studies on Flower-Visiting Insect Pollinators of Mustard (*Brassica napus*) in Jammu region, India were conducted at Entomological Research farm, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu. The blooming crop of the Mustard was visited by 15 species of insects belonging to 4 orders and 7 families of class insects. Hymenopterans were the most dominant visitors constituting (87.48, 88.18) per cent of the insect pollinators, followed by other insect pollinators (12.52, 11.82%) in 2014-15 and 2015-16 respectively. Among the hymenopterans species, *Apismellifera* L. was highest in number (28.09, 28.31%) of the visitors of mustard flowers, followed by *Apiscerana* F. (25.10, 25.48%), *Apisdorsata* F. (18.00, 18.09%), *Apisflorea* F. (8.53, 7.90%), *Xylocopafenestrata* (5.55, 5.71 %) and other insect pollinators (12.52, 11.82%). of the total flower visiting insect pollinators in 2014-15 and 2015-16 respectively. The foraging activity of honeybees increased with temperature and sunshine and decreased with relative humidity, wind speed and rainfall. However, the species differences in the population dynamics of bees were evident as of all the honey bees *Apismellifera* was most abundant followed by *A. cerana>A. dorsata>A. florae >X. fenestrata.* The foraging population of *Apismellifera* was highly significant and positively correlated with maximum temperature and sunshine hours and negatively with relative humidity in the evening but was non-significant with minimum temperature, relative humidity in the morning, rainfall and wind speed. Same trend was observed for *Apisflorea* However, the foraging population of *Apisceranawas* significant and positively correlated with maximum temperature and minimum temperature but was non-significant with relative humidity in the morning and evening, rainfall, sunshine hours and wind speed. Same trend was observed for *Apisdorsata* and other pollinator but other pollinator was highly significant and positively correlated with sunshine hours. In case of *Xylocopa fenestrate*was non-significantwith all-weather parameters. This clearly reveals that all the four species of honeybees and other pollinators varied in their response to climatic conditions prevailing at a unit time.

Keywords: Mustard, insect pollinators, *Apis* spp., Weather condition.

OP 2: Genetic Dissection and association mapping of nutrional traits in Common bean (*Phaseolus vulgaris* L.) from North-Western Himalayan region of Jammu and Kashmir

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Common bean (*Phaseolus vulgaris* L.) is the most important grain legume in human diets due to its high nutritional and commercial value. In sub-Saharan Africa, more than 200 million people depend on this crop as a primary staple food. Beans are also called “poor man’s meat” as it contains high protein, starch, dietary fiber and is an excellent source of micronutrients like iron, zinc, potassium, selenium, molybdenum, thiamine, vitamin B6 and folate. In Jammu and Kashmir it is grown in all regions which fall under temperate zone. Seed quality traits are important components of common bean crop improvement programmes, four nutrional traits were studied for association mapping in the present study. A set of 91 common bean lines were evaluated for phenotyping of seed quality traits viz. soluble protein, starch, sugar and phenol content. Then SSR marker genotyping was done with a set of 91 markers to study marker trait associations (MTAs) through association mapping for seed quality traits. We identified six MTAs for soluble protein having a phenotypic variation (%) range from 13.1 to 31.7, three MTAs for starch content contributing phenotypic variation range of 13.9% to 28.2%, 9 MTAs for sugar content contributing to phenotypic variation range of 11.3% to 30.3% and 3 MTAs for phenol content having phenotypic variation range of 17.3% to 23.9%. These MTAs will be useful for future molecular breeding programmes to enhance nutrional content in local landraces of J&K through marker assisted selection.

Keywords: Common bean, nutrional traits, MTAs, SSR markers, marker-assisted breeding (MAB)

OP 3: Fungicide residue and its management

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A fungicide is a specific type of pesticide that controls fungal disease by specifically inhibiting or killing the fungus causing the disease. Fungicide residue refers to the pesticides that may remain on or in food or in soil after they are applied to crops that will cause harm to the humans due to unintentional use. Each country adopts own agricultural policies and Maximum Residue Limits (MRL), Waiting period (Period after the spray chemical residue remain on the crop/fruit) and Acceptable Daily Intake (ADI). Some countries use the International Maximum Residue Limits -Codex Alimentarius to define the residue limits; this was established by Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO) to develop international food standards, guidelines and recommendation for food safety and in India it is by Food Safety and Standards Authority of India (FSSAI) (Ministry of Health and Family Welfare), New Delhi. Waiting period of mancozeb i.e. for cabbage 27 days, Okra and Tomato 5 days and Maximum residue limit of fungicides in India e.g. Dithiocarbamates in Tomato 3 mg/kg, carbendazim in vegetables 0.50 mg/kg, Tricyclazole in rice 0.02 mg/kg, Copper oxychloride in fruits 20 mg/kg and Propiconazole in wheat 0.05 mg/kg, so that if the residue limit increase as the limit formed by codex India it is harmful to human health. So that to estimate the residue in crops there are different methods i.e. Micro bioassay, Enzyme inhibition method, spectrophotometric method and chromatography (Paper chromatography, Gas chromatography, HPLC). To eliminate the residue farmers use integrated disease management strategy or only recommended dose of fungicides, resistant varieties, bio control agents and genetically modified varieties are safe environment and human health.

OP 4: Viable System of Commercial Corm Production in Saffron (*Crocus sativus* L.)

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Saffron is known throughout the world for its aroma, colour and flavour, hence popularly known as "golden condiment". The trumpet shaped red stigmas actually forms the spice after drying . The saffron reproduces vegetatively through corms. An experiment was carried out at Saffron Research Station, Pampore wherein different sized corms were planted to study the impact of the initial weight of the corms on the commercial corm production. The weight and number of the daughter corms were observed after one planting cycle and it was observed that the initial weight of saffron corms had a profound effect both on the number and weight of daughter corms. The corms weighing >8g gave more corm yield/ m^2 whereas < 3g corms produced least number of corms.

OP 5: High Yielding Version of Traditional Basmati Rice Cultivar using Marker Assisted Selection

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The basmati rice variety 'Ranbir Basmati' is very popular among the farmers of Jammu region due to its palatable taste and short-duration to fit in rice-wheat cropping system. However, the variety has recently succumbed to bacterial leaf blight (*Xoo*) and prone to lodging. The severity and significance of damage caused by both diseases and lodging has necessitated the development of effective strategies for their management. Two major bacterial blight (BB) resistance genes and a semi-dwarf gene were introgressed into an Indian Basmati through marker-assisted backcross breeding. A high yielding introgressed line PAU148 carrying *xa13, Xa21* and *sd1* genes was used as donor parent. Marker-assisted backcrossing was continued till BC2 generation wherein gene specific markers specific for the resistance genes were used for foreground selection and a set of parental polymorphic microsatellite markers were used for background selection at each stage of backcrossing. In BC_2F_2 population 19 plants were found to be positive for all three genes whereas the maximum genome recovery of Ranbir Basmati in BC_2F_2 was 86.9 percent in introgressed line SBTIL121. The introgressed lines carrying resistance genes were further evaluated for bacterial blight resistance. The genotypes carrying both resistance genes exhibited very high level of resistance against bacterial blight while the lines containing either *Xa21* or *xa13* gene alone showed moderate resistance. The pyramided lines were also analyzed for agro-morphological characters in randomized block design (RBD) with two replications. All the lines were found to be significant for all the agro-morphological traits. The identified semi dwarf bacterial blight resistance lines were identified and advanced for further selection and evaluation.

Keywords: Bacterial blight, Marker assisted backcross breeding, Basmati, Semi-dwarf

OP 6: Correlation and Path Coefficient Analysis in Tomato (*Solanumlycopersicum* L.)

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Seven parents including one hybrid check (BSS-488) were evaluated for yield and quality contributing traits during autumn winter season of 2014–2016. They were crossed in a half diallel fashion and the resultant 21 F_1 hybrids along with their parents and one check variety were evaluated in randomized complete block design with three replications for yield and quality contributing traits. Fruit yield per plant exhibited positive correlation with average fruit weight and titrable acidity at both genotypic and phenotypic levels. Total soluble solids found positive correlation with total phenolic content, total antioxidant, lycopene content and total carotenoid content whereas negative correlation with titrable acidity. The path coefficient analysis revealed that average fruit weight (1.069) exhibited very high positive direct effect on fruit yield per plant followed by number of fruits per plant (0.603), days to first fruit setting and equatorial fruit diameter. Hence these characters may be simultaneously selected to develop the high yielding with quality rich varieties.

Keywords: Correlation, path analysis, yield, quality traits and tomato.

OP 7: Combining Ability and Heterosis for different traits in promising Maize Inbred Lines under medium elevations of J&K state

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Maize is the world's most widely grown cereal crop and is the primary staple food in many developing and developed countries. In India maize is grown in both *Kharif* (Monsoon) as well as in *Rabi* (winter) Seasons. The present study seeks to identify hybrids having high productivity level. Fifteen inbreds were crossed with two testers in a line x tester fashion to estimate combining ability and heterosis. Promising hybrids with desirable performance for traits such as days to fifty percent tasseling, days to fifty percent silking, No. of days to achieve 75% dry husk as well as other performance indicators like ear length, ear girth, No. of kernel rows per ear, No. of kernel per row seed index, shelling% and grain yield per hectare were identified from the present study undertaken during *Kharif* 2015-16. Analysis of variance revealed highly significant differences among the genotypes. The investigation identified the best general combiners for grain yield in both the seasons. These include CML 300, DMH0C4, CML 116, CM 152, CM 153, CAO 3118-1, HKI 1105 and CM 212 among lines and V 351 among the testers. The hybrids CML 116 X V 351, HKI 1105 X CML 212, CML 300 X CML 212 and CML 153 X V 351 were identified as potential cross combinations for grain yield over the best check.

OP 8: Seasonal effects on phomopsis blight and little leaf incidence in brinjal cultivars under subtropical conditions of Jammu and Kashmir

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Brinjal, one of the most important vegetable crops, is susceptible to a wide range of diseases which causes severe loss in all stages of growth and development. It is known to suffer from 12 diseases and among them phomopsis blight and fruit rot,caused by *Phomopsis vexans* and little leaf caused by Phytoplasma and transmitted through Leaf hopper vector, *Cestiusphycitis, Hishimonusphycitis* and *Empoascadevastans* have been considered as major constraints to brinjal cultivation in the subtropical conditions of Jammu region. In order to identify the resistant types as well as most suitable season of growing, the present investigation was carried out at Vegetable Research Farm, Division of Vegetable Science and Floriculture, FoA, Chatha, SKUAST-Jammu during three seasons i. e. Spring-summer, autumn-winter and rainy spreading across two years i.e. 2013-14 and 2004-15. A total of fifteenopen pollinated brinjal cultivars namely,Punjab Sadabahar, Arka Shirish, Arka Kusumkar, Arka Keshav, Arka Nidhi, Arka Neelkanth, Pusa Shyamala, Pusa Kranti, Pusa Ankur, Pusa Uttam, PPL, PPR, PPC, BR-14 and Puneri Kateri collected from different parts of the country were screened under the present study. The results revealed that among all the three growing seasons, autumn-winter recorded overall minimum phomopsis incidence (12.46%) followed by spring-summer (20.76%) whereas rainy season recorded maximum disease incidence (24.33%). Similarly, autumn-winter recorded overall minimum little leaf incidence (3.06%) followed by rainy season (7.97%) whereas spring-summer recorded maximum disease incidence (14.95%).Significant genotypic differences with respect to phomopsis blight incidence and little leaf were also observed. Among all the cultivars, minimum phomopsis blight incidence was recorded in Puneri Kateri (9.88%) followed by Pusa Kranti (13.77%) and maximum incidence was recorded in Arka Shirish (23.85%) followed by Arka Kusumkar(23.59%). Similarly, minimum little leaf incidence was recorded in Puneri Kateri (2.43%) followed by PPC (4.51%) whereas maximum incidence was recorded in BR-14 (12.85%) followed by PPR (12.50%).

OP 9: Biomass Production and Carbon Stock Potential under Home Gardens of Kashmir Himaliya

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Home garden agroforestry systems are suggested to hold large potential for climate change mitigation and adaption. This is due to their multifunctional role in providing income, food and ecosystem services while decreasing pressure on natural forests and hence saving and storing carbon, the study was designed to quantify biomass carbon stock and carbon sequestration potential under home gardens. The results of the study revealed in five tree crop combinations. The maximum (104.86 tha^{-1}) biomass production was found under treatment T_1 (Salix+Poplar+Beans+Kale+Apple) followed by (63.03,59.53, and 52.48 tha^{-1}) in treatment T_3,T_4, and T_1, and minimum (44.53tha^{-1}) in treatment T_1, where as carbon stock and carbon sequestration follows same trend as its simply the derivation of biomass. The results from this study will help to estimate levels of atmospheric CO_2 that could be sequestered by tree based land use systems for this climatic region of Kashmir Himalaya, therefore, an attempt has been made to collect the data on biomass, carbon stock and carbon sequestration potential in selected land use systems. The present findings may be used as baseline information for developing prediction models for probable effects of home gardens, future intervention and sustainable management in this region.
Key words: Agroforestry**,** land use system, biomass, carbon stock, sequestration

OP 10: Mode of Action and Safety of Probiotics in Aquaculture

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In large-scale production facilities, aquatic animals are exposed to stressful conditions. The increase of productivity in aquaculture has been accompanied by ecological impacts including emergence of a large variety of pathogens and thus result in serious economic losses. The abuse of disinfectants, pesticides, and antimicrobial drugs has caused the evolution of resistant strains of bacteria and concern of the society. Probiotic is the use of microbial supplements to benefit their host. Probiotics may also improve appetite and lead to enhanced growth and better feed conversion. Presently, the use of microorganisms as probiotics in the culture of aquatic organisms is increasing with the demand for more environment-friendly aquaculture practice.This review provides a summary of the mode of action and use of probiotics in aquaculture.
Keywords: Aquatic probiotics, Aquaculture, Immunomodulation, Feed supplement, Disease control

OP 11: Identification of molecular marker linked to ToLCV resistance in Tomato (*Solanum lycopersicum* L.) through Bulked Segregant analysis

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The experimental material for present investigation comprising F_2 segregating generation originating from a cross between a highly resistant ToLCV line of wild tomato IIHR 2101 (*S. habrochaites*) and a susceptible cultivated line AT-3 (*S. lycopersicum*), both the parents and F_1 were used for Bulked Segregant Analysis (BSA). Disease assessment was taken for this experiment. After phenotyping of the F_2 population, the ratio of resistant to susceptible tomato plants was found to be approximately (3:1). Total 235 plants from F_2 segregating generation were subjected to molecular marker analysis employing a Bulked Segregant Analysis (BSA) approach. Out of 409 primers surveyed for parental screening, only two were found able to discriminate both the parents (highly resistant and highly susceptible) sufficiently. Two markers (Sp and C2_At5g51110) were identified as linked to ToLCV resistant gene through Bulked Segregant Analysis.

OP 12: Using *Photorhabdus* Toxins for Plant Protection-Opportunities and Challenges

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The use of *cry* toxin from the *Bacillus thuringiensis*(Bt) revolutionised crop protection. However, now, it is common to find reports suggesting failure of *cry* toxins for management of target insects. Although a variety of bacterial toxins are known, it is difficult to find any report of utilization of those 'other' bacterial toxins for crop protection. The possible reasons could include absence of a suitable delivery system, unstable toxins, biosafety

issues, and legal issues. *Photorhabdus* bacteria are known to produce several insect-toxic protein toxins, hydrolytic enzymes and secondary metabolites, but have remained underutilized for crop protection. An array of toxins produced by*Photorhabdus*includes-the Toxin Complexes (Tcs), the *Photorhabdus*Insect Related (Pir) proteins, Makes Caterpillars Floppy (Mcf) toxins, the *Photorhabdus*Virulence Cassettes (Pvc),*Photorhabdus* Insecticidal Toxin (Pit),Photox, a Novel actin-targeting mono-ADP-ribosyltransferase. Our group has sequenced the genomes of five Indian *Photorhabdus* strains and worked on the comparative toxicity of Photox toxin produced by these strains. However, the most important concern is-how to use these toxins for insect-pest management? The best approach to use bacterial toxins has been through the transgenic plants, which unfortunately in India and many other countries have not been approved for public use, and have remained entangled in the regulatory issues. The end user wants a simple solution-a product that can be used directly. Purified and isolated bacterial toxins, stabilised in a formulation for a better shelf life could be a potential solution. Focussed efforts are required to develop a suitable strategy for bacterial toxin based products for plant protection.

OP 13: Screening of Rice against leaf folder *Cnaphalocrosis medinalis* (Guenee)

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During Kharif Season 2015, screening of 61 entries of rice (including one susceptible check) was carried out under Irrigated field condition against Rice leaf folder, *Cnaphalocrosis medinalis* (Guenee) at the crop Research Station (Paddy), Masodha. 61 entries were evaluated based on the standard evaluation scale of 0-9. Per cent leaf damage by leaf folder varied between 2.0 to 55.0 at 70 days after transplanting (DAT). Out of 61 entries, 9 entries showed resistant in 12 valid tests by recording less than 10% leaf damage in rice. 4 entries in 3 valid tests reacted moderately resistant (11-20% leaf damage), 2 rice entries showed moderately susceptible out of 12 valid test by recording less than 35% leaf damage. The susceptible check TN1 recorded 55 per cent leaf damage. None of the entries were free from leaf damage to be categorized as highly resistant (0% leaf damage).

OP 14: Conservation of Indigenous Farmers Varieties of Himachal Pradesh: An Overview

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The conservation of indigenous farmers' varieties, which contribute immensely to the plant genetic resources and genetic diversity, is crucial for food and nutritional security. Himachal Pradesh situated in the lap of North-Western Himalayas harbors a rich diversity of traditional farmers' varieties of various crops. These farmers' varieties represent a stunning diversity in taste, aroma, nutrition, pest-resistance and adaptability to a wide range of agro-climatic conditions. However, these attributes of farmers' varieties are often being forgotten because of obsession for yield. The advent of so-called modernization in agriculture along with other factors like habitat fragmentation, over-exploitation, competition from exotics, change in land use, population growth and climate change are leading to a catastrophic loss of these varieties. The well-documented information on the indigenous farmers' varieties being cultivated in Himachal Pradesh is very scanty. Very limited efforts have been made in the state for the conservation and registration of the huge germplasm available with the farming community. The present review presents an overview on the importance of indigenous farmers' varieties and the general status related to such varieties in Himachal Pradesh. The emphasis has also been put on the conservation and registration of indigenous farmers' varieties for sustainable utilization. A step in this direction would help in reviving food, taste, nutrition, culture and sustainability.

OP 15: Agronomic Evaluation for Yield Maximization of Indian Mustard (VAR. RH 749) Under Timely Sown Irrigated Conditions of Jammu

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An experiment was conducted at Research farm, Main Campus, Chatha of SKUAST-Jammu during the *rabi* season of 2016-17. The experiment consisted of 15 treatments and was laid out in Split Plot Design with 3 replications study the effect of different dates of sowing and planting geometry in Indian mustard in the newly identified variety for Zone II i.e. Jammu region namely RH 0749 was grown in this experiment. The three dates of sowing viz. 11/10/16, 22/10/16 and 1/11/16 were grown in main plots whereas 5 planting geometry i.e. 30×10 cm, 30×20 cm, 30×30 cm, 45×15 cm and 45×30 cm were imposed in sub plots. All the standard package and practices besides the procedures for recording observations were followed in the experiment to raise the crop. The data was analysed using standard statistical methods. Maximum average grain yield was recorded in plots which were sown

on 11th October (13.89 q/ha) than 22th October (9.38 q/ha) and 1st November (7.60 q/ha) in comparison. The yield declined progressively with advancement of sowing beyond 11th October whereas among the planting geometry maximum average grain yield was observed in plots sown with planting geometry of 30×20 cm (11.69 q/ha) which however was found to be at par with planting geometry of 30×10 cm (11.46 q/ha) and was found to be significantly higher than other treatments in comparison.

OP 16: Impact of crop establishment method and fertilizer doses on productivity and seed quality parameters of wheat (*Triticum aestivum* L.)

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The experiment was conducted during the winter season (*Rabi*) of 2013-14 at Research farm of ICAR-Indian Institute of Seed Science, Mau. The soil was clay type, very low in organic carbon (0.34 %), available N (240 kg/ha), available P (15.60 kg/ha) and medium in available K (190 kg/ha) with neutral (Ph 7.8) in reaction. The treatments were laid out in split plot design (SPD) with two method of sowing *i.e*., ridge sowing and normal sowing as main treatments and seven combinations of fertilizer treatment *i.e.,* Control, 100 % RDF, 125% RDF, 150% RDF, 100 % RDF + $ZnSO_4$, 100 % RDF + Mn and 100 % RDF + $ZnSO_4$ + Mn as sub treatments with the variety HD 2967 with 3 replications with the objective to know the crop establishment method and fertilizer doses for maximization of seed yield in wheat. Other cultural practices were followed as per recommendation and requirement of crop. Growth, yield components and the seed and straw yields and seed quality parameters were recorded at harvest and the data were statistically analysed. Crop establishment method: Ridge sowing was significantly superior over normal sowing for all observed traits *viz*., plant height 60 DAS, 90 DAS and harvest (59.1, 95.0 and 97.3 cm), number of tillers/plant 60 DAS and 90 DAS (7.27 and 7.44), spike length (11.21 cm), spike weight (2.27 g), spikelet/ spike (20.47), seeds/ spike (58.20), seed weight/ spike (1.87 g) and test weight (42.71 g) and seed quality parameters *viz.*, germination (95.05%), root length (20.95 cm), shoot length (16.61 cm) seedling length (37.56 cm), seedling dry weight (0.170 g), vigour index I and II (3590.7 and 16.13); normal sowing was found to be significantly superior over ridge sowing for traits number of tillers/m row length at harvest (178.7), processed seed yield (38.78 q ha^{-1}), straw yield (55.32 q ha^{-1}) and biological yield (94.10 qha^{-1}). The 100 % RDF+ $ZnSO_4$ + Mn was found to be significantly superior for all the observed traits *viz.*, plant height 60 DAS, 90 DAS and harvest (60.9, 98.4 and 102.3 cm), number of tillers/plant 30 DAS, 60 DAS, 90 DAS and harvest (3.15, 8.50, 8.85 and 8.92), number of tillers/m row length at harvest (184.6), spike length (11.85 cm), spike weight (2.37 g), spikelet/ spike (21.13), number of seeds/ spike (61.78), seed weight / spike (2.10 g), test weight (44.53 g), seed yield (42.65 q ha^{-1}) and harvest index (45.56) and seed quality parameters *viz.*, germination (96.33 %), root length (22.67 cm), shoot length (16.57 cm) seedling length (39.23 cm), seedling dry weight (0.187 g), vigour index I and II (3790.8 and 18.05). 150 % RDF was found to be significant superior for straw yield (60.20 q ha^{-1}) and biological yield (96.10 q ha^{-1}). On the basis of experimental findings, it can be concluded that normal sowing at 22.5 cm row spacing proved to be better when fertilized with 100 % RDF + $ZnSO_4$ + Mn. Besides, they also performed well with respect to seed quality.

OP 17: An Improvement in Farm Profitability through Breeding

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Sugarcane (*Saccharum officinarum* L.) an important agro-industrial crop with complex genetic history, is cultivated in tropical and subtropical regions of India, and it is also one of the most efficient crops in the world in converting energy from sunlight into chemical energy. As an essential sugar crop, sugarcane is receiving an increasing concern for its variety improvement. Plant Breeding has been defined differently by number of scientist and this definitions are keep on changing with new concept and ideology however, the main view "technology use for making plant more effective to convert the solar energy in food, feed, fodder, fiber, medicine" is remain the same. Traditional breeding and cultivation techniques have contributed a lot to increasing sugarcane yield as well as sucrose content. So far as the technique of crossing and raising of seedlings is concerned a satisfactory technique was evolved and is in vogue for the last four decades with slight modifications depending upon the combinations that have to be effected each year but the problem of flowering still remains. The problem of evolving canes suitable for local areas in various states is a perennial problem because for one reason or another varieties go out of cultivation; moreover better varieties are bred and come to replace the older ones from time to time. Breeding for earliness with high sugar is an aspect which concerns the sugar factory most and is a continuous process. Recently, the formulation of breeding aims for production of varieties with certain specialized characters has become more necessary with the continually changing outlook both from the agricultural and factory points of view. In view of

the above scenario, a field experiment was conducted at multi-location of North-Central and North-East Zones across the country under ICAR–All India Coordinated Research Project on Sugarcane to test four early maturing sugarcane clones (entries) viz., BO 153, CoP 08436, CoSe 09452, UP 09453 with two standards BO 130 and CoSe 95422 in Randomized Block Design for yield and quality traits. The mean data (two plant and one ratoon) of four locations viz., Sugarcane Research Station, Gorakhpur; G.S. Sugarcane Breeding and Research Institute, Seorahi; Sugarcane Research Institute (RPCAU), Pusa, Samastipur; ICAR–IISR Regional Centre, Motipur under ICAR–All India Coordinated Research Project on Sugarcane conceded that sugarcane variety UP 09453 was found best among all test entries and standard cultivars for quantitative and qualitative traits viz., NMC (130000/ha), cane yield (79.05 t/ha), sucrose% (17.16%), pol% in cane (13.26%), CCS t/ha (9.41t/ha) respectively. The sugarcane variety UP 09453 is developed by cross of Grl 28/92 x CoSe 92423 through hybridization and clonal selection at Sugarcane Research Station, Gorakhpur (Uttar Pradesh), India. This genotype was tested under different clonal stages for quality along with yield attributes and was also screened for red-rot reaction. The clone was accepted for multi-location testing under zonal varietal trials of North-Central and North-East Zone of ICAR–All India Coordinated Research Project on Sugarcane during 2010 and designated as 'UP 09453'. The sugarcane variety UP 09453 has been release and notified in the year 2018 by Central Varietal Release Committee (CVRC), Government of India, New Delhi for commercial cultivation in North-Central and North-East Zones comprising Eastern Uttar Pradesh, Bihar, West Bengal and Assam. The increasing yield aspects along with surpassed quality of sugarcane variety UP 09453 is being proved effective in boosting farm profitability aiming in doubling farmer's income and socio-economic development of rural regions of the nation.

Keywords: *UP 09453, Breeding, Farm Profitability, Socio-Economic Development and Rural India.*

PP 1: Estimation of heterosis in okra [*Abelmoschusesculentus*(L.) Moench) for yield and its contributing traits under *Tarai*region of Uttarakhand

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The analysis of variance revealed significant differences among all the genotypes for all the fourteen quantitative characters studied indicating a high degree of variability in the materials during both the respective year. The magnitude of heterosis varied from cross to cross for all the characters studied. For fruit yield per plant, among 36 cross combinations, maximum relative heterosis was observed in EC169506 ×ArkaAnamika (43.13 % and 37.13 %) followed by EC169400 ×ArkaAnamika (25.55 % and 30.10 %), IC117351 ×ArkaAnamika (25.00 % and 30.20 %) and EC169430 ×ParbhaniKranti (244.39 % and 29.48 %) during both the respective years consistently. Whereas, only two cross combinations *viz*., EC169400 ×ArkaAnamika (23.70 % and 24.27 %) and IC117351 ×ArkaAnamika (23.36 % and 29.25 %) exhibited consistent significant positive heterosis over better parent in desirable direction during both the respective years for fruit yield per plant. The high heterotic response in these hybrids for fruit yield per plant resulted mainly due to substantial heterosis for number of fruits per plant, fruit length, plant height and inter-nodal length.

Keywords: Fruit yield, Heterobeltiosis, Okra, Relative Heterosis and *Tarai* region

PP 2: Quantification and metabolic variation of lignan and fatty acids in the oilseed crop*Sesamumindicum* L.

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Information on quantification and metabolic variation of lignans and fatty acids in the oilseed crop of *Sesamumindicum* L. is limited. This study presents and discusses the composition, quantity, and variability available for the two traits in the sesame germplasm grown in diverse agro climatic regions of India. HPLC and GC analysis of sesame seeds harvested over a period of three crop seasons revealed a considerable amount of variability in these two important nutritional compounds. The antioxidant lignanssesamol, sesamin and sesamolin were reported in the range of 0.16 to 3.24, 2.10 to 5.98 and 1.52 to 3.76 mg/gram of seed, respectively. Similarly oleic and linoleic acids ranged from 34.71% to 45.61% and 38.49% to 49.60%, respectively. The black sesame seeds were found rich in sesamin, sesamolin, total lignan content and oleic acid and are thus identified nutritionally and pharmaceutically more important than white and brown seeds. Pearson statistics showed a high correlation between the components within a particular trait but no correlation was found between the traits. The study recorded promising cultivars for use in sesame breeding aimed at improving lignan and fatty acid contents, and those that can be of direct use in human foods, nutrition, health and welfare.

Key words: *Sesamumindicum* L. Seed coat colour. Lignans. Fatty acids. HPLC. GC. Pearson correlation

PP 3: Insect-pest and disease management in fruits crops through organic pesticides.

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Green Revolution as we know is the turning point of Indian Agriculture. After the success of the Green Revolution it became evident that this kind of farming has many unwanted side effects, both on natural resources and on human health.Residues of harmful pesticides in food or drinking water endanger both farmer's and consumer's health. There aroused a need to shift from conventional agriculture to organic agriculture. Different types of organic insecticides are now used in agriculture for management of insect pest and diseases. Spinosad is a biological product made from a naturally occurring soil bacterium called *saccharopolysporaspinosa* have insecticidal properties. New insecticides spinosyns act on an insect's nervous system, causing hyperactivity, paralysis, and death in a relatively short amount of time. Sulfur besides managing fungal disorders, can also be used to manage mites, pear psylla, and San Jose scale. Copper products are the second most widely used organic fungicides behind sulfur products for use in organic farms according to a survey conducted by the Organic Farming Research Foundation (OFRF, 2012). Horticultural and plant oils are commonly used to suppress certain fungal diseases, like powdery mildew (Bogran*et al.* 2006). Lime sulfur is effective against both insect pests and plant fungal diseases. It is also widely used for foliar disease management. Sulfur is frequently used to prevent foliar diseases (Koehler, 2009). Potassium bicarbonate is primarily used for the management of powdery mildew. *Bacillus thuringiensis* (Bt) is probably the most common microbial organic insecticide available. Iron phosphate is applied around the base of plants that are prone to damage by feeding slugs or snails. Kaolin is applied with water to form a dry white film on the surface of plants (Caldwell *et al*. 2013). Insects are inhibited from laying eggs or feeding on the plant due to the clay film barrier. Lime sulfur is normally used for the management of fungal diseases,it also works against certain insects such as plant rasping mites, pear leaf blister, and some sap-feeding insects. Soft bodied insects such as aphids, whiteflies, and mealy bugs, as well as immature stages of pests and beneficial insects alike are more susceptible to potassium laureate.

Key words: Organic pesticides, Green Revolution, Insect and Diseases.

PP 4: Molecular and biochemical analysis of Indian Pea genotypes

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Genetic diversity of any crop is important for successful employment of breeding programmes. In the present study, genetic diversity of 40 *Pisum* genotypes was characterised by using 24 EST-SSRs and 3 biochemical traits. The PIC value for SSR markers ranged from 0.50 to 0.09 at an average of 0.35. Jaccard's similarity coefficient ranged from 0.17 to 0.92 with an average value of 0.45 exhibiting considerable genetic diversity. The 40 genotypes were found clustered into two major clusters A and B. Population structure analysis divided the genotypes into two major populations. The mean data of various genotypes for protein content (%), total sugar content (%) and ascorbic acid content (mg/100g) were found in the range of 25.09 to 16.07, 19.97 to 12.65 and 5.57 to 3.01, respectively. The information gathered from EST-SSR markers and biochemical characters may aid plant breeders to utilise breeding programmes for improvement of the target traits in pea.

Keywords:*Pisumsativum* L., Genetic diversity, EST-SSRs, PIC, Biochemical characterization

PP 5: Role of Microbial diversity in Biocontrol of plant pathogens

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The ever increasing global population implies the need for increasing agricultural productivity. Extensive use of chemical fertilizers and pesticides to increase crop yield has cause significant impact on environment and human health. Rhizosphere is a hot spot for bacterial diversity as it harbours species which show a great deal of functional diversity and metabolic diversity(Rawat and Mustaq,2015). The beneficial bacteria that colonize plant roots and promote its growth are termed Plant Growth Promoting Rhizobacteria (PGPR).PGPR have attracted much attention in their role in biocontrol of plant diseases and offer environment friendly sustainable agricultural systems. The antagonistic effects by PGPR over various phytopathogens assist the possibilities for their use as biocontrol agents. Recent finding suggest that competition for nutrient, niche exclusion, induced systemic resistance and production of metabolites such as antibiotics, siderophores and hydrogen cyanide are the chief modes of biocontrol activity in PGPR. Due to the ease with which they can be cultured, mostbio control research has focussed on number of bacterial(*Bacillus, Burkholderia, Lysobacter, Pantoea, Pseudomonas* and *Streptomyces*) and fungal (Ampelomyces, Dactylella, Gliocladium, Trichoderma) genera as they demonstrate wide range of protection in a variety of plants. Thusacombinatorial approach using several PGPR strains to maintain an extended level of pathogen protection in plants will help achieve high yields without causing harm to the environment.

PP 6: Effect of melatonin modulates on photosynthetic performance in broccoli cv. Palam Samridhi

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Melatonin plays an important role in the function and survival of organisms and is a tryptophan derivative . Investigation was carried out at the division of Basic Sciences and Humanities during 2017 -18 to investigate the effect of foliar application of melatonin on photosynthetic pigments in broccoli. Thirty days old and uniform seedlings of broccoli cv. Palam Samridhi were transplanted in the field at a spacing of 45 × 45cm. Different concentrations of melatonin, *viz* 0, 20, 40, 60 and 80ppm were sprayed on the plant foliage at 15 days after transplanting (DAT) replicating each treatment four times. Treatments were evaluated for photosynthetic pigments viz. leaf chlorophyll and carotenoids contents. Results indicated that foliar application of different concentrations of melatonin significantly improved photosynthetic attributes wherein Mel 60ppm resulted in highest leaf carotenoid (0.025 and 0.028mg/g) at 30 and 60DAT. However, leaf chlorophyll content was maximum (0.69 and 1.43mg/g) with Mel 80ppm at respective days.

Keywords: Broccoli, carotenoids, chlorophyll, melatonin.

PP 7: Identification and evaluation of various biotic and abiotic factorsinfluencing the cocoon production of Jammu district

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Sericulture is an agro-based industry, which suits to rural-based farmers that requires low investment. It has high potential for higher returns (Ganie *et al.*, 2012) and play vital role in improvement of rural economy in India. Recently adoption and implementation of new ideas by research institutions in mulberry cultivation and silkworm rearing, the industry is now practiced as a main profession. It is the only cash crop that gives returns within 30 days. During 2016-17, the total raw silk production in the country was 30,348 MT, which is an increase of 6.4% over the previous year. The area under mulberry during 2016-17 was up by 3.9%. The employment generation in the country is raised to 8.51 million persons in 2016-17 compared to 8.25 million persons in 2015-16, indicating a growth of 3.15% (CSB, 2018). Jammu and Kashmir is producing bivoltine silk of high quality comparable to international quality helps in improving the economic condition of the sericulture farmer and weaker sections of the society by providing employment opportunities. Presently about 36,000 rural families are generating income of Rs. 2026.00 lakh annualy (Economic survey, J and K, 2016-17). There is an immense potential for the development of this agro-industry owing to favourable climatic but the constraints such as non-availability of quality mulberry leaves, un-scientific rearing techniques, poor quality of seed, lack of proper supervision, competition from other crops and handicrafts, lack of proper extension and marketing activities hampers development of sericulture. It is observed that, even though the production level has increased to a great extent in the recent past; still there exists a wide gap between the actual yield obtained by the rearers and the production level actually possible with the existing modern technology. Hence, the crux of the problem of growth of sericulture is how to increase the output per unit of input and thereby reduce gaps between lab to field. Currently, the problem of concern to all is that, even though the cocoon yield level has increased, there still exists a gap between what is achieved and what could be achieved in cocoon yield among the rearers Therefore, an attempt will be made to analyse the magnitude of the gaps in attainable cocoon yields and to explore the possibilities of relaxing existing constraints in order to bridge the attainable yield gaps and to assess the efficiency of silkworm rearers in Jammu divison.

Keywords: biotic, abiotic, socio-economic, constraints, reares etc.

PP 8: Integrated Pest and Disease Management in Mulberry-A trending approach towards a profitable enterprise

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Mulberry belonging to the Genus Morus is extensively grown in our country. Mulberry is a perennial plant which is the main source of food to *Bombyximori* L. Since mulberry leaf is available throughout the year, it makes the plant prone to various diseases and pests. Various pathogens like fungi, bacteria, viruses and nematode cause diseases in mulberry. Among the pests few sap suckers and defoliators are considered to be major as they cause extensive damage to the mulberry. These diseases and pests results heavy loss in leaf yield and quality.

Feeding these inferior quality leaf adversely affect the silkworm growth and cocoon quality. Even though sole adoption of chemical methods are effective in managing these pests and diseases but continuous usage of chemicals cause environmental pollution resulting in adverse effects on soil flora, fauna and also human health due to residual toxicity. In many instances the situation forces the farmer to depend on these synthetic chemicals which are not only costly but also unsafe on environment. To manage or control these diseases and pests an integrated approach of disease and pest management seems to be an ideal strategy.

