National Workshop on Outscaling Farm Innovation

Proceedings & Recommendations

3-5 September, 2013
NASC Complex, New Delhi

Organizers

Trust for Advancement of Agricultural Sciences (TAAS)
Indian Council of Agricultural Research (ICAR)
Asia-Pacific Association of Agricultural Research Institutions (APAARI)

Co-sponsors

National Rainfed Area Authority (NRAA)
Planning Commission Govt. of India

Progress Through Science

Trust for Advancement of Agricultural Sciences (TAAS)

GOAL

An accelerated movement for harnessing agricultural science for the welfare of people.

MISSION

To promote growth and advancement of agriculture through scientific interactions and partnerships with stakeholders.

OBJECTIVES

- To act as think tank on key policy issues relating to agricultural research for development (AR4D).
- Organizing seminars and special lectures on emerging issues and new developments in agriculture.
- To institute national awards for the outstanding contributions to Indian agriculture by the scientists of Indian and other origin abroad.
- Facilitating partnerships with non-resident agricultural scientists visiting India for short period.

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Foreword

Innovations in different production processes, markets and associated activities are key sources of agricultural growth and promotion of its inclusiveness. This embodies application of existing (including traditional) and new knowledge and technologies, with an objective of addressing the production constraints and harnessing growth opportunities. The pace of innovations is likely to accelerate as we invest more in technology systems, human capacity and infrastructure. This coupled with expanding agricultural markets are likely to incentivize the farmers and entrepreneurs to adopt technological and institutional innovations.

Since India has made considerable investment in technology systems and farmers' development programs, farmers have taken lead in inventing new methods of sharing with farming community. It was increasingly felt that there should be a platform to share, improve and outscale these farm innovations. Therefore, the Trust for Advancement of Agricultural Sciences (TAAS), the Indian Council of Agricultural Research (ICAR) and the Asia-Pacific Association of Agricultural Research Institutions (APAARI), organized a National Workshop on Outscaling Farm Innovation on 3-5 September, 2013 in collaboration with several other organizations, namely, the National Rainfed Area Authority (NRAA), Haryana Kisan Ayog (HKA), Global Forum on Agricultural Research (GFAR), Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA) and Bharat Krishak Samaj (BKS) associated with agriculture and farmers. The themes covered were crop practices, natural resource management, mechanization and post-harvest activities, livestock, cultivation of high value commodities, diversification, energy, institutional requirements, policy issues, etc. An exhibition organized to showcase the successes of farm innovations was indeed quite interesting and attracted attendtion of the participants. The most notable feature of the workshop has been that it brought together researchers, development agencies, entrepreneurs, venture capitalists, farmers and policy makers.

This publication summarizes the discussions held in the workshop and the salient recommendations that emerged. The discussion has clearly established the rising innovative capacity of Indian farmers and other stakeholders. This momentum should be sustained and the innovations must be outscaled with adequate investment for the institutional development and connecting farming

community. Most importantly, the dialogue must continue, to learn from each other's experiences in this regard.

We are sure, the policy makers, researchers, farmers and other stakeholders will find this publication useful.

Dr. S. Ayyappan
Secretary, DARE
& DG, ICAR

Dr. R.S. Paroda
Chairman, TAAS &
Executive Secretary, APAARI

Acronyms and Abbreviations

AED	Agricultural Extension Division
AI	Artificial Insemination
APAARI	Asia-Pacific Association of Agricultural Research Institutions
APMC	Agricultural Produce Marketing Committee
ATIC	Agricultural Technology Information Centre
ATMA	Agriculture Technology Management Agency
BMCs	Biodiversity Management Committees
CA	Conservation Agriculture
CAU	Central Agricultural University
CAZRI	Central Arid Zone Research Institute
CGIAR	Consultative Group on International Agricultural Research
CIAE	Central Institute of Agricultural Engineering
CIFE	Central Institute of Fishery Education
CSOs	Civil Society Organizations
DAPP	Development Aid from People to People
DDG	Deputy Director General
DMI	Directorate of Marketing and Inspection
DSR	Direct Seeded Rice
GCARD	Global Conference on Agricultural Research for Development
GEPS	Global Extraction Production Service
GFAR	Global Forum on Agricultural Research
HDPE	High Density Polyethylene
HKA	Haryana Kisan Ayog
HRD	Human Resource Development
IAMWARM	Irrigated Agriculture Modernization Water-bodies Restoration and Management

IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICT	Information Communication Technology
IFS	Integrated Farming System
INM	Integrated Nutrient Management
IPR	Intellectual Property Rights
ITK	Indigenous Traditional Knowledge
KCC	Kisan Credit Card
KVK	Krishi Vigyan Kendra
MGNREGA	Mahatama Gandhi National Rural Employment Guarantee Act
MNRE	Ministry of New and Renewable Energy
MPUA&T	Maharana Pratap University of Agriculture & Technology
MSP	Minimum Support Price
NABARD	National Bank for Agricultural and Rural Development
NADP	National Agricultural Development Project
NCAP	National Centre for Agricultural Policy
NFSM	National Food Security Mission
NGOs	Non-Governmental Organizations
NHM	National Horticulture Mission
NICRA	National Initiative for Climate Resilient Agriculture
NRCSS	National Research Centre for Seed Spices
NRM	National Resource Management
PHT	Post - Harvest Technology
PPP	Public Private Partnership
PPV&FRA	Protection of Plant Varieties and Farmers' Rights Authority
PROLINNOVA	Promoting Local Innovation
QPM	Quality Protein Maize
R&D	Research and Development
RAWE	Rural Agriculture Work Experience
RKVY	Rastriya Krishi Vikash Yojana

SAMETI	State Agricultural Management and Extension Training Institute
SAU	State Agricultural University
SHG	Self Help Group
SREP	Strategic Research and Extension Plan
SRI	System of Rice Intensification
SVBPUA&T	Sardar Vallabh Bhai Patel University of Agriculture & Technology
TAAS	Trust for Advancement of Agricultural Sciences
TC	Tissue Culture
TNPFP	Tamil Nadu Precision Farming Project
TPS	True Potato Seeds
UK	United Kingdom
ZPD	Zonal Project Director
ZT	Zero Tillage

National Workshop on Outscaling Farm Innovation

BACKGROUND

Agricultural development is largely driven by innovations in the entire value chain of different commodities. The type of innovation that ultimately makes the difference is the extent and intensity of what farmers make choices. Until recently, very little attention was given to the farmer-led innovations, including technological, management, and institutional. It is now realized that there are numerous innovations, which have yielded higher returns and made farming more economical and sustainable. A number of farm implements have also been designed to enhance farm efficiency. Over the years, farmers have also screened and selected number of varieties which have higher yields and better quality. Similarly, innovations were also expanded in developing the technologies needed during post-harvest operations, such as processing, packaging, value-addition and marketing. It is irony that the farmer-led innovations could not be extended due to lack of awareness. Also, the intellectual property rights on the innovations made by the farmers have often been ignored. It is, therefore, necessary to develop a platform for farmer-scientist interface to recognize the importance of farmer-led innovations and identify ways to commercialize them. This will require developing an inventory of farmer-led innovations, validating and refining them by blending with modern science, so that they can be commercialized and out-scaled for sustainable agricultural growth and development.

The constrained environment and emerging opportunities stimulate farmers to take initiatives at their own capabilities to overcome their problems. As the farmers' innovations are inexpensive, easily accessible, locally appropriate and tested in actual farm situation, they are, more rapidly accepted by other farmers than are the results of formal research imposed on them. Farmers' innovations are a product of farmers' informal experimentation. Faced with the problems of financing, farmers always try low cost technologies to suit their requirements. Another dimension of the farmers' innovations is that their ability to innovate goes beyond production and improves networking, communication, institution building, information management, marketing, planning, accessing resources, etc in view of improving their agricultural and natural resource management activities. In short,

farmers' innovations are all about efficient ways of production and marketing agricultural commodities.

Farmers live and work under a wide range of ecological, climatic, economic and sociocultural conditions, and the range of farming systems is similarly diverse, not just across regions or countries but also within districts and even localities. Each farming system has its own dynamics, strengths, challenges and opportunities. To meet challenges of this diversity, there are very few research scientists and, thus, there is simply no way that they can generate the variety of innovations and adaptations required. In the face of such farming diversity, it is desirable to develop location specific technologies. Local adaptation and location specific development of options need to be the key elements in any agricultural research and development strategy. If scientists recognize and accept this, then they need not spend so much time and money on perfecting the technologies and can spend more time on refining/enhancing farmer-led efforts for wider adoption to suit local realities. Rapidly changing conditions require local capacities to adapt quickly. No innovation is permanent. Conditions for farmers are constantly changing. This is especially not only the case for those who are practicing agriculture under very diverse, complex and risk-prone conditions, but also for those affected by the emergence of new pests and diseases, effects of climate change, and for those who see new opportunities opening up. The key to sustainability in farming lies in farmers' capacity to adapt. Farmers have to adapt more quickly in the present context than in the past. Recognizing farmers' innovation is a step towards encouraging this process and helping farmers find ways to adapt more quickly to ever changing bio-physical and socioeconomic environment.

Although farmers have developed diverse innovations but their potential could not be realized to the extent possible, because of several confounding challenges: i) lack of accommodative attitude of researchers, ii) lack of adequate opportunity for farmers to decide on research priorities, iii) lack of financial support, iv) lack of peer support, and v) illiteracy. In addition, researchers' perspectives also create problems. Some researchers are not familiar with the concept of farmers' innovation, some find it difficult to use the data scientifically, and others have limited knowledge of the concept. The key ingredients for livelihood improvement are not external inputs but rather labour, knowledge and local management capacities that enable people to manipulate skillfully the local resources for their own benefits. Most rural development efforts have failed to mobilize and enhance these internal inputs. In diverse agro-ecologies and situations, the promotion of farmers' innovative ideas and actions, would contribute significantly towards sustainable development of agriculture.

It is, therefore, important to ensure a "bottom-up" approach in which farmers' participatory role must be recognized. Hence, the recent slogan given by the Indian Council of Agricultural Research (ICAR) on "Science with Farmer First" is indeed

very appropriate. As such, it is necessary that farmer-led innovations are given due importance and are recognized for outscaling or for further validation and large-scale adoption for improving the livelihood of resource-poor farmers. Way back in 2011, ICAR, Haryana Kisan Ayog, TAAS, PPV&FRA and CCSHAU had organized a national dialogue, which emphasized on the need to give high importance to the innovations made by farmers themselves. The National Workshop on Outscaling Farm Innovation will help in providing "Way Forward" for faster adoption of farmer-led innovations for greater impact. The technical program is given in **Annexure I**.

An exhibition was also organized to showcase the potential of farmer-led innovations for greater impact on smallholder farmers. Against this backdrop, the national workshop was jointly organized by the Trust for Advancement of Agricultural Sciences (TAAS), Indian Council of Agricultural Research (ICAR) and Asia-Pacific Association of Agricultural Research Institutions (APAARI), and co-sponsored by National Rainfed Area Authority (NRAA), Haryana Kisan Ayog (HKA), Global Forum on Agricultural Research (GFAR), Protection of Plant Varieties and Farmers' Right Authority (PPV&FRA) and Bharat Krishak Samaj (BKS). A total of 267 participants comprising administrators, researchers, policy planners, innovative farmers, including women, CSOs (NGOs, Fos) and representatives of the farming communities as well as private sector in India and representative of Prolinova attended the workshop **(Annexure II)**.