PP 9: Evaluation of Insecticides in Rice against Yellow stem borer, *Sciropophagaincertulas* (Walker) Under Field Condition

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A study was conducted on the evaluation of insecticides in rice under natural field condition against Yellow stem borer; *Sciropophagaincertulas* (Walker). Seven insecticides were used for evaluation in which Fame [Flubendiamide 480SC (g/l)] @ 50ml is applied shows best result in all the insecticides. Dead heart percent at 30 Days is **5.4a** and at 50 Days is **2.9a** and White ear percent is **4.4a** is observed at significant difference (P=0.05). Whereas the infestation of Stem borer on untreated plot shows the dead heart percent at 30 Days is **31.3e** and at 50 Days is **24.0c** at and White ear percent is **40.0d** is observed at significant difference (P=0.05).

PP 10: Screening of Rice Germplasm for Resistance to Yellow Stem Borer *Scirpophagaincertulas*Walker

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During kharif 2016, 383 entries were screened under natural field conditions for resistance to Yellow stem borer based on the standard evaluation scale of 0-9. Per cent damage by stem borer varied between 0.0 to 28.2 at 90 days after transplanting. Highest incidence of stem borer as percent white ears was recorded in culture 25121 whereas 25 cultures were resistant out of 304 culture with '1' scale, incidence ranged between 0.0-9.0% WE. Whereas 52 culture with scale 9.0-19.0% were moderately resistant to stem borer at reproductive stage and 2 culture of scale '3' ranged between 19.0 -29.0% are moderately susceptible to stem borer.

PP 11: Evaluation of Insecticides in Rice against Leaf Folder, *Cnapholocrismedinalis* (Guenee) and Stem borer, *Sciropophagaincertulas* (Walker) on the yield

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A study was conducted for the evaluation of insecticides in rice under natural field condition against Leaf Folder,(*Cnapholocrismedinalis)* and Stem borer (*Sciropophagaincertulas*) on the Production. Seven insecticides were used for evaluation of yield in which Rynaxypyr [Coragen] @ 150ml is applied shows best result in all the insecticides. The production of rice in which Coragen is applied is **3675a kg**at significant difference (P=0.05) is observed whereas the production of rice on untreated plot is **2200d kg** at significant difference (P=0.05) is observed.

PP 12: Evaluation of Insecticides in Rice against Leaf Folder, *Cnapholocrismedinalis* (Guenee)

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A study was conducted for the evaluation of insecticides in rice field against Leaf Folder, (*Cnapholocrismedinalis*). Seven insecticides were used for evaluation; in which Fame [Flubendiamide 480SC (g/l)] @ 50ml is applied shows best result in all the insecticides. Observation is taken at 30 Days is **0.9a** and at 50 Days is **4.4a** is observed at significant difference (P=0.05) Whereas the infestation of Leaf borer on untreated plot at 30 Days is **8.0e** and at 50 Days is **12.0b** is observed at significant difference (P=0.05).

PP 13: Comparison of Efficacy Of Different Types of Cue Lure Based Traps Against Fruit Fly Infesting Cucurbits in Doda Region of J&K

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Fruit fly *Bactroceracucurbitae* is emerging as important pest of cucurbits in Doda region of J&K. *B cucurbitae* has been reported to infest cucurbits in Doda region during July-September. The para pheromone cue lure based male annihilation technique (MAT) is very effective in monitoring and management of male fruit flies. Three different types of Cue lure based traps i.eMcPhail trap and mineral water bottle trap having wicks soaked in a solution of Ethanol, Cue lure and Malathion in a ratio of 6:4:1 and a third one a readymade trap i.eNomate trap @ 3 traps per kanal. To compare the efficacy of these three types of traps, the trail was laid down at cucurbits growing Malnai village of Bhadarwah from July – September. Observations were recorded fortnightly and mean monthly trap catch obtained in three types of traps was calculated. In July maximum male fruit flies were trapped in mineral water bottle trap 20.6 flies followed by 10.3 flies in Nomate trap and 9.2 flies in McPhail trap. In August, maximum flies were trapped in mineral water bottle trap 98.5 flies followed by 67.2 flies in Nomate trap and 65.6 flies in McPhail trap. In September, maximum fruit flies were trapped in mineral water bottle trap 14.6 flies followed by Nomate trap 10.6 flies and 9.2 flies in Mcphail trap. Overall, maximum number of fruit flies was trapped in mineral water bottle traps, which are economical and showing its significance in eco friendly management of *Bactroceracucurbitae* in cucurbits growing area of Doda region.

PP 14: Biological Control of San Jose Scale in apple growing area of Doda region

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San Jose Scale, *Quadraspidiotusperniciosus*, is an exotic key pest of deciduous fruit trees, mainly the apple cultivated areas of Doda region. It found entry into the country through imported nursery stock from European Union and USA. In 1922 it became serious pest of apple in Kashmir. Its fast multiplication rate and protective waxy armature that shields the delicate tiny insect underneath, makes it a problem pest and difficult to manage by most of insecticides due to stage specificity. All over the world, a variety of natural enemies have been found parasitizing and predating upon the San Jose Scale. A trail was conducted at Sartangal farm of RHRSS, Bhadarwah and the parasites which have widely been exploited for its biological control were studied. The two aphelinidparasitiods viz. *Aphytisspp*. an ectoparasitoid and *Encasiaperniciosi* an endoparastoid. Their biological characteristics indicate potential for suppression of San Jose Scale. Release of these parasitoids may brought relief from pestilence of scale insect in apple orchard of Doda region.

PP 15: Integrated Management For Viral Diseases

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Plant disease are considered an important biotic constraint, which leads to significant crop losses world wide. Among all the plant disease, viral disease pf plant cause enormous economic losses particularly in the tropics an sub tropics which provide ideal condition for the perpetuation of viruses and their vectors. Many diverse approaches have been tried to minimize the losses caused by these diseases. The approach are mainly based on avoidance of source of infection, avoidance or control of vectors, modification of cultural practice, use of resistsnt varieties obtained through conventional breeding procedures, use of transgenic plants containing alien genes that impart resistance to viruses. Although the use of resistant varieties has been found to be the most economical and practical for effective management of viral disease. The development of integrated disease management practices also require correct identification of causative viruses, because symptoms can be misleading, and adequate understanding of the ecology of viruses and their vectors.

Keywords: Integrated management; Losses; Resistant varieties.

PP 16: Integrated Pest Management-A Tool for Sustainable Agriculture

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Insect Pests are most important biotic factors in limiting food production in our country. They result in substantial yield losses either through direct damage or by transmitting diseases. Even though chemical pesticides serve effectively in controlling pest damage but large scale use of pesticides causes many environmental problems like pesticide poisoning, insecticide resistance, resurgence of insect pest, effect on non target organisms and pesticide residue. Recent advances in IPM seems to be an alternative strategy leading towards a slogan of " Low External Input Sustainable Agriculture" focussing mainly on understanding virulence of insect through its biology, favourable climate, Susceptible hosts, Natural enemies, Time of occurrence etc. Hence adoption of IPM based practices were found to offer an alternative to pesticides and was feasible, economically viable, environmentally safe and effective for pest management in crops.

PP 17: Molecular marker assisted introgression of white rust resistant genes in *Brassica juncea*

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Brassica, a genus of plants belonging to the mustard family (Brassicaceae), is the second most important oilseed after soybean cultivated in India. Among different *Brassica spp*., *Brassica juncea* contributes 85 percent of total rapeseed mustard production in the country. White rust caused by *Albugo candida* (Pers.) Kuntze is a major disease of the oilseed mustard *Brassica juncea*. The Indian genotypes are highly susceptible to white rust and a considerable loss to the extent of 89.8 percent in seed yield has been reported under severe conditions.Among the various strategies to manage this disease, the most effective way is through introgression of white rust resistance genes (*AcB1-A4.1* from Heera and *AcB1-A5.1* from Donskaja) in the popular Indian mustard cultivars. Genetic resistance is the most efficient and cost-effective method of protecting mustard plants from white rust disease. For an effective resistance breeding programme, the knowledge of inheritance of gene(s) and their allelic relationship is important. Use of molecular markers can be complemented with conventional plant breeding for more effective transfer of specific trait. For adopting this strategy, the availability of functional molecular markers tightly linked with gene(s) of interest are required, which further need to be validated before using in marker assisted selection (MAS)/marker assisted backcross breeding (MABB). Once molecular markers closely linked to desirable traits are identified, marker assisted selection can be performed in early segregating populations and at early stages of plant growth. The introgression of white rust resistant genes *AcB1-A4.1* and *AcB1-A5.1* and evaluation of pyramided lines for different traits is very effective and efficient method for improving the well adapted popular Brassica cultivars.

Keywords: Mustard, molecular marker, white rust, *Brassica juncea*

PP 18: Fertility Requirement for Yield Maximization of Indian Mustard(VAR. RH 749) Under Timely Sown Irrigated Conditions of Jammu

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An experiment was conducted at Research Farm, Main Campus, Chatha of SKUAST-Jammu during the *rabi* season of 2016-17. The experiment consisted of 12 treatments and was laid out in factorial randomized block design with 3 replications to find out the most economical fertilization schedule in Jammu region for yield optimization in the newly identified variety of Indian mustard for Zone II i.e. Jammu region namely RH 0749. The treatments consisted of three levels of nitrogen i.e. 80, 100 and 120 kg two levels of phosphorus i.e. 20 and 40 kg/ha and two levels of potassium i.e. 0 kg (No potassium) and 30 kg/ha. All the standard package and practices besides the procedures for recording observations were followed in the experiment to raise the crop. The data was analysed using standard statistical methods. Among the various fertilizers, significantly higher seed yield was recorded in plots which were fertilized with nitrogen @ 120 kg/ha (12.86 q/ha), Phosphorus @ 40 kg/ha (12.43 q/ha) and potassium @ 30 kg/ha (12.83 q/ha) respectively. However, the incremental yield increase w.r.t. increased dosage of nitrogen declined progressively.

PP 19: Validation of leaf color chart (LCC) for different wheat varities

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The fertilizer is essential as well as expensive input in agricultural production. Fertilizer plays a leading role in increasing crop production by almost 41%. Of the agronomic factors known to augment wheat yield, the true rate and status of the plant nutrients mainly nitrogen, phosphorus and potassium are more widely understood today with micronutrients as trace element than theywere a decade ago. There is a correlation between fertilizer use and agricultural production, its effect being manifested quickly on the plant growth and ultimately on crop yields(Bruinsma, 2003). Among the primary nutrients, nitrogen though an expensive input is very important as it is intimately involved in the process of photosynthesis and directly reflected in the total dry matter production. The nitrogen is the most limiting nutrient in almost all the soils. Blanket fertilizer recommendations over large areas are not efficient because N supply varies widely from field to field. Crops thus require different amounts of nutrients in different fields, depending on native nutrient supply and crop demand. It is more beneficial if N inputs could be adjusted to actual crop conditions and nutrient requirements. Cropdem and based N application is one of the important options to reduce N loss and to increase N use efficiency of a crop.An adequate supply of nitrogen can increase the yield as much as 60%. Top dressing by split application of N is needed when the crop has a great need for N and when the rate of N uptake is large (Dobermann and Fairhurst, 2000). Cropdemand based N application is one of the important options to reduce N loss and to increase N use efficiency of a crop. Leaf colour chart (LCC) can be used for adjustment of fertilizer N application based on actual plant N status (Balasubramanian*et al*, 1999). Need based N application would result in greater agronomic and physiological efficiency of N fertilizer than the commonly practiced method. The LCC can be used to monitor plant N status in situ in the field and to determine the right time of N top dressing. The experiment was conducted at Research Farm, Chatha, SKUAST-Jammu during *rabi* 2015-16 to 2016-17 to study the Validation of leaf color chart (LCC) for different wheat varieties.. The treatment comprises of three varieties i.e. WH-1105, HD-2967 and DPW-621-50 as main plot and six levels of nitrogen management by LCC in sub plot (18 treatments) with three replication under Split-plot design. The results revealed that application of 50 kg N/ha as basal + top dressing of 50 kg N/ha in two equal splits at LCC 4 significantly increased yield of wheat crop (HD-2967) and saved 25 kg nitrogen/ha with the help of LCC during top dressing. The results of the study implied that 50 kg N/ha as basal + top dressing of 50 kg N/ha in two splits when LCC threshold 4.0 are found to be effective as a decision tool for optimizing N application in wheat.

PP 20: Cisgenics as Biotic Stress Resistance in Crops

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The conventional plant breeding has played a vital role in the crop improvement programme but has some demerits like linkage drag, requires long period to release a variety. Transgenics produced are said to carry foreign gene segment, can contaminate the environment and cause allergies in humans. An alternate modern method called cisgenics has been introduced. Cisgenics is a the genetic modification of a recipient plant using one of the techniques of recombinant DNA technology, using no foreign DNA but using natural gene (containing introns and flanking regions such as native promoter and terminator regions in a sense orientation) from closely related crossable-sexually compatible-plants. Plants produced by cisgenic approach are safer as compared to those produced by conventional breeding due to lack of linkage drag, variety is released in one year and has no problems associated such as allergies, contaminations etc. Some plants made biotic stress resistance by cisgenic approach are: *Botrytis* resistant strawberry was made by introducing gene coding for Polygalacturonase inhibing protein (PGIP) i.e. *FaPGIP*with the promoter from a fruit-specific expansion gene (FaExp2). Venturia resistant apple by introduction of *Vf* genes from apple (*Malus floribunda*) in apple against apple scab. Resistant potato varieties has been made by introduction of several Resistance genes (R-genes) present in wild potatoes against *Phytophthora* infestans causing Late blight by the Durable Resistance against Phytophthora (DuRPh) program. Resistant potato against late blight was made by transferring *Rpi-vnt1.1* gene from *Solanum venturii* (wild potato) into *Solanum tuberosum* (edible potato). Blackleg resistant *Brassica napus* has been made by introducing the *Brassica Rlm1* gene from Brassica.

PP 21: Production and Characterization of a Thermo-Alkalistable Protease from Bacterial Isolate A-3

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Life depends on the existence of powerful and specific catalysts: the Enzymes. Protein assay was carried out by Lowry's method. Dialysis was carried out by using dialysis membrane. Bacterial isolate A-3 produced the biggest zone of hydrolysis. The Bacterial isolate A-3 formed was a gram negative bacillus. The optimum enzyme production took place at a time interval of 48hours.Soyabean meal increased protease activity to 44.5U/ml versus control 42.5U/ml. Protease activity gradually increased with pH reaching an optimum level at pH 9.0 (27.5U/ml). The purified protease is quite stable in a broad pH range 9.0-12.0. The enzyme was active between room temperature 33˚C and 70˚C with an optimum around 60˚C. The addition of $CaCl_2$ and $MgSO_4$ increased protease activity by 109.25% and 104.75%. The enzyme was slightly inhibited by the chelating agent EDTA with 20% of its original activity being lost. The endogenous proteases were inactivated by incubating the diluted detergents (10%) at 100˚C for 15 mins prior to the addition of enzyme. Ammonium sulphate fractions with maximum specific activity were pooled in and subjected to dialysis after which partially purified enzyme prepration was used for native page and zymogram analysis. The gel was observed for band formation after destaining. However, smear was observed indicating the presence of protein in sample.

PP 22: Insect Pest Complex and their Succession on Okra *Abelmochousesesculantus* in North Kashmir

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Okra being the new introduced crop to the kashmir valley is gaining its importance because of its nutriotional value. An attempt was made to study the major biotic limiting factor in the yield *i.e.* insect pests to achieve the results, experiment was carried out in *kharif*season at faculty of Agriculture, Wadura in free choice conditions to study insect pest complex of okra. Data from the experimental findings revealed that sucking pests including jassids (*Amrascabigutulla*), white flies (*Bemisiatabaci*), thrips (*Thripstabaci*) and aphids (*Aphis gosyipii*) caused most of infestations. However, chaffer beetle damage was observed one 3 plants chaffer beetles caught in the light trap were *Melolontha indica, Holotrichialongipennis*and *Brahmina*spp. Moreover, rose chaffer *Protaceaalboquatata*was observed to feed on damaded fruits. Further studies need to be carried out at different lcations as our studies depicted the absence of major lepidopteran pest, both species of fruit borer *Eariasvitella* and *E. insulana.*

PP 23: *Petrobianlatens*(Muller) (Arachnida: Tetranychidae) first report from Jammu and Kashmir, India

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Among the biotic constraints, insect pests cause considerable loss in yield and change their status over time. The crops are heavily attacked by armyworm, cereal leaf beetle, wheat aphid, grasshopper, white grubs, ghujia weevil, and termites. *Petrobialatens* (Muller) (Arachnida: Tetranychidae) was first time recorded in Kashmir, which is one of the states of Indian union during survey conducted in rabi 2017-18 to know the pest complex on wheat crop. The mites feed only on leaves, which results in leaf yellowing and mottling, in unhealthy grain formation and in wilting and dying of plants. An entire field can appear yellow-brown during heavy infestations. Most damage is seen during periods of dry and hot weather. Extensive mite injury is sporadic, usually occurring when winter rains are followed by a dry period and the plants are stressed. Thus reducing yields.

PP 24: Physilogical and Biochemical Responses to High Temperature Stress in Crops

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Global climate change and increasing human population challenge global food production systems. New arable land is limited so increased productivity has to come from existing land, which necessitates minimizing losses resulting from abiotic and biotic stresses along with efficient harvesting and storage techniques. Global surface temperatures increased by about 0.6°C during the last century. Climate models project global mean temperatures to

increase (above values in 1990) in the range of 0.4 to 1.1°C by 2025, 0.8 to 2.6°C by 2050 and 1.4 to 5.8°C by 2100. Projections also indicate increased frequency of short episodes of hot, cold and frost days. Adaptation strategies to combat the negative effects of climate change and climate variability are needed. One promising strategy is to improve existing genotypes and develop new genotypes that can tolerate abiotic stresses, including high temperature stress. Targeted and controlled breeding programmes generally result in narrow genetic diversity. In most crops, present tolerance to environmental stresses is limited, particularly in the case of high temperature. Genotype development needs sources of new genes and tolerance traits. Exploration of wild relatives of cultivated crop species, landraces and other genetic resources can provide that opportunity and play a critical role in developing climate smart genotypes. Wild species have served as gene donors to modern cultivated crops and represent a vital source of untapped genetic diversity that needs to be preserved, expanded and utilized. Wild relatives often contain characteristics useful for tolerance to high temperature, drought, salinity tolerance and disease resistance, which can permit the adaptation of crops to a far wider range of environments and stresses.
Keywords: Tolerance; abiotic stress; High temperature stress and adaptation

PP 25: Constraints responsible for non-adoption of autumn rearing in Jammu province of J&K state

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The present research study was carried out in Jammu division of Jammu and Kashmir state with 225 rearers. The sample of the present study was drawn from three potential cocoon producing districts i.e., Kathua, Udhampur and Rajouri and from each district, three mulberry circles were selected purposively on the basis of maximum silkworm rearers. The results of the study shows that only 63 per cent sericulturists were found to have adopted silkworm rearing during autumn season. The constraints faced by them in adoption of autumn rearing were insufficient and inferior quality mulberry leaf, high silkworm and mulberry disease incidence, lack of season specific silkworm hybrids, improper disinfection due to unavailability of separate silkworm rearing house, insufficient training programmes during rearing at their door steps, lack of technological products, traditional practices, competition from high investment crops and international border disturbances. The remedial measures suggested to overcome the reported constraints were plantation of more mulberry trees, adoption of recommended pruning schedule, use of alternate source of manure in place of costly fertilizers and incomplete decomposed farm yard manure, supply of thermo-tolerant hybrids for autumn season, supply of chawki worms as per sericulturists rearing capacity, providing proper spacing to late age worms, ambulant training programmes, proper disinfection of rearing place after and before rearing, maintainance of hygienic conditions during rearing, use of recommended dose of bed disinfectants, proper disposal and decomposition of rearing waste and to create awareness about economical benefits of silkworm rearing and mulberry plantation in comparison to high investment cash crops among the sericulturists.
Key words: Constraints, adoption, sericulturists, ambulant, hygiene, thermo-tolerant.

PP 26: L-Asparaginase: A Potential Therapeutic Agent

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Asparaginase, an amidohydrolase that catalyses the breakdown of L-asparagine to L-aspartate / ammonia, is found to have tumour inhibitory properties. L-Asparaginase is commonly used as a combination chemotherapy drug for the treatment of acute lymphoblastic leukaemia (ALL) in adults and children and non-Hodgkin's lymphoma in children. Our cells require a steady supply of the amino acid asparagine to build proteins. Most cells can make their own supplies of asparagine using the enzyme asparagine synthetase. The enzyme takes aspartate and adds an amine, forming the characteristic amide group of asparagine. Some blood cells, however, rely instead on the blood for their supply of asparagines. L-Asparaginase therapy takes advantage of this fact by performing the opposite reaction catalysed by L-Asparaginase, it takes asparagine, a secondary amino acid that is important in the growth of many cancers and pulls off its amine, releasing aspartate and ammonia preventing the absorption of asparagine by tumour cells thereby depriving the tumour cells of their extracellular source of L-asparagine. L-Asparaginase is a remarkably effective therapy for those specific cases where blood cells become cancerous, such as in acute lymphoblastic leukemia. Asparaginase, prepared from *E. coli*, was introduced into cancer chemotherapy over 50 years ago and remains an important agent in the therapy of acute lymphocytic leukemia. L-Asparaginase is widely present in plants, animals and microbes but not in humans. Various microorganisms such as bacteria, yeast and fungi are generally used for the production of L-asparaginase as it is difficult to obtain the same from plants and

animals. L-Asparaginase from bacteria causes anaphylaxis and other abnormal sensitive reactions due to low specificity to asparagine. Toxicity and repression caused by bacterial L-asparaginase shifted focus to eukaryotic microorganisms such as fungi to improve the efficacy of L-asparaginase.Therefore, exploring different sources for isolation of L-asparaginase possessing high specificity to asparagine and to overcome hypersensitive reactions caused due to bacterial sources could be of significance importance for the upgradation of therapeutic index of asparaginase therapy.

Keywords: Asparaginase, Tumor Cells, Chemotherapy, Cancer

PP 27: Medicinal plants of Jammu region possess activity against breast cancer cell line-MCF-7

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Cancer is a disease that severely effects the human population globally. Scientific and research interest is drawing its attention towards naturally-derived compounds as these are considered to have less toxic side effects compared to current treatments such as chemotherapy. Medicinal plants have been used for thousands of years in folk medicines in Asian and African populations. Compounds which have been identified and extracted from terrestrial plants for their anticancer properties include polyphenols, brassinosteroids and taxols. This review discusses the demand for naturally-derived compounds from medicinal plants and their properties which make them target for potential anticancer treatments. Various botanicals have been investigated in Jammu region for their anticancer potential against the human breast cancer cell line (MCF-7) like *Aeglemarmelos* (Bael), *Betulautilis* (Bhojpatra) and *Daturametel* (Datura). *Aeglemarmelos* belonging to the family Rutaceae has been widely used in indigenous systems. Preclinical studies have shown that *A. marmelos* leaf extracts were effective in inhibiting the growth of breast cancer cell lines MCF7. *Betulautilis*belonging to the family Betulaceae contains betulin that can be easily converted into betulinic acid. Betulinic acid was identified as highly selective growth inhibitor of human melanoma, MCF-7 and malignant tumor cells. *Daturametel* belongs to the family Solanaceae and its methanolic leaf extract is considered to have a high anticancer potential on human breast cancer cell line (MCF-7).

Keywords: Aeglemarmelos, Betulautilis, Daturametel, Breast Cancer, MCF-7.

Recent Developments in Horticulture

OP 1: Constraints Perceived by the Farmers in Adoption of Improved Ginger Production Technology-A study of Low Hills of Himachal Pradesh

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Ginger is an important spice and medicinal crop. It is mostly grown as a cash crop, supporting the livelihood and improving the economic level of mid and low hills farmers of Himachal Pradesh. The present study was conducted using multistage sampling technique in Jhandutta and Sadar blocks of Bilaspur district of Himachal Pradesh which falls under Sub-Montane and Low Hills Subtropical zone (Zone-I) of the state. A sample of 100 ginger growing farmers was collected by personal interview method through well-structured pre tested schedule. The constraints were categorized into four categories namely technological constraints, input supply constraints, economic and marketing constraints and general constraints. Thereafter, mean percent score (MPS) was worked out and ranks were assigned in the descending order according to the mean per cent score obtained. The results of the study revealed that in case of technological constraints major constraints faced by the farmers were lack of knowledge about high yielding varieties and lack of technical guidance with MPS of 89 and 87. The major input supply constraints were worked out to be non-availability of improved high yielding varieties of ginger crop and lack of processing facilities in the study area with MPS of 84 and 82. Among the economic and marketing constraints, high fluctuations in market price (MPS 89) and high cost of inputs (MPS 84) were major constraints and in general constraints category, lack of resources followed by low risk bearing abilities of farmers were major constraints with MPS of 78 and 70, respectively. Overall, among all the major categories of constraints, technological constraints were up to greatest extent with MPS of 77.86 followed by economic and marketing constraints with MPS 76.75, input supply constraints with MPS 75.00 and general constraints with MPS 59.67, which indicated the need of strengthening the research-extension farmer linkage, provision of cheap credit facilities, establishment of processing units as well as organized regulated markets for efficient production and marketing of ginger crop in the study area.

Keywords: Ginger, Schedule, Constraints, Mean percent score

OP 2: Improved Production Technologies for Boosting Productivity and Profitability of Fruit Crops

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India is blessed with a diversity of agro-climatic conditions prevailing in the different regions of the country. A wide range of climatic and edaphic conditions in the Indian sub-continent ensures that it is ideally suited to produce almost all types of fruits. The horticulture crop production surpassed food crop production for the first time during 2013-14 and this trend continued during 2017-18 with 305.40 MT. Within horticulture, production of vegetables is estimated at 181 MT in 2017-18, about 1% higher than the year before, while that of fruits is estimated at 95 MT, 2% higher than the previous year. Despite significant increase in production of horticultural crops, low productivity and profitability in several fruit crops is still a hurdle and is required to be attended in order to meet future challenges and avail global opportunities in the country. The role of innovative horticulture technologies is thus required to be continuously updated and given to all the stakeholders leading to safe, remunerative and sustainable production. Production of disease-free, quality planting materials of only released and recommended varieties/hybrids both in the public and private sectors. Improving efficiency by gap filling and rejuvenation of old, unproductive, senile orchards through substitution of old varieties with improved high-yielding varieties of crops like mango, cashew etc. High-density planting by reduction in planting distance or use of plant growth inhibitors and dwarfing rootstocks as recommended in crops like mango and citrus. Promoting cultivation of crops, which produce higher biomass/unit time, e.g., banana, pineapple, papaya in areas requiring poverty-alleviation and nutritional security. Use of plant growth regulators and chemicals for improving productivity like paclobutrazol in mango and GA3 in grapes. Application of frontier technologies e.g. micro-irrigation, fertigation, INM, etc. for improving productivity of high value crops. Develop IPM strategies with biological control for important diseases and insects affecting commercial crop production.

OP 3: Effect of Different Planting Dates, Fertilizer Doses and Protected Structures on Yield and Economics' of Off-season Bittergourd Production for Enhances Socio-Economic Status of Farmers

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Protected structures act as physical barrier and play a key role to minimized biotic and a biotic stress to the crop experiments were conducted on off-season production of Bittergourd(var.Pusa Rasdar) is becoming the most important and popular vegetable crop for protected cultivation in plain condition of Indian. The off-season and year round Bittergourd crop can be grown successes fully under insect proof-net-house and polyhouse structures for supply of high quality Bittergourd to the up-market available in Delhi and other big cities of the country. The trials was conducted under IP net house and polyhouse condition at CPCT, IARI, New Delhi, during 20014 – 2015. Crop was transplanted 20 days age group seedling in all planting dates. The experiment was carried out in randomized block design with three replication and 24 treatments combination. Used four level of macro nutrients *i.e*. NPK/1000m^2 @ 15+ 07+16kg, @ 20+12+21kg, 25+17+26kg, @30+22+31kg, three date of plating i.e. 15th August, 1st September, 15th September and two condition viz. IP-net house and Polyhouse were used for conducting experiment. The performance of one crop data of Bittergourd var. Pusa Rasdar was analyzed. The marketable yield of Bittergourd 12.29kg/m^2, net income Rs. 294.18/m^2, C:B ratio1:2.50 were found significantly higher under optimum dose of NPK @25+17+26 kg/1000m^2) as compared to other NPK doses. The 1st planting date on 15th August was enhanced more fruits yield 13.23kg/m^2, net income Rs. 333.69/m^2 and BC ratio 1; 2.71 among the both September plating. Protected structure insect proof net house was enhancing higher quality fruits yield 10.34kg/m^2, net income Rs. 217.89 and B.C. ratio 1: 2.71 as compared to polyhouse condition. The combination of 15th August Planting, NPK dose @25+17+26 kg/1000m^2) under insect proof net house was produced yield 9.19 kg/m2, Net income Rs. 140.05 and BC ratio 1:2.12 as compared to all treatment of polyhouse. for Pusa Rasdar var. of Bittergourd. The observed that one of the best combination @25+17+26 kg/1000m^2) with 15th august planting under Insect proof net house was found significantly higher marketable yield of Bittergourd 16.19kg/m^2, net income Rs. 450.05/m^2, C:B ratio1:3.28 as compared to other combinations. However the under polyhouse condition the combination @25+17+26 kg/1000m^2) with 15th September planting was found significantly higher the marketable yield of Bittergourd 12.49kg/m^2, net income Rs. 269.25/m^2, C:B ratio1:2.18 as compared to net house condition during the years, respectively. It was concluded that the optimum dos of NPK@25+17+26 kg/1000m^2) with 15th August planting under net house condition and 15th September planting under polyhouse condition were observed best economical combination to the farmers during off-season in the plain condition of India.

OP 4: Studies on Big and Small fruited Coloured Capsicum under Semi-Climatic Control Greenhouse for Boost More Profitability of Farmers

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Cold climatic condition under high altitude and plain of Indian condition prevailing of low night temperature, energy, high rainfall, hail-fall, frost, water-logging, higher relative humidity and cold wind are limiting factors for growing sweet pepper under open field conditions. Capsicum is one of the high value vegetables that give maximum profit to the farmers during early, off and rainy seasons if grown in greenhouses. It has also vast potential for export as well in value addition. An experiment on evaluation of small fruited coloured capsicum was conducted at CPCT farm under fan-pad polyhouse condition during 2014-2015. Two big fruited capsicum var. *Bachata* (yellow), *Paserella* (red**)** and three varieties of small fruited type orange (*var. 9967422*), yellow (*var. 9956434*) and red (*var. 9954559*) were evaluated. The total yield of small capsicum was recorded as 10.40kg/m^2 (orange var. 9967422), 11.50kg/m^2 (yellow var. 9956434) and 8.80 kg/m^2 (red var. 9954559). Which is more than big size coloured capsicum and the yield was 9.60kg/m^2 in *Bachata* and 9.75kg/m^2 in *Paserella* varieties? Among quality parameters, TSS and shelf life was found more in small fruited varieties *i.e*. 1-2% and 2-3 days respectively. The blossom end rot was found below 2% in small capsicum varieties as compared to 7-8% in big size capsicum varieties. Considering the sale price of coloured capsicum, the cost of big fruited capsicum is Rs. 17.50-25 per fruit while the cost of small fruited (baby) capsicum fruit is Rs. 2.40 to 3.30 per fruit. Hence, the small fruited varieties could be affordable and acceptable to lower income group of the consumers of the country and the growers can also earn more by growing coloured small (baby) capsicum.

OP 5: Diagnosis and Recommendation Integrated System in Fruit Crops

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Several factors influence the growth and productivity of any fruit tree. One among them is plant nutrition, which not only affects the yield but also the health of the trees and quality of the fruits. The nutrient status of any fruit orchard can be assessed by analysis of soil and leaf nutrient content. Nutrient index survey is the best alternative to examine the macro-and micro-nutrient status of fruit orchards. However, it might be affected with the type of cultivar, stage of growth and position of leaf to be sampled. Hence, a new concept *viz*., Diagnosis and Recommendation Integrated System (DRIS) was developed. DRIS norm is the best diagnostic tool, which recommends the nutrient application only in a direct economical response of fruit. Diagnosis and Recommendation Integrated System originally called as "Physiological diagnosis" is an integrated set of norms representing calibrations of plant tissue composition, soil composition, environmental parameters and farming practices as function of yield of a particular crop. On deriving such norms, it is possible to make diagnosis of the condition of a particular crop, thereby isolating these factors which may likely influence growth and production. Optimizing these factors create conditions which are likely to increase the chance of obtaining higher yields and quality produce. Importance of nutrient balance in determining yield and quality of crops is well established but there is no means to quantify it until the introduction of the DRIS in which leaf analysis values are interpreted on the basis of inter-relationship among nutrients, rather than nutrient concentration themselves. The concept of DRIS is based on the comparison of crop nutrient ratios with optimum values from a high yielding group (DRIS norms). The DRIS provides a means of simultaneously identifying imbalances, deficiencies and excesses in crop nutrients and ranking them in order of importance. Further, this approach indicates whether the deficiency of any nutrient is natural or an induced one. The concept has been shown to be a valuable tool in making diagnosis of mineral imbalances in a variety of fruit crops.

Keywords: DRIS, fruits

OP 6: Field Performance and Economic Evaluation of Gladiolus Planter

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Gladiolus is a high value flower crop grown mainly for its elegant cut spikes to fulfil the domestic as well international market requirements. Conventionally, the gladiolus corms are planted manually at 15-20 cm spacing keeping row to row distance at 30 cm. At this spacing, it would require about 0.17-0.22 million corms for planting of one hectare area. Planting this huge number of corms demands for engaging large number of agricultural labours at the same time planting operation is quite tedious and time consuming. Considering the amount of drudgery involved and shortage of labour during the peak season, a tractor operated 6-row gladiolus planter was developed. The performance was evaluated for three corm spacing (15, 20 and 25 cm). The performance indicators included in the study were corm spacing along the row, coefficient of uniformity, missing index, multiple index, quality of feed index and mechanical damage. The cost of operation was also determined and compared with conventional method of planting. The result indicated that planter was able to place the gladiolus corms at required nominal spacing of 15, 20 and 25 cm with coefficient of variation of 11.53, 10.90 and 10.74 percent respectively. The coefficient of uniformity was found 86.90, 88.55 and 87.75 percent for all the three spacing in order. The maximum missing percentage was found as 4.20 percent for lower value of corm spacing with no multiples. The quality feed index was observed as 96.09, 96.30 and 96.66 with precision index as 7.33, 7.20 and 7.44 percent. The highest value of mechanical damage was observed as 4.26 percent. The field capacity of the planter was observed as 0.132 ha/h with a field efficiency of 81.25 percent. The economic analysis indicated a saving of about 90 percent in cost of planting over manual method.

OP 7: Pepino (*Solanum muricatum* Aiton) Fruit: A Quality Perspective

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Pepino is an annual shrub and native of Andean region of South America belonging to family Solanaceae. It is also known as melon pear, sweet pepino, pepino duke, king kiwi, toma, tree pepino and mellow fruit. Pepino plants are usually annual but some time behaves like biannual/perennial. Flowering starts in April-May months and fruit setting in July-August. On an average each plant produces 15-25 fruits per year. The delicious fruits are highly juicy (with 95-98% juice recovery) and moderate sweet in nature. They possess characteristics of pleasing aroma like melon fruit. The proximate composition of pepino fruit is as following: dry matter: 6.22%-8.20%, Total soluble

sugar: 6.00%-10.80%, ascorbic acid: 38.30mg/100g to 68.80mg/100g, TSS: 7.10%-10.60%, titratable acidity: 78.00mg/100g – 106.00mg/100g, Starch: 22.80mg/100g – 97.50mg/100g, Protein: 0.12g/100g – 0.15mg/100g. Ripe fruits can be consumed raw as a dessert fruit and fruit salad. The fruits have muskmelon like flavour, highly juicy, aromatic and used for preparation of juice and squash. When fruits are fully ripe, it has a cucumber like flavour which could be used as cooked vegetable. Pepino has some medicinal properties, it is good antiscorbutic, because of high vitamin C (40-60mg/100g). Plants has an aesthetic value, it can be kept as pot plant. Important cultivars viz. Valentia, Turia, El Camino, Kawi, Suma, Vista are suitable for cultivation.

Keywords: Total soluble sugar, titratable acidity, antiscorbutic, biannual

OP 8: Evaluation of seedling pecan nut genotypes of Jammu division for their photochemical properties

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The pecan nut [*Carya illinoensis* (Wang). K. Koch.] an important edible nut crop belongs to family Juglandaceae is native to North America. Pecan nut is superior to walnut in quality and thrives best in areas which are considered lower and hotter for walnut cultivation. Though introduced in Palmpur, Himachal Pradesh, way back in 1930 this nut crop could not assume commercial status for the want of suitable cultivars among orchardists. In the present investigations various locations of Rajouri and Poonch districts of Jammu Division were surveyed and out of total population surveyed, morphological, biochemical and molecular analysis was done for 60 seedling pecan trees. Genetic diversity in the available germplasm was assessed by using D^2 statistics and sixty selections were grouped into 8 clusters. Biochemical analysis of genotypes falling in clusters (VII, VIII and III) possessing highest mean values for various parameters was done and it was observed that maximum content of Calcium (74.80 mg/100g), Zinc (5.93 mg/100g), Copper (15.83 mg/100g), Vitamin B1 (0.67 mg/100g), protein (11.56%), oleic acid (76.07%), stearic acid (3.16%) and oil content (74.78%) was observed in selection SKJPM21. Magnesium, Vitamin B6 (0.25 mg/100g), Vitamin B9 (26.16 mcg/100g) and Linoleic acid (41.52%) was recorded maximum in selection SKJPP8. While Manganese (9.47 mg/100g), total phenols (110.25 mg CAE/g, condensed tannins (60.36 mg CE/g), antioxidant capacity (ORAC assay) (828.00 µmol TE/g) and antioxidant activity (DPPH assay) (140.23 mg TE/g) and was observed maximum in selection SKJPP25. Hence, these genotypes i.e. SKJPP8, SKJPM21 and SKJPP25 can serve as good source of various minerals, antioxidants, vitamins and due its high economic returns the area under pecan nut cultivation can be increased.