INAUGURAL SESSION

Indian agriculture is endowed with diversity of resources and production systems, having a greater scope for farm innovations to harness the growth opportunities. With the accumulation of knowledge and information available to farmers, and expanding market opportunities, the rate of farm innovations has risen recently, and it is now increasingly felt that these farm innovations should be shared among farmers and, if necessary, should be upscaled and outscaled for wider impact. With this background this national workshop was organized with the objectives to: (i) discuss the farmer-led innovations for their validation, refinement and dissemination, (ii) blend indigenous traditional knowledge (ITK) with scientific innovation and identify research gaps for reducing the cost of technology through farmers' participatory approach, (iii) help protect the interest of farmers by recognizing their contributions to the national genetic resources through Intellectual Property Rights (IPR) and benefit sharing, and (iv) learn from market innovations to promote inclusive market-oriented development (IMOD), and suggest policy and

institutional measures for outscaling farm innovations for their large-scale impacts. The workshop was attended by policy makers, research managers, representatives of research and development and civil society organizations, farmers and rural entrepreneurs.

The workshop was inaugurated by Mr. Ashish Bahuguna, Secretary, Department of Agriculture and Cooperation, Ministry of Agriculture. The session started with lighting of lamp by the Chief Guest and other dignitaries present on the dais, namely, Dr. R.S. Paroda, Chairman, TAAS and Haryana Kisan Ayog, Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE, Dr. K.D. Kokate, DDG (Extn.), ICAR, Dr. R.R. Hanchinal, Chairman, PPV&FRA, Dr. P.L. Gautam, Vice-chairman, TAAS, Dr. H.S. Gupta, Director, IARI, Shri Ajay Vir Jakhar, Chairman, Bharat Krishak Samaj and Dr. N.N. Singh, Secretary, TAAS.

Dr. Kokate welcomed the Chief Guest Mr. Bahuguna and the distinguished guests present on the dais and also other participants coming from different parts of the country. He said that the present workshop was a follow-up of the discussions held on farm innovations at the second Global Conference on Agricultural Research for Development (GCARD 2) and other discussions organized by TAAS, ICAR and HKA under the guidance of Dr. Paroda in 2005, 2007 and 2011. He indicated that in keeping with the Indian tradition of sharing the experiences of farmers, this workshop would provide a useful interface among farmers, R&D organizations and other stakeholders to share and disseminate the knowledge gained by farmers as a result of innovations made by them or innovative use of scientific recommendations.

Dr. H.S. Gupta, while speaking about the workshop, emphasized that development of agriculture is driven by the innovations made by farmers and scientists. There is a need to identify those innovations which can bring about a change in the life of a smallholder farmer, make an inventory of such innovations and take steps to further refine and outscale them. In the process, due recognition should be given to the farmers and their innovations should be protected through intellectual property rights (IPRs).

Dr. R.R. Hanchinal stressed on the fact that the farmer is a great innovator. A number of very useful crop cultivars and technologies have been developed by farmers. Thirty nine such varieties are awaiting registration. For sustainable use of these innovations, efforts need to be made for outscaling, e.g. production of seed of the cultivars developed by farmers and their marketing. Saline and drought resistant rice varieties evolved by farmers will be of great interest.

Mr. Ajay Jakhar stressed that if farmers' innovations are incentivized then implementation of the proposals like Food Security Bill will not be a major issue. The money spent on this activity will be far less than what would be required

for sustaining the Food Security Bill. Encouraging innovations will help farmers for sustainable, productive and profitable farming. He felt sad about the fact that urban farmers who have better access to media are heard every where even though they do not have much to share, while those who are working in isolated pockets remain unheard in spite of the fact that they really conserve and use ITK for farm innovations. There is a need to have a mechanism of disseminating good ideas developed in such remote areas to other states, and main responsibility of this lies with the public sector organizations and civil society organizations working for farmers.

Dr. R.S. Paroda gave background of TAAS, HKA and APAARI and the role played by these organizations in promoting science and innovations for the progress of agriculture and welfare of farmers and rural communities. He thanked the ICAR for the support provided to organize this workshop and lauded the 'Farmer First' mission of ICAR. He mentioned that the presence of Mr. Ashish Bahuguna on this occasion was of great significance since he is the person to take appropriate policy decisions which will give impetus to outscaling the innovations for agricultural development. Dr. Paroda stressed that India is as *krishak pradhan* (farmer centric) as opposed to the usual *krishi pradhan* (agriculture centric). The Food Security Bill will put greater responsibility of producing more food in the coming years. It is, therefore, of utmost importance to reorient our research agenda to help farmers, particularly small farmers, to increase their productive capacity and income. The micro-technologies developed by farmers need to be encouraged through involvement of private entrepreneurs. Farmers want knowledge not subsidy. The rural youth do not want to go to agriculture; they want better education and better life. Women play an important role in agriculture and they need to be empowered. There is a need for more involvement of women in this area, assessing their needs and ensuring their participation in the development programs. Also, the gaps in innovations developed by farmers will need to be assessed for taking appropriate actions to outscale them. In this regard, self-help groups (SHGs), NGOs and private sector can be of great help. The purpose of this workshop is to identify these gaps and take necessary steps to refine them for greater effectiveness and outscaling of the innovations with the help of the Department of Agriculture and ICAR. One example to cite is that even the established innovation of protected cultivation has a coverage of only 42,000 ha in India against 2 million ha in China.

Dr. S. Ayyappan mentioned that today there is a need to make agriculture more efficient, using practices like precision farming and adopting innovative approaches for creation and sharing value along the value chains. Efforts need to be made to generate efficient marketing systems through self-help groups. He mooted the idea of creating an innovation fund. He highlighted that ICAR has a plan to initiate farmer-student interactions through on-farm training programs. He indicated that a district-wise database of innovative farmers was already available with the ICAR.

Mr. Ashish Bahuguna said that farmers are remembered only in difficult times, when there is need to meet the rising food demand. He works hard against all natural odds to produce more food for us, yet he has no role in determining the price of his produce. The price is driven by market players or consumers, and consumers' interests are protected because they have voice. The result is that farmers' income is gradually falling. The average size of holding of a farmer is 1.16 ha. In order to increase farmers' income, it is necessary to develop low cost small storage devices so that they can withhold their produce till opportune time. The Food Security Bill has put greater burden on him. India is a major player in export of agricultural goods. While meeting these demands, market trends and practices should assure that farmers get a reasonable share of profit. Progress of the country depends upon farmers' progress, and, therefore, innovations contributing to farm prosperity should be upscaled. He assured that the Ministry would look forward to look into the recommendations and implement them.

Dr. P.L. Gautam thanked the Chief Guest, Mr. Ashish Bahuguna for sparing his valuable time to associate himself with this important event and assuring the organizers for help from the Ministry of Agriculture in implementing the recommendations of the workshop. Dr. Gautam conveyed his gratitude to other dignitaries on the dais for their association with the workshop. He took this opportunity to stress the need to impart IPR benefits to the identified innovative farmers for their innovations. At the end, he thanked all the delegates coming from different parts of the country.

SESSION I: SHARING OF KNOWLEDGE ON INNOVATIONS AND TECHNOLOGIES FOR OUTSCALING

This session, primarily, discussed farm innovations and technologies developed by farmers from different parts of the country. Dr. K.D. Kokate, DDG (Agri. Extn.), ICAR and chair of the session, in his initial remarks, said that farmer-led innovations have not been given much attention. It is now realized that there are numerous innovations which have yielded higher returns and made farming more economical and sustainable. A database of farmers' innovations will be useful for outscaling some of them. He further emphasized that in diverse agro-ecologies, promotion of farmers' innovations would contribute significantly towards sustainable development of agriculture. The Krishi Vigyan Kendra (KVK) system has demonstrated the potential of various farm technologies which can be upscaled and require policy interventions for large scale impact. He expected that the diverse stakeholders attending this workshop will share their innovations and some policy recommendations will emerge for up-scaling to harness their potential.

Dr. A.M. Narula shared the issues and thrust areas in the states of Punjab, Haryana, HP and J&K. He cited various technologies, e.g. happy seeder, laser land leveller, direct seeded rice (DSR), protected cultivation, mushroom cultivation, beekeeping, dairy farming, etc. which have been upscaled in the region after large-scale demonstrations by KVKs and policy support by the state governments. He also made a mention of few implements, including small implements for hill mechanization, which need financial support for outscaling. He also shared the experiences about market-led extension and secondary agriculture in the Zone-I. At the end, he also presented the new initiatives being taken up by KVKs in the XII Plan.

Dr. A.K. Singh, spoke about the proven outscalable technologies like land shaping/ aerial cultivation, broad bed and furrow system, zero tillage in lentil and chickpea, cropping system for *Diara/Tal* land, Kantha stitch, leaf plate making, backyard poultry, poultry mud house, rejuvenation of old mandarin orchards, quality protein maize (QPM) cultivation, etc. He also dwelt upon some interventions related to National Initiative for Climate Resilient Agriculture (NICRA) project being implemented in 15 KVKs of the Zone-II. He opined that Farmers' Innovation Support Fund needs to be made available to farmers for identification, development and sharing of farmers' innovations on the basis of their own priorities and decision making process. He

also suggested recognition and implementation of relevant policies to document and reward appropriate farm innovations.

Mr. Sudhir Saxena from Institute of Himalayan Environmental Research & Education, Masi, Almora, Uttarakhand, presented details of the organizational set-up, mode of operation and activities of Promoting Local Innovation (PROLINOVA). He highlighted the achievements of his project on climate change, being taken up in Chamoli and Almora districts of Uttrakhand for improving the capacity of farmers through adoption of local innovations of farmers. He exhorted that solutions to site specific problems in agriculture and related activities should be validated by both farmers and scientists.

Mr. Gurpreet Singh Shergill, The Chief Minister and Babu Jagjivan Ram awardee farmer from Patiala district, emphasized the importance of diversification towards pulses, oilseeds, floriculture, vegetables, etc. along with post-harvest handling and processing for sustainability and profitability. He informed the delegates about his marigold cultivation, started in a modest way in 1996 and today he is cultivating gladiolus, gulzafri, and rose etc. in 4.8 ha of land and earning Rs. 16.8 lakhs annually from floriculture crops only. He also shared his innovative marketing skills and wigged all the farmer delegates to adopt diversification and creation of small cold chain facilities at their farms.