OP 9: Role of micronutrients for increasing fruit crop productivity

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Micronutrients are essential elements that are used by plants in small quantities. In fruit plants 7 essential micronutrients (Zn, Fe, B, Mn, Cu, Mo and Cl) are required for their proper growth and development. The requirement of micronutrients is partly met from the soil or through chemical fertilizers or through other sources. Sandy and other low-organic matter soils are naturally deficient in micronutrients and high pH soils may make some micronutrients less available and therefore deficient. Deficiency of micronutrient in fruit plants causes number of disorders viz. Resetting and little leaf in apple, dieback and leaf mottle of citrus, hen and chicken in grapes etc. The major causes for micronutrient deficiencies are intensified cultural practices, unbalanced fertilizer application including NPK, depletion of nutrients and no replenishment. Generally, the micronutrients are applied through foliar spray because they are required in very low amounts but combinations of Cu, Zinc and boron through basal dressing is also being in praticed in mango, peach and litchi orchards of western U.P. Fruit crops suffer widely by zinc deficiency followed by boron, manganese, copper, iron and Mo in different regions of India. Recently, it has been observed that nutritional status of soil is decreasing continuously with the deficiency of zinc resulting in depressed plants growth which causes heavy loss in quantity and quality of fruits. The sufficient amount of micronutrients are necessary for better plant growth which result in higher yield due to increased growth, better flowering and higher fruit set. Therefore, integrated approach for application of micronutrients along with macronutrients will secure all the nutritional requirement of fruit plants.

OP 10: Effect of conservation techniques on SQI in rainfed orchards of Jammu Zone

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Mango is popular among masses due to its excellent flavour, delicious taste; delicate fragrance, attractive colour and nutritive value which make it rank among the best fruits of world. However, these traits can only be obtained by proper orchard management of which soil health management is of utmost importance for proper nutrition. Soil health alone is an important aspect to be studied in orchards as it plays a major role in determining the yield as well as quality of mango fruit. The mango (*Mangiferaindica*L.) is one of the choicest fruit of tropical and sub-tropical region of the world, especially in Asia. Its population and importance can easily be realized by the fact that itis often referred as "King of Fruits in the Tropical World. The nutrition that soil provides have major bearing on the fruit quality and biochemical indicators. Keeping this in view, a study was conducted to assess the quality of rainfed mango orchards in the Kandi region of Jammu division of J&K as well as the impact of conservation practices *viz.,* trenches and basins (depending upon the slope of orchards). Long-term soil conservation management in mango orchards improved the quality of soils through enhancing the organic carbon fraction and biological status. Various soil physico-chemical parameters mere assessed using standard procedures. Each parameter was given weightage depending upon its importance. The value of OC (g/kg) was 6.8, 7.3 and 7.6 for Reasi, Basohli and Billawar respectively. The nitrogen content ranged from 330-360 kgha^{-1} (Reasi – 330 kgha^{-1}, Basohli-340 kgha^{-1}, Billawar-360 kg ha^{-1}). The overall SQI for the three different agro ecological regions was 0.45 (LESS) for Panthal, (Distt. Reasi), 0.65 (OPTIMUM**)** for Marapatti, Basholi (Distt. Kathua) and 0.95 (MORE) for Billawar. Maximum value for soil moisture content (15.10 %) was recorded in full moon water harvesting structure and minimum, 11.50 % in control. Soil moisture status in Cup and Saucer techniques ranged from 13.8 to 10.6% where as in control plot it varied from 10.9 % to 8.2% respectively. Under plastic and organic mulches soil moisture content recorded was 17.0% and 12%, respectively which was higher as compared to the control. The studies revealed that plastic mulches gave higher values of soil moisture content as compared to organic mulches.
Keywords: Rainfed, Mango orchards, Soil quality, Conservation practices

OP 11: Chronological outlook of Seed Potato Production Scenario in India

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Seed is the basic and vital input in agriculture, its timely availability in adequate quantity that decides the strength and health of agricultural economy in the country. Seed has played a very important role in India's green revolution and shall continue to be the vital component for the days to come (Naik and Buckseth, 2018). There is a saying "as you sow, so shall you reap", which traditionally relate to the quality of seed determining the production, has been the wisdom of our fore fathers. The experience in the country side indicated that farmers who save their own seed, generally select fields which are free from diseases and pests and then select only those plants which are healthy, well filled for seed purpose, harvest them separately, clean, cure and then store in proper containers and inspect regularly for any kind of damage or get good quality seed from other seed farmers on barter basis, indicating thereby the importance of seed in their production system. On account of vegetative propagation, the requirement of seed potatoes (tubers) is voluminous and accounts for 40-50% of the total production. Potato productivity in India is low in comparison to developed countries due to the non-availability of quality seed in required amounts. Seed potato production involving micro-propagation (tissue culture) techniques can overcome many of the problems associated with the conventional multiplication system. The everlasting shortage of seed potatoes in most of the potato growing nations can be overcome through hi-tech seed production system including micro-propagation and aeroponic techniques on account of faster rate of multiplication. Besides, rapid multiplication, disease freedom on account of multiplication of disease free mother stocks under controlled conditions followed by reduced number of field exposures as compared to conventional multiplication system is an added advantage of seed potato production through these techniques. For expanding quality seeds, the entire seed framework needs to be reviewed. The present review will be an endeavor to outline the historical background of seed potato production, issues and challenges faced towards seed potato production, supply frameworks and policy implications with respect to seed potato production in India.

OP 12: Knowledge gap of horticulture extension personnel about cultivation practices of selected fruit crops in Jammu region of J and K

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Knowledge refers to information possessed by an individual. It is defined as "behaviours and test situations which emphasize the remembering either by recognition or recall of ideas, material or phenomenon"

(Bloom1956). Once the knowledge is acquired, it produces change in thinking process of an individual which would lead to further change in attitude and help the persons in making rational decisions. The study was conducted with the aim to assess the knowledge level and knowledge gap of horticulture extension personnel in cultivation practices of selected fruit crops in Jammu region of J and K. Data was collected from 200 horticulture extension personnel (30 horticulture development officers and 170 horticulture technicians) working at gross root level in all ten districts of Jammu region. Four fresh fruit crops namely mango, citrus, pear and apple predominately representing all the three agro climatic zones were selected purposely for the present study. Over all knowledge score of the horticulture extension personnel was categories into three levels low, medium and high on the basis of Singh cub root method (1975). The findings revels that both horticulture development officers (HDOs) and Horticulture technicians in majority possess medium level of knowledge (52-66 score) and (15-20 score) respectively. The highest knowledge gap (58.19%) in manure and fertilizer followed by rejuvenation of old tree and plant protection in case of HDO where highest knowledge gap (62%) was in pesticide usage followed by irrigation and training /pruning in case of horticulture technicians were found. The significant difference among the mean knowledge score of the horticulture technicians falling under sub-tropical zone and temperate zone were also found in the present study.

Keywords: Knowledge, knowledge gap, Horticulture, Extension personnel

OP 13: Strategies for Production of Elite Quality Planting Material of Fruit Crops for Enhancing Productivity of the Orchards

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The inadequate availability of quality planting materials in fruit crops are still a major constraint for realizing a sound fruit industry in the country. Existing infrastructure could meet only 1/3 of the demand for production of quality planting material in this sector. The working on horticulture under planning has projected that there has been fourfold increase of demand for planting materials of fruit crops. It is now well established that there is a need to increase area under fruit crops with quality cultivars, in order to increse production of fruits. In view of growing importance of fruit crops, the demand for quality planting material has increased manifold throughout the country in the recent past. However, the bottleneck in the expansion of area under fruits is the non-availability of genuine and quality planting material in adequate quantity from public and private sector nurseries. It is essential to put a vibrant and active system of recognition of nurseries in place to facilitate, promote and monitor production and trade of planting materials of perennial fruit crops, which are propagated vegetatively. The success story tissue culture technology of banana has not been replicated till today in other tropical and subtropical fruits crops in India. Some of the main problems in ensuring production of quality planting materials are; absence of genetically uniform rootstocks, lack of variability for rootstocks, lack of information on rootstock-scion interactions, year round production through specialized structures, lack of tissue culture protocol for most, lack of vegetative propagation for seed propagated crops, There is a need to develop rootstock for high density planting in crops like mangoes. Rootstocks play an important role in intensive commercial fruit production, and the use of rootstocks in commercial orchards has increased manifold in recent past. They have wider applications such as improving fruit quality, precocity, adapting to different soil and climatic conditions, inducing dwarfness, besides tolerance against biotic and abiotic stress. In several fruit crops, the influence of environment has made it imperative that genotypes need to be developed for different regions and same may be available to different stakeholders as earliest through robust multiplication techniques so that it should to the end users as earliest.

PP 1: Cropping system in fruit crops for income generation under rainfed conditions

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Among the land use practices for wasteland areas, fruit tree plantation is a major one, though emphasis in wastelands development has been given to plantation of trees. A number of technologies are available for the productive management of fruit culture under rainfed conditions. Among the various methods used for efficient use and management, some of the successful methods are integrated crop management practices, plantation of tolerant species and rootstocks, use of modern agro-techniques and suitable cropping systems. Cropping system is considered to be the most ideal strategy to provide food nutrition and income security to the farmers. Monoculture is often risk prone due to crop failures. Under such situations, cropping system approach integrating suitable under and ground storey crops with the fruit trees has been found remunerative providing fruit, fuel and fodder to the poor farmers. Integration of annual crops with fruit trees yields multiple outputs that ensure production and income generation in a suitable manner. The economic returns or monetary gains per unit area and time is one of the major consideration for adoption of a cropping system. The system consists of three main components *viz*. main crop, filler crop and inter crop.Main crops are the fruitspecies having a larger canopy size and prolonged juvenile as well

as productive phase. Generally the crops utilize the entire land after 20-25 years, whereas only 25-30 per cent of land is effectively used up by the main crop up to 10 years. These plants are planted at wider spacing. The filler crops are the fruit species which are precocious in nature, prolific bearer having short stature. These plants are planted with the purpose to generate additional income from the land during the juvenile and initial bearing stage of the main crops. The plants generally hardy in nature and have shorter economic life than main crop and planted within the main crop at a closer spacing..Guava, being a prolific and precious bearing fruit plant and dwarf stature canopy can very well be fitted as second storey crop for additional income at least in the initial years of the orchard. Papaya, Banana, Pomegranate and Phalsa etc. are also used as filler crop.The inter crop occupy thelower most layer of the system and are grown in the remaining unused land. Generally the inter crops are the location specific annual crops, selected as per the climatic and socio-economic suitability. During the initial years any crop can be taken, whereas at later stage shade tolerant crops can be grown as inter crops.

Keywords: cropping system, Intercrops, fruits

PP 2: Nutraceutical Importance of Minor and Underutilized Fruits of Jammu Region

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Minor and underutilized fruits are the fruits whose commercial potential has not been fully utilized. Besides providing food, nutrition and employment opportunities to the youth, minor and underutilized fruits also help in upliftment of small and marginal farmers and the development of value-added products. Aonla, jamun, fig, loquat, phalsa and monkey jack are some of the minor and underutilized fruits of Jammu region. Besides providing economic opportunities, these fruits are full of medicinal properties which is very well recorded in ayurvedic scriptures. Aonla is a rich source of vitamin C and tannins. The edible tissue of aonla contains 3 times more protein and 160 times more vitamin C than apple. Some prominent benefits of jamun are that it is good for diabetic patients, it aids in heart disorder and have anti cancerous properties because of cancer fighting properties of anthocyanin present in it. Loquat is an excellent source of vitamin A and anti-oxidants like chlorogenic acid coumaric acid etc. Fresh loquat is an important source of potassium and vitamin B6. Potassium is an important component of cell wall and body fluids, helps in regulating blood pressure. Furthermore, it is an excellent source of iron, copper, calcium and other minerals. Figs are good source of dietary fibre, vitamin C, copper, pantothenic acid. Fig fruit is low in calories and dried figs are excellent source of minerals like calcium, copper, potassium, manganese and zinc. Moreover, some value-added products with health benefits can be prepared from these underutilized fruits. Like jam, juice, syrup can be prepared from aonla, jamun. Aonla is also used to prepare candy and preserve. These value-added products will help uplifting small and marginal farmers and have nearly similar health benefits and nutraceutical properties as the fruit itself.

Keywords: Nutraceutical value, health benefits, nutrients, vitamin, minor fruits, underutilized fruits.

PP 3: Abiotic Stress Management in Fruit Crops

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Abiotic stress is the negative impact of non-living factors on the living organisms in a specific environment. The main abiotic stresses affecting fruit crops are temperature, water andsalinity.Abiotic stresses which causes more than 50% losses in fruit productivity are the major concern for food and nutritional security of additional 0.4 billion Indians by 2050.These stresses cause germplasm extinction, poor vernalization, unsatisfactory chilling hours, frost injury, cracking and shift in fruit cultivation. High temperature effects vegetative growth, flowering, fruit yield and causes metabolism imbalance in plants. Low temperature leads to black heart, collar injury, crotch injury and splitting of bark in number of fruit plants. Due to low temperature pollination and fertilization is highly reduced in almond anddrying up of fruits and twigs takes place in citrus.Both drought and waterlogging are water stresess which results in lowerproduction and. Thus, thorough understanding of adverse influence of abiotic stresses on different crop species is imperative for devising innovative horticultural practices for overcoming the adverse impacts. Timely intervention with appropriate adaptation strategies would help in realizing sustainable yields. Practices like providing irrigation at critical stages, adopting micro irrigation, use of growth regulators, soil mulching, amendments, and nutrient management are required to alleviate the adverse effects. The advanced irrigations like partial root zone drying (PRD) are another option under limited water conditions. The inclusion of stress tolerant crops or cultivars and adoption of tolerant rootstocks to graft the choice cultivar would further enable the farmers to overcome adverse effects of abiotic stresses. Integration of all the available adoption options would be the most effective approach in sustaining the production and productivity of fruit crops under abiotic stress conditions.

Key words: Fruit crops, Abiotic stress, Management

PP 4: Orchard Floor Management Practices in Fruit Crops

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Orchard floor management is one of the most important practices for successful orcharding to influence the growth and overall development of fruit trees. The orchard floor management system can greatly affect earliness of bearing and yield. Management practices for orchard floor maintenance should be executed in a timely manner during the lifetime of the orchard. Different orchard floor management systems not only suppress the growth and development of weeds but also improve soil conditions, structure and soil nutrient status as a consequence of their biomass. Orchard cultivation refers to the careful management of the orchard soil in such a way that the soil is maintained in a good condition suitable to the needs of the tree with least expenses. This involves maintenance of the physical condition of the soil, its moisture and nutrient content. Mineral nutrition coupled with different orchard soil management practices create favourable conditions for getting maximum and sustainable productivity of good quality fruits within the limits of soil, water and fertility management. The best strategy for managing the orchard floor is to use a non competitive grass alley with a vegetation-free strip in the tree row. The vegetation-free strip can be established and maintained with herbicides. The permanent grass sod between the tree rows will minimize soil erosion, increase soil aeration and permeability, and support equipment movement through the orchard during wet weather. The vegetation-free strip eliminates competition for water and nutrients, minimizes tree damage and provides some radiant heat from the soil surface. Herbicides are directed at the soil and weeds underneath the tree. The vegetation-free strip method is superior to all other orchard floor management options. Vegetation under the tree competes for nutrients and water resulting in reduced growth, yield, and small fruit. Another option is the use of organic mulches in the tree row. Examples of mulching materials include straw, wood chips, and grass residue from mowing. These mulches will suppress weed emergence, but weed removal by some means will still be necessary. Mulches can improve the water-holding capacity of some soils. Synthetic mulches made from polyethylene, polypropylene, or polyester can be placed in the tree row around the base of the trunk or as a narrow strip down the row. Some newer synthetics allow water and air to pass through the mulch.

Keywords: Mulching, Fruits, Herbicides

PP 5: Varietal Evaluation of Chilli under Protected Condition during Off-Season for Boost More Profitability of Farmers

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India is second largest vegetable producer in the world but still production and productivity is very low. This is primarily due to erratic climatic conditions. Consequently, even required 300g per capita per day vegetable is not available. High yielding hybrid varieties of vegetables and protected cultivation technologies have shown great potential in different climatic conditions. However, such findings are very scanty in plain conditions of India. Therefore, present experiment was conducted to evaluate the yield and economic gain in cultivation of green chili in off-season under protected structures during August-May 2014-2015 at CPCT farm, IARI, New Delhi. Chili crop was found susceptible from frost, viruses and wilt in open field cultivation during off-season from October to March month in this period green chili price was found almost atpar, to capsicum. So need of protected structure for growing chili crop during off-season. An experiment was conducted first time on green chili production and their evaluation at CPCT farm under fan-pad polyhouse condition during 2014-15. Five varieties i.e AHB-170, VNR-332, Nirali, Indus 365 and Preeti were transplanted and evaluated and found economical resulted of Chili hybrid VNR 332 had better yield potential @7.7 kg/m^2 and more income generation among the all 9 varieties of chili under protected structure during the off and early season.

PP 6: Vegetable intercropping in horticultural orchards for enhanced profitability

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Intercropping is the growing of two or more dissimilar crops simultaneously on the same piece of land. Intercropping can improve the crop productivity due to increased plant efficiency for utilization of sunlight with an adequate spatial distribution of various plant architectures. In young fruit orchards, growing economic crops in inter spaces of the fruit trees during first few years is referred as intercropping. It enables farmers to utilize not only the vacant space efficiently but also enable them to earn additional income from the same piece of land. They also act as a cover crop and the land benefits by the cultivation, irrigation, manuring given to the intercrops. Vegetables, being short duration, shallow rooted, bushy or climbing types with very low plant height makes them ideal companion of perennial large fruit trees. These are the best inter crops in terms of per unit area productivity and

profitability when compared with cereals, millets or any other crop. Water requirements of the vegetable intercrops should not clash with those of the main fruit trees and should be kept well away from the main fruit trees and irrigated independently. Important vegetables which can be grown as intercrops are Solanaceous vegetables viz., Tomato, Brinjal, Chillies and Capsicum (suitable for well growing established orchards, 3-4 years onwards); Cruciferous vegetables viz., Cauliflower, Cabbage, Knolkhol, Broccoli (suitable for growing in newly establishing orchard, 0-3 years); Cucurbitaceous vegetables viz., Bottle gourd, Bitter gourd, Cucumber, Muskmelon, Watermelon, Pumpkin (suitable for well growing established orchards, 3-4 years onwards); Leafy vegetables viz., Spinach, Coriander, Fenugreek (suitable for growing in newly establishing orchard, 0-3 years); Onion and Garlic (suitable for growing in newly establishing orchards as well as in established orchards); Ginger and Turmeric (suitable for growing under high density orchards) and Leguminous vegetables viz., Peas and Beans (suitable for growing in poor fertility orchards). The intercropping should be stopped when trees develop wide canopy and less space is available between two rows for raising secondary crop and also trees have shading effects on secondary crop. Thereafter, green manuring or cover cropping should be only practiced. It can be concluded that intercropping of short duration vegetables in fruit orchard not only maximize the resource utilization in terms of land, labour and other inputs but also play a pivotal role in minimizing the risk of crop failure by ensuring and enhancing the net income per unit of area. In this way, the sustained promotion of cultivation of high value fruits and other horticulture crops along with improvement in infrastructure can help enhance farmers' income and net profitability

PP 7: Irradiation Effects on *In Vitro* Axillary Bud of Strawberry CV. Chandler

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The effects of different doses (0, 10, 30, 50 and 60 Gy) of radioactive cobalt (60 Co) rays on axillary buds ofstrawberry were investigated under *in vitro* conditions. The results showed that irradiated buds had increased shootproliferation percentage, average number of shoots, shoot length, average number of roots, root length, root initiation percentage, survival percentage and number of leaves. However, at higher doses it showed inhibitoryeffects and significant decreases in all above parameters was observed. The highest shoot proliferation per cent (91.06 %), average number of shoots (8.44) and shoot length (2.77 cm) was recorded when buds were irradiated with 10 Gy gamma dose followed by 30 Gy gamma dose. Gamma doses over 30 Gy resulted in sharp decreases in all parameters examined. The highest root initiation percentage (91.06 %), average number of roots (5.58) and root lengths (3.62 cm) was recorded from 10 Gy gamma rays. After 7 weeks of hardening maximum survival per cent (86.66 %) was recorded in un-irradiated (control) buds followed by buds irradiated with 10 Gy dose whereas, maximum number of leaves were recorded in case of cultures irradiated with 10 Gy. Thus it can be concluded that lower doses of gamma rays can improve the survival and growth of explants under *in vitro* conditions.

PP 8: Hi-tech intervention for increasing productivity of Fruit crops

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Fruit production is an important component of Horticulture industry and it is a prime source that provides relatively higher income, employment opportunity in rural areas besides the nutritional security. In the era of open economy, it has become increasingly necessary that the produce must be competitive, both in domestic and international markets. This demands infusion of technology for efficient utilization of resources for delivering higher output for per unit of inputs with superb quality of the produce. This would be possible only through adoption of Hi-Tech horticulture technologies. India is the second largest producer of fruits after China. The total fruit production in India has been estimated at 92846.000 MT from 6480.000 m ha. The fruit culture today, in not merely a means of diversification but forms an integral part of food, environmental and nutritional security and also an essential ingredient of economic security. The research and development in horticulture has received impressive support in the last 1½ decades. The outcome of new technologies those which are modern, less dependent on environment, capital intensive and have capacity to improve productivity and quality. This has become need of the hour to safeguard the nutritional and aesthetic security of nation owing to ever increasing population of our country. This would be a major challenge for this sunrise sector because of shrinking of land for garden activity and to increase further the production levels per unit area. To make horticulture enterprise more productive, efficient, remunerative and sustainable, it is imperative that Hi-Tech interventions are emphasized in the XI plan to make a dent in overall global horticultural scenario. These interventions are important in giving impetus to export, processing and value addition activities. The important components of Hi-Tech horticulture are: High density plantation (HDP),canopy management, Use of plastics, Protected cultivation Organic farming; Bio-fertilizers, Integrated Nutrient Management (INM) and water management strategies. Use of Integrated Pest and Disease Management, Mechanization,Micro-propagation, Molecular diagnostics-modern immune-diagnostic technologies

for detection of viral diseases, Molecular breeding-use of genetically modified crop varieties and Hi-Tech post-harvest technologies including cold chain. The crop habitat manipulation in certain orchards like HDP technology adopted in banana, papaya, pineapple, and recently in mango, guava, citrus in India, exhibited the change in pest status. Furthermore, use of plastics, fertilizer applications, irrigation systems like drip, sprinkler, have also resulted in secondary pest problems like nematodes, coccids, borers, soil inhibiting termites, white grubs in certain agro-climatic zones of the country. To achieve the success in high tech horticulture vertical integration, effective linkage, credit support and policy are essential.

PP 9: Prospects of Precision Farming in Fruit crops in India

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Precision farming is a new promising technology through which exact or accurate results of farming can be obtained. It involves the application of modern tools of information and space technology for increasing productivity through judicious use of resources like land, water, sunlight energy as well as time. Computers, Global Position System (GPS), Geographic Information System (GIS), sensors and application control are the major categories of technology which enable the precision farming to operate. There are numerous opportunities for adopting few aspects of precision farming. Many fruit crops in India, which are high profit making offer wide scope for precision farming. Precision farming is being practiced in developed countries. But in Indian context it is still in its infancy. India is the second largest producer of fruits in the world. So it is one of the best options for improving land, generating employment, improving economic condition of farmers and the nutritional security by adopting few aspects of precision farming in fruit crop cultivation. In India, precision farming is in its infancy. The main reasons are high cost of technology and high level of fragmentation of farm holdings. However, by following the basic principles of precision farming, Indian farmers can have better yield than through conventional methods. Resource consumption, input, labour cost etc can be lowered and farmers can enjoy a better profit. A package should be developed for fruit crops like banana, mango, strawberry, sapota, citrus, pomegranate, papaya,apple, plum, peach, pear, apricot etc based on knowledge on soil environment and crop needs to enhance the efficiency of inputs in given time frame. Since many of the precision agriculture tools are costly (GIS, GPS, RS, etc.), farmer's co-operatives can be formed. Effective coordination among public, private sectors and growers is, therefore, essential for implementing new strategies to accomplish fruitful success.

PP 10: Genetic characterization of fruit crops

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Due to perennial nature and specific climatic and edaphic needs of fruit crops it takes more than 15 years to develop a variety .Fruit crops are mostly heterozygous due to high degree of outcrossing. Some of the semi-wild and wild species of underutilized fruit crops are on a way of extinction. At the same time, growing public awareness has increased demands for greater dietary diversity, as well as future production challenges. Accurate identification of the germplasm is an integral part for the conservation and sustainable plant genetic resources use. There is unavailability of systematic morphological characterization and evaluation of the fruit species, further morphological characters are highly influenced by environmental conditions and in fruit crops there is low morphological variation and lack of differentiating characters among some closely related species and varieties. Thus Morphological characterization may not answer many new evolutionary and taxonomic questions. New techniques have been successfully used to study the extent and distribution of variation in species gene-pools. Development and utilization of molecular markers to detect differences in the DNA of individual plants has many applications in crop improvement in fruits. Several types of molecular techniques such as RFLP, AFLP, RAPD, STS, ESTs, SSRs or microsatellites, SCARs, and SNPs have recently been used for plant characterization. These techniques have been used in various fruit crops to increase the level of fruit crop genetic resources characterization, maintenance as well as proper utilization in crop improvement programmes. Thus molecular markers are valuable tools for plant germplasm characterizations for assessing genetic diversity, species identification and its utilization in crop improvement programmes.

PP 11: Dissemination of High Density orcharding of Mango in Jammu province

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The fruit industry in Jammu province has made remarkable progress during the last three decades. The area under fruits has increased to about 1.18 lakh hectares in 2016-17. The production has gone up to 2.74 lakh metric tonnes during this period by adopting the certain technologies viz., High density plantation where planting density is one of the most important factors which determine the yield of an orchard. The traditional system of

cultivation has often posed problems in attaining desired levels of productivity due to large tree canopy. In recent year, the concept of fruit production is undergoing a change where emphasis is being given to higher production per unit area. "High density planting technique is a modern method of fruit cultivation involving planting of fruit trees densely, allowing small or dwarf trees with modified canopy for better light interception and distribution and ease of mechanized field operation". Demonstration units on high density orcharding of mango was established in Jammu sub-tropics on the private land of Shri Madan lal Sharma of Flora (Nagbani, Jammu) at a spacing of 4.5 x 4.5metres (rows x plants) using cv. Dashehari accommodating 493 plants ha^{-1}against the traditional system of mango planting i.e 10.0 x 10.0 metres (rows x plants) which accommodate 100 plants ha^{-1}. Subsequently, mango demonstration unit at a spacing of 4.0 x 3.0 metre distance (rows x plants), accommodate 833 plants ha^{-1} was established on the private land of Sh. Jagdish Chander R/O Chann Arorian (Distt. Kathua). The benefit cost ratio at 4.5 x 4.5 metre spacing was maximum after 5th year of the establishment of the orchard which proves the viability of the high density orchards. Three training programmes were undertaken on farmers' fields' from the initial year of layout and planting to after care of orchard establishment of high density mango on the private land of Shri Madan lal Sharma of Flora (Nagbani, Jammu). In the Jammu Province the plantation with higher planting density has been initiated in the mango fruit crop and at present the area under mango high density plantation in Jammu province has been increased to 64 hectare.

Keywords: Mango, Technology Transfer, High Density Planting, Yield.

PP 12: Dissemination of High Density orcharding of Guava in Jammu province

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Fruit industry is most vibrant sector for economic development in the state of Jammu and Kashmir. Horticulture sector has significantly expanded over the years with an area of 3.38 lakh hectares presently under horticulture, with a production of 23.55 LMTs of which fresh fruit production is 20.75 LMTs and dry fruit production is 2.80 LMTs and is contributing about 8% to the State's GDP. It is one of the largest employment generating sectors as one hectare of orchard generates almost 400 man-days per year. About 7 lakh farming families with a population of 33 lakh souls are directly or indirectly dependent upon the horticulture sector in the State. The Jammu Division has shown an increase of 2-3% annually in respect of fruits production and the area has continuously increased in the recent years as envisaged from the figures available but the production trend has not improved upto the desired levels. Planting density is one of the most important factors which determine the yield of an orchard. The traditional system of cultivation has often posed problems in attaining desired levels of productivity due to large tree canopy. In recent year, the concept of fruit production is undergoing a change where emphasis is being given to higher production per unit area. "High density planting technique is a modern method of fruit cultivation involving planting of fruit trees densely, allowing small or dwarf trees with modified canopy for better light interception and distribution and ease of mechanized field operation". The high density planting facilitates to enhance economic production, productivity, and quality of fruits. It provides efficient use of natural resources like land, water and light. It assures effective use of fertilizers and pesticides, which are frequently lost in traditional planting system. Demonstration units on high density planting system of guava were established in Jammu sub-tropics on the private land of Sh. Shammi Saini R/O Gole (Talab Tillo, Jammu) and Sh. Deepak Kumar, Patti (Purmandal, Samba) both at a spacing of 6.0 x 3.0 metres (rows x plants) using cv. Lucknow-49 accommodate 555plants ha^{-1} and other at spacing of 3.0 x 3.0 metre (rows x plants) accommodate 1111plantsha^{-1} established in 2016 on the private land Sh. Om Parkash R/O Sanjwan (Distt. Kathua) against the traditional system of 6.0 x 6.0 metre (rows to plants) spacing accommodating 277 plants ha^{-1}. The benefit cost ratio was found to be maximum during 5th year of the establishment of the orchard which proves the viability of the high density orchards. This shows tremendous increase in net income by use of high density orchard system using canopy management, mulching and fertigation. The technology has gained popularity amongst the farmers across the Jammu sub-tropics. Eight training programmes were undertaken on farmers' fields' at different locations from the initial year of layout and planting to after care of orchard establishment of high density guava plantation. In Jammu Province area under guava high density plantation has increased significantly and the present area brought under guava and others crops under high density plantation is 47.63 hectares.

Key words: Guava, Technology Transfer, Planting density**,** Yield.

PP 13: Management of Cercospora Leaf Spot (*Cercospora grewiae*) Disease in Phalsa

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Phalsa (*Grewia asiatica* L.) belongs to the Family Tiliaceae is an important fruit crop successfully grown in rainfed sub-tropics of Jammu and Kashmir. The plants are shrub in nature and attaining the height of 2.0 meter.

Fruiting and flowering occurs on new shoots so, it requires every year severe pruning in the month of December. In recent past, its cultivation increasing day by day as a sole crop and intercropping between the rows of fruit orchards among the fruit growers of rainfed areas. Diseases are one of the major threats for its cultivation among the diseases, Cercospora leaf spot (*Cercospora grewiae* Srivastava and Mehta) and Phyllosticta leaf spot (*Phyllosticta grewiae*) are the important one. Out of leaf spot diseases, Cercospora leaf spot are frequently occurred in the seed ling stage with the severity of 34.5%. The disease is characterized by tiny lesions on both the side of the leaves which later get covered with a white crust of the fungal growth. These patches rapidly enlarge and turn blackish in centre. Gradually the black growth becomes cushion-like consisting of mycelium and spores. An experiment was conducted during 2016-17 and 2017-18 rainy season in randomized block design for the management of leaf spot disease in phalsa at seedling stage. where in, four fungicides ***i.e.*** copper oxychloride (0.25%), carbendazim (0.1%), (0.2%), mancozeb (0.25%), saff (mancozeb + carbendazim) (0.25%) along with two plant extracts i.e. Drake seed kernel extract (DSKE 4.0%) and Neem seed kernel extract (NSKE 4.0%) were tested for their efficacy to manage the leaf spots diseases in phalsa The fungicides and plant extracts were sprayed twice at 15 days interval after appearance of the disease in the first week of august after appearance of the disease. The fungicide saff (0.25%) was found most efficacious in reducing the disease severity (48.0%). It was followed carbendazim (36.5%).

Key words: Phalsa (*Grewia asiatica*), leaf spot diseases and management

PP 14: Promotion of ber (*Zizyphus mauritiana* Lamk.) in kandi areas of Jammu subtropics

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Ber (*Zizyphus mauritiana* Lamk.) is one of the most ancient and common fruit indigenous to India and belongs to family Rhamnaceae. Ber is perviously recognised as poor man's fruit, also designated as "King of Arid Fruits" owing to fact that it can be grown in unproductive, waste, marginal or inferior soil with pH as high as 9.0 in arid and semi-arid regions which are characterised by extreme variations of diurnal annual temperatures and high evaporations coupled with spare and highly variable precipitations. In Jammu and Kashmir, 60 percent of the area is rain fed which is locally called 'Kandi' belt. Ber can withstand extreme stress caused by drought, salinity, and in some cases waterlogging. Ber is thus ideal and has vast scope for planting in sites unfit for other crops. Ber provides permanent cover to the soil, with the abundant and deep root system helping to maintain soil structure. It is found growing wild as well as in cultivated forms throughout the warmer regions upto an altitude of 1500 metres above mean sea level. The fruit contain Tannins, Mucilage, Reducing sugar, Organic acids (Ascorbic, Tartaric acid and Citric acid). Ber gives a deep insight of its origin, traditional importance, physico-chemical properties and uses. The fruit is eaten raw, dry or fresh and it can be processed into various products which include non-alcoholic and alcoholic beverages, traditional cake, porridge and jam. These products are highly nutritious and boon for undernourished mass. This fruit plays an important role in food security and poverty alleviation. Trees in northern India yield 80 to 200 kg of fresh fruit/tree/year when the trees are in their prime bearing age of 10–20 years. Therefore, it can be an alternative source of livelihoods of people leaving in arid and semi-arid areas. Income from these fruits can be improved through value addition.

Key words: *Zizyphus mauritiana*, ber

PP 15: Effect of plant growth regulators on strawberry regeneration

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An investigation to study the effect of two PGR's viz Gibberellin and Benzyladenene on regeneration of strawberry runners, was carried out during 2012-2013 in the experimental farm of Division of Fruit Science, Faculty of Agriculture, SKUAST-J, Udheywalla, Jammu. The results revealed that the application of plant growth regulators enhanced the runner production in strawberry. Among the treatments, the treatment T_{15} (GA_3 300 ppm + BA 150 ppm) was found superior in runner production in terms of no. of runners/mother plant (13.53), no. of train/mother plant (4.10), no. of runner/train (3.30), plant spread per mother (34.02 cm), plant spread per runner (10.83 cm), no. of leaves per mother plant (22) and no. of leaves per runner plants (7.29). The maximum plant height per mother plant (23.29 cm), plant height per runner (10.88 cm), petiole length per mother plant (19.1 cm), petiole length per runner plant (10.70 cm) and root length per runner plant (5.90 cm) were recorded under treatment T_1 (GA_3 100 ppm). The treatment T_{16} (control) recorded maximum crown diameter (6.92 mm), crown weight (0.66 g) and leaf area (16.57). From the present investigation it was concluded that application of plant growth regulators enhanced the regeneration capacity of strawberry runners and the treatment T_{15} (GA_3 300 ppm + BA 150 ppm) was found superior in runner production and this treatment gave highest cost benefit ratio (1:2.85) as compared to other treatments.

Keyword: Strawberry, gibberellic acid, benzyladenine

PP 16: Productivity enhancement through high density planting in apples

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Apple cultivars Oregon Spur, Red Chief, Red Fuji, Starkrimson, Royal Delicious, Red Delicious, and Lal Ambri on MM-106 rootstock of apple were planted at a spacing of 2.5mx2.5m at Regional Horticultural Research Sub-station, Bhaderwah in order to determine if high density plantings (HDP) would be appropriate for apple cultivation in temperate areas of Doda district. Plant survival, plant height, girth, spread, flowering, fruit set and quality and yield were studied and it was observed that annual pruning, irrigation management and pollination improves the quality and yield of apples under high density planting. Flowering and fruit setting began in Oregon Spur, Red Fuji, Starkrimson and Lal Ambri after three years while in rest cultivars after four years. In general, all cultivars performed well in a HDP system and began crop early. The framework of trees under high planting density performed better than traditional planting density and increases the yield of the trees over the control. The experiment indicated that successful management of apple trees in high density planting system depends on maintaining a balance between vegetative growth and fruiting. A light annual pruning results in trees to maintain balance of vegetative vigour and produce heavy annual crops. It showed that pruning and crop load management are the primary management tools along with fertilizer application that can be used to achieve increased yield and tree growth in apples. The results also showed that irrigation and pollination management increased yield as compared to the un-irrigated and un-pollinated treatments.