Smt. Jaya Devi, the *Green Lady of Bihar* is known for her outstanding contribution in agriculture and enhancing income of the whole community of Dharhara block of Munger District of Bihar. Once a housewife, Jaya Devi became President of SHG federation with as many as 285 women SHGs due to her hard work and persuasive skills. Being the President of Sub-Committee, *Sampark* of SHG Federation, she ventured into contacts with other stakeholders of the region like Agriculture Technology Management Agency (ATMA) and local staff of the line departments. She mobilized financial assistance through NABARD for bringing 5,000 ha under improved agricultural practices and plantation of 25,000 fruit trees (saplings). Her efforts to ensure better quality of life for rural people through improved agricultural technologies coupled with National Bank for Agricultural and Rural Development (NABARD) sponsored watershed management projects brought a paradigm shift in agricultural practices in the area. Under her leadership, 5,000 hectares of Dharaharakol's barren land has been converted into green land.

Mr. Vijay Bahadur Singh, an innovative farmer from Rohtas district of Bihar, apprised the delegates with his innovative way to restrict the entry of *Nilgai* in the farms. *Nilgai* entry in the farms is a problem not only in Rohtas district but also in many areas of Bihar. He explained to the delegates about his methodology of developing a fencing net made up of para twist thread and then trapping the animal. The cost of the technology is about Rs 18,000/ per ha. More than 500 fellow farmers are adopting this innovation.

Dr. B.S. Sohal, Chief Agricultural Officer, Patiala, informed about the activities that his department has initiated with respect to diversified farming and he noted that the most vital part is marketing. He described the benefits of micro level marketing concept via *Atma Kissan Hut*. This mode of marketing promotes quality consciousness, eliminates middlemen, and benefits the consumers. He stressed on the importance of capacity building of the beneficiary farmers. He also enlightened the delegates with regard to multiple use of machinery for cost effectiveness.

Mr. Surjit Singh, a farmer from district Fatehgarh Saheb of Punjab, shared his experiences about advantages of *Raingun* irrigation in heavy soils. He was facing problems with the sowing of happy seeder because a mulch layer of paddy straw placed on soil surface was reducing the evaporation and flood irrigation to the field was causing yellowing of the wheat crop. To solve this problem, he adopted *Raingun* to irrigate the wheat crop sown with the Happy Seeder in 2008. He stated that irrigation with the *Raingun* increased wheat yield to the tune of 1-2 q/ha and also saved about 50 per cent of water. He pleaded for subsidy enhancement on *Raingun* for up-scaling of the technology.

Mr. Lambodar Darwe, a farmer from Dumka, Jharkhand, shared with the delegates his innovative method of lifting water from dry bed of the river for irrigation with the help of PVC pipe having a diameter of 6 inches. With this innovation, water is pumped into small ponds and utilized for irrigation purposes. The device can continuously run for 24-36 hrs. He stated that this innovation is useful for the areas where river stream is dry but undercurrent water remains available despite dry bed. This innovation is very useful for bringing large area under cultivation and is getting popular in Dumka district and also in the adjoining districts like Godda, Giridih, Jamtara, Pakur, etc. where water scarcity is prevalent during drier months.

Mr. Jata Shankar Choudhary, Director, State Agricultural Management and Extension Training Institute (SAMETI), Jharkhand, highlighted the scope and importance of convergence in the field of extension so that concerted efforts are made to have a visible impact. He showed some of the models of convergence for outscaling farm technologies, as experienced by his organization working hand in hand with government agencies and local groups. He explained the efficacy of executing development programmes by unifying similar goals of different programmes under the leadership of one major agency, though, supplemented and complemented by several others.

Recommendations

General Technologies for Upscaling

- In view of the problems of monoculture of paddy-wheat cropping pattern in Punjab and Haryana, efforts should continue in future also to further upscale various technologies related to conservation agriculture

Technologies for refinement

- In view of usefulness of direct seeded rice (DSR) for saving labour and cost of land preparation, further validation of this technology is required to control weeds and germination problem, etc. before inclusion in recommended package of practices.

Issues for outscaling Farm Innovations

- Farm machinery for hilly areas like manual seed-cum-fertilizer drills for pulses, cereals, multi-crop threshers, manual weeders, small tractor (<25 HP), etc. should be available on custom hiring basis at community/kisan club federation level to address labour shortage in agriculture. In general custom hiring of machines at community level is successful based on NICRA experiences.
- Capacity development programmes should be taken up for converting farmers from producers to agri-business managers and farms of such agri-preneurs should be used as farm school for exposure visits of farmers and other stakeholders
- Self employment opportunities can be created for rural youth for marketing of farmers' produce and products through *Kisan* Huts, which need to be set up on road sides or at strategic locations at focal points in big villages/towns/cities to serve farmers of nearby villages.
- Organizing farm women for natural resource management and social upliftment has been proved as successful model in social unrest areas and it needs to be upscaled further.
- The area under protected cultivation is meagre as compared to China and some European countries. Keeping in view the increase in yield per unit area and quality of produce under protective cultivation, huge financial assistance is needed through National Horticulture Mission (NHM) and other state schemes for its horizontal expansion.
- Documentation and validation of farmers' innovation should be done on regular basis and farm innovators should be given due credit. These publications should be widely circulated amongst different stakeholders.
- Ban on sale of fresh apricot from Ladakh region to distant markets should be revisited and examined for improving the economy of tribal farmers of the region.
- A separate National Farm Women Innovators' conference needs to be organized in near future.

SESSION II: KNOWLEDGE SHARING AND COMMERCIALIZATION OF INNOVATIONS: EXPERIENCES OF FARMERS, KVKS AND STATE GOVERNMENTS

The Session was chaired by Dr. S.A. Patil, Chairman, Karnataka Krishak Mission and the Convener of the session was Dr. A.K. Gogoi, ZPD, Zone-III, Barapani. Other speakers in the session were Dr. A.K. Singh, ZPD, Zone-IV, Kanpur, Dr. Sudhakar, ZPD, Zone-V, Hyderabad.

The first lead speaker, Dr. A.K. Gogoi made a presentation on experiences of farmers, KVKs and State Governments in Knowledge Sharing and Commercialization of Innovations. The important points which emerged from his presentation are as under:

- For successful contingency planning for flood resilience in rice farming, interventions like early short duration autumn rice variety *(cv. Luit)* in flood prone areas of Assam; submergence tolerant rice varieties - *Jalshree* and *Jalkunwari* in thirteen worst flood struck districts of Assam; *Joymati* under post flood condition; and natural drainage channel have been found effective.
- For mustard production in Manipur, introduction of new integrated nutrient management (INM) modules and application of 'zero tillage' in mustard and collaboration with Central Agricultural University (CAU), Imphal have resulted in good success. Similarly, promotion of maize variety *RCM1-2*, enhancing seed production through '*Vijay Composite*' and promotion of popcorn *variety ECH-108* have been taken up in Sikkim.
- Across the slope, pineapple cultivation and intercropping with *jhum* paddy, Khasi mandarin, Assam lemon and turmeric have revolutionized income generation of farmers of Nagaland. Use of true potato seed (TPS) technology caused a major shift in potato production in the state of Tripura; 'Paired row system' of true potato seeds (TPS) sowing has been found effective under farm conditions.
- Protected cultivation of *Gerbera, Gladiolus* and *Anthurium* has been instrumental in raising farmers' income manifold in Meghalaya. Breed upgradation through artificial insemination programme; scientific pig rearing including participatory vaccination and balanced feeding management and integration of piggery with fishery have ensured livelihood security in Mizoram.
- Rainwater harvesting and recycling through construction of *Jalkund* and other low cost water harvesting structures; drainage improvement and channelizing

drainage water for irrigation purposes- construction of Rock fill dam and crop diversification are important initiatives for natural resource management (NRM) and biodiversity conservation.

Mr. Laljon Misao, farm innovator from Dimapur (Nagaland) made a presentation on pineapple production and processing which focused on intercropping of turmeric and *jhum* paddy in pineapple. He mentioned that intercropping of *jhum* paddy with pineapple in 1.0 ha area and turmeric in 1.5 ha area, can result a net income of Rs. 1.37 lakhs. The farmer has also earned Rs. 1.12, 3.28 and 5.05 lakhs/ha from cultivation of new variety of pineapple in the year 2010-11, 2011-12 and 2012-13, respectively.

The farmer also harvested Assam Lemon @ 150-600 lemons/plant/year after 4th year onwards initially and later on 800-1000 fruits/ year from 7-8 year old plants. The farmer got an income of Rs. 500-1200/year taking price of Rs 0.50-2.0 per fruit. In the case of orange, 100 fruits/plant/year were harvested initially from a seven year old plant and later on 800-1000 fruits/year from 7-8 year old plants have been harvested with an income of Rs. 200-2000/year @ Rs 2.0/fruit.

Smt. Sketina Kharbani from West Khasi Hills (Meghalaya) made a presentation on protected cultivation of off-season vegetables and flowers. From carnation plants in polyhouse, she earned about Rs. 1.86 lakhs with an expenditure of Rs. 16,968. From vegetables, she could earn Rs. 0.57 lakh with an expenditure of Rs. 0.11 lakh from an area of 200 m × 500 m.

Mr. Raj Mohan Debnath from West Tripura (Tripura) spoke on paired row system of TPS production. In the system, TPS are sown in narrow inter space of 7.5 cm (line to line) × 25 cm (bed to bed) with 1-2 inch for seed to seed distance (6 lines per bed). A total of 100- 120 plants per sq m were maintained in all cases. Two methods, viz, transplantation and seedling tubers were used for production of potato using TPS. Income of the farmers have nearly tripled from Rs. 20,500 (2000-2001) to Rs. 62,899 (2010-2011)

Dr. A.K. Singh made a presentation entitled "Experiences of Farmers, KVKs and State Governments in Knowledge Sharing and Commercialization of Innovations in Uttar Pradesh and Uttarakhand." The highlights are given as under.

- The state of Uttarakhand has shown a growth rate of 3.2 per cent and contribution of agriculture (8.71%) in gross state domestic product (GSDP). The contribution of agriculture and allied sectors in GSDP is 14.1 per cent. The forest areas of 34.84 lakh ha is quite important as cultivated area (7.41 lakh ha) is quite low.