PP 17: Ambri apple variants in Doda district of Jammu and Kashmir in India

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Ambri apple is the most popular variety of apple in India grown in Himalayan region. This variety of apple is considered to be indigenous to Jammu and Kashmir and erstwhile Doda district has naturally growing ambri apple variants with distinguished features. Survey of Ambri apple variants growing in Doda, Kishtwar and Ramban districts revealed that this apple variety has superiority by virtue of its crisp, sweet flavour and excellent aroma. Ambri apple is blush red and slightly striped. The fruit size is medium and shape varies from oblong to conical. This apple varietyripe during September and can be harvested till October in Doda, Kishtwar and Ramban districts. It has a longer shelf life and is an excellent dessert variety.

PP 18: Effect of bagging and fungicide application on post-harvest quality of mango (*Mangifera indica*)

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Mango is an important fruit crop of India and its post harvest quality plays a significant role in increasing its shelf-life. In this research pursuit the pre-harvest study was conducted in an experimental orchard and post harvest study in the laboratory of Department of Horticulture to investigate the effect of bagging and fungicide on post harvest quality of mango under ambient conditions. The maximum delay in ripening was observed with bagging of fruits by brown paper + foliar application of 0.05% carbendiazim (3.04days) followed by bagging of fruits by brown paper+ no foliar application of 0.05% carbendiazim(2.76days). the maximum level of total sugar, total soluble solids, organoleptic quality, no skin shriveling, minimum decay loss and minimum acidity were recorded in fruits treated with bagging of fruit by brown paper + foliar application of 0.05% carbondiazim. Poorest organoleptic quality, fruit skin colour with maximum shriveling and highest decay loss was observed in fruits with bagging (transparent polythene) with or without foliar application of 0.05% carbondiazim. Based on the results obtained from present study, it may be concluded that pre-harvesting bagging of fruit by brown paper + foliar spray of 0.05% carbondiazim was found to be most significant in enhancing the fruit quality of mango.
Keywords: Bagging, fungicide, post-harvest, pre-harvest, foliar spray

Food Science and Technology

OP 1: Utilization of walnut kernels for development of value added products

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Walnuts are commonly referred as ***AKHROT*** in India and we consume walnuts in daily life. Walnuts contain a number of neuroprotective compounds including vitamin E, folate, omega-3 fats and antioxidants that support brain health, protects heart and improves digestive system. Globalization has changed the economic, political, social and cultural system of nations across the globe. Phenomenon like urbanization, growing middle class, westernization, working parents etc. has contributed to the fast growth of walnut processing industry. There is a lot of interest in nuts globally and demand for walnut kernels is increasing and a lot more potential for value added products Presently in Jammu and Kashmir walnuts are mostly consumed as fresh in the form of walnut kernels and some broken kernels are being used by baking industry for development of walnut pastry, a novel product of Kashmir. A study was carried out to develop products using broken kernels viz. roasted walnuts, honey dipped walnuts, and honey glazed walnuts and jaggary walnuts and walnut dates bar. The sensory scores on basis of colour, flavour, taste, body and overall acceptability was judged on five point organoleptic scale. The results revealed that all the products developed were highly acceptable. Further research on physio-chemical and storage stability is undergoing in Ail India Coordinated Research project on "Studies on value addition of walnut kernels". Jammu and Kashmir produces some 3.5 lacs quintals of walnut every year thus contributing around 98 percent of the total walnut output in India. Of this, The Kashmir valley alone produces 95 percent and the rest is grown in Doda and Kishtwar districts of the Jammu region. Conversion of crop into value added product will improve economic returns of both grower and processor. Farming community as well as food processors will be benefitted by value added walnut products development technologies leading in reduction of wastage in walnut processing industry.

Keywords: Walnut, antioxidant, value addition, broken kernels and processing industry

OP 2: Antimicrobial activities of crude aqueous extracts of some Indian medicinal plants

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The present investigation was carried out at Division of Dairy Microbiology, ICAR-National Dairy Research Institute, Karnal, Haryana, India to access the antimicrobial activities of crude aqueous extracts of five Indian medicinal plants including leaves of *Moringa oleifera, Azadirachta indica*, *Caricapapaya*, stem and bark of *Tinospora cordifolia*, and rhizomes of *Curcuma longa.*Antimicrobial activity was determined *in vitro*by agar well diffusion-method against six pathogenic bacteria. The target bacterial species were *Escherichia coli*, *Proteus* spp., *Enterococcus faecium*, *Enterococcus faecalis*, *Staphylococcus aureus* and*Streptococcus agalactiae.* Leaves of *Moringa oleifera, Azadirachta indica* and *Carica papaya*, stem andbark of *Tinospora cordifolia*, and rhizomes of *Curcuma longa* were collected, washed, dried, pulverized and stored at 4°C. Dried powder of selected plant tissues/parts were soaked in distilled water (1:5 ratio) and incubated at 55°C for overnight and filtered to collect the aqueous extract. The filtrate was centrifuged and aqueous extract was obtained. The antibacterial activity measured as a zone of inhibition (in mm) for *Tinospora cordifolia* extract against *E. coli, Proteus spp., E. faecium, E. faecalis, S. aureusand S. agalactiae* was 5.00±0.70, 11.75±0.62, 7.00±0.40, 7.75±0.25, 4.75±0.85, and 5.00±0.70, respectively. Extract of *Moringa oleifera* exhibited a zone of inhibition (mm) of 7.50±1.04, 12.75±0.85, 10.25±0.62, 10.25±0.85, 8.75±0.47, and 8.50±1.25, respectively against bacterial species mentioned. Similarly, the zone of inhibition measuring (mm), 9.00±0.81, 10.00±1.08, 9.00±0.57, 8.00±0.40, 9.00±0.81, and 4.25±0.62 was found against respective bacterial species for *Azadirachta indica* extract. In the same way, *Carica papaya* was seen to exhibit antimicrobial activity against the bacterial species mentioned to an extent of 7.00±0.40, 11.50±0.86, 8.25±0.47, 7.00±0.91, 6.75±0.85, and 7.75±0.47 mm zone of inhibition, respectively. Similarly, the zone of inhibition (mm) for *Curcuma longa* was measured to be 6.50±0.28, 4.75±0.85, 3.50±0.64, 4.25±0.85, 3.50±0.28, 3.25±0.25, respectively against *E.coli, Proteus spp., E. faecium, E. faecalis, S. aureus and S. agalactiae*. *M. oleifera* and *A. indica* plant aqueous extracts were seen to possess comparatively higher antibacterial activity. The current investigation supports the belief that these plants are sources of antibacterial agents.

Keywords: Antimicrobial, Plant extracts, Bacteria, Zone of inhibition

OP 3: Standardization of digestion procedure and the Effect of cooking on amylose content of RIL's bamati rice by spectrophotometry

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Amylose content of rice is considered to be the most important characteristic for predicting its cooking and processing properties. It is commonly used as an objective for cooked rice texture. Low amylose levels are associated with cohesiveness, tenderness, and glossiness of cooked rice. Conversely, high levels of amylose cause rice to absorb more water and consequently expand more during cooking, and the grains tend to cook dry, fluffy, and separate. In diabetes type 2, there is a deficiency of insulin which results in improper/ slow breakdown of food. This results in sugar level spikes immediately after a meal, which can be harmful. Hence, diabetics must have food stuffs which have a slow release rate so as to not cause any spikes. In order to find out the most suitable method of cooking rice for diabetic patients, we found out the amylose content of rice cooked by different methods and co-related it with Glycemic Index (GI). Glycemic Index is release of glucose in the blood by the breakdown of carbohydrates. Higher the glycemic index, faster breakdown of food and thereby more release of glucose in the blood, so immediate requirement of insulin, which can be toxic for diabetic patients. Glycemic index and amylose content are inversely proportional to each other. There is a wide variation in the amylose content of rice depending on the way it is cooked. In this study, an attempt was made to assess the total amylose content giving overnight digestion, using different glass containers and the effect of cooking on amylose content of rice is described using various experimental approaches.

Keywords: Glycemic Index, amylose, diabetes type 2, insulin, cohesiveness.

OP 4: Effect of Ohtmic Heating Assisted Lye and Salt Concentration on Peeling Quality of Tomato

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The peeling qualities of tomato by using ohmic heating assisted lye-salt concentrations were investigated. The principle of ohmic heating is dissipation of electrical energy into heat which results in internal energy generation. The other methods of peeling are possess various disadvantages which include use of caustic, high pH, problem of waste disposal, high pressure and energy and excessive use of water with the latter. In this study, ohmic peeling was attempted to potentially address these problems. The peeling performance of final product was evaluated in terms of time of skin cracking, percentage of peeling and ease of peeling. When the lye-salt concentration of the medium increased, the heat generation in the medium would be quicker due to higher electrical conductivity. The wax melting would accelerate, resulting in low process time. In terms of time of cracking, the best performance of ohmic treatment was obtained at 0.3% NaOH concentration at 1214.28 V/m. The condition showed the probable to be good for processing because they required a relatively short time (less than 60 s, approximately). Moreover, the potential to preheat the media to 60 ºC with reusable media could further shorten the peeling time. Ohmic tomato peeling treatments with NaOH (0.1, 0.2 0.3 and 0.4%) were better than those by ohmic heating with either NaCl or KOH, in terms of quality of peeling.

Keyword: Ohmic heating, lye and salt concentrations, field strength, peeling.

OP 5: Functional oligosaccharides: Application and Manufacture

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Modern consumers are increasingly interested in their personal health, and expect the foods they eat to be – beyond tasty and attractive – also safe and healthy. As interest in the link between diet and health gathers pace, many consumers seek ways to feel well and stay healthy by eating nutritionally designed foods. Non-digestible carbohydrates such as dietary fibers, oligosaccharides, and resistant starch have various physiologic functions and the promotive effects of many non-digestible carbohydrates on well-being, better health and reduction of the risk of diseases have been well examined. Among non-digestible carbohydrates, the functional oligosaccharides present important physicochemical and physiological properties beneficial to the health of consumers, and for this reason, their use as food ingredients has increased rapidly. The functional oligosaccharides are intermediate in nature between simple sugars and polysaccharides and are claimed to behave as dietary fibres and prebiotics. These compounds as non-absorbable food ingredients are microbial food supplements and may benefit the host by selectively stimulating salutary bacteria in the large intestine. They can be extracted or obtained by enzymatic hydrolysis from a variety of biomass sources or synthesized from simple oligosaccharides by

enzymatic transfer reactions. The best known functional oligosaccharides include fructooligosaccharide, glucooligosaccharides (GOS), isomaltooligosaccharides, soybean oligosaccharides, xylo-oligosaccharides and maltitol. The functional oligosaccharides of various origins (viruses, bacteria, plants and fungi) have been used extensively both as pharmacological supplements, food ingredients, in processed food to aid weight control, to regulation of glucose control for diabetic patients and reducing serum lipid levels in hyperlipidemics. Moreover, consumption of the functional oligosaccharides reduces the risk of civilization diseases such as cardiovascular disease, colon cancer, obesity, inflammatory bowel disease (IBD), acute infections, and mineral absorption. There is a market for the functional oligosaccharides that assist in constructing a healthy diet, and also for foods directly targeted to certain risk groups. In addition, the functional oligosaccharides are also used in feeds, pharmaceuticals, or cosmetics as stabilizers, bulking agents, immunostimulating agents or prebiotic compounds.

Keywords: Functional oligosaccharides, prebiotics, dietary fibre, colonic microbiota, hyperlipidemics

OP 6: Studies on extraction of biocolours from horticultural crops

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There is an increasing interest in anthocyanins, as natural food colorants, in food products and also in pharmaceutical products due to their antioxidative potential. Natural organic pigments are generally extracted from fruits, vegetables, seeds, roots and microorganisms. Anthocyanins are polyphenolic group of compounds which have been named vitamins of the 21 st century due to their impressive medical and health benefits. Anthocyanins are used to color a number of foods, including gelatin desserts, fruit fillings and certain confectionaries. Generally for maintenance of good manufacturing practices, level of anthocyanin is used as an indicator to evaluate the quality of colored food. The present study deals with extraction of anthocyanins from karonda pomace. The fresh karonda (*Carissa carandas*) fruits are generally not consumed due to highly acidic and astringent properties . Karonda is a widely used medicinal plant by tribals throughout India and popular in various indigenous system of medicines like ayurveda, unani and homoeopathy and is a good appetizer. Peel is rich in anthocyanins and can be utilized for extraction of biocolours. For extraction of biocolours, pomace of karonda fruits was subjected to different treatments i.e., pectinase enzyme, microwave assisted treatments and various solvents for extraction of anthocyanins. Highest anthocyanin content of 220.76 (mg / 100 g) was observed in solvent extraction by using ethanol 50 % + citric acid 0.1 % and it showed highest L*, a* and b* values as 11.27, 20.36 and 6.44 respectively. It was followed by microwave assisted extraction for 30 seconds (213.0 (mg / 100 g) whereas in control it was 189.03 (mg / 100 g).

OP 7: Biological and therapeutic properties of aloe vera

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Aloe vera (*Aloe barbadensis* Miller) a cactus-like, is an important medicinal plant belonging to family Lilliaceae. Aloe vera gel is derived from the leaf pulp of the plant has become a big industry worldwide in the food industry, due to its application as it is utilized in functional foods especially for the preparation of health drinks. Aloe vera is considered to be the most potent, important and the most popular plant in the research field. Various parts of the plant contain 200 active compounds including amino acids, saponins, sugars, vitamins, enzymes, minerals, anthraquinones, lignin and salicylic acid, as well as 75 nutrients. Aloe vera is a useful source of vitamins. Aloe vera gel has a bitter taste due to presence of aloin which can be unpleasant in raw state and its palatability could be enhanced with addition of some other fruit juices. The biological activities of aloe leaf extracts are more likely due to a synergistic action of the compounds rather than a single compound. Aloe vera possess numerous activities including, anticancer, antiallergic, antioxidant, antimicrobial, hepatoprotective, anti-inflammatory, immunomodulatory, antiulcer and antidiabetic. Some of these activities are due to the presence of polysaccharides (acemamman; glucomannan). Acemamman (acetylated gluconmanan) is a polysaccharide rich in mannose units located within protoplast of the parenchymatous cells that improves wound healing, modulates immune function and antiviral effects. Glucomannan is another polysaccharide that can be found in aloe vera. This is a good moisturizer and it is used in cosmetics. It has been reported that aloe vera is used in medicine to cure eczema, arthritis diabetes, and is said to prevent infection. It also improves human's immune system defiencies, constipation and digestive system. Other uses include seborrheic dermatitis, thermal burns and sunburn, cystic acne, peptic ulcers, amputation stump ulcers, lacerations, colds, tuberculosis, gonorrhea, asthma, dysentery and headaches. It has been used as laxative and insect repellent. Presently, the use of aloe vera has gained recognition because of herbal movement initiated by naturopaths, yog gurus, alternative medicine promoters and holistic healers. Now-a-days aloe vera juice is available in the market to enhance immune response against various diseases. A few products are Aloe sports drink, Yoghurt drinks with aloe pieces, Aloe jelly desserts with chunks of aloe, Aloe sherbets with citrus juice, Aloe fruit smoothies and Aloe concentrates *etc.*

Key words: Aloe vera, Composition, Biological Activities, Functional Food, Polysaccharide, Medicinal Properties

OP 8: Thermosonication Technology and Its Application in Food Industry

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Nowadays, consumers prefer nutritious and safe food products having natural taste and freshness. It is known that traditional thermal techniques can extend the shelf life of food products and their safety, but they cause loss in nutritional parameters. Thermosonication (TS) is an emerging non thermal processing technique used for food. It is a combined method of thermosonication and heat. The product is subjected to ultra-sound and moderate heat simultaneously and they both together have some synergistic effect. It is a form of energy generated by sound waves of frequencies that are greater than the upper limit of human hearing range, typically above 20 kHz. By coupling thermosonication with thermal treatment, increased levels of microbial kill and enzyme inactivation can be achieved while minimizing changes to the organoleptic properties of foods. The advantages of sonoprocessing over thermal treatment are minimal flavour loss, significant energy saving and greater homogeneity. This method produces a greater effect on inactivation of microorganisms than heat alone. When thermosonication is used for pasteurization or sterilization purpose, lower process temperatures and processing times are required to achieve the same lethality values as with conventional processes. The enzymes and microbial inactivation by thermosonication treatment is attributed to heat and cavitation, which is the phenomenon of formation, growth and explosion of bubbles in a liquid. During implosion, very high temperatures (approximately 5000 K) and pressures (estimated at 50000 kPa) are reached inside these bubbles. The explosion leads disruption of cell wall of micro-organisms causing their death. The process of thermosonication is used for extending the shelf life of liquid food like fruit juices.

Key Words: Thermosonication, cavitation, microbial inactivation, enzymes inactivation

OP 9: Oscillating Magnetic Field and Its Application in Food Industry

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Consumer expected that the food they consume have high nutritional value with minimal preparation time and safe to eat. In order to meet these demands, food manufacturers are looking for new methods and technologies. A new technology which may meet manufacturers needs is oscillating magnetic field. It involves exposure of foods to magnetic field pulses with a frequency between 5 to 500 kHz at temperatures in the range of 0 to 50°C for a few milliseconds. A magnetic field is generated when an electric current flows through a coiled wire. The magnetic field intensities that are able to inactivate microorganisms range from 5 to 50 T. Magnetic field of this density can be generated by using superconducting coils, coils that produce DC fields and coils energized by the discharge of energy stored in a capacitor. Magnetic field classified into different types -low intensity and high intensity, homogenous or heterogeneous in nature, static or pulsed field. OMF may have some potential to inactivate microorganisms in food. The inactivation mechanisms involves two theory. The first theory stated that a "weak" Oscillating Magnetic Field could loosen the bonds between ions and proteins. A second theory considers the effect of magnetic field on calcium ions bound in calcium-binding proteins, such as calmodulin. Another theory involve beaking of covalent bonds present in nucleic acids or change in its orientation. It is a new kind of physical cold sterilization technology exhibiting various advantages over other processes are low temperature rise of material, low power consumption, high efficiency, easy control over process, strong penetrating ability. The process is useful for processing of solid food, liquid food and food in flexible packages. The food involve use of oscillating magnetic field for inactivation of microorganisms includes milk, yogurt, orange juice, and bread roll dough.

Keywords: oscillating magnetic field, pulsed field, calmodulin, microbial inactivation

OP 10: Probiotic potential of lactic acid bacteria isolated from different sources of food and milk products

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Probiotic are the live bacteria and yeast that are good for health, especially for our digestive system. Probiotic must compete with thousands of species already in the gut. In the present study total six isolates were isolated from different food (Dosa batter, Chocolate and Pickle)and milk products (Curd, Cheese and Kaladi). These isolates were studied for their antimicrobial property and Probiotic potential. The result revealed that out of six isolates, five isolates viz L1, L2, L3, L4 and L5 had good antimicrobial potential against human pathogens (*E.coli*, *P.aerugonisa* and *S.typhi*) and among them L1 with 41.00mm, 39.00mm and 45.00mm respectively showed significant potential followed by that of L2 with 38.00mm, 26.00mm and 28.00mm respectively. Further all these isolates were

evaluated for their probiotic potential viz, pH tolerance, bile salt tolerance, temperature sensitivity, lactose utilization and NaCl tolerance and the result showed that all the isolates isolated from curd (L1), Cheese(L2), Kaladi(L3), and Dosa batter(L4) showed good probiotic potential than the isolates from chocolate and pickle. Morphological and biochemical studies revealed that all the isolates had characters similar to genus Lactobacilli. This study concluded that the isolates L1 and L2 had best antimicrobial and probiotic potential and these isolates can be further studied for their identification at species level and bioactive antimicrobial compounds.

OP 11: Post harvest management of losses in horticultural crops

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Losses of horticultural produce are a major problem in the post harvest chain. They can be caused by a wide variety of factors, ranging from growing conditions to handling at retail level. Agriculture ministry says that 25-30 per cent of fruits and vegetables in India are wasted. Not only are the losses clearly a waste of food, but also represents a similar waste of human effort, farm inputs, livelihood, investments and scarce resources such as water. Many practices can be adopted to control post harvest losses. Initially postharvest handling operations such as precooling, sorting, grading, pretreatment etc are very important. Dehydration of fruits and vegetables is one of the oldest form of food preservation and till today it is widely adopted .Dehydration of fruits and vegetables also lowers the cost of packaging, storing and transportation by reducing both the weight and volume of the final products. Now a days technology of postharvest management is growing up day by day and many advances are made in storage as well as packaging of fruits and vegetables. Modified atmospheric storage, controlled atmospheric storage, vaccum storage etc. very helpful to extend storage life. A cold chain is a temperature controlled supply chain .An unbroken cold chain is another uninterrupted series of storage and distribution activities which maintains a given temperature range favouring storage life.

OP 12: Studies on the influence of fortification with pomegranate peel and seed powder on the physico-chemical, functional and shelf life characteristics of *dahi*

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Dahi with added antioxidants from natural sources appears to be a convenient food format to satisfy consumer interest in original *dahi* nutrients, beneficial effects of starter cultures, and health benefits of added antioxidants. It was with this background that the current study was undertaken to evaluate the effect of fortification with pomegranate peel powder and pomegranate seed powder on the quality of functional *dahi*. The study revealed that pH, moisture and ash was higher for pomegranate peel powder while protein and fat content was higher for pomegranate seed powder. The total phenolic content and in turn the antioxidant activity determined by two different methods was significantly higher ($P<0.05$) for peel powder than that of seed powder. Water holding capacity of peel powder was significantly higher ($P<0.05$) than that of seed powder. Emulsifying capacity and emulsion stability of seed powder was significantly better ($P<0.05$) than that of peel powder. The *b** coordinate was significantly higher ($P<0.05$) for peel compared to seed powder. The results revealed that with the increase in the incorporation levels of fortificants, there was a significant decrease ($P<0.05$) in the physico-chemical quality and sensory appraisal of *dahi*. Results were comparable with control up to 0.5% level of peel and seed powder fortification. Based on the these results 0.5% pomegranate peel powder and 0.5% pomegranate seed powder was selected as optimum level for fortification and comprehensive quality attributes of functional *dahi* along with control were studied. The results indicated that fortification upto a level of 0.5% had no significant effect ($P>0.05$) on the physico-chemical quality, textural attributes, colour coordinates and sensory appraisal of the functional *dahi*. However, the total phenolic content and antioxidant activity was significantly higher ($P<0.05$) in peel powder fortified *dahi* followed by seed powder fortified *dahi* and lowest in control. Functional *dahi* fortified with 0.5% pomegranate peel powder or 0.5% pomegranate seed powder could be stored for 28 days at 4±1°C without any appreciable loss of quality and acceptability.

Key words: Antioxidant activity, *Dahi*, Functional foods, Pomegranate, Peel, Seeds

PP 1: Formulation and Nutritional Evaluation of Weaning Food Prepared from Composite Flours

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Malnutrition is one of the major public health problems among children in developing countries. It affects the child at the most crucial period i.e. stage of development, which can lead to permanent impairment in later life. The objective of this study was to formulate composite weaning foods using different blends of brown rice, mungbean, apple pulp powder and walnut powder to meet the nutritional requirement of infants. The weaning foods were developed in the ratios of 100:0:0:0:brown rice: mungbean: apple pulp powder: walnut powder, 85:5:5:5: brown rice: mungbean: apple pulp powder: walnut powder, 80:10:5:5: brown rice: mungbean: apple pulp powder: walnut powder, 75:15:5:5:brown rice: mungbean: apple pulp powder: walnut powder, 70:20:5:5: brown rice: mungbean: apple pulp powder: walnut powder, 65:25:5:5: brown rice: mungbean: apple pulp powder: walnut powder and 60:30:5:5: brown rice: mungbean: apple pulp powder: walnut powder. The blended mixtures of each treatment were packed in aluminium laminates and stored for a period of 6 months at ambient temperature (32 ± 2^0C). The prepared formulations were investigated for antinutritional factors, beta carotene, vitamin A, minerals and overall acceptability. The highest mineral content (iron 5.42 mg/100g and calcium 77.79 mg/100g) was observed in T_7 (60:30:5:5:BR:MB:APP:WP) and the lowest iron content of 3.09 mg per 100g and calcium content of 46.62 mg per 100g were recorded in treatment T_1 (100:0:0:0:BR:MB:APP:WP). The beta carotene, vitamin A and phytic acid content increased with increase in proportion of mungbean flour. The highest beta carotene content of 7.19 (µg/g), vitamin A of 11.99 (I.U) and phytic acid content of 176.08 (mg/100g) were recorded in treatment T_7 (60:30:5:5:BR:MB:APP:WP). The highest oxalate content of 35.99 mg per 100g was recorded in treatment T_1 (100:0:0:0:BR:MB:APP:WP) and the lowest oxalate content of 28.49 mg per 100g was recorded in treatment T_7 (60:30:5:5:BR:MB: APP:WP). However, sensory evaluation of weaning foods revealed that T_5 (70:20:5:5: BR:MB:APP:WP) recorded highest mean score for overall acceptability (7.68) and was recommended for weaning food formulation. The product could be served in the form of porridge with water/milk. The study has shown a way for effective utilization and value addition to locally grown food commodities.
Keywords: Weaning food, brown rice, mungbean, apple pulp powder and walnut powder.

PP 2: Assessment of Biochemical Characteristics of Foam Mat Dried Apricot Powder

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The foam mat drying is a good way of dehydrating liquids foods in short times due to the porous structure of the foamed materials. This technique can be successfully employed for drying a variety of fruit juice concentration and pulps. The study was carried out for the production of apricot powder using glycerol mono-stearate and egg albumin as foaming agents followed by drying at temperature 65ºC. Apricot pulp was foamed by incorporating glycerol mono-stearate (1, 2 and 3%) and egg albumin (5, 10 and15%) as foaming agents and dried at air temperature of 65°C in a batch type cabinet dryer. The maximum stable foam formation was 94.34 per cent at 15 per cent egg albumin with whipping time of 20 min. The drying time required for foamed apricot pulp was lower than non-foamed pulp at selected temperature. Biochemical and sensory properties of fresh apricot fruit and reconstituted juice from foam-mat dried apricot powder were determined. The results showed a significant ($P\leq0.05$) increase in the mean values of beta carotene content (23.037 to 29.838%), antioxidant activity (29.994 to 38.639%), crude protein content (2.845 to 12.048%), total phenolic content (19.020 to 28.005%) with increase in the concentration of foaming agents. However, the values of these parameters decreased with increase in the storage period. On the basis of sensory evaluation, the highest overall acceptability scores were recorded for apricot powder having 10 per cent egg albumin.
Keywords: Foaming, Glycerol mono-stearate, Egg albumin, Apricot.

PP 3: Probiotic potential of lactic acid bacteria isolated from different sources of food and and milk products

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Probiotic are the live bacteria and yeast that are good for health, especially for our digestive system. Probiotic must compete with thousands of species already in the gut. In the present study total six isolates were isolated from different food (Dosa batter, Chocolate and Pickle)and milk products (Curd, Cheese and Kaladi). These isolates were studied for their antimicrobial property and Probiotic potential. The result revealed that out of six isolates, five isolates viz L1, L2, L3, L4 and L5 had good antimicrobial potential against human pathogens (*E.coli*, *P.aerugonisa*

and *S.typhi*) and among them L1 with 41.00mm, 39.00mm and 45.00mm respectively showed significant potential followed by that of L2 with 38.00mm, 26.00mm and 28.00mm respectively. Further all these isolates were evaluated for their probiotic potential viz, pH tolerance, bile salt tolerance, temperature sensitivity, lactose utilization and NaCl tolerance and the result showed that all the isolates isolated from curd (L1), Cheese(L2), Kaladi(L3), and Dosa batter(L4) showed good probiotic potential than the isolates from chocolate and pickle. Morphological and biochemical studies revealed that all the isolates had characters similar to genus Lactobacilli. This study concluded that the isolates L1 and L2 had best antimicrobial and probiotic potential and these isolates can be further studied for their identification at species level and bioactive antimicrobial compounds.

PP 4: Correlating lycopene and moisture content in dried tomatoes using image processing technique

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Omatoes (Lycopersicon esculentum) are food staples that contain high levels of lycopene, a red caratenoid thought to provide a health benefit and is responsible for the deep red colour of ripe tomatoes. Appearance and colour of tomatoes are the critical factors for acceptance of food item by the consumer. The conventional method for the measurement of Colour like Minolta chromameter, and Dr. Lange colorimeters are based on surface characters which makes the measurements obtained quite unrepresentative and furthermore the global analysis of food's surface becomes more difficult. This study presents a method based on computer vision system to measure the colour of tomatoes during drying and to correlate this colour with lycopene and moisture content of tomatoes. The colour was also measured by using Hunter lab colorimeter and then correlated with lycopene and moisture content. L*a*b* colour space was used due to the uniform distribution of colours, and because it is very close to human perception of colour. The results indicated that L*a*b* values obtained by Hunter lab and by analysing the images using image processing showed a significant decrease during drying. The regression of moisture content produced reasonably a good correlation with experimental results of moisture content. The correlation of lycopene was also good with experimental results of lycopene content

PP 5: Nutritional value, Potential and Phytochemical properties of Underutilized fruits in the Jammu Subtropics

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The underutilised fruits including Bael, Jamun, Karonda, Ber, Phalsa, Custard Apple and Wild Pomegranate are fruits widely found in the *kandi* area of Jammu. . These fruits have the potential to cut to the great problems in rural development, hunger, malnutrition, and gender inequality, however, they are under exploited and not fully utilised. Bael, Jamun, Karonda, Ber, Phalsa, Custard Apple and Wild Pomegranate trees are drought resistant or tolerant plants. Therefore, the domestication of the underutilised fruits found in the Jammu subtropic region could be considered to be a sustainable solution to enhance the fruit availability, thereby increasing the food security since the global warming currently affects the food production. . The fruits are rich in macronutrients, micronutrients, and dietary phytochemicals and have several health benefits. Recent consumers' preference and acceptability for naturally processed, additive-free, safe and yet palatable products are unprecedented. These have been attributed to the toxicity concern, carcinogenicity nature and legislative rules on synthetic antioxidants such as synthetic antioxidants such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), which are being widely used as food additives to prevent oxidative deterioration of food products. In addition to this, underutilized fruits are known to produce a variety of antioxidants, which militate against cellular oxidative damage through the removal of reactive oxygen species (ROS) and reactive nitrogen species (RNS), both in food and human body, by delaying the oxidation process and also inhibiting the polymerization chain reaction initiated by free radicals. High polyphenol intake from fruits and vegetables has also been associated with decreased risk for cardiovascular disease and other developing degenerative diseases, as suggested by several epidemiologic and intervention studies. This is because fruits and vegetables contain antioxidant compounds, such as flavonoids, carotenoid, and polyphenols, which have protective effects to human body. These compounds help our body to balance out the ratio with free radical by scavenging free radicals, decomposing peroxides, and making complex of redox-catalytic metal ions. The role and significance of lipid peroxidation in food deterioration have also led to the growing interest in the study of antioxidants. Having a wide degree of adaptability with high degree of tolerance, they can thrive well under adverse climatic conditions. These fruits also serve a potentiality in sustainable agriculture. Hence, research and development work, awareness to farmers and feasibility for the cultivation of underutilized fruits must be given due consideration.

Keywords: Underutilised fruits, phytochemicals, antioxidants, mirconutrients, CVD'S.

PP 6: Functional Food Products from fruit and vegetable wastage

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Large amount of food wastes or by-products are generated from the food industry annually around the world from a variety of sources. By-products are an excellent source of nutraceuticals, bioactives, inherently functional and possess many components that are good for human health. By-products converted to the functional food ingredients is the healthy trend in the food industry. The concentrations of phenolics and other phytochemicals present in the peels, pulp/pomace and seeds of many fruits and vegetables namely citrus, apples, peaches, pears, banana, pomegranate, berries, mangoes, onions, potatoes, tomatoes and sugar beet are generally substantially higher than in their respective edible tissues, suggesting these wastes and residues to be the potential sources for isolating bio-active compounds. The phenolics and flavonoids present in apple, date pit, rambutan (Nephelium lappaceum) peel, tomato peel extracts strongly inhibit tumour-cell proliferation. Penta-O-galloyl-glucoside (PGG) present in mango seed kernel extract and mango peel is used in pharmaceutical industries as it possesses anti-tumor, antioxidant, anticardiovascular and hepato-protective effects. Pomace of apple, pear, orange, peach, blackcurrant, cherry, artichoke, asparagus, onion, raspberry, tomato and carrot, durian seeds (gelling and thickening agents), mango peels, date pits, cauliflower trimmings, empty pea pods and okara are used as dietary fibre supplements and as a functional ingredient in processed food products due to the presence of pectins and carotenoids and bound antioxidants. The terpenoid and flavonoids in banana foliage exhibit anthelmintic properties. Some of the fruit and vegetable wastes are excellent source of biopigments examples being betalains in beet root pulp and carotenoid in carrot pulp.The large volume of the low cost by-product gives health beneficial products and economic benefit to labour, stakeholder and country.

Keywords: Food by-products, Antioxidants, Bio-active compounds, Functional food ingredients, Health, Bio-active compounds, Economy.

PP 7: Bioactive peptides and Protein hydrolysates: Nutraceutical potential and Functional Food Components

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Consumer's increasing interest on the health-promoting properties of food derived bioactive peptides has given an impetus to research sector and to functional food industry for development of new functional, nutraceutical and designer foods. Bioactive peptides or biopeptides are group of diverse intercellular signalling molecules that are encryoted in intact molecules and are released from their encrypted position during gastrointestinal transit in body, endogenous proteases(autolysis) or exogenous proteases (protein hydrolysates) and during food processing (eg milk fermentation and cheese ripening). These peptides are formed by series number of amino acids joined by covalent bonds also known as amide or peptide bonds which, above and beyond their nutritional capabilities, have a positive impact on the body's function and human health by alleviating conditions such as coronary (ischemic) heart disease, stroke, hypertension, cancer, obesity, diabetes, and osteoporosis. Consequently, biopeptides and protein hydrolysates in addition to their nutritional properties have been validated to confer antimicrobial, antithrombotic, antihypertensive, opiate, immunomodulatory, mineral binding, antioxidative and osteoprotective activity and can thus be used as an alternative to synthetic drugs due to their wide spectrum of therapeutic action, low toxicity level, and structural diversity. Protein hydrolysates are essentially produced by enzymatic hydrolysis of protein source by appropriate proteolytic enzymes under hydrolysis conditions, followed by isolation of desired and potent bioactive peptide from complex mixture of active and inactive peptides. Therefore, because of such an impressive array of functions attributed attributed by these biopeptides and protein hydrolysates along with the availability of vast food commodities, processing by-products and under-utilized resources to generate these value-added products, they can be used as an important functional ingredient in food and pharmaceutical industry. This review illustrates the above stated properties of food-derived bioactive peptides, their processing methods, bioavailability and their use in development of second generation functional foods.

Keywords: Biopeptides, Protein hydrolysates, Nutraceuticals, Functional foods, Bioavailability

OP 8: Pulsed Electric Field in Food Preservation

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The technology of food preservation is based on prevention of microbial growth or inactivation of microbes. In order to achieve a gentle non-thermal pasteurization or cell disintegration Pulse Electric Field (PEF) is one of the most promising among the novel emerging technologies. It works on the application short pulses of high electric

fields with duration of microseconds to milliseconds and intensity in the range of 10-80 kV/cm to the foods placed between two electrodes. The food product is subjected to force per unit charge, called electric field, which is responsible for the irreversible cell membrane breakdown in microorganisms. This leads to dielectric breakdown of the microbial cell membranes and to interaction with the charged molecules of food. The electric field may be applied at ambient, sub-ambient, or slightly above-ambient temperature in the form of exponentially decaying, square wave, bipolar, or oscillatory pulses. Food is stored under refrigeration conditions after the PEF treatment. This technology is considered superior processing technology because it results in minimum detrimental changes in physical, sensory and nutritional quality of foods. It is due to this reason PEF has renewed the interest among the processing techniques as an alternative substitute for conventional thermal processing of liquid food products such as fruit juices, milk, and liquid egg. The PEF treatment was shown to be very effective for inactivation of microorganisms, increasing the pressing efficiency and enhancing the juice extraction from food plants, and for intensification of the food dehydration and drying. In several scientific fields such as Food technology, medicine, biotechnology and cell biology, the effect of PEF on bio membranes have been thoroughly studied. Besides the advantage of providing microbiologically safe and minimally processed foods, it efficiently and economically improve the energy usage.

Keywords: PEF, processing, technique, microbial, electric field, preservation.

OP 9: Effect of different drying methods on physiochemical properties of carrot pomace

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The aim of the study was to determine the effect of different drying methods on selected physiochemical properties of carrot pomace obtained after carrot juice extraction. The carrot juice yield is 60 to 70 per cent and up to 80 per cent of carotene may be lost with left over carrot pomace. It also has good residual amount of vitamins, minerals and dietary fibre. So far, the left over pomace after juice extraction is either dumped or fed to animals and not directly used for human benefit. Dried carrot pomace can be used to develop exudates and flavors. Drying of carrot pomace was performed by using different methods such as convective drying at 60ºC (CDCP) and freeze-drying (FDCP). Moisture content, ash content, water activity and color of freeze dried and convective dried carrot pomace were evaluated. These response variables were compared with the values of a control sample (fresh carrot pomace) at the same temperature. The 60°C convective dried samples witnessed minimum drying time with lower moisture content (4.24%) and water activity (0.386 a_w) having darkest color. On the other hand, freeze dried samples had moisture content (11.9%) and water activity (0.509 a_w) and were observed to be light in color as compared to convective dried pomace. Among the drying methods, FDCP was found to be best in context to retention of quality parameters as compared to CDCP.

Keywords: Carrot pomace, convective drying, freeze drying and physicochemical properties.

PP 10: Studies on stability and quality of phalsa blended beverage

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Phalsa (*Grewia subinaequalis* L.) fruit is highly perishable in nature and has very short shelf life. Due to its acidic taste it is not palatable, hence processing is essential. Blending of two or more juices is thought to be a convenient alternate for utilizing them in some value added fruit drinks which will be of high quality in respect to both sensory and nutritional aspects. The present investigation was carried out in Division of Food Science and Technology, SKUAST Jammu during the year 2015-2016. In the present study, phalsa pulp and pear juice were blended in the ratio of 100:00, 95:05, 90:10, 85:15, 80:20, 75:25, 70:30, 65:35, 60:40, 55:45 and 50:50 for the preparation of crush as per FPO specifications. The processed products were stored at ambient conditions and subjected to physico-chemical, microbial and sensory evaluation at an interval of one month for a period of three months. However, with the advancement of storage an increasing trend was observed in reducing sugars, total sugar and pH but decreasing trend in titratable acidity, tannin, phosphorus and iron content during three months of storage. In blended phalsa-pear crush no microbial count was observed in all treatments during three months of storage. The blended crush prepared from the treatment T_5 (80:20:: phalsa:pear) was adjudged the best (7.29) on the basis of overall acceptability.

PP 11: Studies on storage stability of guava RTS

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A study was undertaken for preparation of guava ready to serve and its physiochemical characteristicsviz., TSS, acidity, total sugars and microbiological count as well as organoleptic attributes viz., colour, flavour, taste and overall acceptability of RTS were evaluated at an interval of 2 months up to 6 monthsof storage. Results indicated that the minimum physio-chemical changes viz., TSS (10.11-10.17°Brix),acidity (0.42-0.50%), reducing sugars (3.27-3.58%), total sugars (6.26-7.02%) and sensory attributesshowed decreasing values with duration of storage. Considering above chemical constituents as well assensory attributes of processed nectar. The guava is commercially used in processing industry due itsattractive pulp colour and could make significant contribution to food industry.

PP 12: Decomposition of Kitchen organic waste

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Kitchen organic waste includes vegetables and fruits peeling, used tea leaves, leftovers. It is an organic source of nitrogen which should be recycled in to manure instead of going into garbage . this waste, if collected at municipality kura sangrah and thrown at dump site in large heaps, it starts releasing carbon di oxide, ammonia, methane and hydrogen sulphide. These action not only damage ecosystem, it reduces the nutritional and economic value of the food waste. By adopting decomposition at domestic level, we can save the all values of food waste. With the aim of decomposition of food waste as soon as it is generated at source, present study was undertaken . 10-12 holes were carved in an empty wrapper of wheat flour and are placed under sunlight. Daily kitchen waste was thrown in it which was then covered with 3-4 handful of bio decomposer mix (BDM).everyday, over this material, same process was repeated . When one wrapper was filled, process was done in another wrapper. Bio decompose mix was the mixture prepared by mixing 45 kg of cow dung manure, 8 kg of dry leaves manure and approximately 1 kg of sand. As soon as the BDM spread on nutritive peeling, microorganisms and physical decomposer present in the mix started eating and taking their growth cumulatively. Within four days after filling the wrapper, whole food waste was found decomposed completely in the above process, cow dung, manure acted as starter culture. Dry leaves and sand helped to maintain moisture level and oxygen level for decomposition respectively. C:N ratio of the compost was 30:1 . Finished compost gave Nitrogen =6%, Phosphorus =4%, Potasssium =2%. pH was near neutral .microbial load varied between $2.4x10^6$ to $2.0x\ 10^7$ cfu /ml for bacteria and $3.5x\ 10^4$ to $2.0\ x10^7$ for fungi.

PP 13: Ultrasound Technique in Food Processing and Preservation

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The increasing interest amongst consumers towards minimally preserved and processed foods has lead food processors on the development of novel technologies among which one of the versatile and innovative technology that has shown promise is ultrasonic processing. Ultrasound technique is one of the non-thermal method which is being used for food processing these days. Ultrasonic techniques are increasingly used in the food industry for both the analysis and processing of foods. Power ultrasound is also used for the processing of food materials in a variety of ways including mixing, emulsification, cutting, meat tenderization as well as ageing. Potential applications for high power ultrasound in the food industry are wide-ranging and include enzyme activity inhibition, hydrogenation of oils, extraction of proteins and enzymes, the inactivation of microorganisms and improved heat and mass transfer, crystallization of fats and sugars, degassing, foam breaking, ultrasonically aided drying, mixing and emulsification, spirit maturation and oxidation processes, humidifying and fogging, cleaning and surface, decontamination, cutting, effluent treatment precipitation of airborne powders, stimulating living cells, ultrasonically assisted freezing, ultrasonically aided filtration, enhanced preservation (thermal and chemical) . Additionally, low power ultrasound is thought to be an attractive non-thermal method because of its potential to overcome problems which occur during heat treatments such as physical and chemical changes, nutritional loss and change in organoleptic properties.

Keywords: Ultrasound; Non-thermal; Food Processing; Food Preservation

PP 14: Potential of Probiotics and Prebiotics as functional foods: a review

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The increase in the awareness of the relationship between health and diet has led to an increasing demand and quest for food products that assist and support health above and beyond providing basic nutrition. A probiotic is a viable microbial dietary supplement that beneficially affects the host through its effects in the intestinal tract. Probiotics are used to develop fermented dairy products such as yogurt or freeze-dried cultures. In the future, they may also be found in fermented vegetables and meats. Lot of health-related benefits with intake of probiotics, include reduce in the lactose intolerance and enhancement of immune system, have been reported in human studies. Some evidence advocates the role of probiotics in reducing the risk of rotavirus-induced diarrhea and colon cancer. Prebiotics are nondigestible food ingredients that benefit the host by selectively stimulating the growth or activity of one or a small number of bacteria in the colon. At present, claims about reduction of disease risk are only probationary and more research is needed. Among the claims are constipation relief, suppression of diarrhea, and reduction of the risks of osteoporosis, atherosclerotic cardiovascular disease associated with dyslipidemia and insulin resistance, obesity, and possibly type 2 diabetes. The combination of probiotics and prebiotics in a synbiotic has not been studied. This combination might improve the survival of the bacteria crossing the upper part of the gastrointestinal tract, thereby raise their effects in the large bowel. In addition, their effects might be additive or even synergistic.

Keywords*:* Probiotic, Synbiotic, Prebiotic, bifidobacteria, lactobacilli, inulin

PP 15: Mushroom: An excellent nutraceutical for alleviating poverty and malnutrition

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World population is increasing day by day by 80 million people per year. On one hand, at present, 1.3 billion (approx.) people are living in extreme poverty; On the other hand, we are faced with the problem of decreasing land resources and their fragmentation. There is a need for alternate food resources for sustainable nutrition under adverse climatic conditions. Mushroom is such nutraceutical product which has large potential in Indian Markets. Currently, tones of agriwaste is discarded, burnt or dumped which creates environmental pollution. This waste can be used alone or in combination to make mushroom substrate and profitably recycled to produce nutritionally rich mushrooms. Mushrooms are full of nutrition; high in protein content, rich in amino acids, low calorie value, having high ratio of unsaturated fats, vitamins and minerals. They have been reported with a wide range of properties including anti tumor, cardiovascular and anti-microbial. In developing countries, mushroom production is a boon in the field of food, medicine and generating employment. Mushrooms have become attractive as a functional food and as a source of development of drugs and nutraceuticals. They are an excellent source of folic acid and vitamins that prevent anemia. The active constituents found in mushroom are polysaccharides, dietary fibres, oligosaccharides, peptides and proteins, alcohols, phenols and mineral elements such as zinc, copper, iodine, selenium etc. In a country like India, most people live below subsistence level and suffer from protein deficiency. Thus, India's potential for mushroom cultivation in view of geographical diversity, vast man power, biodiversity, climate diversity is quite congenial. In this context, farmers, farm women and rural youth being major stakeholders are being promoted for round the year mushroom cultivation by Krishi Vigyan Kendra every year through front line demonstrations, vocational and skill development trainings to boost the adaptation and cultivation by the stakeholders with promotion of entrepreneurship and nutritional security for the rural masses.

PP 16: Ultrasound Technology and Its Application in Food Industry

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Food researchers today are focused on the development of not only microbiologically safe products with a long storage life, but, at the same time, products that possess characteristics of fresh food and have high nutritional quality. This focus is based on the needs of the consumer. Traditionally, thermal treatments have been used to produce safe food products. But this treatment also results in loss of the nutritional and organoleptic quality of foods. Thus, one of the challenges in food science today is to develop new technologies that can simultaneously ensure high-quality properties and long storage life. Ultrasound is one of the nonthermal methods which is being used for processing of food in recent times. Ultrasound refers to sound waves which propagate through solids, liquids, or gases with a frequency greater than the upper limit of human hearing (> 18 kHz). The principle aim of this technology is to reduce the processing time, save energy and improve the shelf life and quality of food products. In food industry, the application of ultrasound can be divided based on range of frequency into two categories-Low power ultrasound (<W/cm2; >100 kHz) which is used to study physicochemical properties of food

and High power ultrasound(10–1000 W/cm2; 20–100 kHz) which involves cavitation phenomenon and is used either to destroy cellular structures or to enhance or inhibit activities within foods. The advantages of ultrasound over the heat treatment are minimization of flavor loss, greater homogenity and significant energy savings. Ultrasound can be used for food preservation in combination with other treatments by improving its inactivation efficacy-Ultrasonication (ultrasound at low temperature), Thermosonication (ultrasound and heat), Manosonication (ultrasound and pressure), Manothermosonication (ultrasound, heat and pressure). Use of ultrasound in food processing includes extraction, drying, crystallization, filtration, defoaming, homogenization, meat tenderization, enzyme inactivation and microbial destruction.

Key Words: Ultrasound, cavitation, thermosonication, manosonication, microbial inactivation

PP 17: Reviving Traditional Food Processing Techniques To Ensure Nutritional Health

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A study was undertaken undertake process documentation of some popular traditional foods of Kashmir in 2017. The inventory included thirteen foods like *Hokh Gaad* (Dehydrated Fish), *Gair* (Dehydration of Water Chestnuts*), Verr* (Red Chilli Cakes), *Gulkand* (Fermented Rose), *Bunafsha Khambeer*(Fermented Viola), *Tomul Sott*(Ground Rice Powder), *Kenke Sott* (Ground Maize Powder), *Makai Sott* (Ground orn Powder), Koshur Anchar (mixed pickle of carrots, knol-khol and cauliflower), Hareesa (Meat porridge), Shab Deg (The overnight cooked pot), Gaad Nadder te Mujj (Fish, Lotus Stem and Radish), Tehherr (Cooked Yellow Rice). As compared to carcinogenic food colors, being added to foods, *Verr* is a ground red chilli cake made with whole spices, fried shallots, oil and salt made hygienically at home. Made in bulk, they last over a year. Similarly the *Tomul Sott, Kenke Sott Makai Sott* are the traditional breakfast cereals that are added into the pink salt tea consumed in mornings. Healthy as they are, they satiate well in our fast pace lifestyles. *Hareesa* is a meat porridge consumed as breakfast in winter mornings that too have greater residual value. The *Tehher* is often cooked in times of despair or grief as alms to feed people. A total of thirteen popular foods were identified in the study. They conform to all the food groups like carbohydrate, fats, proteins, vitamins and minerals. It may be rightly concluded that traditional foods are wholesome and nutritious and have socio-cultural significance aswell. Given the lifestyle changes, the traditional cereals can go a long way in ensuring nutritional health for all. There is a dire need to process some of these at grass-roots and foster market led linkages so that these may be available off the shelf.

PP 18: Nutraceuticals: the Current prospective

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Nutraceuticals are food or part of food that provides medical or health benefits including the prevention and/or treatment of a disease. Nutraceutical has advantage over the medicine because they avoid side effect, have naturally dietary supplement, etc. Nutraceutical; on the basis of their natural source, chemical grouping, categories into three key terms –nutrients, herbals, dietary supplements, etc. The food sources used as nutraceuticals are all natural and can be categorized as Dietary Fiber, Probiotics, Prebiotics, PUFAs, Antioxidant, vitamins and Polyphenols. Nutritional therapy is a healing system using dietary therapeutics or nutraceuticals based on belief that foods can not only be sources of nutrients and energy but could also provide medicinal benefits. This goal is achieved by using efficacy of such nutraceuticals in detoxifying the body, avoiding vitamin and mineral deficiencies, and restoring healthy digestion and dietary habit. As a concept, "Nutraceuticals" is still in its stage of infancy in India although growing much faster than global rates at CAGR of 18% for the last 3 years driven by functional food and beverages categories. The most rapidly growing segments of the industry were dietary supplements (19.5 percent per year) and natural/herbal products (11.6 percent per year). Global nutraceutical market is estimated as USD 117 billion. FDA regulated dietary supplements as foods to ensure that they were safe. In 2006, the Indian government passed Food Safety and Standard Act to regulate the nutraceutical industry. Herbal nutraceutical is used as a powerful instrument in maintaining health and to act against nutritionally induced acute and chronic diseases, thereby promoting optimal health, longevity, and quality of life. Although nutraceuticals have significant promise in the promotion of human health and disease prevention, health professional, nutritionists, and regulatory toxicologist should strategically work together to plan appropriate regulation to provide the ultimate health and therapeutic benefit to mankind.

Key words: Nutraceutical, dietary supplement, global market, regulation

PP19: Development and Characterization of physically modified rice flour noodles incorporate with encapsulates of Flaxseed oil

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Celiac disease is an immune-mediated enteropathy induced by ingestion of gluten containing products in genetically susceptible individuals. Consumer demands for gluten-free products are increasing. Noodle, as the staple food in most Asian countries, is widely enjoyed throughout the world and is the food of choice for people of all ages because of its variety, versatility, and mouthfeel. Rice is regarded as one of the most appropriate cereal grains for producing gluten-free products owing to its benefits of high digestibility, hypoallergenic properties and bland flavor. Untreated rice is unable to meet the requirements for the noodle processing due to the poor network development of rice protein with the noodles. So the present study was carried out to develop and characterize of rice noodles from physically modified rice flour noodles incorporated with xanthan gum and encapsulates with flaxseed oil and further, the quality of noodles was improved with the incorporation of encapsulated flaxseed oil. It was observed that degree of gelatinization of treated flour, Water absorption Index and swelling power decreased and oil absorption index increased. Final viscosity of treated flour is higher compare with native rice flour. Cooking loss was less than 8%, cooking time was around 10 min and encapsulation efficiency was 94%.HTT and ANN and XG incorporation greatly altered the physicochemical properties of the treated flour for noodle making. HTT and ANN with XG incorporation improved the texture of dough for sheeting and cutting Cooking and textural qualities of rice noodles made by either raw rice flour or its hydrothermally treated flour were significantly different ($p<0.05$). Simulated digestion of RDS is high in HTT-ANN-3% MIX at 120 min of 0.5ml aliquots. GC-MS showed that HTT-3% XG contain omega -3 fatty acid mainly **α-**linolenic acid and its retention time is 25.802. Overall acceptability is more of treated noodles compared to noodles made from native rice flour only.

Keywords: Xanthan Gum (XG), Hydrothermally treated four (HTT), Annealed flour (ANN), flaxseed oil, rheology, rice flour, noodle quality

Agripreneurship

OP1: Crewel scenery-A profitable business for micro entrepreneurship development (A case study)

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The recent technological development in stitching and designing of garments offer prospects for all sections of rural people particularly for landless ones. It is being increasingly realized that women's income in a family is important in relation to the nutritional, economic and educational standard of the family. Crewel is one of the most beautiful artisan skills in Kashmir region by rural women of apparels in distinctive styles. Revival of traditional embroidery like many other traditional pastime is currently enjoying a revival. Crewel scenery can be made by developing simpler motifs in less time in comparison to shawls and woollen garments. Different training was imparted and crewel scenery was found to be more appropriate and profitable business. Nowporacheshmeshahi village in Srinagar district nearer to the market has a wide scope of crewel scenery and its marketing to local shops and tourists in Kashmir valley. An action research conducted after six month training at Women Empowerment Cell in The Directorate of Extension revealed that the trainees undertook crewel scenery as a profitable business. The overall acceptability of the product on parameters of crewel scenery as cloth, texture, design, colour, and metallic threads frame, less time consuming attractive and cost was studied. It was also observed that these crewel sceneries are in great demand in the market and there is a scope for micro-entrepreneurship for rural women.

OP2: Transfer of Innovative Agri-Technologies through Women Empowerment Cell at SKUAST-Kashmir

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Agriculture technology is changing rapidly and high lightening the importance of documenting innovative technologies in agriculture would help in accelerating the agriculture production and also in improving the socio-economic conditions of the farming community. Need based training programmes are being conducted by the State Agricultural Universities and Krishi Vigyan Kendra's in various disciplines such as horticulture, food processing, vermicomposting, apiculture, sericulture and others for farm women in J&K state. Women play an important role in economic welfare of the family and society. Agriculture being an important occupation for the rural people in Jammu &Kashmir region has potential for development. The state grows a variety of food crops like rice, maize, wheat pulses, oilseeds and has a monopoly of growing temperate fruits like apple, pear, peach, plum,apricot, cherry, walnut, almond and quince. The Horticulture industry serves as a major economic boost for the development of the state. Agro-based industry is regarded as the sunrise sector of the Indian economy in view of its large potential for growth and likely socio-economic impact specifically on employment and income generation. The study was carried out to collect the required information on various agro based technologies transferred and farm women response to the innovative technologies. For transmitting the latest agriculture techniques to the farmers field orienting them to establish better relation with banks and adoption of latest agri-technologies. There is need to update the technical knowhow and to train the farmers, farmwomen and rural youth in scientific farming. It was revealed that Women empowerment cell, Directorate of Extension, SKUAST-Kashmir is playing a vital role in disseminating agri-technologies and thereby helping the farm women to aware the latest technical knowledge and developing new skill related to agriculture and allied field.

Keywords: Farm women, innovative technologies, agriculture, women empowerment

OP 3: Study the Extent of Participation and Empowerment of rural women in Oyster Mushroom Cultivation in Koderma District of Jharkhand

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The novel experiments were undertaken among 40 on-campus trainees and 40 off-campus trainees spread among three purposively selected villages under two blocks of Koderma district under the domain of KVK, Koderma. 20 on-campus trainees and 20 off campus trainees were selected randomly from each selected villages. For the purpose of this study, Two variables namely, extent of participation and impact of KVKs in empowering rural women have been operationalzed as the degree to which rural women participant in various activities in oyster

mushroom cultivation. The respondents were interviewed personally by a well structured interview schedule. The findings on the extent of participation are given under the overall participation and activity wise participation. The salient findings of the study are, majority (64.45 %) of the respondent had medium level of overall participation, followed by high (18.85 %) and low (15.70 %) level of overall participation. Attending group meeting (2.25), operating commercial ventures (1.94) and attending village development work (2.15) are the major activities in oyster mushroom cultivation, economic activities and social developmental activities respectively. It was also found that majority of the respondents (75.36%) had increased their knowledge level after going through these training courses, (46.25%) of the respondents had improved their skill, (39..75 %) of the respondents became fully independent. The study also revealed that rural women became Socially, Economically, Psychologically empowered and had the power of taking decisions.

Key words: Extent of Participation, Empowerment, oyster mushroom Cultivation, rural women.

OP 4: Entrepreneurship in food processing sector by skill development

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India is the world's second largest producer of food next to China and has the potential of being the biggest in the world. Food and food products are the biggest consumption category in India, with spending on food accounting for nearly 21% of India's GDP. India's agricultural base is quite strong but wastage is very high and processing of food products is very low. The processing of food commodities at village level will not only controls post harvest losses but also provide additional employment to the local people. In India 60 percent of population depends on agriculture and agriculture based activities India's strong agricultural base, variety of climate zones and accelerating economic growth holds significant potential for food processing industry that provides a strong link between agriculture and consumers. Hadoti region is considered as major producer of soybean, amla, guava, rice, oranges, coriander and garlic of Rajasthan. Food processing is the major sector for economic uplifment and therefore the study was conducted with the objective to strengthen the livelihood security of rural youth, providing opportunities in establishing food processing unit .Youth gets opportunities to become and entrepreneur. The research was conducted on 85 trainees of food processing training who were introduced food processing machineries and further giving technical support for establishing food processing units. After establishing and efficiently running unit the economic and social empowerment was judged by their success stories. It was found that each individual was earning on an average Rs. 20,000-100,000 per month and got social recognition, confidence leadership ability, cooperation, satisfaction through skill development in the field of food processing.

OP 5: Financial and Management aspects of rice mills in Jammu district of Jammu and Kashmir state

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The present study investigation entitled "**A Study on Financial and Management aspects of rice mills in Jammu district of Jammu and Kashmir state"** was carried out on the basis of primary as well as secondary data. For the study purpose, two modern rice mills were selected from Jammu district. The present study is of exploratory research nature and convenience sampling tools were used. The paper discusses the investment pattern of the modern units with different processing capacities. The results of the study revealed that for a mill of processing capacity of 25000 quintals per annum referred as Mill 1 in the study, a total of rupees one crore were investment whereas an initial sum of □44 crores were invested for the Mill 2 having 700000 quintals processing capacity per year. The results showed that the capacity utilization in Mill 1 was 81 percent as compared to 86 percent in Mill 2. Procurement costs were higher when the paddy was purchased from commission agents instead of directly from the farmers. The Benefit Cost Ratio was found to be 2.35 in Mill 1 and 1.54 in Mill 2. But since the Cash flow in Mill 2 is much higher than Mill 1, so the Net Present Value of Mill 2 is much higher and the payback period is less as compared to Mill 1. From the study, we evaluated that the head rice processed from per quintal of paddy was around 50 percent in Mill 1 whereas it was 65 percent in Mill 2 and the returns were quite higher in Mill 2. Interruption in power supply is one of the main constraint faced by Mill 1 as it is in rural area whereas such problem is less in industrial areas. The labour is not readily available in Mill 1 and repair and maintenance is major concern due to the use of old machinery and equipments.

Keywords: Investment, paddy processing, net returns, rice mills

OP 6: Mushroom Cultivation: A viable micro-enterprise for farmers and farm women

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Agriculture continues to be main strength of Indian economy. With the variety of agricultural crops grown today, the country has achieved food security by producing about 260 million tons of food grains. However, the struggle to achieve nutritional security is still continuing. Mushrooms are one such component that not only use vertical space but also help in addressing the issues of quality food, nutrition, health and environmental sustainability. The present study was conducted to dind out the impact of vocational train in programs on mushroom production for entrepreneurship development. For this purpose, 50 farmers who had undergone training and demonstration on mushroom production techniques were randomly selected from 5 villages of Tehsil RS Pura of Jammu district. It was observed that the pre-training knowledge score was not satisfactory for all aspects of training program. However, knowledge score gained by respondents post training was more satisfactory in all aspects. The study revealed that exposure to training had increased the knowledge of farmers, farm women and rural youth regarding production methods and techniques by 85% (approx.). The study indicated favorable attitude of the trainees towards mushroom cultivation and was found to enhance the economic level of the beneficiaries and a viable source of livelihood.

OP 7: Harad: A Boon for Higher Income and Entrepreneurship Development for Kandi Villages of Jammu Region

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Jammu and Samba districts mostly characterised by subtropical conditions locally known as Kandi is rainfed, characterized by undulating terrain, unpredictable weather, and prolonged dry spells, provides conducive environment for the luxuriant growth and fruiting of Harad will help farmers to meet contingencies by directly providing recurrent, seasonal or occasional flow of food, fodder, timber, medicinal fruits and other products or earn cash to meet the contingencies thus helping in reducing household vulnerability to risk and thereby ensuring the sustainable livelihood security. Farmers of kandi villages namely Mathwar, Rabta, Mohargarh, Sungal, Sagoon, Purmandal, Garota, Ranjan, Kotbalwal, Manwal etc. have adopted themselves to traditional Harad based agroforestry practices according to their needs and circumstances that are growing naturally in the forest or cultivated on the bunds of farmer's fields or village common lands under traditional agroforestry systems are the source of livelihood for the resource poor farm families of the villages. About 7000-8000 wild/planted Harad trees in Mathwar block alone have a green and dry fruit production trade of more than 350 Tonnes and 15-20 Tonnes respectively, that is being exported to Pakistan and gulf countries through Amritsar border fetching a total income of more than 40 lakhs per annum. With coming up of superior grafted clones of Harad through frontline demonstrations by Krishi Vigyan Kendra Jammu and afterwards value addition processes, the expected economic returns from these grafted clones at an early bearing age of 7-8 years will Rs 593750 per ha that will be almost double than the existing seedling plantations. Improved scientific production technology and cultivation of superior clones including Raj Haradwill not only boost the adaptation and productivity but also provides opportunities for development of entrepreneurship among the rural masses.
Keywords: Harad, Agroforestry, Kandi

OP 8: Agripreneurship development make agriculture a more attractive and profitable venture

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Indian economy is basically agrarian economy. Agriculture and allied sectors are considered to be main source of the Indian economy because these are important sources of raw materials for industries and they demands for many industrial products. A shift from agriculture to agribusiness is an essential to revitalize Indian agriculture and makes more attractive and profitable ventures. In the face of growing unemployment and poverty in rural areas and slow growth of agriculture there is need of entrepreneurship in agriculture for more productivity and profitability of agriculture. Agripreneurship plays various roles in the growth and development of national economy through entrepreneurship development which increases the income level and employment opportunities in rural as well as urban areas. It helps in inducing productivity gains by smallholder farmers and integrating them into local, national and international markets. It helps in reducing food costs, supply uncertainties and improving the diets of the rural and urban poor in the country. It also generating growth, increasing and diversifying income, and providing

entrepreneurial opportunities in both rural and urban areas. Agriculture have several areas of entrepreneurship include the activities like, dairying, sericulture, goat and sheep rearing, rabbit rearing, floriculture, fisheries, shrimp farming, vegetable cultivation, nursery farming, farm forestry. Other areas like agro produce processing units-rice mills, dal mills, decorticating mills etc; agro produce manufacturing units-sugar factories, bakery, straw board units etc; agro-inputs manufacturing units-fertilizer production units food processing units, agricultural implements etc; agro service centres; apiaries,feed processing units, seed processing units, mushroom production units, commercial vermin-compose units, goat rearing farmers club, organic vegetable and fruits retail outlet, bamboo plantation and jatropha cultivation. There is a great scope for entrepreneurship in agriculture and this potentiality can be tapped only by effective management of agri elements such as – soil, seed, water and market needs.

PP 1: The Issues of Gender Inequality in Society

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Gender is a common term where as gender discrimination is meant only for women, because females are the only victims of gender discrimination. It is true that gender inequality still exist in our country. The gender inequality contributes in the form of gender stereotypes or unequal pay between man and women. Now in 21st century gender inequality has been burning topic of the year now. Women want equal pay, equal feeling of importance in the government and equality all around. Gender equality is a constitute of development as well as instrument of development. It is an instrument because without gender equality other goals of development like poverty alleviation, economic growth, environmental sustainability will not achieved. Equality of control enables women to gain improved access to resources. Equality of participation and control are the necessary pre-requisites towards gender equality. There are many special challenges still faced by the women but the progress has been made when gender equality is viewed over a long time. Much more can be accomplished, however when women's contribution in society is whole valued, when they have prominent role in decision making and when women and men work in partnership to achieve these aims. However, reaching gender equality would benefit everyone of both genders. Men don't have gender equality in the form of stereotypes. Man can help reach gender equality by stop acting dominant over women. Gender equality is not something that is going to achieved overnight, it is a multistep process that will take everyone both man and women. There is a solution of every problem. For reducing gender inequality in India, we should offer high level of education to girls and increase women empowerment. We should also give them opportunity in active politics and social activities so that social integration in Indian society can be made. Government should make policies and strategies regarding stopping the sex identification and abortions.

PP 2: The Gendering of Entrepreneurship: Deconstructing the new trends in Srinagar City

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Like men, women entrepreneurs have an equal role to play in the nation's development. Women entrepreneurs seem to influence positively the economic growth and employment creation in a country like India and also it is a vehicle to empower women economically, socially and politically. Undeterred by unrest and other odds, many female entrepreneurs are running their own business units in the Kashmir Valley, particularly in the Srinagar city. Over the years there has been a new trend being seen in the valley where more and more women are coming forward to be part of any business foray despite facing the different odds and hardships. Entrepreneurs are the driving forces behind any economy. Entrepreneurship is a social phenomenon and it is not inherent within a person, rather it exists in the interaction between people. To be a successful entrepreneur it requires practicing as a manager by acquiring various skills and efforts in learning to understand a business. A large number of women entering into entrepreneurship are developing the new norms of livelihood through the state sponsored schemes in some form or other. This study focuses on what motivates women to start their own start ups and what are the various issues they face while exploring these options. It further tries to deconstruction the social stigma attached to the women entrepreneurship in the valley.

Keywords: Gender, Women Entrepreneurship, challenges, Empowerment.

PP 3: A Skill Development of Nomadic Women about Value Addition in Pashmina Wool

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Pashmina, the golden fibre is a very fine and warm fibre which mainly comes from the Changthangi goat native to Ladakh. The Changthangi goat is the source of world's finest Pashmina measuring 12-15 microns in fibre thickness. The fibre is collected during the spring moulting and one goat produces approximately 80-170g of the fibre. It takes 3 goats wool to make 1 woven shawl. Pashmina has played a decisive role in Ladakh's history and continues to significantly impact its economy. Being the main source region for Pashmina, Changthang in Ladakh exports the raw material to Kashmir via Leh. Europeans identified Pashmina as Cashmere because it was first encountered by the British in the valley of Kashmir through its famous shawl manufacturers. Looms of Ladakh was conceived as a farm to fashion initiative, committed to extend due recognition to the Pashmina goat rearing communities and its artisans. Selected respondents who were able to identify the Pashmina material and interested for receiving training on value added utility article for study. Nearly one-third of the respondents were interested in use of Pashmina/ sheep and yak wool material for making Pashmina shawl, Knit caps, sheep and yak wool knit caps, gloves, socks and slippery. Majority 92 per cent of the respondents were interested and fully satisfied in making Pasmina Shawls, knit caps, sheep and yak wool shawls, knit caps, gloves, socks and slippery. Majority of the respondents perceived all the three articles very useful. Almost 87.00 per cent respondents were willing to start income generating venture by preparing pasmina dress coats, pashmina short jackets, women vest and almost 98.00 per cent were willing to start an enterprise by preparing pashmina shawls, knit caps, sheep and yak wool gloves, socks and slippery.

Keywords:, training, satisfaction level, pashmina shawls, gloves, socks, sheep and yak wool

PP 4: Challenges faced by entrepreneurs

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In the contemporary era, there is demarcation between men and women occupations in Indian society. However, in our society men have more visible and recognized role than women; largely because men are paid for their productive work and women are not. Women entrepreneurs can play an important role in India in the wake of globalization and economic liberalization. Women entrepreneurship can create new economic opportunities for women and contribute to overall development of women. There are various programmes initiated by the government like DWCRA, STEP, SGSY, TREAD etc. in order to empower women as entrepreneurs. But the development of women entrepreneurship is very low because women face several constraints like male dominance, lack of education, inadequate technical competencies etc. Women need support from the family members, government and society, male colleagues etc., so that they can connect to the main stream of national economy and thereby contribute to the economic development.

Keywords: Women Entrepreneurship, Constraints etc.

PP 5: Capacity Building of Rural Women for Self Employment Through Training In *Tie* And Dye Technique

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Women entrepreneurship promotion is a dependable path to her economic stability and also of her economy. The strategic development of any economy requires equal participation and equal opportunities to all sex and genders for capacity building. Women have tremendous potential to contribute in harnessing technology for human and social development. Through proper training along with their contribution to the family, women may also provide their inputs for overall development of society. Capacity building is a process of unlocking the potential of an individual, organization and community to enhance their ability to achieve the desired goals, making the effective use of their resources over time. The Indian handicraft sector provides employment to millions of artisans which predominantly include women. Tie and dye is an art with basic skills and limited investment. It is a process of using various techniques of tying the cloth with thread and designing the fabric to make it aesthetically appealing to be used in variety of ways for clothing and textile, commercial and domestic interiors etc. Owing to its use and marketability, skill development trainings were regularly organized by KVK, RS Pura for women and adolescent school dropouts. The objective of the training was to equip the trainees with knowledge and skills required for efficiency enhancement in the field of tie and dye technique. A total of eighty women and girls from 2 villages, *Balachak* and *Tallvachak* were imparted the specific technique (ranging from 5-7 days) Audio, visual aids such as sample displays, presentations and demonstrations were used to create interest among trainees. The impact analysis

of the trainings revealed that 96.6% of the participants received gainful knowledge through vocational trainings and skill upgradation programs in two years (2015-17). Further, it was revealed that 89% of the beneficiaries applied the skill for personal and household needs, thus, saving the money. A majority (59.5 %) of the trainees augmented their family income by making a variety of products for sale on demand/order such as designer *dupattas*, bedsheets, dining sheets, table mats, tray covers etc. The economic appraisal indicated a minimum of 55-60% net gain per unit. However, the net gain in certain products was as high as 80-90% per unit as per the market value. Thus, efforts in capacity building are empowering rural women economically and can be viewed as prelude to change in socio economic scenario in rural sector of Jammu District.

PP 6: Empowerment of Tribal farm women through Backyard poultry farming in Rajouri district of Jammu and Kashmir, India

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In rural economy poultry farming contributes an important role especially for the socio-economic development of the weaker section of the society in the District Rajouri. It generates self employment, provides supplementary income and supplements protein rich diet at relatively low cost. After analyzing the background and social scenario, KVK Rajouri scientists intervene to make Backyard poultry farming as more productive, remunerative and commercial by introducing improved breeds like CARI Debendra, Vanaraja, Chabro etc. those are phenotypically similar to existing local poultry population. The improved breed of chicks were being given as frontline demonstration unit (30 chicks/Unit) to the 250 no. of Tribal Farm Women of Block Budhal of District Rajouri under TSP Project "Enhancing Livelihood Opportunities through Agro-Technological interventions of Tribal communities of Budhal and Poonch blocks of Rajouri and Poonch Districts". The selected farm women were trained about the minimal management practices, feeding, etc. From the list of practicing farmers of KVK under improved backyard poultry farming, hundred twenty numbers of respondents were selected randomly and structured interview schedule was used to elicit information from the respondents. From the study it was found that moderate knowledge was gained by the respondents on the improved poultry farming and adoption was satisfactory with about 62.00 % among the tribal women. Lack of poultry production knowledge, inadequate veterinary services and predator/ climatic conditions were the major constraints in the study area. Therefore, KVK scientist and animal husbandry service units have planned to train more number of women's of tribal communities in Rajouri district through Farmer, rural youth and other training programmes to increase the level of awareness and benefits from the backyard poultry.

Keywords: Backyard Poultry farming, CARI Debendra, Vanaraja**,** Chabro, Farmer income

PP 7: Challenges Faced by Dairy Entrepreneurs of Jammu District of J&K State

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The entrepreneurs are considered 'change agents' in the process of socio-economic development of a country and they are the 'spark plug' who transform the economic scene of an economy. Entrepreneurship has been accepted globally as an effective tool for widening the entrepreneurial base for those who have poor financial resources or managerial background. Jammu district has immense potential for entrepreneurship development in terms of diversity of rural occupations. Considering the importance of dairy farming in Jammu district and the need of development of entrepreneurship in this sector the study entitled "Challenges faced by Dairy Entrepreneurs of Jammu District of J and K State" was undertaken. Four out of eight blocks were selected by cluster sampling method and each cluster comprised of 3 villages. Thirty respondents were selected randomly from the prepared list of dairy entrepreneurs based on preset criteria from each cluster, making a sample size of 120 respondents in total. To identify the challenges faced by dairy entrepreneurs, constraint analysis was done. The data were collected with the help of a well structured interview schedule and it was observed that 'Non remunerative price of milk offered by the dairy cooperative society', 'no incentive for supplying clean milk to society' and high cost of dairy input were the major economic constraints. 'High cost of milk transportation from rural to urban areas', 'Non availability of AI and veterinary services by dairy cooperative society' and' Inadequate floor space leading to overstocking of animals' were the important infrastructural constraints. 'Poor conception rates in buffaloes/ crossbred animals', 'Decline in milk yield after F1 generation in crossbred animals' and 'Lack of training for scientific rearing of crossbred animals' were the major technical constraint felt by dairy entrepreneurs. 'Middlemen still control a very

large portion of milk procurement' was seen as the crucial 'threat' by SWOT analysis hampering the growth and expansion of dairy entrepreneurship in Jammu. The study was concluded with the impression that dairy entrepreneurship has a very bright future ahead if various challenges identified through constraint analysis are well taken by the Govt. and implementing agencies for improving the entrepreneurial abilities of dairy farmers.
Keywords: Challenges, Dairy entrepreneurs, Constraint analysis, Entrepreneurship

PP 8: Impact of Dairy SHGs on Livelihood of Women Dairy Entrepreneurs

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Agriculture and animal husbandry are two main pillars of Indian agriculture on which entire structure of village life rests. They are twin occupations, which from time immemorial have played a significant role in improving the rural economy. Dairy farming is a crucial component of Indian agriculture and it is more than wheat and rice crops put together. It has the highest potential of generating income and employment through augmenting productivity of milch animals. It is considered a 'treasure' of the Indian economy, particularly for the rural systems. It provides nutrition, draft animal power, organic manure, supplementary employment and a daily basis cash income. It is one of the promising sectors for entrepreneurship development in India. Livestock rearing provides employment especially self-employment to a substantial number of rural and urban population, many of whom are women who play a major role in the care and management of livestock. The emergence of women entrepreneurs and their contribution to the nation is quite visible in India. The women in business are a recent phenomenon in India. The spread of education and increased awareness are aiding women to spread their wings into areas which are monopoly to men. Women entrepreneur is defined as the woman or a group of women, who initiate, organize and operate a business enterprise. The Government of India has defined women entrepreneur as "an enterprise owned and controlled by women having a minimum financial interest of 51 percent of the capital and giving at least 51 percent of the employment generated in the enterprise to women". A self help group (SHG) is a small economically homogenous affinity group of rural poor generally not exceeding 20 members voluntarily coming together. These are small informal and homogenous groups whose strength ranges from a minimum of 5 to maximum of 20 needy members. The competencies required for an entrepreneur can be acquired through training and development. One of the important areas of economic development is to bring forth latent talents and nurture a strong entrepreneurial spirit in individuals. This could be motivated through planned training activities. As the situation changes people also need to acquire the new knowledge, skills and attitude to cope up with the changing environment. Therefore, training has continued to be the most important device for developing individual's work efficiency.
Keywords: Women Entrepreneur, Dairy, SHGs, Impact.