- The contribution of Uttar Pradesh in production of wheat (32%); rice (13.44%); sugarcane (35%) and overall food grains (20%) in the national basket was mentioned. The growth of agriculture in XI Five Year Plan (3%) and XII Five year Plan (5.1%) proposed with emphasis on food and nutritional security, NRM, diversification, post-harvest technology (PHT), risk management, women empowerment, rural livelihood security, rural infrastructure development, human resource development (HRD) and institutional reforms were enumerated. He further highlighted the strengths, weaknesses and opportunities in different agro-ecological regions of the state, viz., eastern zone, central zone, Bundelkhand zone and western zone. As a strategy, he emphasized on diversification of rice-wheat system; enhancing productivity of rice, wheat and sugarcane; tapping the potential of eastern region for the second green revolution; tackling the problem of sodicity; enhancing productivity of livestock, water harvesting and crop productivity.
- The strengths of hill agriculture for cultivation of off-season vegetables, fruits, flowers and minor millets were focused. Addressing problems of soil and water conservation are key for hills and interventions like protective cultivation, poultry, goatery, mushroom, fishery, small farm tools, women empowerment, transportation and marketing are very important.
- The hybrid rice in Uttar Pradesh has yielded 22-100 per cent more over local check with productivity levels ranging between 55-92 q/ha in various demonstrations at farmers' fields. The varieties were *PRH-10, PA-6444, PA-6111* and *NPH-8899*.
- The case of district Krishi Vigyan Kendra (KVK), Bijnor, Uttar Pradesh showing diversification of rice with scented and hybrid rice was presented indicating decline in area under coarse rice from 70 per cent to 51 per cent and increase in area under scented rice from 22 to 28 per cent and under hybrid rice from 8 to 21 per cent. The variety *PRH-10* of rice has shown yield realization of 68 q/ha in farmers' conditions. *Pusa-1401* scented rice released in 2008 by IARI, New Delhi has spread in about 12,000 ha in district Saharanpur where the average yield of 52 q/ha with net income of Rs. 1,11,000 and rice recovery between 66-70 per cent have been recorded.
- Paddy variety *Swarn Sub-1* released in 2009 for water logged condition is under practice in more than 3,500 acres with productivity levels of 45 - 50 q/ha in district Behraich of Uttar Pradesh. Potentiality of salt tolerant paddy variety *CSR-36* has been established at pH level ranging between 8.9 to 9.3, by harvesting yield of 46.2 q/ha, showing an increase of 60 per cent over farmers' practice in district Kaushambi, Uttar Pradesh.
- Summer groundnut introduced in 2001 in district Mainpuri, in the state of Uttar Pradesh has spread to 16 districts in an area of about 2.0 lakh ha with productivity gains of 26 q/ha and net income of Rs. 31,500/ha. The case of district Chandauli was also highlighted where in zero tillage (ZT) wheat has

spread over 51,000 ha with more than 1000 ZT machines in the district. Success of Direct Seeded Rice in flood prone areas with yield realization of 47.5 q/ha at farmers' fields in district Kushinagar, Uttar Pradesh was highlighted.

- The intercropping of sugarcane with mungbean (*PDM-139*) fetched an yield of 7.29 q/ha of mungbean and 580 q/ha of sugarcane. The mungbean production is an additional gain as compared to sole crop cultivation. For controlling shoot borer in sugarcane, the success of Trichocard @ 2 kg/acre four times during the crop stand with investment of Rs. 360/acre were highlighted.
- The success of peach based farming system as replacement to sugarcane crop in western Uttar Pradesh was described. Peach cultivation with intercropping of vegetables in place of sugarcane has provided net profit of Rs. 2.4 to 3.0 lakhs/ha and this practice has spread over in 62 villages of district Saharanpur.
- Farmers of district Muzaffarnagar, Uttar Pradesh grow *Gladiolus* (variety white prosperity, *JB Gold, American* and *Red Beauty*), the farmers with an investment of Rs. 3.2 lakhs/ha/year are earning about Rs. 2.5 lakh/ha/year. The practice has spread to 33 villages of district Muzaffarnagar.
- Goat rearing in different flock sizes gave returns between Rs. 846 to Rs. 1350/goat/year, which is an economic enterprise for small farmers and landless.
- The poly mulching technology for management of weeds upto 90 per cent, enhanced soil moisture and soil and water conservation. Yield gains have been demonstrated successfully in hills of Uttarakhand. It also hastens 7-10 days early flowering and fruiting.
- The small water harvesting tanks of 40 m^3 volume are boon for hill agriculture, specially for vegetable cultivation. The technology has been adopted by thousands of farmers in district Champawat and other districts of Uttarakhand.
- For control of white grubs, use of Entomopathogen and Light Trap (VL white grub beetle trap-1) have been found quite successful in the hill districts of Uttarakhand. It has shown increased yield of tomato, potato, chilli and frenchbean to the tune of 19.8, 48.0, 46.87 and 17.69 per cent.
- The success of Voice Krishi Vigyan Kendra (vKVK) model of communication with farmers by using mobile technologies by the experts of KVK was shared. This technique can be used to reach more number of farmers.

The salient points emerged from the presentations of the panelists are given below:

Dr. S.K. Singh, Principal Scientist, Indian Institute of Pulses Research (IIPR), Kanpur presented the success of technology demonstrations for harnessing pulses' productivity in 137 districts of 11 states. For each district specific technology modules including improved varieties and technologies were developed and demonstrated. Five major crops, viz., chickpea, lentil, greengram, pigeonpea and blackgram were covered

in the programme. The yield advantage ranging between 30 to 39 per cent were observed over local checks in 11,372 demonstrations conducted at farmers' fields.

Mr. Satya Veer Singh, Dy. Director Agriculture Muzaffarnagar district, Uttar Pradesh, made a presentation with a focus on convergence of ATMA and KVK for preparation of strategic research and extension plan (SREP)/ development aid from people to people (DAPP); training of field functionaries; deciding techniques/ inputs for field programmes; identification of field problems; and evaluation of programmes; supporting infrastructural development at KVK (honey processing unit and soil micro nutrients lab).

Mr. Jitendra Pal Singh, a farmer, from Muzaffarnagar district, Uttar Pradesh presented his success in raising ornamental plants. Mr. Singh started raising ornamental plants in 1997 and now with 4 acres of land, he is earning about Rs. 30.0 lakhs annually. He has further trained 32 entrepreneurs who are earning Rs. 8.0 lakhs annually by growing plants like Washingtonia palm, bottle palm, fish tail palm, Bamboos, *Ficus*, *Ashoka pendula, A. alba*, *Nickdevia* species, etc.

Dr. M.P. Singh, Programme Coordinator Champawat, Uttarakhand shared the experiences in successful integrated farming system modules in hill agriculture. Integrated farming system of vegetable, fish, poultry fetches an income around Rs. 59,500 from 1000 m^2 and polyhouse integrated farming system model fetches around Rs. 65,000/year from 1500 m^2 in hill areas of Uttarakhand.

Mr. Habib Khan, a farmer from district Lucknow, Uttar Pradesh enumerated the success of tissue culture banana. He owns only 1.0 ha of land. He started tissue culture banana cultivation in 2007 and entered into an agreement with a private company in 2010 wherein, he started primary and secondary hardening and selling tissue culture plants to banana growers. He has experimented different plant spacings of 5'×5', 5.5'×5.5', 6'×6' and 8'×4'. In two combinations, viz., 6'×6' and 8'×4' , he has got higher production and sufficient row space for easy field work. For primary hardening of 8 lakhs and secondary hardening of 4 lakh plants, he made initial investment of Rs. 9 lakhs in the first year. He started earning about Rs. 6.0 lakhs as net income from second year. He is now earning about Rs. 20 lakhs from tissue culture plant nursery, tissue culture banana cultivation and potato cultivation.

Dr. N. Sudhakar, Zonal Project Director, Zone V, Lead Speaker, gave a brief account of agriculture scenario in Andhra Pradesh and Maharashtra and details of the existing KVKs and their importance in technological interventions with large scale impact. Some of the successful technological interventions of KVKs, viz, direct seeding of rice

with drumseeder in Chittoor, Karimnagar and other districts, cultivation of zero tillage maize in Karimangar district, *in situ* moisture conservation of *rabi* sorghum in Pune district etc. were highlighted for upscaling of these technologies through convergence of KVKs, Department of Agriculture, Farmers' Clubs, etc.

Mr. Dnyaneshwar Bodke, President, Abhinav Farmers' Club, Pune, made a presentation on genesis and achievements of Abhinav Farmers' Club'. Activities of the club included enhancing the income of farmers through hi-tech farming, empowerment of women through SHGs, etc. The farmers' club has promoted 112 SHGs in 26 villages. The members of the SHG were trained and given the responsibility of harvesting, cleaning, grading and packing of vegetables. Marketing of quality vegetables helped in economic empowerment of women. The members of the farmers' club are also involved in dairy farming to provide additional source of income.

Mr. Venkat Reddy, a progressive grape grower from Andhra Pradesh spoke on his experience in improving soil fertility through incorporation of subsoil, which helped in enhanced production of grapes and other crops with good quality. Shri P. Premanand, a farm entrepreneur from Kadappa district, Andhra Pradesh spoke on value addition in Millets'. After getting the necessary training in processing of millets from KVK, Kadappa, the farmer took up production of various products of millets. Initially, it was started as a home scale business by employing three women workers. With the growing demand for his products like multi-grain atta, nutrimalt, etc. he started commercial production of these products on large scale in the brand name of AMPLE. Nutrimalt, one of his products was included as a health drink in place of tea in 20 Government Residential Schools in 2011. According to him, now, more than 70,000 school children of nearly 400 Government Residential Schools and hostels are drinking nurtrimalt daily as a health drink.

Mr. K.V. Deshmukh, Director, ATMA, Pune, made a detailed presentation on the agriculture scenario of Maharashtra and various interventions of the government in improving the marketing facilities and linkage of farmers to market, establishment of farmer-producer companies, etc.

Recommendations

Based on in-depth discussions, following recommendations emerged:

General

- There has been considerable diversification and preference of farmers towards hybrids in general, and hybrids of rice, maize and vegetables in particular. Cultivation of *basmati* rice even in non-traditional areas, crop substitutions and intensification through summer cultivation are happening. Such dynamic changes need to be supported by matching inputs, technical guidance and policy support.
- The success of technology demonstrations for harnessing pulses' productivity

in 137 districts across 11 states needs to be further strengthened. This model may be adopted for other commodities also.

- The programmes like rural agriculture work experience (RAWE) and experiential learning need to be further strengthened with a capsule course on practical farming, to be taught by experienced and innovative farmers.
- The farmer innovators should be facilitated by the specialized institutions in developing suitable business plans.

Innovations for Outscaling

- Protected cultivation for small and marginal farmers needs to be promoted, especially in hill regions. Integrated Farming System model of fish- poultry - vegetables using water harvesting techniques are quite profitable and sustainable for hill agriculture.
- Value addition of millets, pineapple and other local products should be outscaled for higher returns to the farmers.
- Farmers have shown interest in growing ornamental plants, tissue culture banana and vegetable seedlings. Such examples need to be outscaled.

Policy Issues

- Successful example of Abhinav Farmers' Club in organizing farmers and enhancing their income through diversification suggests that this kind of model should be facilitated across the country for capacity development of farmers and farm women.
- The location-specific marketing models have evolved which improve direct access of farmers for better marketability and higher returns for their produce. Thus, the focus should be to identify and analyze successful marketing models existing in different parts of the country so as to harness the advantages of such models.

SESSION III : OUTSCALING OF INNOVATIONS AND TECHNOLOGIES AND CONVERGENCE MODEL

The session was chaired by Dr. S.N. Puri, Vice-Chancellor, CAU, Imphal. The session had presentations from 3 conveners-cum-lead speakers, namely, Dr. Y.V. Singh, ZPD, Zone VI, Dr. Anupam Mishra, ZPD, Zone VII, and Dr. S. Prabhu Kumar, ZPD, Zone VIII and 13 delegates which included farmers, officials from Development Departments, Directors of Extension, Programme Coordinators of KVKs and scientists from ICAR Institutes.

Dr. Y.V. Singh highlighted the efforts made by the 70 KVKs located in Rajasthan and Gujarat in outscaling models on pressurised irrigation, water harvesting, value addition in spices and medicinal plants and public private partnership model in promoting vegetable cultivation in Jaipur district. He stressed the need for district-specific secondary agriculture for making agricultural sector more remunerative.

Dr. Anupam Mishra, in his lead presentation, narrated the outscaled technologies in Madhya Pradesh, Odisha and Chhatisgarh. He highlighted the ridge and furrow method of sowing in soybean, system of rice intensification, line sowing, crop diversification towards pulses, oilseed and high value crops, entrepreneurship development enterprises, especially mushroom production and backyard poultry, etc.

Dr. S. Prabhu Kumar presented the lead paper on 'outscaling of technologies through convergence – experiences of team KVK'. In his presentation, he highlighted the experiences of KVKs of his Zone in outscaling of the technologies through convergence.

Mr. Jai Singh Rana, a progressive farmer of Dholpur presented his entrepreneurial efforts of apiculture in Dholpur district where 55 farmers of 40 villages have adopted apiculture entrepreneurship and are earning Rs. 3-4 lakhs per annum. Now 500 bee keepers are producing 25 lakhs kg honey in mustard growing districts of Rajasthan. High production of honey had led to low price in honey sector. He stressed the need for honey filter plant facility in each district, plantation of nectar producing plants to stop migration of honey bee keepers during off-season and fixation of minimum support price for honey.

Mr. Ganpat Lal Nagar presented his entrepreneurial model on safed musli cultivation and processing in Baran district of Rajasthan, use of raised bed technique increased production, harvesting using chiselling plough for reducing the cultivation cost upto Rs. 30,000/ha. He also developed peeling and washing machine to process 90% of the raw musli. Now the farmers are able to earn Rs. 6-15 lakhs per annum and 180 farmers are growing musli and using processing machine in Baran district. Such model needs upscaling in other musli growing districts like Jhalawar, Kota, Bundi and Chitorgarh.

Dr. U.S. Tonk, Programme Coordinator of Kutch highlighted outscaling of date palm technology in coastal area with sea water intrusion. Now 19 lakh date palms are producing 16 lakh tonnes of table fruit in Kutch. The pollinator developed by the KVK has reduced the labour cost and drudgery which saved Rs. 30 lakhs in the district. The technology needs further upscaling in saline affected coastal area of Saurashtra and Kutch.

Dr. I.J. Mathur, Director Extension, Maharana Pratap University of Agriculture & Technology (MPUAT) Udaipur presented convergence model developed by MPUAT on integrated farming system (IFS) including basket technology, value addition, Aloe vera, musli and garlic and backyard poultry and goatery for small and marginal farmers.

Mr. Roshan Lal Vishvakarma, a farmer from Narsinghpur district of Madhya Pradesh highlighted his innovation of sugarcane bud chipper. The implement saves the cost of seed of sugarcane by Rs. 28,000/ha, transportation cost in sugarcane seed, is easy to handle and also makes the seed treatment possible. This implement is most suitable for small and marginal farmer. He has sold more than 7,000 sugarcane bud chippers till date and has signed MoU with Tata Agro for supplying 4,000 implements.

Mr. Sanjeet Mohanti from Puri district of Odisha presented his innovation on mushroom production for disinfection of the inoculation chamber floor using heating torch connected with gas cylinder with spirit spray and camphor for 15 minutes. Disinfection is done in two days interval in rainy season and weekly interval in other seasons. He also presented the technique to reduce the cost of mushroom production. Mr. Mohanti has a mushroom processing unit and provides training to the rural youth. Till now, he has trained 1,100 youths and SHGs. He is producing and supplying 1,000 mushroom spawn bottles and 2q mushroom per day.

Dr. R.K.S. Tomar, Programme Coordinator, KVK Datia, presented the KVK-ATMA Convergence model operating in all the districts of Madhya Pradesh as a special programme for sustaining double digit growth in agriculture in Madhya Pradesh.

Dr. J.S. Urkurkar presented the outscaling model through seed production programmes in Chhattisgarh. He highlighted the role of para-extension workers and their technical backstopping. He also highlighted the Krishi Gyan Portal, and other mass dissemination methods used in outscaling of technologies.

Dr. Ajay Koshal, Project Director, ATMA Chhindwara, Madhya Pradesh, in his presentation explained outscaling of sweet corn varieties, namely, *Sugar 70* and *Sugar-75,* through KVK-ATMA-PPP Model. Besides, he shared his experiences of contract farming in potato production with private players.

Mr. Sadananda, a farmer from Karnataka, who rose from mere machine operator to Secretary, Flower Growers Association, through integrated farming on 2.36 acre land with a meager resource of one irrigation borewell, polyhouse, nursery, water storage pond, vermicompost, *azolla*, biogas units, dairy, sheep and dog breeding. Through this IFS model, his net income was Rs. 2.60 lakhs in 2003-04, which enhanced to Rs. 12.10 lakhs in 2012-13, a phenomenal growth in a decade. His strengths as IFS farmer are staying on the farm, consolidated land holding, interlinking different components on the farm, recycling farm and animal waste for fuel and manure, less dependence on external inputs and labour,

effective utilization of bore well and rain water, crop planning according to market demand, market linkage, good expert contacts, organic farming and other innovative approaches. He has outscaled his success through sharing experiences with more than 25,000 farmers, students, scientists and SHGs who visited his farm and awareness through mass media coverages (more than 150 TV, radio, newspaper coverages). More than 500 farmers replicated IFS model, already in operation in Bangalore's rural district. Govt. of Karnataka released more than Rs. 60 crores to replicate the model through Rastriya Krishi Vikas Yojna (RKVY) in neighboring districts.

Mr. Samikannu, a farmer from KVK Dharmapuri, Tamil Nadu, made a presentation on precision farming - an innovative approach for profitable corporate farming. Under Tamil Nadu Precision Framing Project (TNPFP), precision farming was demonstrated to the farmers who got convinced that it was easy and economically viable due to the following attributes:

- 60-140 per cent yield increase; 90 per cent first grade quality produce with price premium to the tune of 25per cent
- 50 per cent electricity economy; 50–60 per cent water, fertilizer, weedicide and pesticide saving
- Extended shelf life and harvest period to match the lean season

In order to address the constraints like non-availability of inputs, information on new technology and markets and improve product quality, 17 farmers' corporates were started during 2004-07 and this model extended all over Tamil Nadu through National Agricultural Development Project (NADP). The farmers' corporate facilitated the entire process of crop planning, input procurement, crop activities, harvest, marketing, etc. Major aspects of the marketing are:

- Due to Directorate of Marketing and Inspection (DMI) the possibility of negotiation on price is possible (increment by 15–20 per cent)
- One of the members is responsible for transporting the produce on rotation basis
- Confirmation of the actual market condition
- Signed MoU for export of drumstick to the United Kingdom (UK)

This success led to creation of 15 more farmers' corporates in the Dharmapuri district whose major activities included district and state level discussions regarding agricultural issues, organizing demonstrations under ATMA /NADP, conducting Farm School under ATMA for drumstick and facilitator farmers at KVK. The convergence that paved the success of farmers' corporates are ATMA, NABARD and State Development Departments. The outscaling farmers' corporates through precision farming influenced the horizontal spread as detailed below:

Year	Institutional support	Area (ha)
2004-07	TNPFP-TNAU	400
2007-08	TNAU, State Depts. (Agri. Horti.) under RKVY	12,800
2013	State Depts. (Agri. Horti. Engg.) under RKVY, IAMWARM (World Bank Aid)	80,000

Dr. B. Mohan, Programme Coordinator, KVK, Namakkal while making his presentation on public private partnership model for promotion of fodder production in Tamil Nadu, an innovative approach of KVK, emphasized that on an average, nearly 30 per cent of farmers visit KVK for fodder seeds. On looking into the demand for fodder, the KVK initiated public-private partnership in fodder seed production with an objective to develop a standard for fodder seed production for livestock and to increase the economic standard of the farmers through production and supply of fodder seeds. The process started on 2nd Dec. 2012 with signing of MoU with farmers – KVK - Dept. of Animal Husbandry, Tamil Nadu. The roles of the partners are: farmers are fodder seeds producers, Krishi Vigyan Kendra, Namakkal as Co-ordinator, Dept. of Animal Husbandry, Tamil Nadu as purchaser. The salient features of fodder seed production agreement plan are:

- Farmers should produce fodder seeds such as grasses, cereals, legumes and tree fodders as per specifications with 10 per cent moisture level and handover the same to the KVK.
- KVK should train and demonstrate fodder seed production to the fodder seed producers and check the quality of seeds before supplying to the Dept. of Animal Husbandry.
- Department should inform about their needs to the KVK in advance in order to procure seeds from the farmers and then supply, for which Department should pay the amount within thirty days from the date of purchase.
- 15 per cent service charge will be credited to the KVK for conducting training, demonstration, seed testing, cleaning of seeds, packing and forwarding.

The number of farmers signing MoU for fodder seed/slips production in Tamil Nadu is 90 from 14 districts. As per the demand, seed material of fodder crops taken up for production are grasses (bajra, hybrid grass-CO(CN).4, guinea grass-CO(GG).3), cereals (fodder sorghum – *COFS 29*, fodder maize – *African tall*), legumes (hedge lucerne, fodder cowpea – COFC8) and tree fodders (*Subabul, Sesbania*). In conclusion, he highlighted that thirty tonnes of fodder seeds worth Rs.1.30 crores covering 11,088 acres under fodder crops has been supplied. On an average, farmers earn Rs.1.0 lakh/acre from fodder seed production excluding the fodder which is used for their own farms. High incidence of seed shattering in *COFS -29* had been reported by KVK, Namakkal to TNAU breeders and a non-shattering type evolved for seed production.

Dr. Puthira Prathap, Senior Scientist (Agrl. Extn.), Sugarcane Breeding Institute, Coimbatore, Tamil Nadu, while making presentation on outscaling sugarcane varieties: the case of *Co 86032* variety, stressed the strong institute-industry-farmer partnership. Sugarcane Breeding Institute has outscaled the variety, *Co 86032* to about 3.4 lakh hectares in Tamil Nadu. The geographical spread of the variety was very rapid in view of its exceptional yield and quality parameters which found immediate acceptance among the cane growers and sugar factories. At present, this variety occupies around 90 per cent of the cultivated area in Tamil Nadu and over 60 per cent in Karnataka and Maharashtra. The journey started in the mid-eighties with the screening of 200 SBI clones for ethanol, one of which was *Co 86032* (known as *ES 353*) in Sakthi Sugars Ltd., Appakudal in Tamil Nadu. From Sakthi Sugars, the variety spread to the command areas of Bannari Amman Sugars, Ponni Sugars, EID Parry and New Horizon Sugars, Puducherry in the early nineties. The co-op/public sector sugar mills in the state too followed suit. In view of its impact in improving yields and recovery in Tamil Nadu, the variety was estimated to generate about Rs.350 million annually in the past decade. An estimated Rs.11.20 billion is the annual additional income generated through this variety in tropical India. By growing this variety, the farmer could get additional returns in terms of yield to the tune of 10 tonnes/ha compared to other varieties, thereby creating a huge impact on his socioeconomic status. This was possible due to the strong association the Institute has developed with the sugar factories of the region. The sugarcane R&D workers' meetings in Tamil Nadu, Puducherry and Karnataka, a unique outreach initiative from Sugarcane Breeding Institute, has a history of over three decades. Jointly organized by the Sugarcane Breeding Institute, SAUs and the Sugar Industry. These meetings have endeavoured to focus on the problems of the sugarcane farmers and sugar industry and evolve appropriate strategies to improve the sugarcane productivity in the region. The outscaling of *Co 86032* is discussed in every R&D meeting in a separate session on 'Current varietal position and performance of new sugarcane varieties'. Distribution of quality seed material of *Co 86032* including tissue culture seedlings from SBI (breeder seed production) was one of the major factors of outscaling. The Institute's outreach efforts such as participatory research projects, reporting success stories of farmers growing *Co 86032* variety through the user-centered website, CaneInfo, video films and frontline demonstrations too helped in the process. To sustain these outscaling efforts, Sugarcane Breeding Institute, at present places thrust on varietal rejuvenation of *Co 86032*, till a suitable replacement variety is identified. Supply of quality tissue culture (TC) seedlings of *Co 86032* will also continue, thereby sustaining seed production.