PP 9: Women Empowering Through Self Help Group

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Self help group play an important role in reducing the poverty .self help group is a small voluntary association of poor people. NABARD in 1992 launched SHG Bank linkage programme with the policy backup of the Reserve bank of India. The SHG bank linkage programmes initiated by NABARD in active collaboration with non-governmental organisation NGO aimed at enhancing the coverage of rural poor under institutional credit. Thereby focusing on poverty alleviation and empowerment. SHG is a holistic programme of micro-enterprises covering all aspect of self-employment, organization of the rural poor into self help groups and their capacity building, planning of activity cluster infrastructure build up, technology credit and marketing, SHG is a group of informal association formed by the community women, which has specific number of members like 15 or 20 .It is a small voluntary association of poor people from the same socio-economic background. The participation of women in SHG made a significant impact on their empowerment both in social and environmental aspects. The group should meet regularly. Ideally the meeting should be weekly or atleast monthly. Compulsory attendance of all the group meeting will make it easy for SHG to stabilize and start working to the satisfaction of all .memberships. The major function of SHG .to encourage and motivate its member to save .to peruade them to make a collective plan for generation of additional income.to act as a conuct for formal banking services to reach them. Goal of SHG including empowering women, developing leadertship abilities among poor and needy people, increasing school enrolments and improving nutrition and use of birth control.

PP 10: Entrepreneurship Development and Agricultural Development

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Throughout the world, but particularly in developing countries, entrepreneurship, and rural entrepreneurship in particular, is increasingly being recognized as a key element for economic development and poverty alleviation. The transformation of agricultural producers into entrepreneurs is of critical importance in efforts to enhance rural economic and social development. Agricultural entrepreneurship is an innovation or investment of farmers in order to improve or expand their farming business for gaining more profit or growth. Agriculture and allied sectors are considered to be manistay of the Indian economy because these are important sources of raw materials for industries and they demands for many industrial products particularly fertilizers, pesticides, agriculture implements and a variety of consumer goods. It is also worth nothing that the emergence of the free market economies globally has resulted in the development of a new spirit of enterprise "Agripreneurship" and the increased individual need for responsibility for running their own business. Entrepreneurship in agriculture as the creation of innovative economic organisation for the purpose of growth and gain under conditions of research and uncertainity in agriculture. Agripreneurship have the potential to contribute to a range of social and economic development such as employment generation, income generation, poverty reduction and improvements in nutrition, health and overall food security in the national economy. Successful entrepreneurship also depends on supportive and coordinated government policies. Entrepreneurship is conducive to economic growth and the creation of employment. Agriculture is a profitable business but more importantly, It's a business for those with a mission to contribute humanity's continued existence and is a great avenue to impact your immediate society while making profits.

Technical advances and innovations in livestock and companion animals

OP 1: Clean Milk Production Practices Adopted by the Dairy Farmers of R.S. Pura Block in Jammu District

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Clean milk production is considered as one of the important factors in the economy of the state. The adoption of clean milk production practices has great potential for increasing the quality of milk production. Considering the importance of adoption of clean milk production practices followed by dairy farmers and the quality milk production the present study was conducted in R.S. Pura block of Jammu district to evaluate clean milk production practices adopted by the dairy farmers. Multistage random sampling technique was used to select the respondents. R.S. Pura block was purposively selected for the study. From the selected block, a list of villages with maximum populations of milch animals was identified. Out of the list of identified villages, two villages were randomly selected for the study. From each selected villages 20 dairy farmers were selected randomly, thus making a total of 40 farmers. The data were collected by personal interview method using structured interview schedules. The data were coded, classified, tabulated and analyzed using the software; Statistical Package for the Social Science (SPSS 16.0). The results of the study revealed that cleaning of animal house daily was adopted by majority (92.50) of the respondents, very few 27.50 percent of respondents have construction of the pucca floor and well drainage system in the animal shed. Only 22.5 percent of respondents provide ventilation to animal house whereas 32.5 percent of respondents collect the dung and dispose away from the animal house. Very less 17.5 percent of respondents keep milking area clean, disinfested and free from flies and insects. Majority (72.50 percent) of respondents adopted the practice of vaccination milking animals regularly. None of the respondents' cleaned animal shed fifteen minutes before milking, adopted regular examination of milking animal by veterinary doctor and clip hairs around the udder and hind quarter of the milking animal as a preventive measure for clean milk production. A very low 22.50 percentage of respondents wash udder for removal of mud and dung. Not a single respondent practice post and pre-milking tip dipping in potassium permanganate solution. All the respondents (100%) washed their hands with plain water before milking and trimmed their nails regularly. Only 52.5 percent of respondents covered their head with cap or handkerchiefs at time of milking. Milking by healthy person is adopted by majority (85 %) of respondents. None of respondents practiced washing entire animal or washing hind quarter or back of cows before milking and changed the clean dress before milking. Majority 82.5 percent of respondents milked milch animals randomly. Only 24.3 percent of adopted the practiced of milking the healthy animals first. Very few 11.90 percents of respondents uses separate utensils for milking of healthy and sick animal. Majority 77.50 percent of respondents complete milking within 6-7 minutes. None of the respondents dispose fore-milk and practiced post-milking feeding to keep animal in standing position for 15 min. after milking. Only 12.5 percent of the respondents adopted the practice of passing the milk from a sieve or muslin cloth for removal of the dirt.

OP 2: Impact of AICRP on Cattle on Enhancing the Milk Productivity of Indigenous Cattle

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India harbours second largest cattle population of 190.9 million which accounts for nearly 12.88% of the total world cattle inventory. Since 1998, the country also retains the pride of largest milk producer in the world. The national annual milk production has increased from 17 million tonnes in 1950-51 to 176.4 million tonnes in 2017-18 with the per capita milk availability (grams per day) of 130 in 1950-51 to 374 in 2017-18 against the present world average of 294 grams per day. The per cent contribution of cattle in national milk production was 47% of which 26% by crossbreds, 1% by pure exotic breeds, 11% by defined Indigenous breeds and 9% by non-descript cattle. These figures clearly suggest that the lower proportion (20.81%) of crossbred cattle population contributes 53.81 per cent (31.1 MT), while the large population (79.19%) of indigenous and non-descript cattle contribute only 46.19 per cent (26.7 MT) of the national cattle milk production. Considering the increase in human population and demand for milk production, the milk production potential of indigenous and non-descript cattle needs to be improved for meeting the demand of the future. Hence, Government of India has implemented many breed improvement programmes exclusively focusing on the genetic improvement of Indigenous/ non-descript cattle of the country. The Indigenous Breeds Project (IBP) implemented by ICAR-CIRC, Meerut over a decade under the AICRP on Cattle also envisages the genetic improvement of Gir, Kankrej and Sahiwal cattle breeds. The IBP mainly aims to ensure the availability of frozen semen of indigenous breeding bulls, improve the AI coverage,

establish proper performance recording system and managemental practices so that the major portion of the non-descript cattle can be upgraded to defined indigenous cattle breeds along with the conservation, propagation and genetic improvement of indigenous cattle breeds. The project also envisages the establishment of bull mother farms in the form of germplasm units from which the future young bulls are used for breeding the cattle in the farmer herds or field units or data recording units. The results of associated herd progeny testing programme revealed an increase of 2563.79 kg from 1875 kg in Gir, 2004.31kg from 1669.96 kg in Kankrej and 2066.57 kg from1574.62 kg in Sahiwal cattle. The significant improvement in milk production of daughters attained in the short period ensures ample scope for genetic improvement of vast population of non-descript cattle as the frozen semen doses of progeny tested indigenous bulls can be used for breeding to improve the national milk production in near future.

OP 3: Exploiting high fertile bulls through first generation biotechnology for doubling the farmers income

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Artificial insemination (AI) is the only biotechnology in India which is playing a pivotal role in dissemination of elite germ plasm, and making India top most milk producing country in the world. As per National dairy development board only 28% of breedable bovine are covered by AI with about 97 million sperm doses from 3280 bulls per year, with concentration of 20 million sperm per French mini straw (0. 25 mL). In order to make best use of bulls with high genetic merit bulls as well as sex-sorted semen, low sperm number per AI dose are being used widely. Insemination of females using semen of low-fertilizing capacity accounts for a significant loss to the dairy industry. The use of low fertile semen accounts a huge loss to dairy industry. In the present study the semen samples were collected from high and low fertile Sahiwal bulls, and diluted to 80 million sperm / mL, 60 million sperm / mL, 40 million sperm / mL, and 20 million sperm / mL, and packed into French mini straws, equilibrated and cryopreserved. Frozen thawed semen samples were evaluated for various sperm kinetic parameters such as VAP, VSL, VCL, ALH, BCF, TM, PM, and RM, and sperm functional attributes such as membrane integrity, acrosome reaction, capacitation status, protamine deficiency, and hypo-osmotic swelling (HOS) response. The percentage of various sperm kinetic parameters such as VAP, VSL, VCL, TM, PM, and RM were significantly ($P<0.05$) higher in 20, 15, 10, and 5 million sperm doses of high fertile bulls as compared to corresponding 20, 15, 10, and 5 million sperm doses of low fertile bulls. The percentage of sperm with intact membrane, live acrosome intact sperm, and non-capacitated sperm were significantly ($P<0.05$) higher in all sperm doses of high fertile bulls as compared to low fertile bulls. The dilution effects are more remarkable in low fertile bulls, and in case of high fertile bulls, the sperm dose may be reduced from 20 million to 10 million per straw to cover a vast population of breedable cattle that have not been yet covered under AI in India.

OP 4: Improvement in characteristics of frozen-thawed sperm doses of Sahiwal bulls after preputial washing as assessed by advanced sperm function tests

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Preputial cavity majorly contributes to the microbial contamination of bovine semen, as such flushing it properly before semen collection becomes necessary to harvest quality ejaculates. The present investigation was carried out to access the effect of varying volumes of flushing liquid for preputial washing on various semen quality parameters in Sahiwal bulls. A total of 12 bulls were chosen and randomly divided into three groups. In Group I, 100 mL of normal saline was used for preputial washing, in Group II, 700 mL of NS, and in Group III,700 mL of NS in combination with *Moringa oleifera* leaf extract was used. *Moringa oleifera*leaf extract was used for its antimicrobial activity. Preputial washing was done one day before semen collection, once a week. Semen, following routine protocol, was collected, diluted and cryopreserved in liquid nitrogen, packaged in French mini straws with 20 million spermatozoa per straw. Post-thaw viability (CFDA and PI staining) results revealed live spermatozoa percentage significantly higher ($P<0.05$) in Group II and Group III, compared to Group I, which may be attributed to lower microbial contamination and improvement in hygiene quality of semen at collection. There was not any significant difference ($P>0.05$) in dead sperm percentage between the three groups. Moribund sperm percentage was significantly higher ($P<0.05$) in Group I than Group II and Group III. Acrosome integrity was studied following FITC-PNA staining technique, that divided spermatozoa into four different patterns of, Live with intact acrosome, Dead with intact acrosome, Live with reacted acrosome and Dead with reacted acrosome. The live acrosome-intact sperm percentage in Group I was significantly lower ($P<0.05$) than other two groups. Total acrosome-intact sperm percentage was significantly lower ($P<0.05$) in Group I compared to Group III. It was concluded from the study that using larger volumes of flushing liquid for preputial washing in Sahiwal bulls improves the post-thaw sperm quality.

Keywords: Semen, preputial washing, post-thaw, sperm quality.

OP 5: Quality assessment of frozen-thawed low sperm doses of high fertile Sahiwal bulls using advanced *in-vitro* sperm function tests

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Three high fertile bulls, having significantly higher conception rates (using their frozen semen) were selected for the experiment. The semen was subjected to filtration after initial dilution to remove dead and abnormal spermatozoa. It was further diluted up to 80 million sperm / mL, 60 million sperm / mL, 40 million sperm / mL, 32 million sperm / mL, 24 million sperm / mL, 16 million sperm / mL and 8 million sperm / mL, and packed into French mini straws such that each French mini straw contained 20 million, 15 million, 10 million, 8 million, 6 million, 4 million and 2 million sperm dose, respectively. The straws were equilibrated at 5°C and cryopreserved in liquid nitrogen (LN2). The frozen-thawed sperm doses were evaluated for post-thaw motility (%), membrane integrity (CFDA and PI), acrosome reaction (FITC and PI), protamine deficiency (CMA3staining), capacitation status (CTC Assay), lipid peroxidation (TCA/TBA) and hypo-osmotic swelling test (HOST).The motility, live sperm and HOST positive sperm percentage showed a decreasing trend with increase in dilution. Dead and moribund sperm percentage showed an increasing trend with anincrease in dilution or reduction in the number of spermatozoa per straw. The percentage of live spermatozoa with intact acrosome decreased with increase in dilution. Live acrosome-reacted spermatozoa differed non-significantly. The percentage of dead spermatozoa with intact acrosome and deadacrosome-reacted spermatozoa, both increased with increase in dilution. No significant ($P>0.05$) variation was observed in lipid peroxidation, although the mean values increased with increase in dilution rate. Chromatin integrity measured as a percentage of protamine deficient spermatozoa was observed to vary non-significantly ($P>0.05$) amongst all the dilutions. Cryocapacitation status, assessed by CTC assay revealed decreasing trend in Pattern F (%) while as increasing trend in Pattern B (%), with increase in dilution. The AR pattern although showed a slight increase with an increase in dilution, varied non-significantly ($P>0.05$).It was concluded from the study that semen quality gets reduced in terms of *in-vitro* sperm function assays with an increase in dilution, and this effect was observed to be much more marked and higher in magnitude at dilutions beyond 8 million sperm concentration per 0.25 mL French mini straw.
Keywords: High fertile, filtration, low sperm doses, sperm quality.

OP 6: Foldscope Microscopy for Semen Evaluation and Estrus Detection in Dairy Animals

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Foldscope is an ultra affordable, low cost paper microscope developed by Prkash Lab at Stanford University, California and is brought to India by DBT-Prakash Lab initiatives. It is made up of a paper sheet and a single lens of 140x magnification with resolution up to 2 micron. Its utility was tested for evaluation of quality of semen being used for AI. The estrus stage of animals being inseminated was also visualized using Foldscope on the basis of crystallization pattern of cervical mucus. It was observed that pre-insemination evaluation of each semen dose being used can be tested for motility and insemination results in dairy animals may be improved by avoiding use of substandard or dead semen. This technique is very easy to perform and can be done at farmers door step also. Similarly cervical mucus fern like crystallization property can be evaluated for the cow being inseminated to make sure that cow is in proper estrus stage and so as to get maximum fertility by performing precision AI. This technique was demonstrated to the field veterinarians and they found it very useful. Foldscope is very handy tool and images can be further magnified and visualized by attaching a smart mobile phone to it. It was concluded that Foldscope has potential to revolutionize the AI practice of field veterinarians besides this Foldscope can be used for field diagnosis of various problems for which low magnification microscopy was needed.

OP 7: Effect of coloured Light Emitting Diodes (LED's) light on Carcass characteristics and Carcass quality parameters of broiler birds'

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The present study was designed to evaluate the carcass characteristics and meat quality parameters of broiler birds' performance under coloured light emitting diodes (LED). The study consisted of four light treatments; rearing of broilers in pens under incandescent light bulbs as control group (T_C) and rearing of broilers in pens under white (T_1), green (T_2) and blue (T_3) LED light bulbs. A total of 240 straight run commercial broiler chicks were allocated under different treatment groups from day old to 6^{th} week of age in side open broiler house with appropriate arrangements so that light of one pen couldn't affect the birds of other pen. Carcass characteristics of broiler birds were evaluated on the basis of dressing percentage and the proportion of prime cuts in dressed carcass.

The data on dressing percentage indicated that dressing percentage yield at 6th week of age was highest in T_3 group (69.23±0.30). Dressing percentage did not differ significantly ($p \leq 0.05$) among different treatment groups. However, it was highest in LED's groups as compared to control group (Tc). Breast yield, Drum stick, Neck and thorax yield, Thigh yield and Giblets yield did not differ significantly ($p \leq 0.05$) among different treatment groups. Back yield of T_3 group differ significantly ($p \leq 0.05$) with control ($T_{c)}$ group. However, no significant difference ($p \leq 0.05$) on back yield was found between T_c, T_1 and T_2 groups. Wings yield of T_1 group differ significantly ($p \leq 0.05$) with T_c group but did not statistically different with the other groups. Whereas, no significant difference ($p \leq 0.05$) among different treatment groups was found in meat quality parameters such as pH, water holding capacity, shear force, bone meat ratio, colour instrumentation, texture and flavor. pH, water holding capacity and shear force did not differ significantly ($p \leq 0.05$) among different treatment groups. pH of meat sample was highest in T_2 group (6.26±0.02), water holding capacity was highest in T_2 group (63.33±6.14) and shear force was highest in control group (3.82±0.02). Bone meat ratio did not differ significantly ($p \leq 0.05$) among different treatment groups and ratio was highest in T_1 group (0.83±0.11). Lightness, redness and yellowness did not differ significantly ($p \leq 0.05$) among different treatment groups whereas Lightness, redness and yellowness were highest in T_2 group (51.81±0.78), Tc group (0.67±0.05) and T_3 group (9.04±0.07) respectively. Flavour and texture did not differ significantly ($p \leq 0.05$) among different treatment groups. Flavor and texture was highest in T_1 (5.34±0.25) and Tc (6.33±0.21) respectively.

Key words: LEDs, Broiler birds, Carcass characteristics, Meat quality parameters, Dressing percentage, Prime cuts, Colour instrumentation.

OP 8: Crop residues for feeding animals in India: technology development and adoption in crop/livestock system

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The country has about 4.9% of the total cropped area under cultivated forages. In India, cattle of intensive cropped area obtain only about 25 per cent of their feed from grazing in nearby forests and other uncultivated lands, the balance comes from crop residues unsuitable for human consumption. The importance of crop residues for feeding animals in India, with reference to their relevance as the main source of feed in crop/livestock production system, priorities of their users, the availability of cereals straws in terms of quantity produced and uses. The availability of these feeds depends on type of agro-ecosystem, cropping patterns, type of animal species and prevailing animal production systems. The efforts to develop and transfer of technology for crop morphology and nutritive value, urea treatment, supplementation and the use of U.M.M.B. The importance of on-farm testing of know technologies now far out weights the need for basic or strategic research in supplementation development efforts is therefore essential. To promote more intensive use of crop residues, projects need to emphasize large scale on farm research and development efforts with Krishi Vigyan Kendras and farmers participation. To ensure greater efficiency and economic impact in the use of crop residues as feed, overcoming nutrition as the major constraints to productivity. The result could be increased live stock production and importance of animals in sustainable crop/live stock production. All cereals straws and sugarcane top has great potential for the fibrous crop residues (FCRs), which have in common their high biomass and their low crude protein and high crude fiber content. Crop residues are more nutritious and can be used judiciously to improve the overall diet.

OP 9: Effect of vitrification techniques and solutions on morphology and viability of cumulus oocyte complexes in sheep

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The experiment was conducted to study the effect of three vitrification techniques and three vitrification solutions on morphology and viability of cumulus oocyte complexes (COCs) in sheep. For that, ovaries of ewe were collected from municipal slaughter house from Jammu and oocytes were recovered by three methods viz., aspiration, puncture and slicing. A total of 5400 usable oocytes (Good and Fair quality) were vitrified using Ethylene glycol-sucrose (EGS) (1800 COCs), Dimethyl sulphoxide-sucrose (DMSOS) (1800 COCs) and Ethylene glycol-dimethyl sulphoxide-sucrose (EG+DMSO+S) (1800 COCs) vitrification solution at concentration 10%, 15% and 20% by three different vitrification techniques viz. Conventional straw (CS), Open pulled straw (OPS) and Hemi straw (HS). Out of the 5400 COCs vitrified, the highest percentage (89.66%) of normal COCs and highest percentage (85.63%) of live COCs were recorded at 15% concentration of ethylene glycol-dimethyl sulphoxide-sucrose (EG+DMSO+S) vitrification solution by OPS vitrification technique. The results showed that overall morphology and viability of cumulus oocyte complexes (COCs) in sheep at 15% concentration of ethylene glycol-

dimethyl sulphoxide-sucrose (EG+DMSO+S) vitrification solution by OPS technique is much better and superior than other techniques.

Keywords: Oocytes, Vitrification solution, Morphology, viability, Sheep

OP 10: Induction of parturition in cattle with terminal diseases

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Six cattle were presented to clinic with diseases like TRP/DH at terminal stage and cattle were having gestation period of 8.5 to 9 months. The clinical examination revealed normal rectal temperature in two animals and elevated rectal temperature in remaining animals. Dyspnea were observed in all the animals. The radiography examination of thoracic cavity revealed alteration in diaphragmatic outline and radiopaque sharp foreign bodies penetrating inside the thoracic cavity. The cardiac outline was not clearly observed. On the basis of above clinical and radiographic findings arrived at tentative diagnosis of TRP as well as DH. On per rectal examination fetus movement were observed in all the animals. On the basis of above finding it was decided to treat the animal initially by medicinal treatment followed by induction of parturition in all the animals to save the life of fetus. In all the animals calving was successfully induced within duration of 32-38 hrs after injecting Estradiol valerate @ 10 mg/animal and Inj Dexamethasone @40 mg/animal initially followed by Inj Cloprostenol @ 500 mg/animal after 10 hrs. Four cattle died within 24-36 hrs after calving and other two animals were subjected to herniorraphy for treatment of DH. The surgical treated animals were observed for 24 hrs in clinic. On basis of improvement observed in condition both the animals were discharged.

OP 11: Technological Interventions for Increasing Farmers Income through Fish Farming

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Due to burgeoning population growth, increasing affluence and changing dietary habits of the population, there has been phenomenal increase in the demand for fish. There is need for the agriculture sector to continuously evolve to remain ever responsive to manage the change and to meet the growing and diversified needs of different stakeholders in the entire production to consumption chain. Fish as a cheapest source of animal protein constitutes a major share in the global food basket and world fish production sector faces the challenge to boost the production to meet the protein hunger in the future. India is the second largest producer of fish in the world; it contributes 5.68 per cent of the global fish production. India is also a major producer of fish through aquaculture, and ranks second in the world, after China. The total fish production during 2014-15 (provisional) was 10.1 million metric tonnes (and approximate 10.8 million tonnes fish production in the country in year 2015-16) ; the contribution from the inland sector was 6.60 million metric tonnes, and from the marine sector was 3.40 million metric tonnes. Fishery is one of the most promising sectors of agriculture and allied activities in India, with an overall growth rate of 6 per cent projected during the Twelfth Five Year Plan. Besides this, fisheries supports the livelihood of almost 1.5 million people in the country. From the last decade, where the average annual growth rate of export of fish and fisheries production in the world remaining 7.5 per cent, Indian remain at the first place with an average annual growth rate of 14.8 per cent in the export of fisheries product. Aquaculture can play increasing role in poverty alleviation, livelihood support and nutritional security, generating income and employment across the chain of seed production, fish culture, harvesting, trading, marketing as well as processing. Major constrained to be addressed for sustainable development of freshwater aquaculture includes, productivity, quality seed, feed ingredients and feed formulation, species diversification, disease management, etc.

OP 12: Phenotypic Antimicrobial Resistance pattern of *Staphylococcus aureus* isolates in Mastitis Affected Cows

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The study was conducted on mastitis (clinical and subclinical) affected cows at organized dairy farms in and around Jammu. Pooled milk samples were aseptically collected in sterile milk collection vials and were subjected to microbial culture. Isolation and identification of *Staphylococcus aureus* was doneon the basis of morphological and biochemical characteristics using standard bacteriological methods. A total of 52 *Staphylococcus aureus* isolates were identified as Gram positive cocci (in clusters) showing typical jet black / grey colonies with / without a halo zone on Baird Parker Agar. Biochemical tests revealed oxidase negative, catalase positive, coagulase positive and DNase positive results. The isolates were studied for antimicrobial resistance pattern phenotypically against a panel of 13 selected antibiotics using disc diffusion technique performed according to CLSI guidelines in

Mueller-Hinton agar. The isolates were mostly sensitive to enrofloxacin (100%), vancomycin (92.3%), ciprofloxacin (88.46%), chloramphenicol (84.61%) and tetracycline (86.53%) whereas maximum resistance was shown by the isolates to penicillin G (88.46%), ampicillin (84.61%), amoxyclav (63.7%) and methicillin (32.69%). A total of 17 Methicillin resistant Staphylococcus aureus (MRSA) were isolated showing maximum sensitivity to enrofloxacin (100%) and vancomycin (100%).Multi drug resistance (MDR) i.e. resistance to 3 or more of the antimicrobials was also observed in most of the *Staphylococcus aureus*and Methicillin resistant Staphylococcus aureus (MRSA) strains.

Keywords: Antimicrobial resistance, Mastitis, Phenotypicand *Staphylococcus aureus*

OP 13: Laboratory colonization of *Chrysomyia megacephla* (Diptera: Calliphoridae) in different diet from Jammu, India

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The blue bottle fly, *Chrysomyia megacephla* (Meigen) maggots has currently been shown to be re-markable for wound healing. The objective of this work was to establish a colony of *C.megacephla* under experimental laboratory condition. The parental adult flies were collected from natural environment/field including garden, different meat/fish shop of the locality of the University, R.S. Pura, Jammu. The flies were reared on different diets *i.e.* in liver of sheep (diet I), fish meat (diet II) and liver extract (Diet III) separately to acquire *adlibitum* amount of larvae for further study. The candidate species of adult *C.megacephla* containing 10 female and 5 male flies per cages (30X30X30cm) and replicate of four cages for each type of diet were evaluated over one continuous generation. Each four cages of diet I, was supplied with approximately 100grams liver of sheep in a petridish with a wet tissue paper to avoid dryness of meat. Similarly, for diet II and diet III types, fish meat and freshly prepared uncontaminated liver extract in petridish with wet tissue paper, respectively was placed in four separate cages each. Immediately after hatching of egg on first observation, the parent flies were shifted to another new cage. Upon emerging, the adults were placed in new cages and provided with essential diet. Recording the time required for egg hatching, larval developments, and pupation, and total time for egg-eclosion was performed every three hours intervals for eggs and every six hours intervals for larvae and pupa. . Time required for different stages of life cycle starting from hatching of egg to emerging of adult to lay of egg was recorded in days. The duration (days) of life cycle period for diet I, using sheep liver was 13 days, as in diet II of fish meat was 10 days, and liver extract was 24 days. Life cycle in fish meat was found shortest amongst the three diets. The whole study was carried out in the month of september 2018.

Key Words: Artificial diet, Colonization, *Chrysomyia megacephla.*

OP 14: Effect of Norgestomet Treatment on Fertility of Ewes During Non Breeding Season

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The present study was conducted on 30 randomly selected ewes during non breeding season, maintained at Govt Sheep Breeding Farm Panthal, Katra, Reasi, Jammu. The selected ewes were divided into 5 groups (GI, GII, GIII, GIV, GV) consisting of 6 ewes (n=6) in each group, and the selected animals received different hormonal protocols (GI= 1/3 Norgestomet + 200 IU PMSG, GII=1/3 Norgestomet + Ram effect, GIII= 1Norgestomet + PMSG 200 IU, GIV=1Norgestomet + Ram effect, GV=untreated control). All the treated ewes of different treatment groups exhibited estrus within 43.16±3.97 hrs, 51.83±1.95 hrs, 26.93±1.49 hrs and 29.16±1.62 hrs with a mean duration of estrus 27.83±1.81 hrs, 24.66±0.71, 34.33±2.75 hrs and 30.33±2.89 hrs in GI, GII, GIII and GIV, respectively. The Conception rate was almost similar in the GI, GII, GIII (50%) groups. The lambing rate was similar in all the groups (100%), however, none of the ewes of the untreated control (GV), exhibited estrus.

Keywords: Ewe, Estrus induction, Norgestomet, PMSG, Ram effect

PP 1: Sperm Kinetics and Functional Attributes in High and Low Fertile Sahiwal Bulls

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The fertility of the bull and quality of cryopreserved semen contribute to the outcome of AI as much as the cow factor. Insemination of females using semen of low-fertilizing capacity accounts for a significant loss to the dairy industry. To improve the effectiveness of AI programme, tests that can precisely identify the fertilizing potential of cryopreserved spermatozoa need to be evolved. The present study was designed to investigate sperm kinetics and functional attributes in high and low fertile Sahiwal bulls. The present study was carried out at Artificial Breeding Research Center (ABRC), ICAR-National Dairy Research Institute, Karnal, Haryana, India. Bulls were classified into high and low fertile based on conception rate ranging from 43 to 58 % and 25 to 37%, respectively. Ejaculates with mass motility ≥ 3+ and individual progressive motility ≥70% from 8 bulls were collected as per standard procedure. Each ejaculate was diluted with Tris-egg yolk-glycerol extender upto 80×10^6 sperm/ml and diluted semen samples were packed in French mini straws. The semen filled straws were then kept for equilibration at 5 ºC for 4-5 hours and then frozen. Frozen-thawed semen samples were evaluated for CASA parameters viz., VAP, VSL, VCL, ALH, BCF, STR, LIN, TM, PM, RM, and SM, and sperm functions such as membrane integrity, acrosome reaction and hypo-osmotic swelling (HOS) response. The VAP, VSL, VCL, TM, PM, RM were significantly ($P<0.05$) higher in high fertile as compared to low fertile bulls. However, Slow pct was significantly ($P<0.05$) higher in low than high fertile bulls. The percentage of live, live acrosome intact and HOS responsive sperm were significantly ($P<0.05$) higher in high as compared to low fertile bulls. Percent moribund, dead acrosome intact and dead acrosome reacted sperm were significantly ($P<0.05$) higher in low fertile as compared to high fertile bulls. It was reported that sperm kinetic parameters, fluorescent sperm function tests for viability, acrosomal status and membrane integrity may be used for assaying the fertility level of Sahiwal bull semen.

PP 2: Effect of vitamin C on electrolyte concentrations in water deprived goats

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This work is aimed to study the effect of vitamin C on electrolyte concentrations in blood and urine in water deprived goats during summer and winter seasons. Eighteen adult male goats were selected for the experiment during both summer and winter seasons. In each season, there were two treatment groups: T1 and T2 group. In T1 groups, water was restricted and subdivided into three experimental periods: in period 1 (experimental days 1 to 7), goats were adapted to the water restriction regime by limiting access to water gradually from 15 to 3 hour per day. During the second period of the experiment (experimental days 8 to 14), animals had access to water for 3 hours/day. In the final period of the experiment (experimental days 15 to 22), animals had access to water only every second day for 6 hours. In T2 group, the same protocol as mentioned above was followed with addition of vitamin C supplementation (180 mg/kg body weight/animal/day). In the control group (both season), water was offered ad libitum (24 hours) throughout the experimental period. Blood and urine samples were collected and different electrolyte concentrations were estimated.In T1 group, serum and urine sodium, potassium and chloride levels showed increasing trend ($P<0.05$) in both summer and winter seasons.Urine sodium and chloride concentrations showed increasing trend up to day 22 in both seasons in T2 group; whereas, potassium concentration showed similar trend from day 7 during winter season, but during summer concentration increased up to 7 day, then decreased. Significantly lower ($P<0.05$) serum and urine electrolyte values were observed in vitamin C supplemented group as compared to water deprived group in last days (mainly 14 and 22 days) of experiments. The overall summer value of serum sodium and chloride were higher as compared to overall winter values in all the groups; whereas, overall summer value of potassium was higher only in control group as compared to winter season.Overall summer value of urine sodium was higher in all groups, significant variation found in T2 group. Overall potassium concentrations in urine was significantly higher ($P<0.05$) in T1 in summer. Summer chloride concentrations in urine were higher in treatment groups; whereas, lower in control.Water deprivation had negative impact on electrolyte balance, which can be ameoliorated by supplementation of ascorbic acid at the rate of @180mg/kg b.wt./day.

Keywords: electrolytes, goats, summer, vitamin C, water restriction, winter

PP 3: Effect of Modified French Mini Straw on Cryosurvival of Low Sperm Doses

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Low-sperm numbers in AI-doses are being used widely to make the best use of high genetic value bulls as well as sex-sorted semen. Sperm concentration needed for AI to obtain reasonable fertility, taking into consideration genetic value of bull and numerous others components is one of the essential constituents for successful AI breeding program. However, low sperm concentrations in AI-doses lead to reduced post-thaw viability. The present investigation was designed to study the effect of modified sperm packaging on functions of low sperm doses of Sahiwal bulls. Ejaculates with mass motility ≥ 3+ and individual progressive motility ≥70% from 8 bulls were collected as per standard procedure. Four types of straws prepared based on position of cotton plug viz type I (normal French mini straw with no displacement of cotton plug), and type II, type III and type IV with cotton plug pushed 2cm, 4cm and 6cm, respectively from the manufactures end. Each ejaculate was split into four parts viz., Part I, Part II, Part III and Part IV and diluted upto 20, 15, 10 and 5 million sperm/0.25ml, respectively. 20 million doses were filled in all types of straws and 15, 10 and 5 million doses were filled in type I straws. The semen filled straws were then kept for equilibration at 5 ºC for 4-5 hours and then frozen. Frozen thawed samples were evaluated for sperm functions such as progressive motility, membrane integrity, acrosome reaction and hypo-osmotic swelling (HOS) response. There was significant ($P<0.05$) reduction in percent progressive motility, live, live acrosome intact and HOS responsive sperm from 15 to 5 million sperm doses. In type II, type III and type IV straws, no significant difference in percent progressive motility, live sperm, moribund sperm, dead sperm, live acrosome intact sperm, live acrosome reacted sperm, dead acrosome intact and dead acrosome reacted sperm was reported. It may be concluded that the present modified packaging attenuates the dilution effect and provides enhanced cryosurvival of low sperm doses without compromising their freezability.

PP 4: Recent Advances in Technologies to Improve Animal Health

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New technologies and procedures in the world of Veterinary medicine have changed the way veterinarians face many animal health issues. Some of the recent advances that benefit animal health today are discussed here. One example of a diagnostic technology that is catching on in a big way in veterinary medicine is diagnostic ultrasound. Using high frequency inaudible sound waves, ultrasound allows the clinician to visualize organs and tissues in a way that can dramatically affect the outcome of a pet's health problem. Over the last 5-10 years ultrasound imaging (sonography) has become commonplace in veterinary practices across the country.Flexible endoscopy is another relatively new tool for veterinarians. This technology uses long flexible scopes and fiberoptics (or in some cases miniature video cameras) to look into the gastrointestinal tract or airways of the lungs to better understand a pet's health problems. Rigid endoscopes are a close relative to the flexible endoscopes only they're not flexible. These rigid scopes are used increasingly in animal medicine to evaluate joints (arthroscopy), the abdominal cavity (laparoscopy), and thoracic cavity (thoracoscopy). The mechanization of various aspects of the PCR assay, such as robotics, microfluidics and nanotechnology, has made it possible for the rapid advancement of new procedures. Real-time PCR, DNA microarray and DNA chips utilize these newer techniques in conjunction with computer and computer programs. The PCR and reverse transcription–PCR (RT–PCR) assays have greatly accelerated the speed and accuracy of diagnoses of animal disease, especially of the infectious agents that are difficult to isolate or demonstrate. The PCR has made it possible to genetically characterize a microbial isolate inexpensively and rapidly for identification, typing and epidemiological comparison.
Keywords: Advances; Technology; Animal Health

PP 5: Constraints Related to the Dairy Development in Jammu And Kashmir

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Livestock plays an eminent role in generation of livelihood on daily basis for farmers and boosts economy of the region. In case of Jammu and Kashmir, livestock sector plays an important role in the socio-economic

upliftment of the state, with dairying being no exception as a potential source of additional income for the rural people. Although the per capita availability of the milk has increased to about 400g/day in the year 2016-17 against the national average of 355g/day, but the percentage share of milk production of the state is only 1.4 percent to the total milk production of the country. The farmers of the state are not able to derive maximum genetic potential from the sizeable population of bovines, due to several constraints. The constraints that hinder the development of dairy sector in the state and require immediate attention are reviewed and categorized into institutional, technical and financial constraints. Poor interest of the dairy farmers towards the cooperative dairy enterprises, lack of availability of superior germplasm to the farmers, unavailability of emergency animal health care and doorstep AI services have hampered the growing scenario of milk production in the state and are categorized into institutional constraints. The majority of the farmers being marginal and small have meagre economic stability and land holdings which leads them to invest least in the management and nutrition of the animal, leading to direct decrease in its production performance. Moreover the lack of adoption of the modern farm practices, little knowledge about the management and disease prevention practices and the ignorance of the milk producers about the profitable market, form the technical constraints. Among financial constraints, the major are small land holdings, low income and low level of knowledge about financial institutions, credit schemes and animal insurance. Keeping in view the good prospectus for the growth of dairy sector in Jammu and Kashmir and the employment generation potential of the dairy sector in general, there is a need to manage these constraints with proper strategies and efficient planning.