Recommendations

Based on the discussions, the following recommendations emerged:

General

- Outscaling of district specific secondary agriculture is required for livelihood security in drought prone districts of Rajasthan and Gujarat.
- Emphasis has to be given to outscaling of farm ponds for sustainable production in rainfed, arid and semi-arid districts of Rajasthan and Gujarat.
- The KVK-ATMA convergence model tried in Madhya Pradesh with focus on institutional arrangement and policy support of State Government through integrating different government schemes, proactive technological backstopping by KVKs and active participation of farmers and ATMA staff may also be outscaled in other states.
- There is a need to prepare the road map of exposure visits of the farmers to the fields of innovative and awardee farmers of the country.

Innovations for Outscaling

- Precision farming and redgram transplantation technique are the best practices for increasing crop productivity and hence need to be outscaled.
- There is a need for outscaling of biocontrol methods in integrated pest management of paddy in Puducherry, and promotion of secondary agriculture through value addition and branding.
- Farm mechanization like sugarcane bud chipper, pressurized irrigation, water harvesting and use can promote sustainability with higher yields, and, therefore, should be given focused attention.
- Promotion of integrated farming system involving high value products like vegetables and livestock for higher farm income and value addition is urgently needed.
- Outscaling the production of commodities for diversification like date palm, safed musli, apeary, sweet corn, spice, medicinal plants, etc. needs to be done with adequate support of planting material, inputs and production practices.
- Partnership among farmers' organizations, state line departments, and KVK is very productive in outscaling innovations, production of planting material, fodder, etc.
- Outscaling of improved varieties can be rapid if there is partnership among the R&D organizations, industry (e.g. sugar) and farmers. In other crops, nursery could be an innovative and income generating enterprise.
- The cost effective mushroom production technology developed by Mr. Sanjeet Mohanti from Puri should be promoted on large scale in other parts of the country as well.

Technology Refinement/Researchable Issues

- There is need to develop cost effective need based machinery for planting and intercropping in sugarcane as well as other crops.
- Lodging is major problem, particularly in wheat, and hence there is need to develop appropriate machinery to harvest lodged plants.
- The cost effective technology needs to be developed for producing female calves only.
- Speeding up research on standardizing the dosage for organic products for fertigation is extremely important.
- There is need for tomato planter to be developed alongwith development of small machines for small farmers.

Policy Issues

- The KVK-ATMA convergence model by intervening institutional arrangement with policy support for integrating different central and state sponsored schemes and working directly with farmers in all districts in Madhya Pradesh has been proved as an effective outscaling model. The model needs to be adopted by other states also.
- Subsidy needs to be provided for apiculture and custom hiring implements
- There is need for plantation of nectar producing trees on wasteland/forest land to stop migration of apiculture farmers
- Fixation of minimum support price for honey is required to be done to promote its production.
- There is a need to develop innovation fund for validating and refining of the farm technologies
- Patenting of date palm pollinator developed by KVK Kutch is needed and promotion technology needs to be developed for drudgery reduction and saving labour in date palm area.
- There is a need to change of the water soluble fertilizers from chemical list to fertilizer list
- There should be provision of subsidies on the transport vehicles and cold storage based on the local needs for the farmers' corporates

SESSION IV: CONSERVATION AGRICULTURE AND SYSTEM BASED DIVERSIFICATION

The session was chaired by Dr. J.S. Samra, CEO, National Rainfed Area Authority (NRAA) and co-chaired by Dr. Alok K. Sikka, DDG (NRM), ICAR. Dr. M.L Jat, Senior Cropping Systems Agromomist, CIMMYT convened this session.

While setting the context of the session, the chairman emphasized that in India rice and wheat together account for about 90 per cent of cereal production and since 1970's Rice-Wheat (RW) system emerged as a major food production system. The average yield increases in rice and wheat during 1970-1990 were about 2 per cent per year. However, since 1990's we have realized the second generation problems of the Green Revolution, i.e. decline in factor productivity, depleting water table, deteriorating soil health, resistance of *Phalaris minor* against isoproturon that led to decline in the yield growth. These issues coupled with escalating input costs and shrinking farm profitability made farming unattractive and hence the sustainable food security is a critical issue. Therefore, new technological options of conservation agriculture based management practices, for example, zero tillage, bed planting, laser levelling, residue management, direct seeding of rice, etc. were considered as potential solution to these issues. However, major impact of these technologies could be realized under irrigated RW systems of North-West India, though there is tremendous potential of outscaling these in different ecologies. The most important concern not only for today, but more particularly, for future is water scenario under the emerging challenges of climate change. Climate change is a reality and India is most vulnerable for that. With each °C rise in temperature in the arid and semi-arid regions, there will be at least 10 per cent increase in irrigation water demand. However, the water availability is expected to decline, whereas, water demand will increase in India. For example, during the period of 2008-2012, total fresh water withdrawal was about 761 billion cubic meters and about 90 per cent of this is associated with agricultural water withdrawal, which includes both irrigation and livestock production. In order to satisfy growing demand for food, India would require to produce 37 per cent more rice and wheat by 2025 with nearly 10 per cent less water available for irrigation. Therefore, this session on outscaling innovations on 'Conservation Agriculture and System Based Diversification' is very important. The deliberations in the session through six panelists from diverse backgrounds and further discussions will be helpful for designing strategies and prioritizing investments for outscaling these innovations for greater impact on the smallholder farmers.

After the presentation by Dr. M.L. Jat, the panelists presented their views. Dr. Raj Gupta highlighted that it is now generally agreed that easy gains from the original Green Revolution technologies have for the most parts been realized and future gains have to come primarily through bridging the management yield gaps that ranges from 14-47 per cent, 18-70 per cent and 36-77 per cent in wheat, rice

and maize, respectively. Thus, for addressing the issues of resource fatigue and bridging *'management yield gaps'*, conservation agriculture (CA) based management solutions are the cornerstone. However, the natural resource management problems are often complex in nature and require site-specific management solutions. While elaborating three key elements of conservation agriculture i.e. (i) minimal disturbance of soil, (ii) rational soil covers using crop residues or any other organic mass, and (iii) efficient and viable cropping systems emphasized that CA based practices have proved to produce more at less costs, reduce environmental pollution, promote conjunctive use of organics (avoid residue burning), improve soil health and promote timely planting of winter crops to address issues of terminal heat stresses. He further stressed that like any other tillage and crop establishment technology, it may not be a panacea for all present day ills, but has proven to bring out South American Agriculture out of its stagnant state almost 20 years ago, skyrocketing the cereal and oilseed production systems. For outscaling of CA based management practices, he highlighted the following strategies and steps:

- Take stock of the available technologies/practices adapted to different production systems and define their domains for upscaling and outscaling
- Capture farmer innovations on CA and align them with scientific validation and refinements
- Provide a common neutral platform for policy makers, R&D managers, researchers, private sector representatives, NGOs, CGIAR institutions, civil society organization (CSOs) and the farmers to assess local/national and regional needs, exchange information, and accordingly define priorities for the deployment of CA with a focus on small holder resource poor farmers
- Institutional arrangements, developmental needs and enabling policy for scaling-up and scaling-out of CA systems
- Convergence and synergy of investments with a clear message to go to farmers
- Capacity development, empower youth, and promote local innovation systems with an out of box extension strategy
- Develop CA based integrated farming systems on a watershed basis
- Analyse adoption pattern and behavioral change of farmers under different typologies to understand adoption of CA
- We also need in-depth strategic research on the following aspects:
    - Water × nutrient interactions under CA
    - Basic understanding of dynamics of weed, disease, insect and pests under contrasting management systems and develop integrated management strategies accordingly

- ♦ New plant types adapted to CA system for optimizing resource use efficiency
- ♦ Design and develop CA machinery suited to different farming systems
- ♦ Crop-livestock interactions and crop residue tradeoffs in relation to CA systems under irrigated, favourable rainfed and unfavourable rainfed production environments

Dr. B.P. Bhatt, while emphasizing the strategies for sustainable intensification and accelerated adoption of innovations in Eastern India, highlighted that Eastern India occupies 21.8 per cent of the total geographical area and supports about 33.5 per cent population of the country. The region is, though, endowed with rich natural resources, social capital and traditional knowledge is having very low productivity and farm income. This is primarily due to high population pressure on natural resources, high risks due to climatic uncertainties, low investment capacity of the resource-poor farmers coupled with several other socioeconomic and structural issues. To address these issues and improve productivity and profitability on a sustainable basis, we have to devise location-specific and farmer-circumstance specific sustainable intensification options. Hence, IFS modules for smallholder farmers having key enterprises relevant to specific situations and aligned with output market. He highlighted the following points:

- There is large area under rice-fallow in Eastern India and hence, cropping system optimization with combinations of crop varieties and agronomic management practices particularly zero tillage is one of the important strategies for sustainable intensification
- Maize is one of the important crops for diversification in Eastern India
- There is > 4 m ha wetland area in the eastern region which needs to be utilized suitably. Fish, *makhana* and water chestnut can be cultivated in 1.1 m ha partially water logged area
- The traditional water management system 'Ahar-Pyne' is very helpful in Bihar
- Late harvest of monsoon season crops and late planting of winter crops is one of the important features in Eastern India. Conservation agriculture based management practices can help to address this issue
- As the land holdings are small and fragmented and for timeliness in operations mechanization is important. Hence, creation of custom service windows will help mechanization access to resource-poor farmers and generating employment.
- Agroforestry and horticultural diversification are still untapped potential that need special emphasis

Dr. B. Gangwar, while highlighting viable farming systems under major ecologies of India, presented several models of integrated farming systems relevant to

different agro-ecologies. He mentioned that 86 per cent farmers are small and marginal and are dependent on farming for their livelihoods. Mere crop cultivation will not be helpful to them. Therefore, IFS approach is important. He presented 18 predominant farming systems in the country. However, despite the fact that there is more income in IFS, still outscaling of these IFS modules is challenging.