Keywords: Constraints, Dairy, Development, Jammu and Kashmir

PP 6: Clinical and Laboratory Diagnosis of Common Bacterial Diseases of Broiler and Layer Chickens in Jammu Region

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The present experiment was carried out to compare clinical and laboratory diagnosis of some commonly occurring diseases (bacterial and viral) of poultry during the period from March 2015 to July 2017 in the Division of Veterinary Pathology in collaboration with Division of Veterinary Microbiology and Immunology. A total of 70 chickens (45 broilers and 25 layers) from commercial farms, local poultry dressers and clinical cases brought for postmortem to Division of Veterinary Pathology were screened during the study. Clinical diagnosis was made on the basis of history, clinical signs and postmortem findings of the affected birds whereas confirmatory diagnosis was made by cultural examination, morphological, biochemical and molecular tests of different samples taken from these birds. During the clinical diagnosis, out of 45 broilers, 25 (55.5%) chickens were diagnosed as colibacillosis, 10 (22.2%) as salmonellosis, 6 (13.3%) as pododermatitis (bumble foot), 1 (2.2%) as fowl cholera, and 3 (6.6%) as chronic respiratory disease (CRD). Out of 25 suspected layer chickens, 12 (48%) were diagnosed as colibacillosis, 8 (32%) as salmonellosis, 3 (12%) as fowl cholera and 2 (8%) as CRD. During the labortary diagnosis, out of 45 suspected broiler chickens, 12 (26.6%) were diagnosed as colibacillosis, 5 (11.1%) as salmonellosis, 4 (8.8%) as bumble foot and none as fowl cholera. Correspondingly, out of 25 layer chickens, 6 (24%) were diagnosed as colibacillosis, 4 (16%) as salmonellosis, 1 (4%) as fowl cholera and 1 (4%) as CRD. It can be concluded that for diagnosing poultry diseases, laboratory diagnosis is more reliable in comparison to clinical diagnosis.

PP 7: Effect of ovarian side on quantity and quality of oocytes from sheep ovaries

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The experiment was conducted to study the effect of side of the ovaries viz., right or left ovaries on quantity and quality of sheep oocytes. For this purpose ovaries of sheep were collected from municipal slaughter house in Jammu city and oocytes were recovered by three techniques viz., aspiration, puncture and slicing. 900 ovaries of each side were taken for experiment and numbers of cumulus oocytes complexes (COCs) collected from sides of ovary were graded and recorded. The overall mean numbers of usable oocytes recovered from ovaries were 3.11±0.02. The mean number of usable oocytes were significantly higher ($P<0.05$) in left ovaries (3.29±0.02) as compared to right ovaries (2.93±0.02) but number of poor quality oocytes did not differ significantly ($P>0.05$) between ovaries of left and right side. The results showed that left ovaries were more active and hence recovery of higher number of good as well as fair quality oocytes from left side sheep ovaries.

Keywords: Ovarian side. Oocytes quality, Sheep

PP 8: Clinical Efficacy of Mifepristone and Misoprostol for Induction of Parturition in Bitches

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Seven Bitches were presented in clinical complex over a period of three years with a history of completion of gestation period but were not showing any sign of initiation of whelping. Ultrasonography was done to confirm the pregnancy and all the bitches were found to be positive. The mean gestation period calculated as the interval from the first mating to the day of presentation was 66.00±0.75 days and ranged between 64 to 69 days.4 bitches allotted in group-I were administered 5mg/kg b.wt of mifepristone orally, b.i.d for 2 days. 3 bitches allotted to group-II were administered mifepristone as in group-l and were given misoprostol @ 2.5 mg/kg intravaginally mixed with liquid paraffin once. Following the initiation of treatment as well as completion of process of parturition was observed in 3 out 4 treated animals (75.50%) within 50 h in group-I and within 46 hr in 3 out of 3 bitches(100%) in group -II. The remaining 1 bitch in group-l was presented to the clinic again with the complaint that the animal had still not shown any signs of parturition even after 72 h and the animal was subjected to caesarean section. The mean time taken for the expulsion of the first pup from the time of initiation of treatment was recorded as 28.75±3.09 h and 20.66±9.01 in group -I and group -II respectively. The first pup was delivered as early as 21hr in one bitch and 12 hr in one bitch in group –l and group –ll respectively. The time taken for the delivery of the entire litter following first dose of mifepristone treatment averaged 39.50±6.38 h and 30.0±9.86 in group -I and group -II respectively. Further, 80% and 75% of the puppies born were found to be alive at 24h after delivery in group-l and group-ll respectively. The results of the present study indicate that though there was statistically no difference in time taken for delivery of first pup and overall whelping time, but combination of mifepristone and misoprostol resulted in 100% induction of whelping.

PP 9: Comparative efficacy of intravaginal progesterone sponge and other progesterone inserts on reproductive performance on post-partum anestrus buffaloes

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The present study was carried out to study the effect of different progestational inserts including self-made intravaginal progesterone sponge on estrus induction in postpartum anestrus buffaloes located in different villages of R.S. Pura areas of Jammu district. A total of 48 postpartum anestrus buffaloes were divided into four groups with 12 buffaloes in each group. Estrus was induced in buffaloes using different progesterone insert Viz. CIDR (Group I), Crestar (Group II), Intravaginal progesterone sponge (Group III) and Intravaginal progesterone sponge along with carboxy methyl cellulose (Group IV), respectively for 9 days in all the buffaloes and Inj. Folligon 600 IU were administered on day of withdrawal of inserts. Hormonal, biochemical, enzymatic and minerals parameters were analysed. Estrus induction response was 100% in group I and III while 91.67 % were observed in group II and IV in treated animals and onset of estrus occurred within 37.07±1.58h, 33.32±2.23h, 39.33±2.24 and 40.33±2.4h and mean duration of estrus was 22.31±0.79h, 21.08±0.69h, 27.08±0.69 and 23.64±0.50h in Group I, II, III and IV, respectively. The onset of duration was significantly higher ($P<0.05$) in group compared to group to II, the lowest duration of estrus was observed in group II which was significantly lower ($P>0.05$) compared to group III and IV. The pregnancy rate was 50.00%, 63.64%, 66.67% and 54.55% in Group I, II, III and IV, respectively.

PP 10: Clinico-therapeutic management fetal abortion in goat

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A non-descript primiparous goat was brought to the Teaching Veterinary Clinical Complex, F.V.Sc. and AH, Jammu with the history that the goat had continuous straining since 8-10 hours and blood tinged discharge from the vagina. The goat was anorectic and showing inappetence from last 3 days. On general examination the goat was dull, depressed and having rectal temperature 102.5°F. Ultrasonography reveals one dead fetus inside the uterus. Firstly vaginal passage was adequately lubricated with sterile liquid paraffin and hand is inserted in the birth canal. The head and one fore limb was palpated. Traction was applied on the fore limb but limb got disarticulated and removed. Again traction was applied on the head and by gently pulling fetus was removed. After removal of fetus, the goat immediately received intravenous infusion of DNS 500 ml, Intramuscular antibiotic injection Enrocin, 3 ml, parentral non-steroidal anti-inflammatory drug (NSAID), Melonex, 2 ml and herbal uterine ecbolic,

Porsche 30ml per OS. 2 Furea boli was kept in the uterus for maintaining uterine hygiene. Furea bolus, antibiotic and anti-inflammatory drugs were administered for another 3 days at the same dose rate and route. On follow up at two weeks, the goat was quite active, feeding normally and had made uneventful recovery.

PP 11: Strategies to Counteract Climatic Stress in Fisheries

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It is now widely accepted that climate change is no longer simply a potential threat, it is unavoidable; a consequence of 200 years of excessive greenhouse gas (GHG) emissions from fossil fuel combustion in energy generation, transport and industry, deforestation and intensive agriculture (IPCC, 2007). IFAD and other development agencies have recognized climate change as one the greatest threats facing mankind today (IFAD, 2008) and have highlighted the fact that the poorest and most vulnerable will be disproportionately affected by its impacts (IFAD, 2008). Climate change will have significant impacts on fisheries and aquaculture. At low latitudes these are likely to be largely negative for fisheries, damaging important ecosystems such as coral reefs and mangroves and causing reductions in fish stocks due to rising water temperatures and reduced primary production. This could have significant effects on food security and employment in areas dependent on fisheries that are particularly vulnerable to the impacts of climate change; these include reef fisheries, fisheries in shallow lakes or wetlands and fisheries in other enclosed or semi-enclosed bodies of water. However, some areas may experience localized increases in fish stocks due to in-migration of species from other areas and rising primary production. Brackish and saltwater aquaculture could benefit from rising sea levels and freshwater aquaculture in cooler regions could benefit from increased feed efficiency and reduced cold water mortality, though reductions in availability of wild fish for feed and seed, increased spread of disease and reduced water quality pose threats.

Keywords: Climate change, Fish Production, Aquaculture

PP 12: Scenario of bovine mastitis etiology in Jammu and their molecular details

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Mastitis is regarded as one amongst the oldest diseases with which farm animals have been affected since ages. It is more or less like a headache to veterinarians due to the increasing number of cases as well as the increased farm losses. Mastitis is defined as inflammation of mammary gland and is the most important production disease of dairy animals having the large impact on farm economics by decreasing milk yield, and an increase in treatment costs. In India the annual economic loss due to mastitis has been calculated to be Rs. 7165.51 crores; losses being almost same for cows (3649.56 crores) and buffaloes (3515.95 crores). Sub-clinical mastitis (SCM) has been estimated to account for 57.93 per cent (4151.16 crores) of the total economic loss due to mastitis. Mastitis being a multi-etiological disease is inflicted by organisms as diverse as bacteria, viruses etc. Although the majority of mastitis is of bacterial origin, however, involves only few species for most cases, such as *Escherichia coli, Staphylococcus aureus, Streptococcus uberis* etc. In India the scenario is totally different with subclinical mastitis being more prevalent (varying from 10-50% in cows and 5-20% in buffaloes) than clinical mastitis (1-10%) and *Staphylococci* (39%) constituting the major organism to be isolated followed by *Streptococci* (31%), *Corynebacterium* (25%) and *E.coli* (5%). Early diagnosis of subclinical mastitis is extremely important to check its development to clinical cases which is possible by molecular tests. Molecular diagnostic technologies have also been used as a routine tool for diagnosing mastitis pathogens. There are enumerable studies that deal with the distribution and characterization of bacterial species which have been involved in the mastitis and also help in identifying the different virulence factors of those organisms isolated from cows suffering from clinical mastitis. Various studies have found that a variety of virulence genes are present in the mastitis strains which can be detected genotypically, but in Jammu region data on molecular characterization of mastitis origin bacteria is still lacking. The currently used standard biochemical/phenotypic tests lack the sensitivity required to accurately determine the species involved in the infection. The identification and characterization of virulence factors of the isolates involved in bovine mastitis help in enhancing the understanding of their pathogenesis and thus may pave way for reduction in losses incurred to the dairy industry.

PP 13: Effect of Micromineral Supplementation on Udder Health of Dairy Cows

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The study was conducted on 16 pregnant dry cross bred cows in 2nd to 5th parity, with moderate to high milk yield, that were divided into two groups of 8 animals. Group 1 cows were fed micromineral supplement containing Cu, Zn, Mn and Co @ 7g/day for 6 weeks before the expected date of calving. Group II cows were kept

as control. Plasma samples were analysed for estimating oxidative stress parameters including Superoxide dismutase(SOD), Glutathione peroxidase (GPx), Glutathione-s-transferase (GST)and Lipid peroxidase (LPO)estimated by standard methods. Results revealed significantly higher (6.636±0.896) plasma LPO levels in the cows of control group compared to that of the mineral group (3.258±0.614) whereas plasma antioxidant levels (SOD, GPx and GST) were non-significantly increased in the animals of supplemented group as compared to the control group. Daily milk yield recorded for complete lactation length of all the cows indicated significantly higher value in supplemented group compared to that of the control group. On the basis of California Mastitis Test (CMT), incidence of subclinical mastitis (SCM) was seen more in the cows of control group. Somatic cell count (SCC) and standard plate count (SPC) values of control group were significantly higher ($p<0.005$) as compared to that of the supplemented group. It is concluded that micromineral supplementation during late dry period improves early lactation udder health by decreasing oxidative stress and incidence of SCM in dairy cows.

Keywords: Dairy cows, Micromineral, Oxidative stress, Subclinical mastitis

PP 14: Assessment of utility of conserved mitochondrial COI gene for differentiation of obligate and non obligate myiasis causing flies

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The present study was carried out for comparative analysis of the mitochondrial gene for the subunit I of cytochrome oxidase (COI) in different species of myiasis causing flies. Mitochondria DNA (mtDNA) is commonly employed as a molecular marker in phylogenetic and population genetic studies of metazoans. Cytochrome oxidase subunit I gene (COI) has been demonstrated to be suitable for genomic studies due to its larger size and better-conserved structure. In the present study larval stages of different flies (*Oestrus ovis, Gastrophilus spp* and *Calliphora spp*.) were collected. *O. ovis* larvae were retrieved from sheep heads while *Gastrophilus* larvae were collected from faecal samples of horses dosed with 0.2mg/Kg Ivermectin. *Calliphora* larvae were isolated from a maggot infested wound, identified and preserved for DNA isolation. After genomic DNA isolation 1630bp COI gene of different obligate and non obligate myiasis causing flies was amplified using universal primers (UEA1 and UEA10). Restriction fragment length polymorphism (RFLP) of amplicons was also carried out and their restriction profiles were compared. A clear genetic difference between different obligate and non obligate myiasis causing larvae examined was demonstrated by using *Hinf* I enzyme. The results thus obtained offer a preliminary investigation into the molecular identification of these parasites. it will be possible to obtain more data on intra-or inter-specific relationships of Diptera larvae causing myiasis and which will be instrumental in highlighting the relationships among larvae belonging to different subfamilies.

PP 15: Biochemical Alterations in *Oestrus ovis* infested goats of Jammu Region

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Study was conducted to evaluate the biochemical alterations in normal healthy adult and *Oestrous ovis* infested goats of Jammu region. Twenty five blood samples each of healthy and *Oestrous ovis* infested goats were collected from different slaughter houses of Jammu region. About 5 ml of whole blood was collected from every animal. Blood was taken in well cleaned, dry, sterilized and labelled microcentrifuge tubes, and allowed to clot. After clotting, the tubes were centrifuged to collect serum at 3000 rpm for 15 minutes. The serum samples were collected in labelled tubes separately and stored in deep freeze (-20^{o}C) for further biochemical analysis such as serum total protein, albumin, urea and creatinine. Mean serum total serum protein, albumin, urea, creatinine levels of healthy animals during study was 6.60±0.721g/dl, 4.27±0.282g/dl, 16.13±0.282 mg/dl and 0.536±0.212 mg/dl. Mean serum total serum protein, albumin, urea, creatinine levels of *Oestrous ovis* infested animals during study was 5.13±0.640g/dl, 2.55±0.249 g/dl, 25.59±2.10 mg/dl and1.460±0.378 mg/dl. There was significant($p<0.01$) decrease in total protein, albumin levels and significant increase in urea and creatinine concentration of *Oestrous ovis* infested animals when compared with normal adult healthy goats. Thus, it can be concluded that *Oestrous ovis* infestation in goats causes severe biochemical alterations as evident by compromised hepatic and renal function tests.

PP 16: Identification of Larval Stages of Trematodes in Snails of R.S. Pura, Jammu

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The prevalence of parasitic infection in snails was studied in adjacent villages of R.S. Pura, Jammu during the monsoon season (July to September). A total of 378 snails of different species were collected from Jajwal (190), Kheri (68), Badyal (25), New Agra Chaka (67) and Kalali (28) villages and brought to the laboratory for further examination.Two genera of snails were identified in which *Indoplanorbis*(310) predominated to the *Lymnaea*(68). The results revealed that five *Indoplanorbis* snails collected from Badyal and six*Indoplanorbis* snails collected from Kalali hosted the cercarial stages of *Echinostoma* spp. Echinostomes comprise a group of at least 60 species of foodborne and zoonotic intestinal trematodes, and are endemic worldwide. The micrometric measurements of cercariae in the present study revealed a total length of 724.12 µm, with length of head and tail regions being 249.86 µm and 472.6 µm, respectively. The transformed metacercariae were found to be round, 160 µm in diameter. The cercariae showed a visible head collar, but the number of spines could not be clearly ascertained. However, the head collar of metacercariaehad a total of 37 collar spines arranged in two alternating rows, including 5 corner spines on each side. Based on above criteria, the larval stages were identified to be belonging to *Echinostomarevolutum*. Heavy infections with Echinostomes, especially *E. revolutum*, may cause emaciation and catarrhal enteritis, and death may occur in young and non-healthy animals. Consequent of the presence of zoonotic echinostome cercaria in snails collected from rice fields, further studies are needed to confirm the species based on molecular studies and ascertain the prevalence at a large scale.

PP 17: Evaluation of maggot therapy in reducing oxidative stress accelerating chronic wound healing

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Molecular oxygen plays a central role in the pathogenesis and therapy of chronic wounds. Overproduction of reactive oxygen species (ROS) results in oxidative stress thereby causing cytotoxicity and delayed wound healing. The beneficial effect of *Lucilia sericata* maggot in healing of chronic wound is widely reported, however the mechanism of maggots in accelerating the wound healing have yet to be fully elucidated. The present study was aimed to evaluate the effectiveness of maggot therapy in reducing oxidative stress in chronic wound healing. The study comprised of 48 numbers of Wistar rats where chronic wound was created by inoculating mixed colonies of bacteria. Animals were further divided in 4 groups with 12 rats each being presented as control, antibiotic, maggot and maggot and antibiotic in combination treated. All treatments were applied once and held for 24 hours. Different oxidative stress parameter in maggot treated wounds evaluated with controlled one and recorded significant increase of Glutathione-S-transferase with a decreased level of Lipid peroxidation (LPO) in maggot treated wounds in comparison with other groups ($P<0.05$) on 14^{th} day, with complete healing. In the present observation, early and quick reduction of (LPO level might be due to the molecules responsible for the beneficial action of maggots are contained in their excretions/secretions (ES), which inhibited ROS at the wound bed. Maggots' ES inhibit multiple pro-inflammatory responses of activated neutrophils thereby restrict the production of ROS and controlled oxidative stress Increases. Increase GST level in maggot treated animal might be due to free radical scavenging activity of ES of blowfly maggot which corroborates the findings of other researchers. The study further in opinion of that detailed study of ES of *L. Sericata* and its molecular properties involvement in oxidative stress reduction needs to be explored adequately.

Key words: Chronic wound, maggot therapy, oxidative stress

PP 18: Exfoliative Vaginal Cytology in Bitch Using Foldscope

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Vaginal cytology is a valuable tool in breeding management of female dogs as it reflects the endocrine events of the estrus cycle. Vaginal cytology is used to predict fertile period in bitch, as isolated female dogs fail to show required behavioral and physical symptoms. Necessity of compound microscope limits cytological observations at owners door step so as to suggest correct breeding time in bitch. Foldscope is an origami based low cost affordable paper microscope developed by Prakash Lab. at Stanford University, USA and recently brought to India by the Department of Biotechnology, Govt. of India. It is very portable and may be carried as part of diagnostic kit to the owners door step. The present study was made to compare the usefulness of Foldscope tool to study exfoliative vaginal cytology in bitch and determine fertile stage of estrus cycle. A total of 6 female dogs from veterinary clinics

and canine owners were used to study at different estrus period. Samples were taken from the vagina using sterile swab to prepare slide which were further fixed and stained using standard Giemsa stain. Observations of cytology using Foldscope were compared with the compound microscope and its usefulness was assessed. It was evident that Foldscope have sufficient magnification and resolution to observe epithelial cells, cell margins and nucleus were clearly visible. Different types of cells intermediate, parabasal and anucleated superficial cells were identified using Foldscope. It was concluded that exfoliative vaginal cytology observations are possible using Foldscope instrument and is useful for veterinary practitioners and pet owners for determining suitable breeding time.

PP 19: Urethrostomy as a salvage procedure for the management of ruptured urethra due to failure of tube cystostomy technique used primarily forthe treatment ofcystorrhexis secondary to obstructive urolithiasis in a sheep

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A 6 months old uncastrated male sheep brought to the clinic with the history of retention of urine for last 3 days. Sheep was fed on wheat bran and concentrate diet. Furosemide was administered i.m. as a primary treatment. On physical examination, there was bilateral distention of abdomen. Paracentesis abdominis revealed ruptured urinary bladder. Cystorrhaphyand tube cyststomy was done via left caudal paramedian approachunder lumbosacral spinal analgesia. Urine was coming freely through Foley's catheter for a week but after that there was recurrent blockade of Foley's catheter. Sheep was again brought to the clinic and examination revealed severe swelling and necrosis of perianal, ischial and caudal aspect of left thigh muscles due to accumulation of urine subcutaneously following ruptured urethra. Perineal urethrostomy was done under lumbo-sacral spinal analgesia to maintain urethral patency. Foley's catheter was removed and several cuts were made on swollen area for oozing of urine accumulated subcutaneously. Post-operatively, analgesic and anti-inflammatory (meloxicam), antibiotic (enrofloxacin) was injected i.m. for 5 days, and betadine was applied over necrosed portion. On telephonic conversation with owner, sheep recovered in about 3-4 weeks.

PP 20: Molecular characterization of Indigenous Silkworm breeds (*Bombyx mori)* using SSR markers

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The molecular characterization and genetic variation among domesticated organism like Silkworm (*Bombyx mori*) is an important aspect for selection of suitable parents for breeding programme. The selection of parents based on phenotypic traits along with genetic variation (DNA profiles) may be the better option as phenotypic traits expresses variation due to environmental influence. It is also believed that unique DNA profiles could provide a solution to the said problem as they are environmentally neutral. Knowing the genetic structure of those may provide information to improve the conservation of commercial lines by estimating inbreeding over generations and the consequences of excessive use of those lineages. The present investigation was undertaken to elucidate the SSR based genetic variation in twenty silkworm parental breeds using a panel of 27 SSR markers. Altogether 233 allelic variants were detected among the twenty breeds with an average of 6.13 alleles per locus. The number of alleles ranged from 5 in case of S0514 to 13 in case of S0314 with allelic size ranging between 87 to 459 bp. The polymorphism per cent revealed in the form of percentage of unique alleles was recorded to be the maximum in the case of S1711 and S1904, (70.00%) and the minimum in the case of S1115 and S2620 (16.6%) with an average value of 45.95. PIC values ranged from 0.57 (S2206) to 0.94 (S0409, S1902, S2714) with mean of 0.84, reflecting the presence of high allelic variation.

Keywords: Silk worm, SSR marker, Polymorphism, genetic variation.

PP 21: Surgical removal of a mummified foetus in cross bred cow-a case report

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A five years old jersey cross bred cow was brought to the teaching veterinary clinical complex of SKUAST-J, R.S. Pura with history of eleven and half months of pregnancy and no signs of parturition. During investigation the owner revealed that the animal had clear fluid discharge about two months back but no foetus was delivered. Per –rectal examination revealed a hard uterus in the middle of abdominal cavity. Pervaginal examination showed closed cervix. Caesarean section was planned and animal was prepared for aseptic surgery. Caesarean section was performed through left oblique incision starting from stifle to umbilicus. The uterus was exteriorised

and abdominal cavity was packed with saline soaked drapes. The macerated foetus was removed and uterus was closed in two layers. The abdominal wound was closed as per routine in three layers. Skin sutures were removed on twelfth post operative day.

PP 22: Horn cancer in cattle and its surgical management-A report of three clinical cases

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Horn is a hard permanent outgrowth of the cornual processes of the frontal bones. Horn cancer is generally unilateral and is encountered in cattle in the age group of 5-10 years. Cattle (2 cows and 1 bullock) aging between 6-8 years with the history of trauma and bending of right horn were presented to the Teaching Veterinary Clinical Complex, R.S. Pura, Jammu. Unilateral growth was observed in all the cases with the common clinical signs of frequent head shaking, rubbing the head on hard surface, foul smelling discharge with the subsequent bending of affected horn. Portion of horn was replaced by tumor tissue in one case with increase in nasal discharge of the affected side. Friable cauliflower shaped mass was visible which was diagnosed as Horn cancer and was subjected to surgical intervention. An amount of 20-30 ml, 2% lignocaine hydrochloride was infiltrated to desensitize the cornual nerve. The horn tumor was removed surgically from the base by flap method and cauterization of the mass was done. Vincristine therapy was given post operatively in one case and the animals recovered uneventfully. The histopathology of the tumourous mass confirmed it to be a squamous cell carcinoma.

PP 23: Survey on reproductive status of dairy cattle

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Ananalysis was accompanied in adjoining villages of R. S. Pura Jammu among 30 farmers owning a total of 87 dairy livestock. It was recorded that animal holding per family ranges from 1-7 (average 2.9). The status of these livestock according to the survey was18.37%, 27.28%, 26% and 24.68% non-lactating, lactating, heifers (> 1 year-up to calving) and calves (up to 1 year) respectively. In adult dairy animal 47.16% were lactating among which 13.71% were pregnant; 22% were dry of which 18.61% were pregnant. Among the adult stock 37.68% were heifers of which only 3.18% were pregnant. The survey analysis showed that the average age of first calving in cattle is 3.14 years and in buffalo is 4.67 years. The average inter calving period (ICP) in cattle and buffalo is 18.4 months and 19.75 months respectively. It was also observed that 65% of the pregnant cattle were bred though A.I services and the rest of 35% were served by local bulls. Among buffaloes 94% were bred through natural service and only 6% by Artificial Insemination technique. From the surveyed data it may be concluded that the Inter Calving Period in the dairy animals is longer which suggests management problems and required technological interventions. Apart from this, anestrus is mainly prevalent among the reproductive disorders.

PP 24: Scope and Potential of ornamental fisheries for doubling the farmer's income

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Ornamental fisheries/aquarium keeping, always remain an interesting activity throughout the world. Aquarium fish keeping provides not only aesthetic pleasure but may also acts as regular income and employment provider. Indian waters possess a rich diversity of fishes having ornamental characters, which includes both indigenous as well as exotic nature. From last few years, aquarium fishes are receiving great demand in local as well as foreign markets. Ornamental fisheries sector has the great potential for engaging unemployed, under-employed youth as well as low income farmers. This enterprises also possess the peculiar characteristics of being easily adopted by both urban as well as rural youth; comparatively less resource/input requirement for initiating the business; comparatively less space and water requirement-one can even start aquarium and ornamental fisheries business in one small room of his/her house. Ornamental/aquarium fisheries will definitely plays an important role in fulfilling the target of doubling the farmer's income as well as entrepreneurship development especially women. Therefore, the farmers who are mainly engaged in crop production and/or in veterinary enterprises may adopt the practices of ornamental fish culture side by side and engage themselves and enhance their overall income per unit area.

Key words*:* Ornamental fisheries, aquarium fisheries, farmer's income

PP 25: Evaluation of Biochemical Profile of Estrus Induced Ewes in Non Breeding Season

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The present study was aimed to study estrus induction in 30 randomly selected ewes during non breeding season at Govt Sheep Breeding Farm Panthal, Katra, Reasi, Jammu (J&K). Ewes selected were divided into 5 groups (GI, GII, GIII, GIV, GV), each group consisting of 6 ewes (n=6), which were treated with different hormonal protocols as (GI= 1/3 Norgestomet + 200 IU 3 PMSG, GII=1/3 Norgestomet + Ram effect, GIII= P4 sponge + PMSG 200 IU, GIV=P4 sponge + Ram effect, GV=untreated control). All the ewes (100 %) covered under hormone protocols exhibited induced estrus. In conclusion, in all the treatment groups (GI, GII, GIII, GIV) biochemical parameters viz, Glucose, Calcium and Phosphorus levels increased significantly ($P<0.05$), while as Cholesterol, Albumin increased non significantly ($P>0.05$) and Globulin decreased significantly ($P<0.05$) at induced estrus. In untreated control (GV), none of the ewes exhibited estrus, hence no sampling was done on that day.

Keywords: Biochemical profile, Crestar and P4 Sponge, Ewe, Estrus induction, PMSG, Ram effect

Promoting the competitiveness of Indian Agriculture in a weakened global economy

OP 1: Cross Validation of Non-Linear Height Diameter models in R

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Statistical models are widely used in developing tree height and diameter relationships in forest management. Although most of these models can adequately fit tree height and diameter relationships, they may produce some extrapolation errors when applied beyond the range of model development data if the sampled trees are collected from young or middle-aged stands. Therefore, predictive capabilities of model should be carefully evaluated and validated before they are used in a long term forest management work. Predictive capability of a model can be identified in advance with help of method known as cross validation. This paper is an attempt to show the important steps of cross validation method of different non-linear models in R software in order to identify their predictive performance using a real life height and diameter data of 300 Pinus trees.
Keywords: Non-Linear models, Cross validation, Pinus, R-software.

OP 2: Stratified Random Sampling for Apple Production in Jammu and Kashmir: A Statistical Investigation

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In this study, we focus on the standardization of sampling technique and comparison of distinct types of sample allocation methods in comparison with various stratification tools (optimum strata boundaries, number of strata and optimum sample size etc.) obtain efficient estimators of area and production of apple in Jammu and Kashmir. For this purpose, various aspects involved in optimum stratification with reference to data collected from the selected orchardists in district Shopian, during the year 2011-12 have been analyzed**.** Stratification is done on the variable "Area under Apple" that is having high correlation with estimation variable (Production of Apple). For the construction of strata, methods used are, equalization of strata total, equalization of cumulative of $\sqrt{f(x)}$, equalization of cumulative of ½{r(x)+f(x)} and equalization of cumulative $\sqrt[3]{f(x)}$ of were used and their relative efficiencies for estimating total production of apple in the study district of the state have been analyzed. Equalization of cumulative of $\sqrt[3]{f(x)}$ method along with Neyman allocation resulted in least variance and maximum percentage gain in efficiency when the number of strata goes from 2 to 4and sample size from 10 to 40. Thus, we can conclude that equalization of cumulative of method $\sqrt[3]{f(x)}$ with L>2 can be preferred for the estimation of apple production in the study district of the state Jammu and Kashmir, India.
Keywords: Stratified Random Sampling, Optimum Stratification, Neyman allocation, Relative efficiency

OP 3: Socio-Economic Survey: A Case Study of Manigam Village of Ganderbal District of J&K

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The research study on socio economic status of Manigam village of Ganderbal district has been conducted on the socio economic conditions and infrastructure availability. A socio-economic survey is regarded as one of the most significant source of statistical data on domestic spending and income as well as other data on the status of housing, individual and household characteristics and living conditions. The present paper is an attempt to focus on the socio economic conditions and the infrastructure availability in the village (Manigam).

OP 4: A Supply Chain analysis of cherry in Kashmir

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The present investigation entitled “A Supply Chain Analysis of Cherry in Kashmir” was carried out during 2014-15. Both primary and secondary data were analyzed for this investigation. The primary data was collected from

District Srinagar of Hazratbal block in which sample respondents of 6 villages were selected purposively. The secondary data was collected from official website of, Directorate of Horticulture Planning and Marketing (GOI). Hundreds cherry producers, twenty-three wholesalers, thirty-seven retailers and two processors were interviewed. The study was focused to identify the agencies involved, channels used in the marketing of cherry, value additions and gross and returns from cold storage and also to calculate the gross marketing margins and price spread of all the intermediaries involved in various marketing channels. Three marketing channels were identified

(I) Producers-pre-harvest contractors-wholesalers-retailers-consumer
(II) producers-commission agent-wholesalers-retailer-consumer and
(III) Producers-retailer-consumer was identified. Channel II was the major route for cherry's trade as more than 40% of the farmers sell their produce through this channel. Similarly, 35% farmers followed channel I for selling their produce whereas 19% producers, followed channel III respectively.

The estimates of regression function have revealed that the fertilizer, labour and education level are the significant and positive determinants on yield, while chemical spray have shown negative contribution. The price spread of cherry with respect to various marketing channels has indicated that the producers' share has an inverse relationship with the number of intermediaries. The net price received by the producers is relatively higher in the channels in which the produce is directly sold to the consumers or retailers. Across different varieties, producers receive higher absolute net returns in Mishri followed by Double and Makhmali. The study has highlighted effective measures to reduce marketing losses at various stages. Study has emphasized on the strengthening of institutions, establishment of processing units, cold storages and development of market infrastructure in the area.

Keywords: marketing channels, marketing efficiency, cherry

OP 5: Hill Agriculture, Livelihood Security and Resource Use Efficiency: An Economic analysis of Rajmash production in Jammu region of J&K state

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The Hill farming is supposed to be very fragile due to its unique ecological entity and topographical diversities. The hills are rich in resources for horticultural crops as well as some pulses. The present study was designed to measure resource use efficiency in rajmash production in Bhaderwah and Bhalla blocks of Doda district of J&K state. The input-output data was taken from the sample of 100 rajmash growing farmers and Cobb-Douglas type of production function was used to work out the efficiency of different resources. The results revealed that human labour, seed, manure and fertilizers and plant protection chemicals had the elasticity of 0.105, -0.388, 0.013 and 0.062, respectively and was statistically significant. The marginal value productivity (MVP) in respect of manure &fertilizers (8.981) and plant protection chemicals (11.344) was more than unity level and for human labour (0.872) it was less than unity level. In case of machine labour (-2.275) and seed (-9.772), MVP value was found to be negative, indicated more than optimum use of these two resources.

Keywords*:* Hill Farming, Resource Use efficiency, *Rajmash*, Production Function, MVP

OP 6: Marketing Costs, Margins and Price Spread of Wheat in Jammu District of J&K State

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The present study aimed to examine and compute the marketing costs, margins and price spread of wheat in two of the wheat grown blocks of Jammu district of J&K state. It is based on data collected from 80 producers (farmers) selected from ten randomly selected villages and 20 market functionaries from two market areas of Jjammu district of J&K state. The percentage of marketable and marketed surplus increased with increase in size of holding. the small farmers sold their produce more than marketable surplus either due to distress sale or due to failure of farmers in prediction on farm requirement. Most of farmers sold their produse in peak period i.e. April to June. They did not hold stock to lean period because lack of storage facilities and poor financial position of the farmers. Among all the channels, Channel-1: "Producer to Consumer", Channel-2: "Producer to whole seller to Retailer to Consumer", Channel-3: "Producer to Retailer to Consumer". Among all the Channels, Channel-1 was found most efficient to the farmers because 91.26 per cent of produce was sold through this channel. Net price received by the grower was Rs. 1269 per quintal which accounted for 71.83 per cent producer's share on consumer's rupee.

Keywords: Marketing efficiency, Market arrivals, Marketing channel, Market margins, Price spread

OP 7: Employment potential in marigold cultivation in Jammu subtropics of Jammu and Kashmir

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Marigold crop being a labour intensive crop requires a lot of manpower for different operations and thus is able to generate higher employment opportunities for the farmers which are often having disguised employment in case of cereal crops. The present study was undertaken in Jammu province of Jammu and Kashmir state. Primary data were collected from subtropical area of Jammu and Kathua districts which were selected purposively on the basis of highest area under cultivation. Five villages from each district were selected on the basis of highest number of growers and 10 farmers from each village were selected randomly constituting a sample of 100 farmers. The study revealed that marigold cultivation provided 115.13 mandays (MD) and 137.54 MD in Jammu and Kathua districts with an overall average of 124.84 MD/ha in a season. The most labour intensive operations were plucking of flowers (harvesting) followed by intercultural operations, irrigation, transplanting, land preparation and pesticide application which needed 30, 29.66, 27.54, 16.33, 10.00 and 6.25 mandays, respectively. The study also revealed that marigold crop provide a total of 124.84 mandays in comparison to 85.37 mandays as needed in rice and 49.58 mandays in wheat. It was also found that marigold crop is earning more net profits i.e. Rs.474742.60/ha with a cost benefit ratio of 1:5.03 while rice and wheat has a cost of cultivation of Rs.40359.01/ha and Rs.22730.69/ha earning a gross profit of Rs.106271.36/ha and Rs.41915.92/ha which makes its net returns Rs.65912.35/ha and Rs.19195.23/ha with a cost benefit ratio of 1:2.63 and 1:1.84.