Col. S.C. Deshwal presented a success story of farmer-led horticultural diversification. He emphasized that he started farming with a vision that when the price of a factory product is decided in the factory, why the prices of farm produce can't be decided at the farm rather than '*Mandi*'. That's what is the major 'Mantra' of his success which made him the '*Carrot King*'. He elaborated that there are three things involved in farming which are interlinked and should be dealt with in totality, (i) production, (ii) harvest and post-harvest, and (iii) storage, supply chain and marketing. For this, one should have a full team, faith and networking. He repeatedly emphasized that 'market intelligence' is the key to success.

Mr. Vikas Chaudhary highlighted young farmers' perspective on outscaling natural resource management innovations through farmer cooperatives. He emphasized that the farmers are facing several issues with traditional farming technologies and some of those are as under:

- Water, soil health and environmental pollution
- Labour shortages, high production costs and low profit margins
- Youth are moving away from farming as farming is becoming unattractive

While elaborating the problems in current farming practices, he mentioned that the blanket, large area recommendations are really not very helpful under the emerging climatic risks, for example, 2012-13 (both *kharif* and *rabi* seasons). He further highlighted that:

- Unidirectional process of technology development and flow will not be very useful.
- Local adaptation of technologies with active participation of farmers is a must for large scale adoption.
- Real time access to information/knowledge with location-specific technology is a must to address the emerging challenges.
- Active participation of all stakeholders is critical in technology development, and refinement.

- Farmers need a common neutral platform so that they can have a synthesised and relevant technology rather than so many conflicting and contradictory messages. Therefore, the farmer is the best common neutral platform and hence all the stakeholders should come together to work collectively with the farmer.
- We need new ways of farming for bringing youth back to farming.

Major (Retd.) Manmohan Singh shared his experiences on innovative practices to conserve natural resources and improve farm income. He shared the innovative diversification models for crop diversification with lot of success. However, he emphasized that policy is the key for large-scale adoption of these models. He repeatedly emphasized on crop insurance and its implementation strategy.

Recommendations

General

- Diversification is important for sustainable food security and resilient livelihoods but for diversification, IFS is critical.
- Conservation agriculture based cropping system management deploying key component technologies relevant to specific situations is critical for sustaining natural resources while improving productivity under the emerging challenges of climate change.
- Labour, market and diversification are interlinked and need to be dealt with in a holistic manner.
- MNRGA and agriculture need to be linked for better use of resources and improving productivity and diversification of labour intensive enterprises/crops/practices.
- Several technologies, innovations and approaches are available but business as usual will not do. There is a great need to adopt an innovative and dynamic approach.
- Everything will not work everywhere and hence there is a need for prioritization and define domains for which a real participatory and multi-stakeholder approach is needed.

Technologies for Outscaling

- There is sizeable potential area for conservation agriculture based management practices such as laser levelling, zero tillage, direct seeded rice, raised beds, residue retention, diversification and cropping system optimization and hence there is a need for focussed attention.
- Convergence of investments is the key for outscaling of innovations which should be given due attention.

- Capacity development at different levels and scales is very critical for outscaling of innovations and should be strengthened.

S. No.	Technologies	Relevant ecologies/domains	Potential area (m ha)
1.	Laser levelling	Irrigated systems	50
2.	Zero tillage	Food grains	60
3.	Direct seeded rice	Short duration HYYs/Hybrids, basmati & rainfed rice	20
4.	Raised beds	Maize-wheat, legume-wheat, cotton-wheat, vegetables, sugarcane etc	30
5.	Residue retention	Rice-wheat, maize-wheat, rice-maize	15
6.	Diversification & cropping system optimization	Rice-wheat, sugarcane-wheat, cotton-wheat, vegetable based systems	15

SESSION V: PROTECTED CULTIVATION AND MICRO-IRRIGATION

The session was chaired by Padamsri Dr. K.L. Chadha, President, Horticulture Society of India and convened by Dr Brahma Singh, President, Indian Society for Protected Cultivation, New Delhi. The following speakers made presentations and shared their experiences on protected cultivation of Micro-irrigation.

A. Protected Cultivation

Dr. Balraj Singh, Director, NRCSS, Ajmer, made a presentation on technology perspective; Dr. A.K. Saini, Additional Director General, Horticulture (Haryana), Panchkula; Dr. S K Yadav , Project Officer, Center of Excellence on Vegetables, Gharaunda, Karnal, made presentations on outscaling opportunities; Mr. M Mustaq, MD, Classic Agricon, Chandigarh made presentation on input availability scenario and future perspectives; Shri Dattu Dhage, farmer, Maharashtra made presentation on large-scale production of vegetable seedlings under low cost polyhouse.

B. Micro-irrigation

Dr. TBS Rajput, Water Technology Center, IARI, New Delhi, presented technology

perspective on Micro-irrigation and Dr. P. Soman, Vice-President, Jain Irrigation, Jalgaon spoke on the outscaling perspective; Mr Udhav Asaram, Khedkar, Jalana shared his experiences on rain water harvesting and Maj. Man Mohan Singh shared his experiences on micro-irrigation.

Presentations made by the speakers clearly indicated that protected cultivation and micro-irrigation are taking roots in the country, though at a slow pace. Success stories presented by the farmers have indicated that yield and quality of crops under protected cultivation and micro-irrigation in the country are as good as reported from other countries and much better from open field conditions and flood irrigation. Both the innovations are out scaleable.

It was realized that China, which started outscaling these technologies at the same time as India, has exceeded in area coverage (34,50,000 ha) in comparison to India (32,000 ha) and has become the largest producer of vegetables in the world having three times more production than India. This is attributable to the use of these innovations.

Keeping in view the shrinking major agriculture resources like land and water, protected cultivation and micro-irrigation are becoming essential for outscaling on priority. Protected cultivation is considered as greenhouse farming, which is misnomer. Greenhouses, by and large have controlled environment with continuous energy requirement and initial high investment. In fact, protected cultivation succeeds with low cost structures or material like plastic and nets with and without use of captive power.

Protected structures suitable for Indian conditions are: plastic low tunnels, plastic walk-in-tunnels, nethouses or screen houses or screens (shade, insect, bird, blue-bull, hail etc), naturally ventilated polyhouses, sticky traps, different local structures. Plastic cladded mud-houses, underground greenhouses for cold desert of Ladakh and Lahaul and Spiti and others modified structures, mulching, mushroom and orchid houses etc.

Farming practices like mushrooms, orchids, cactus and succulents raising ornamental potted plants, etc., are important protected cultivation activities. Development of protected cultivation and micro-irrigation technologies suitable for different agro-climatic zones of India has been emphasized by the speakers by exhibiting the potentials and appropriateness keeping in view local resources. As application of imported techniques and technology in totality would not yield desired results, intensive research and development on protected cultivation and micro-irrigation to suit local conditions, has been rightly emphasized by the speakers.

Recommendations

Based on the discussions, the following recommendations emerged:

General

- Keeping in view the diminishing availability of farm labourers, mechanization of protected cultivation is recommended preferably by exploiting solar energy.
- Rain water harvesting for protected cultivation and other farming activities need to be promoted through appropriate government support.
- Suitable literature on both protected cultivation and micro-irrigation is required to be generated by ICAR and SAUs and disseminated. Books, bulletins and CDs having appropriate questions and research and success story based answers, list of resource (inputs) centers, government supports, other relevant information, etc. would help fast outscaling of these innovations.

Innovations for Outscaling

- The protected structures should be utilized round the year by adopting appropriate cropping systems.
- Large-scale production of vegetable crops' nursery under protected structures in plug trays using soil-less medium (coco peat) be encouraged throughout the country on priority.

Technology Refinement/Researchable Issues

- There is need for development of suitable protected structures for different agro-climatic regions of the country.
- Crops with economic potentials for protected cultivation need to be identified.
- There is a great need for developing suitable varieties and hybrids of crops for protected cultivation.
- Management of pollination under protected structures including development of parthenocarpic varieties wherever possible should be given greater attention.
- There is a need for development of low cost machinery for both production of crops and creation of structures having micro-irrigation.
- Research on production of fruit crops like banana, pomegranate, papaya, etc. under protected structures in areas having low and very high temperatures is recommended.
- Development of indigenous water soluble fertilizers for fertigation and extension of subsidies on these, like other fertilizers needs to be given priority attention.
- Research on water requirement of different crops at different stages of growth and different age of fruit and other crops is required to develop irrigation and/ or fertigation schedules and placement of laterals and drippers in horticultural crops.
- Drip irrigation devices for use of poor quality water needs to be developed.

Policy Issues

- Ensure risk management through suitable insurance protocols.
- Strengthen mechanisms of demonstration on protected cultivation and micro-irrigation.
- Arrangements to scale development among students, farmers, government and non-government organizations and other stakeholders on protected cultivation shall maintain momentum of progress on the ventures- establishment of training centers.
- There is need to have a national research centers or project directorate exclusively on protected cultivation under aegis of ICAR which may also take up research on soil-less cultivation (hydoponics, aeroponics, etc.).
- There is need to extend interest free finance to interested farmers for adopting protected cultivation and micro-irrigation.
- Horticulture development programs, particularly, orchards' development need to be linked with micro-irrigation for efficient use of water.
- Peri-urban and urban horticulture, the need of the day, would require adoption of protected cultivation, particularly, near big towns along highways and express-ways in clusters.
- Creation of facilitation centers on protected cultivation and micro-irrigation to ensure availability of quality inputs for production and maintenance of structures close to clusters of protected cultivation.
- Present policy on government support for these two innovations needs to be continued for at least a decade.
- Micro-irrigation needs to be promoted in flood irrigated areas to save water or avoid misuse or overuse of water.

SESSION VI: ENERGY: SOLAR, BIOGAS, WIND, AGROFORESTRY

This session was chaired by Dr. Gurbachan Singh, Chairman, Agricultural Scientists' Recruitment Board, co-chaired by Dr. Gajendra Singh, Former DDG (Engg.), ICAR and convened by Dr. Pitam Chandra, Director, CIAE, Bhopal. Dr. B.S. Pathak, Former Professor of Eminence (Energy), Ghaziabad and Dr. N.S. Rathore, DDG (Engg.), ICAR were Lead speakers followed by six panelists,

Dr. M.M. Roy, Director, CAZRI, Dr. Sarabjit Singh Sooch, Director, School of Energy Studies, PAU, Dr. A. Jagdeesh, Wind Energy Expert, Nellore, AP, Dr. V.K. Jain, Director, MNRE, New Delhi, Dr. Rupendra K. Pachouri, Dept. of Electrical Engg., Gautam Bhuddh University, Greater NOIDA, UP.

At the outset, the Chairman did indicate that appropriate renewable energy technologies were available but outscaling was not happening. The current energy scenarios for India and Indian Agriculture were presented by the key speakers and the panelists. Dr NS Rathore, one of the lead speakers corroborated the chairman's remarks by presenting a number of solar thermal technologies to meet the process heat requirements of agriculture and rural sectors. The requirements, were mainly related to post-harvest processing and value addition. Prof. Pathak, the other lead speaker, presented the overall energy scenario of India and the projections pertaining to the energy demands and the likely shortfalls. He emphasized that the technology for conversion of agro-residues to liquid fuels is still not economical and the efforts are continuing world over in this direction. Decentralized agro-residues based power generation plants based on gasification route are practical and have been set-up at the different locations.