Keywords: Marigold, employment, Jammu, Kathua

OP 8: Round the Year Farming Cycle for Enhancing Farmers Income in Jammu

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Jammu and its surrounding areas are known for basmati cultivation (aromatic Rice), which is a novelty of the area. This often fetches premium prices to the growers and thus is a profitable enterprise to the farmers. However, this enterprise alone is not sufficient to meet the growing personal demands of suburban farmers of Jammu. Therefore, KVK Jammu in the past few years have tried to incorporate different enterprises into a farming calendar for increasing farmer's income. Studies have been conducted to identify suitable enterprises for small and marginal farmers. Yearly farming activities of progressive farmer's have been studied and have been documented. Study was conducted to identify suitable enterprises and their cultivation practices, analyze relative profitability and B:C ratio. Primary data were collected from randomly selected farmers from R.S. Pura block of Jammu district. The results indicated that marigold cultivation, mushroom farming, small diary and basmati cultivation are most suited enterprises for a small farmer of the area (up to 1 ha). Marigold cultivation and Mushroom production in district Jammu is increasing besides there is good demand for milk in the town. Various Governments incentives along with efforts of University and regular interventions of Krishi Vigyan Kendra Jammu has resulted in quantum jump in production and productivity of these enterprises in the area. The benefit cost ratio of 2.87 to 4 in each of thses enterprise is also very encouraging which will help in promotion of these enterprises in the district. Besides economical gains, these enterprises if incorporated in farming cycle will provide year round employment to the farm household. Each farm family will get daily returns from his enterprises like dairy, and will get seasonal remuneration from marigold and mushroom and further will get assured annual returns from Basmati and wheat cultivation.

Key words: Basmati, Marigold, Mushroom, dairy farming, B:C ratio, cultivation cost

OP 9: Doubling farmers' income: An overview of vision

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The Prime Minister's vision of doubling farmer's income by 2022 is a serious challenge for all the stakeholders. Achieving this goal will improve the well-being of our farmers and boost agro-based manufacturing growth in rural India. At present most of the terms of trade are against farmers, therefore doubling their income by 2022 seems a distant dream unless we address the post-production issues. Discussion and defining objectives for the purpose is the very first need for achieving income doubling. Doubling farmers' income implies increasing income from farm production. Several forums have designed various strategies for boosting farm income. In this study, we have tried to look into the seriousness of efforts that are being put by various agencies to fulfill Prime Minister's vision of doubling farmer's income by 2022.

Keywords: Ministry of Agriculture and farmers' Welfare, NREGS, PMKSY, PMFBY, NSSO, e-NAM, MSP

OP 10: Income Status and Employment Pattern of Vegetable Sellers (Migrants) in Punjab

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The Punjab state has been demanding labor for various activities through pull factors from the neighboring states of Uttar Pradesh, Jammu and Kashmir and Rajasthan since long. But the laborers has started coming to Punjab even from far-off places of Bihar, Orissa, West Bengal and Madhya Pradesh states for gainful employment. Ludhiana city is also known as the Manchester of India. Keeping in view the objectives of the study, the primary data were collected by personal interview method of the respondents. The study brought out that the major factor which motivated the migrant vegetable sellers to come to the state of Punjab was the economic distress faced by these persons in their native places caused by unemployment, under employment, relatively low wages, etc. The study brought out that the monthly net income of the respondents worked out to be Rs 3920 and the annual net income found out to be Rs 47040. This income of the migrant vegetable sellers were higher than their counterparts those were doing other labors like that of in the construction sector, agricultural sector, rickshaw pullers, etc. The study further revealed that twoof the respondents had permanent shop as vegetable sellers whereas 13 respondents had temporary shelter, 27 respondents had roadside rehriand 15 were hawkers. Another 43 of the migrant vegetable sellers were doing their business in "ApniMandi" because these mandis are held almost daily in Ludhiana city. The study suggested certain policy implications like the management of *rehris* of the vegetable sellers on the roadside that creates traffic problems in the big city like Ludhiana. Further, it suggested that the price list of various vegetables may be displaced at the *"ApniMandis"* for the benefit of the vegetable buyers, i.e. consumers.
Keywords: Migrant Vegetable Sellers, Apni Mandi, Net income

OP 11: Strategies for Doubling Farmers' Income by 2022

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The agriculture sector received an unprecedented 84 per cent hike in budget allocation (Rs. 47,912 crores) during the financial year 2016-17 and the goal was to look beyond food security to doubling farmers' income by 2022. First time '*Krishi Kalyan Cess*' @ 0.5 per cent on all taxable services has been proposed in the budget (GoI, 2016).The average monthly income per caput farming increased from Rs. 1,060 in 2003 to Rs.3,844 in 2013 from abide by (Situational Assessment of Agricultural Households) by the NSSO, a compounded annual income growth rate of 13.7%. To double the income of farmers by 2022, in nominal (numerical) terms—which do not take inflation into account—would require a 15% compounded income growth rate, which is a marginal increase over the achieved increase from 2003 to 2013. However, to increase the income in real terms would imply restructuring agriculture processes and policy interventions. In an effort to boost the agriculture sector, the Indian government has set an ambitious goal to double farmers' income by 2022. In doing so, it has unveiled strategies ranging from irrigation to crop insurance. But if the food value chain is to undergo true transformation, it needs to move from a production driven system to one driven by demand, one that increasingly connects consumers with producers. This will require new approaches and innovations, as well as increasing collaboration between the private sector and other stakeholders in the food system. It will require integrated value chains that connect farm to fork, competitive markets that provide better prices to farmers, and an enabling environment that supports innovation and action. The Government of India has already planned to take many measures to increase farm income, stabilize production and, consequently, improve small farm productivity. Integrate farming system approach involving synergic blending of crops, horticulture, dairy, fisheries, poultry, etc. seems viable option to provide regular income and at site employment to small land holder, decreasing cultivation cost through multiple use of resources and providing much needed resilience for predicted climate change scenario. HYV and hybrid seeds are very essential for a successful crop production and increasing the yield by 15-20% depending upon the crop and it can be further raised up to 45% with efficient management of other inputs. Micro-irrigation along with the nutrient application can be highly efficient and priority should be given to empower farmers with micro irrigation.

PP 1: A Study on Consumer Behaviour towards Organic Basmati Rice in Jammu

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The project entitled **"A Study on Consumer Behaviour towards Organic Basmati Rice in Jammu"** was carried out in Jammu region in 2018. A total of 150 sample respondents were selected from the sample area. The data collected was subject to analysis for examining the objectives of investigation. From the study it was revealed that 70 per cent respondents liked the health attributes in organic basmati rice. It was inferred that 89.33 per cent of the respondents purchase the organic basmati rice from specialized retail outlets, 6.67 per cent of the respondents purchase from kirana stores, 4 per cent of the respondents purchase from exclusive outlets. The study revealed that 44 per cent of respondents were ready to purchase if the price got increased between 0-20 per cent, 38 per cent of respondents were ready to purchase if the price got increased between 20-40 per cent, 12 per cent of respondents were ready to purchase if price got raised between 40-80 per cent, whereas only 6 per cent of respondents were ready to purchase when more than 80 per cent price of organic basmati rice got hiked. It is also reflected from the study that 90 per cent of the respondents observed that organic basmati rice was better than other basmati rice. The study revealed that 44 per cent of respondents observed that prices of organic basmati rice are high. Regarding the customer perception, the study revealed that 26.67 per cent of respondents believe in the previous experiences to make a perception about Organic basmati,36 per cent believe in the current experience, 17.36 per cent believe on the expectations from the company/brand and only 20 per cent believe on the marketing/ advertising.

Keywords: Organic farming, consumer behaviour, attitude, consumer perception

PP 2: Scenario of Agricultural Marketing in India: Challenges and Future Recommendations

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In India, agriculture directly or indirectly is the source of livelihood to majority of the population. Indian agriculture has seen a lot of changes in its structure. India has seen agriculture as a predominant tool of economic development as other sectors of production depend on it. Efficient backward and forward integration with agriculture has led to globally competitive production system in terms of cost and quality. Cooperatives seem to be well positioned to coordinate product differentiation at the farm level and to integrate forward into value added processing activities. Indian agriculture is balanced and made efficient through proper and better management practices. With the emergence of new inputs and new technologies in the market, agriculture has changed from deficit oriented to surplus oriented sector. New methods of marketing like Contract farming are visible, providing farmers with better returns. Using modern ICT can bring out better solutions as it can facilitate agricultural marketing functions and processes include buying and selling, payment, grading, standardization, transportation in an efficient manner. Fiscal and Political instability is threatening agricultural policies, as there is Political disagreement and fiscal comprehension in agriculture. Increasing domestic demand for food due to rise in population leads to restricting our exports, private market intermediation, multi languages and dialects, natural calamities, less media coverage, lack of professionalism in management, lack of market and marketing information, lack of agricultural education, lack of technical training etc, are some of the problems and challenges in Indian marketing system. These can be managed by adopting following recommendations like by establish physical communication, develop agricultural infrastructure, establishment of Regulated markets, storage and warehouse facilities established up to the most remote areas, education of agriculture to masses, information technology must reach all over the country. There must be proper road connectivity and good all weather roads. Enhance control and coordination over the agricultural markets. Extent of financial support to farmers and agroprocessing units, training of new marketing techniques should be implemented. Enhancement and support for Public-Private cooperation. The government has to examine its policies and regulations to strength the marketing network and ensure that prices are being determined on competitive basis and markets are being manipulated.

Keywords: Agricultural Marketing; Marketing Trends; Cooperatives; ICT; Marketing Challenges

Environment and Sustainability

OP 1: Sustainable Development of Clean Renewable Energy in India

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Renewable energy plays an important role in meeting national targets for sustainable development, responding to climate change and environmental issues, and ensuring national energy security. India is considered to have potentials for developing renewable energy. In order to meet the demand for electricity for socio-economic development and to take advantage of natural resources and technological advances in renewable energy, the Government of India has issued the Strategy development of national renewable energy and mechanisms, policies and incentives to support it. In the process of implementing the strategy, regular assessment of internal and external environmental factors is essential to make appropriate adjustments. This is also the research going in India, by analyzing strengths, weaknesses, opportunities, and threats, for renewable energy development in India based on collected data, opinions of experts, investors, renewable project owners, and a case study. World energy consumption is based on 80% upon fossil fuels which are the polluting sources that accelerate global warming. Besides, climate change revealed that current energy and environment equilibrium is unsustainable. Energy policies should now integrate climate change policies in order to save the environment that the people live in. This challenge is very crucial one in front of the not only a single country, but also all countries in the world. Thus, unsustainable patterns of energy production and consumption in any country threaten not only human health and quality of life but also affect ecosystems and contribute to climate change. There arises a question that who is going-2-to save or sustain our planet for the future generations? Who is going to pay for the proper maintenance of the planet? Can sustainable energy developments be an engine for sustainable future?

Keywords: Current status of Clean Renewable Energy, climate change. Energy, Economy, Environment

OP 2: An Investigation into Briquetting of Pine Needles for saving the ecology of hills

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Himalayan forests are rich in Pine trees (Pinus roxburghii Sarg) and the pine needle is one of the reasons to enhance the forest fire. There are numerous ways to resolve these problems, of which briquetting and/or pelleting are the most commonly utilized technologies (Kaliyan and Morey, 2009). The bulk density of loose biomass, which is typically about 40 - 200 kg/m^3 can also be increased to densities as high as 600 – 800 kg/m^3. Thus, briquette making has the potential to meet the additional energy demands of urban and industrial sectors, thereby making a significant contribution to the economic advancement of developing countries. The technology involves use of a cost effective binder to prepare the briquettes. The pine needles briquettes were made after drying for 10 days using three processes i.e. reduction by cutting, mixing with cow dung in the ratio of 3:1(pine needles: cow dung), converting to char, mixing with cow dung in the ratio of 3:1 (pine needles: cow dung) and size reduction with Hammer Mill, mixing with cow dung in the ratio of 3:1 (pine needles: cow dung) briquetting with screw press. The size of one briquette is approximately 7.5 cm in height and 7.5 cm in diameter. The weight of the briquettes are 90, 100, 115 g for sample S1, S2 and S3 per bricks, respectively due to different physical properties. A test were carried out to know the ash content and calorific value. Biomass residues normally have much lower ash content (except for rice husk with 20% ash) but their ashes have a higher percentage of alkaline minerals, especially potash. Pine needle briquettes had 12.24% of ash content, which lies in the good quality charcoal (1.2% to 8.9%). The calorific value of the pine needle briquette was higher in all cases as compared to pine needle biomass but S3 has higher calorific value of 5012 kcal/kg.

OP 3: Estimation of Soil loss from a Watershed

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Soil is a nature's gift to mankind and nature protected it with dense cover of trees and grasses but man and animals disturb balance between soil, water and plant with the result the process of erosion starts.Soil erosion is the common land degradation problem worldwide because of its environmental impacts and causes depletion of fertile agricultural land and the resulting sediment deposited at the river networks creates river morphological changes and reservoir sedimentation problems. Soil erosion is taking place at a rate of 16.35 ton/ha/annum which is more than the permissible value of 4.5-11.2 ton/ha. About 29% of the total eroded soil is lost permanently to the sea and 10 % of it is deposited in the reservoirs. The remaining 61% is dislocated from one place to the other. Soil loss is determined by either theoretical estimation based on values of watershed parameters or actual measurements in

the field.The rates of soil erosion can be estimated using erosion prediction equations developed. Among these algorithms are Universal Soil Loss Equation (USLE) and its recent updated the Revised Universal Soil Loss Equation (RUSLE) or Modified University Soil Equation (MUSLE). The Universal Soil Loss Equation is an empirical model that is widely used all over the world for the assessment and prediction of soil erosion due to water runoff. Remote Sensing (RS) and Geographic Information System (GIS) being a well-known tool available for dealing with the major water resources problems. Average annual soil losses were calculated by multiplying five factors: R; the erosivity factor, K; the soil erodibility factor; LS, the topographic factor; C, the crop management factor and P; the conservation support practice. Estimation of erosion is essential to issues of land and water management, including sediment transport and storage in lowlands, reservoirs and irrigation and hydropower systems. To estimate soil erosion and to establish soil erosion management plans, many computer models have been developed and used.

OP 4: Sustainable Forage Management Practices Adopted by the Farmers of Kandi Belt of Jammu Division

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The present research pursuit was conducted in Kandi belt of Kathua and Samba districts of Jammu division to analyze the sustainable forage management practices adopted by the farmers to feed their livestock. From each selected district 3 rainfed Kandi blocks were selected randomly. From each block 3 villages were selected purposively. Thus, 18 villages from two districts (9 from each district) were considered. Eight farmers from each village involved in forage utilization resources were selected randomly thereby making a total sample size of 144 respondents. The main results revealed that Dhaman (*Grewia optiva*) and Lucenia were used by all the farmers as fuel and fodder. Kikar and Farlai were used by 79.16 per cent 13.88 percent each for fuel, fencing and fodder respectively. Palah was used as fuel and fodder each by 90.27 per cent of the farmers. Khair was used by all the farmers for the purpose of fuel (100%) fencing (15.97%) and fodder (71.52%). Mulberry was used for fodder and fruits by (6.94%) each. Ber and Garna was utilized for fuel, fencing, fodder and fruits by100 per cent and 27 percent of the respondents respectively. Regarding forage crops and grasses, all the respondents feed maize stalk to the animals as dry fodder and only 15.64 per cent feed it to the animals as green fodder. Wheat straw is fed to the animals as dry and green fodder by 100 percent and 7.45 percent respondents respectively. Bajra is fed to the animals as dry and green fodder by 16.05 per cent and 11.11 percent of the farmers respectively. A wild grass which is not commonly cultivated has been given as green and dry fodder by 84.72 per cent and 7.63 percent of the farmers to the animals respectively.
Keywords: Sustainable agriculture, Forage utilization, Fodder, Rainfed

OP 5: Agricultural Extension and Nutritional Security

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Agriculture has great potential to alleviate poverty and improve the food and nutrition situation in vulnerable rural communities. To do so, efforts must be made to incorporate nutrition objectives into agricultural development policies and programmes. Agricultural development programmes that aim to increase production of staple crops are essential for food security, yet they are insufficient for alleviating hunger and malnutrition. Effective efforts to improve food security must occur in conjunction with efforts to improve nutrition security. Nutrition security refers to the "quality" aspect of food; its consumption and satisfactory use and utilization by all individuals of a household. While food security may increase the total quantity of food energy consumed – typically via increased production and consumption of staple foods – only nutrition security can guarantee the quality and diversity of food necessary for good health and nutritional status. Programmes aimed solely at increasing production, raising incomes and increasing energy intake will not reduce malnutrition as effectively as programmes that also recognize the importance of diet quality and diversity. For instance, animal source foods, legumes, fruits and vegetables are important components of nutrition security. Thus, the agricultural sector can contribute to nutrition security through small livestock and poultry ventures, aquaculture and horticulture. In addition, to maximize the efficiency of nutrition security initiatives, agricultural interventions should include strategies to increase nutrition education, empower women and optimize household use of resources. Nutrition security should be a priority in all areas where food security is a challenge. Doing so requires explicit incorporation of nutrition objectives into the design and implementation of agriculture development initiatives to ensure they are i) not detrimental to nutrition and that ii) potential opportunities to improve nutrition are identified and are fully utilized.
Keywords: Agriculture, Nutritional Security

OP 6: Tree borne oil seeds (TBOs) as a sustainable and environmental friendly alternative source of biofuels

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A biofuel is a fuel produced through contemporary biological processes, such as agriculture and anaerobic digestion, rather than fuel produced by geological processes. Biofuels are gaining increased public and scientific attention, driven by factors such as petrol price hike, and increased greenhouse gas emissions due to fossil fuels. Fossil fuels have been "out" of the carbon cycle for a very long time, their combustion therefore disturbs the carbon dioxide balance in the atmosphere. Among the biofuels, Biodiesel is the most common biofuel in Europe. In most cases, biodiesel is compatible with diesel engines from 1994 onwards, which use 'Viton' synthetic rubber in their mechanical fuel injection systems. Biodiesel is made primarly from oily plants such as soybean or oil palm and to lesser extent from other oily sources such as waste cooking fat from restaurant deep frying. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using transesterification. Various oil crops like soyabean and rape seed are already being used as a commercial source of bio-diesel but it has led to a debate of whether food crops like soyabean should be diverted for fuel production at this time of hunger crisis. Thus the need of the hour is to find non food alternatives to supply this growing demand of bio diesel. Various oil seed bearing tree species like *Pongammia pinnata, Jatropa curcas, Azadirachta indica* have also been reported to have great potential for producing Bio-diesel. The present paper intends to review the potential of these Tree borne oil seeds over first generation biofuels derived from agricultural feedstock.

Keywords: Biofuels, Carbon Flux, Forest biomass.

OP 7: Design and Development of High Concentrating Industrial Solar Heating System

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In order to promote eco-friendly production in the industries, a solar thermal system for heat application to suit temperature up to 250°C was developed. The system consists of a common frame to house the components such as Fresnel film, aluminum an-iodized reflector sheet, stand for heat application and manual tracking system. The UV stabilized Fresnel film focuses incoming beam solar radiation at its focal point and the well placed reflector reflects the concentrated high intensity solar beam onto the conducting bottom of vessel to create temperature as high as 250°C. The system works on the principle of Fresnel lens and concentrated solar power (CSP). Fresnel film having several concentric rings, each ring slightly thinner than the next one, focus the light towards the center. CSP is basically a solar thermal technology, where the light energy of the sun is concentrated by using reflecting surface to generate heat to be used for variety of heating application. Results revealed that the bottom of the stand attained temperature upto 109°C in just 10 minutes of time during experiment conducted in winter. Maximum temperature of 204°C was observed at 13.14 hrs. Instantaneous insolation recorded by pyranometer was in the range of 650-982 Wh/m^2. Fresnel film based concentrating solar heating system permits low cost heating, eco-friendly, noise less and emission free option to conserve the environment.

OP 8: Energy Efficient Low-cost Poly-house Pond Model for Mitigating Environmental Variations in Aquaculture

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Temperature is a critical water quality parameter in aquaculture as most cultivable fish and shellfish species have optimum temperature level for growth and survival. Low water temperature reduces the metabolic activity of fish and shellfish, retards growth, increases mortality and thereby affects the production in winters. Among the commercially important culturable aquatic organisms, the giant freshwater prawn *Macrobrachium rosenbergii* has become the target species owing to its fast growth rate, attractive size, omnivorous feeding habit, compatibility for poly-culture with carps and good export market (Gupta *et al.*, 2007). In many parts of India, especially northern states the water temperature drops below 8.0°C during winters, affecting the growth and survival of prawns adversely. In this direction poly-house pond culture model may help to increase the water temperature during winter. The information regarding effectiveness of poly-house pond culture model with additional heating source

for rearing of freshwater prawn during winters is inadequate. Therefore, an attempt has been made to develop a poly-house pond culture model with additional heating source to study the production potential in terms of growth performance of freshwater prawn and its effect on water quality parameters during winters. The present study has demonstrated that the use of poly-house pond culture model with heating effect resulted in significant increase in water temperatures. Increased water temperature (>19°C) in heated poly-house treatments resulted in enhanced growth and survival of freshwater prawn *Macrobrachium rosenbergii*. Present work clearly indicates that plastic covered ponds with heating source maintain 3-4°C higher water temperature than simple pond without heating source. Further research work is needed to design poly-house which can keep minimal thermal load levelling for better thermal efficiency of the pond.

Keywords: Temperature, Poly-house Pond Model, *Macrobrachium rosenbergii*, Growth performance

OP 9: People's Participation in Sustainable Management of Natural Resources

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Environment is one of the most important pillars of sustainable development. The different objectives of society-social, economic and environmental-need to be integrated where possible, and traded-off where they are incompatible. The relationship between development and environment is well established. The common property resources which are mostly natural must be protected for overall growth of the rural areas. Protection of environment is mainly in the hands of the people and the initiative requires people's participation. It is usually observed that unless the people are put at the core of any development activity, the environmental development ceases to exist. People's participation plays an inevitable role in driving the fruits of development schemes and can play an important role in afforestation and arresting of deforestation. Their participation is the most determining factor of biodiversity conservation. Such efforts not only lead to optimum utilisation of natural resources but also generate more employment for the rural people. Institutional and individual roles and responsibilities have to change, so that new pattern of behavior will foster sustainable development which at a local level depends not just on the motivations, skills and knowledge of individual people, but on action taken by groups or communities as a whole. Similarly, the community-based natural resource management (CBNRM) approach combines conservation objectives with the generation of economic benefits for rural communities. The three key assumptions being that: locals are better placed to conserve natural resources, people will conserve a resource only if benefits exceed the costs of conservation, and people will conserve a resource that is linked directly to their quality of life. When a local people's quality of life is enhanced, their efforts and commitment to ensure the future well-being of the resource are also enhanced.

OP 10: Water challenges and opportunities in India

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Water is the most precious natural resource and something that most of us take for granted. Water is scarce, about of 70% of the earths surface is covered by water. It could mean that there is more than enough water on the earth. But we rarely consider that that about 97.5% of the total water is saline. Only about 2.5% is "Fresh water" i.e not saline can directly be consumed by us and most the land organisms. Further out of total fresh water on earth around about 68.9% is in the glaciers and about 30.8% is ground water. Only about 0.3% is in rivers, lakes, ponds, streams and few other sources where we can access easily. Certainly, this quantity about 0.007% is too small. Thus preserving the quality and availability of fresh water resources has now become a pressing environment challenge. This water is readily available for about 7.3 billion people and other land organisms. Presently one third of the total earths population is not able to sufficient water for drinking requirements. By the middle of the current century 2/3 rd of the world could face water scarcity. People living in the developing countries are the worst sufferes. Scarcity of water puts major constraints on increasing food production for the growing population, economic growth, and protection of social and environmental goals. Most of the water sources are polluted and contaminated. For India this issue has a immense importance. An important reason is the ground water is the most important source of water supply, especially for rural areas. Rural culture has developed historically utilizing ground water through dug wells or tube wells. Purification and treatment etc, are almost non exist in rural areas. More than 1.5 million children are estimated to die of diarrhea alone every year. Estimates are that country loses 73 million working days due to water borne disease. Contamination of water due to natural chemicals adds another dimension. Fluoride arsenic and iron present in the substratum contaminate ground water. Only 14% of the rural population has access to latrine of some kind. Obviously, the rest defecates in open. Where latrines are present they are not properly built they also lead to the contamination of the ground water.

OP 11: Pesticides Residues in Food-A Challenge in Nutritional Security

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In the early years after independence, India was a food deficient country with frequent droughts and famines. Though India was primarily an agrarian economy at that time, agricultural productivity was low and food grains contributed to 75% of the total cropped area. Improved GR seed varieties, along with investments in irrigation, promotion of fertilizers and pesticides led to massive gains in agricultural productivity. But this Green Revolution (GR) brought a negative impact on agriculture sustainability as the irrational use of pesticides and chemical fertilizer deteriorate the nutritional quality of food grains. Earlier the emphasis was laid on sufficiency in food grain production, but now India struggles with chronic malnutrition and child stunting, even though it produces enough calories to keep hunger at bay. But new policies could diversify India's diet with more nutritious foods, and not just feed India's people but also feed them well, says a team of Cornell Agricultural Economists.The Global Nutrition Report (2017) highlighted that the vast majority (about 88%) of countries face a serious burden of two or three of these forms of malnutrition. As far as India is concerned, the numbers are disappointing. Every third child under the age of five are affected by stunting and every fifth child under the age of five have been defined as "wasted 'or "severely wasted" which means that they do not weigh enough for their height. Moreover 50% of women of reproductive age suffer from anemia and more than 22% of adult women are overweight. Specific effects of pesticides includes damage to the central and peripheral nervous systems, cancer, allergies and hypersensitivities, reproductive disorders and disruption of the immune system and Neuronal dysfunction. The major reason found in the report was lack of awareness about eating the balanced diet, the diet lacking in micronutrients and also the reckless use of pesticides in the vegetable and fruit crops during pre and post-harvest of crops. Vegetable farmers by and large depend on chemical pesticides to counter the problems of insect pests. Increased use of pesticides results in contamination of the environment and the excess accumulation of pesticide residues in food products. Hence, the followingstrategies should be adoptedto reduce pesticide residues in food grains, vegetables and fruits are organic farming, washing and processing of food products, optimum use of pesticides, use of natural pesticides and bio pesticides, implementation and amendment of pesticide-related laws in the country**.**

OP 12: Global Ecological Resources Versus World Inhabitant's Growth

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At present about 7.65 billion population inhabit on the globe. The human kind needs 2800 million tonnes of cereals right now to nourish every one sufficiently, adjacent to which worldwide production is no more than 2100 million tonnes. This inconsistency in necessitate and production has left over 868 million inhabitants malnourished universal and 850 million of them live in developing countries. On the other hand speedy urbanization, ever-increasing purchasing supremacy and budge in diet are just about demand for comfortable diets and protein of animal origin. As a result, by 2050 the utilization of dairy products and animal protein not the butter is anticipated to enhance by 173 and 158 %, respectively, as that of 2010. In order to meet the future demand and to handle with 9 billion global populations by 2050, agricultural production desires to enhance by 60% together with of increase in animal production and animal products. Feeding these rapidly increasing inhabitants with the existing 0.23 ha of cropland per capita is one of the prevalent challenges. In addition to this, the humankind is facing an added principal challenge of climatic change. If such population intensification continues with same speed, it requires three earth planets to make available the resources for human population consumption and to incorporate connected wastes it generates in 2050.

Key words: urbanization, inhabitants, agricultural production

PP 1: Effect of sulphur and poultry manure on nodulation attributes of french bean at flowering stage

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A field experiment was conducted to know the Effect of sulphur and poultry manure on nodulation attributes of French bean at flowering stage at the Research Field of Regional Research Station Wadura Sopore. The increase in the nodulation activity with the increasing levels of sulphur could be attributed to concomitant increase in ferridoxin content which is responsible for nodulation activity. Ferridoxins are rich in sulphur and contain Fe-S clusters which play vital role in N_2 fixation (Ali *et al.,* 2004; Duke and Reisenauer, 1986). Similarly, increase in poultry manure application resulted in a significant increase in nodulation activity. The maximum number (15.38,

15.58 and 15.48), fresh weight (130.65, 116.30 and 108.82 mg) and dry weight (25.14, 25.39 and 25.26) of nodules plant^{-1} was recorded with the application of 6 kg poultry manure ha^{-1} but being at par with the application of 4 tons poultry manure ha^{-1}. There was a significant increase in nodulation activity with poultry manure application. Farori *et al.* (1995) showed that application of chicken manure significantly increased nodulation and dry matter production. This may be due to the fact that manures are known to provide plant nutrients and improve soil physical properties. Poultry manure and sulphur interaction showed positive and synergistic effect on nodulation activity at lower levels of poultry manure application and the maximum number in 2013, 2014 and over season pooled was recorded as (18.20, 18.25 and 18.23), fresh weight (139.09, 139.15 and 139.12 mg) and dry weight (28.40, 29.10 and 28.75 mg) of nodules was recorded with 30 kg S ha^{-1}in combination with 4.0 tons poultry manure ha^{-1}. Higher levels of poultry manure (6 tons ha^{-1}) resulted in antagonistic effect on nodulation activity with 20 and 30 kg S ha^{-1}. The results obtained are in agreement with the findings of Farori *et al.* (1995).

Key words:. Ferrodoxin, Poultry Manure, Number, Sulphur and Weight

Extension system and Policy issues

OP1: Market Led Extension: Prospectus and Challenges

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Agricultural sustainability can only be achieved when the ends are target from the means. This does not include only safe production in terms of consciousness of future generation needs but building up the capacity of the Agricultural system towards increase in productivity cum profit maximization through the new trend of extension services. Under WTO, the globalization/ liberalization of market demands farmers at all levels to transform themselves from production and selling in the domestic market to producer cum seller in the wider market scene to realize the optimum returns on their investments. The need for market led is of necessity by the paradigm shift of present agriculture scenarios which calls for conversion of the sector into profit oriented business. FAO estimates that more than 32 percent of all food produced in the world were lost in2009 due to lack of post-harvest operation or processing among others. Similarly, more than 13% of Gross Domestic Product was reported loss yearly in India due to loss of food grains. Existence of many middle men has also resulted into less return on farmer's investment as well as high cost paid by the consumer. However this loss can be minimized by the market led extension approach through adequate supply of information by SWOT analysis of the market, establishing market and agro processing linkages, direct marketing, and capacity building in terms of improved production and post-harvest operation such as proper handling, grading, standardizing, value addition, packaging as well as storage and transport system.

Key words: Market Led Extension, Capacity Building, SWOT Analysis

OP 2: Market Led Agricultural Extension-A Review

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With globalization of the market, farmers need to transform themselves from mere producers-sellers in the domestic market to producers cum sellers in a wider market. After 70 years of Indian independence, the quality, timely and cost effective delivery of adequate inputs remains a dream. Farmers are not able to sell their surplus produce remuneratively leads to plenty of distress sales among farmers. Market led extension as a market ward orientation of agriculture through extension, including, economics and is the perfect blend for reaching the door steps of farming community with the help of appropriate technology. 'Market-Led Extension' was initiated by MANAGE through a three day national workshop on Market-Led Extension during 18^{th}-20^{th} December, 2001. Market led means identification of customer needs and wants before offering service. The basics of market led extension are market oriented production, updated knowledge of market, market analysis, market intelligence, use of technology and appropriate extension approaches. Market information service may operationally be defined as a service, usually operated by public sector, which involve the collection on a regular basis of information on prices and, in some cases, quantities of widely traded agricultural products from rural assembly markets, wholesales and retail markets, as appropriate, and dissemination of this information on a timely and regular basis through various media to farmers traders, government officials, policy makers and others, including consumers.

OP 3: An overview of Public-Private Partnership

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Public-private partnership models vary from short-term simple management contracts to long-term and very complex build operate transfer form, to divestiture. These models include ownership of capital assets, responsibility for investment, assumption of risks, and duration of contract. The PPP models can be classified into four broad categories supply and management contracts; turnkey projects; lease; concessions and private ownership of assets. A management contract is a contractual arrangement for the management of a part or whole of a public enterprise by the private sector. Supply of equipment, raw materials, energy and power, and labour are typical examples of supply or service contract. Turnkey is a traditional public sector procurement model for infrastructure facilities. In this category of arrangement an operator (the leaseholder) is responsible for operating and maintaining the infrastructure facility and services, but generally the operator is not required to make any large investment. In concessions, payments can take place both ways: concessionaire pays to government for the concession rights and the government may also pay the concessionaire, which it provides under the agreement to meet certain specific

conditions. Under a franchise arrangement the concessionaire provide services that are fully specified by the franchising authority. The private sector carries commercial risks and may be required to make investments. In a Build-Operate-Transfer the concessionaire undertakes investments and operates the facility for a fixed period of time after which the ownership reverts back to the public sector. In this type of arrangement, operating and investment risks can be substantially transferred to the concessionaire.

OP 4: Contract farming practice in India: A review

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Contract farming has long been practiced and now becoming increasingly common in both developed and developing countries. Contract farming is agricultural production carried out according to an agreement between a farmer and buyer on volume, quality, time of delivery, use of inputs, and price or pricing formula. In other words-contract farming is defined as a system of production and supply of agricultural/horticultural produce under forward contracts between producers/ suppliers and buyers. The meaning of such an arrangement is the commitment of the producer to provide an agricultural commodity of a certain type, at a time and a price, and in a quantity required by a known and committed buyer. Contract farming works informally in the Indian economy.

OP 5: Public Private Partnership for Rural Development

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Public Private Partnership is describes as a spectrum of possible relationships between public and private sectors for the cooperative provision of infrastructure services. Private actors may include private businesses, as well as non-governmental organizations and community-based organizations. A Public Private Partnership is a contractual agreement between a public agency and a corporation. Through this agreement, the skills and assets of each sector are shared in delivering a service or facility for the use of the general public. The process of implementation of the PPP involves decision by the government to adopt any one of the following; service contract, management contract, lease, concession, greenfield projects and divestiture. The potential benefits expected from PPP are Cost-effectiveness: Higher Productivity, Accelerated Delivery: Clear Customer Focus, Enhanced Social Service, Recovery of User Charges. In the states, the application of PPP projects is mostly in the areas of roads, ports, airports, railways, urban infrastructure etc. The need is to use PPP extensively both for infrastructure development as well as for social development to transform India into a developed country. PPP is a tool and the benefits depend on how we encourage and use it.

OP 6: Public private partnership in agriculture development

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As the world's third largest producer of agricultural crops, India needs to take steps to improve productivity in agriculture. The Government should encourage better agronomic practices, create the right commercial, technical and regulatory environment and strengthen agricultural innovation systems like research, education, extension and infrastructure. In this direction the Government of India and some State Governments have initiated "Public Private Partnership (PPP)" concept particularly in the area of Research and Extension. Potential areas and nature of partnership depends up on need of the farmer and relative strength of public private partners like technology dissemination, sale of inputs and processing, marketing of agricultural products infrastructure support for production, processing and marketing and different combination of all these areas. Potential private extension services providers who could be the partners in public private partnership in agriculture extension are as follows unemployed agriculture graduates, farmers organization, input dealers, agri-business companies, NGOs, print and electronic media, private banks and funding agencies. According to a UN survey conducted in 1995, there was a sharp difference in the proportion of public and private sector investments in agricultural research in developing and industrialized countries in 1993. Many studies examine the role of public private partnership in agriculture research and identified a total of 75 PPPs in the CGIAR that were active in 2004 or later. Of these, 47 partnerships (63 percent) are concentrated in four of the CGIAR's larger or older commodity centers: the International Rice Research Institute (IRRI), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT), and the International Maize and Wheat Improvement Center (CIMMYT). PPP misperceptions between public and private sectors with regard to intentions, goals and credibility of achievements. Lack of accurate mapping of proprietary assets and responsibilities between these sectors for

effective functioning. Lack of appreciation and follow-up of best practices. Lack of political leadership, vision and strategy between private sector and government ideology, lack of legal and policy framework. Cost in PPP projects are likely to be greater than for traditional government procurement process are the challenges of public private partnership.

OP 7: Agricultural Extension Services: Status and Prospects

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Disseminate of information about new technologies is very important, so that the farmer is able to make use of the latest agricultural developments. There also exists some gaps between research findings and the needs of farmers. For technology to be successful, it is important that it should serve a useful purpose to the end user. The institution that bridges the gap between farmers and agricultural research scientists is the Agricultural Extension Service. The main objective of Agriculture Extension Services or AES's is to transmit latest technical know-how to farmers. Besides this, the AESs also focuses on enhancing farmers' knowledge about crop techniques and helping them to increase productivity. This is done through training courses, farm visits, on farm trials, kisan melas, kisan clubs, advisory bulletins. National commission on Agriculture defines; An informal out of school education and services for the members of the farm families and others directly or indirectly engaged in farm production to adopt improved practices in crop, livestock and fisheries production, management conservation and marketing. Extension in today's Indian context, includes all those agencies in the public, private, NGO and community based initiatives that provide a range of agricultural advisory services and facilitate technology application, transfer and management. In India, in terms of number of staff and organizational reach, the public sector extension staff of the Department of Agriculture (DoA) works in every states dominate in extension. Majority of the states have their staff upto Block level. In the case of public sector extension, the major reform in recent years has been the establishment of a district level co-ordinating agency, the ATMA (Agricultural Technology Management Agency). Agricultural Extension faces challenging times in India, though there is greater attention at the Central Government level on enhancing funding and promoting reforms in extension.