Dr. M.M. Roy presented the appropriate solar thermal technologies developed at CAZRI and demonstrated in the socioeconomical background of Rajasthan. These technologies included solar cookers, solar dryers, solar animal feed cooker, solar candle maker, etc. Dr. Sooch highlighted the increasing interest of dairy farms in large size biogas plants to make better use of cattle dung for biogas production. The success of 100 m^3 size biogas plants of fixed dome type was presented. Use of biogas for electricity generation was being made by the farmers of Punjab. However, development of technologies for removing CO_2 from biogas and bottling of methane are being pursued. Dr. Jagadeesh presented the current technology for harnessing wind energy, which can be utilized for water pumping. Dr. Pachouri presented the potential of wind energy that exists in different parts of India. Dr. V.K. Jain informed the house that biomass based power plants were coming up in India. However, the major challenge was to collect, transport and store biomass for sustaining power generation in these plants. Dr. Jain also indicated that although an atlas of surplus biomass in India to facilitate planning of biomass based power plants existed, it required updating considering that cropping systems in different parts of the country keep changing, and therefore, availability of surplus biomass would also change.

Recommendations

The following observations and recommendations emerged from the session:

General

- Keeping in view the scenario of non-renewable fuel shortages and increasing energy demand for agriculture, it is imperative to develop and utilize renewable energy for sustainable agricultural and rural development.
- Ministry of New and Renewable Energy (MNRE) has prepared an atlas of biomass available for power generation in India. Considering the changing cropping patterns and utilization, there is a need for updating this atlas for better energy planning.
- Burning of agro-residues needs to be discouraged and banned effectively. The surplus residues can be briquetted and subsequently converted into mechanical or electrical power. Decentralized agro-residues based power generation technology has been developed, demonstrated and documented for the range of 50-500 kW. The cooperative and commercial models of such enterprises developed by ICAR need to be replicated.

Innovations for Outscaling

- A large number of solar thermal technologies suitable for Indian agricultural and rural sectors such as solar dryers, solar water heaters, solar milk pasteurizers, solar cookers, solar candle makers, etc. have been developed and demonstrated. These technologies are required to be outscaled to meet thermal energy requirements on farm as well as agro-processing considerably.
- Cost of solar photo voltaic energy has been falling in the recent past. Solar photo voltaic power should be utilized to meet energy and power needs on farm and agro-processing.
- Robust and reliable biogas technology utilizing animal dung, poultry droppings and some agro-processing byproducts has now been developed and amply demonstrated starting from domestic to large-scale (say 500 m^3) applications.
- Agriculture is endowed with huge quantities of agro-residues and the surplus quantity of agro-residues is either burnt or discarded at present causing both economic loss as well as environmental degradation. Technologies have been developed and demonstrated for deriving industry-grade solid, liquid, and gaseous fuels from agro-residues. These agro-residue based fuel technologies need to be outscaled.

Policy Issues

- Ministries of Agriculture, Rural Development and New & Renewable Energy need to jointly formulate and implement a scheme for promotion of renewable energy in agriculture and rural sectors to effectively promote use of renewable energy.
- A dedicated TV channel on Agriculture and Rural Transformation needs to be operationalzed for mass awareness among all.

SESSION VII: POST-HARVEST TECHNOLOGY, VALUE ADDITION AND SPECIALITY AGRICULTURE

The session was chaired by Dr. H.S. Gupta, Director, IARI and co-chaired by Dr. Nawab Ali, Former DDG (Engg.). Dr. Dr. K.K. Singh, (ADG, Process Engg.) ICAR, was the lead speaker. Dr. Singh, in his speech covered the whole gamut of processed products and technologies developed by ICAR institutes and SAUs which are fit for adoption and outscaling by entrepreneurs.

Dr. Usha Singh, from RAU, Pusa, Bihar presented a brief about quality protein maize products and emphasized on cross marketing concept, rural level supermarkets and creation of food parks for outscaling of these products. Mr. Arvind Beniwal from Palla village, Delhi talked about his experiences about specialized cultivation of strawberry at large scale and also emphasized on the problems faced by the farmers. He urged for a processing centre and adequate knowledge transfer through existing extension mechanism of the state. Col. Deshwal from Sun Rise Veg. Pvt. Ltd., Bulandshahar, UP emphasized that value addition starts from selection of good quality seed material, scientific cultural practices, primary processing and goes up to developing processed products. He emphasized on reliability of the quality product. Mr. Devender, Patoda, Gurgaon, Haryana presented his experience about bee keeping and demanded proper marketing facility. Mr. Kanwal Singh Chauhan, Sonipat, Haryana who has specialized in cultivation of mushroom and baby corn emphasized that for outscaling of innovations, complete facility from production to processing, storage to marketing is necessary. Contract farming with assured price to participating farmers helps a lot in this regard. Smt. Krishna Yadav from (Krishna Pickles), Delhi narrated the story of her journey that how she rose to the present level of owning four firms of pickle making (with 145 products) from a very modest start with 2 kg pickle in the year 2000. Patience and perseverance is the key to her success. Mr. Kundan, KAD Bio-resources Pvt. Ltd., Ahmedabad, Gujarat explained how a training on business incubation facility from IARI helped him in establishing a business unit on Soya nut. He is expecting a turnover of one crore in first year only.

Recommendations

Based on the discussions, following recommendations emerged:

General

- There is a need for creation of awareness among people about the nutritional and economic benefits of using soybean in daily diet. Also, there is a need for

specialized training of food entrepreneurs in production and marketing of soybean based food products and promotion of such food through community kitchen. SMS of KVKs, in Food & Nutrition Home Science, processing and marketing, may be trained on soy food production and marketing. Same is true for quality protein maize.

Innovation for Outscaling

- Contract farming of speciality agriculture produce and contract making/ manufacturing of processed products may help outscaling innovations with low investment and hence be given focussed attention.

Policy Issues

- Establish and operate agro-processing centre in the production catchment to minimize losses, and transform raw food commodities into palatable safe and quality edible products. There is a need for better and economic utilization of crop residues and by-products.
- Creation of speciality agriculture hubs with production, processing, storage and marketing facility will help a lot. These hubs should be supported by adequate facilities for exports.
- Cross marketing concept, rural level supermarkets and creation of food parks are required for outscaling of innovations.

SESSION VIII: AGROBIODIVERSITY

The Session was chaired by Dr. P.L. Gautam, Vice-Chancellor, CPU, co-chaired by Dr. R.R. Hanchinal, Chairperson, PPV&FRA and convened by Dr. R.C. Agrawal, Registrar General, PPV&FRA. The lead speaker was Dr. M. Mahadevappa, Director, JSS Rural Development Foundation who spoke on policy interventions for promoting innovations in agrobiodiversity conservation and sustainable use. Four panelists, namely, Sh. P. Narayanan Unny, Kerala, Shri Dattatreya Hegde, Karnataka, Sh. Sundaram Verma, Rajasthan, Mr. Sultan Singh, Karnal, Haryana, also made their presentations.

Dr. P.L. Gautam, the chairman of the session introduced the topic and stressed upon the importance of conservation and sustainable use of plant genetic resources and agrobiodiversity. He informed that a number of IPRs are available in India, but the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act 2001 in India is unique and takes care of the

rights of farmers, breeders and industry. The Biological Diversity Act (BDA), 2002 of India aims at conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner. The Act regulates access to biological resources of India and also provides for benefit sharing in case of access to such resources.

Dr. R.R. Hanchinal, Chairperson of the PPV&FR Authority and the co-chair the session talked about the importance of PPV&FR Act 2001 which is mandated for recognizing the contribution of the farmers in respect of the contribution of the conservation of plant genetic resources and make them available for the development of new varieties. He further informed that this Act promotes innovation in terms of development of new varieties of plants and conservation of plant genetic resources in agrobiodiversity hot spot makes available unique germplasm which may be used for development of new varieties. The authority also promotes conservation efforts of farmers and the community by way of awards and rewards in recognition to the farmers and the community from the Gene Fund.

Dr. Mahadevappa, the lead speaker, made a very elaborate presentation on "Policy interventions for promoting innovations in agrobiodiversity conservation and sustainable use". He talked about the importance of agrobiodiversity, its conservation and sustainable use, the importance of innovations in agrobiodiversity, and important policies existing in the country for the promotion of innovations in agrobiodiversity conservation and sustainable use. He also stressed that the conservation must build upon and strengthen the acknowledged traditional role of women as conservators of knowledge and genetic resources as it provides them opportunities for supporting and strengthening agrobiodiversity conservation. He urged to integrate R&D efforts into conservation and management of the rich cultural heritage and diversity and to provide support for those areas which are dominated by indigenous people and ethnic minorities.

Mr. P. Narayanan Unny, a farmer from Chittur of Palakkad district, Kerala, informed that during the early days of his farming, he brought many sweeping changes in the way farming was done at Chittur. He figured out that many of the traditional rice varieties, which were of value, were getting extinct. He propounded the cause of conservation of *Navara* variety of medicinal rice. After years of continuous efforts, he was able to collect and segregate enough *Navara* seeds. He gradually moved into cultivating solely *Navara* rice at his farm. During this time, he turned to organic farming in a serious manner, and gradually evolved into the concept of *Navara* Eco Farm. The low yield of *Navara* rice made its cultivation commercially unviable. *Navara* – a medicinal rice type, is one of the native genetic resources of Kerala, famed for its use in Ayurveda. Even though *Navara* is identified with medicinal values from very olden times; the cultivation of this rice variety is

almost negligible. The reasons for this are many, including non-availability of pure seeds, low yield and high cost of production leading to commercial non viability of cultivation of this variety. He requested for funds to take up research in the characterization of *Navara* rice.

Mr. Sunda Ram Verma who is an innovative farmer from the arid region of Sikar district in Rajasthan, narrated his innovations through visuals and videos. He narrated his experiments on various techniques of dryland farming since last 15 years through which he has successfully developed a unique method of tree planting in dry regions. From his experience and educational training, he found that two phenomena, (i) evapo-transpiration through weeds, and ii) upward movement of water due to capillary action of soil, are the major causes of water loss from the soil. If these losses are prevented then the soil can retain sufficient water for a tree even in dry regions. In 1982-83, he conducted a systematic experiment in different types of soil to validate his observation. Mr. Verma is also actively engaged in conservation of biodiversity, conducting various on-farm experiments in agriculture related to pest control, seed selection, variety selection and has till date collected and submitted over 400 germplasm of various local varieties in the National Bureau of Plant Genetic Resources, New Delhi.

Mr. Dattatreya Hegde, a farmer with a flair for conserving special pickle mango types in the Western Ghats, Uttara Kannada, spoke about the large number of local varieties of mango (*Mangifera indica*) and kokum (*Garcinia indica*) which he maintains at his farm. Spread over an area of 15 acres in the serene environs of the Western Ghat forests, he has some 35 varieties of mango and a half a dozen types of kokum. Though arecanut (betelnut) is his main cash crop Mr. Hegde started to plant fruit crops a decade and a half ago. Today he receives some 20 per cent of his family income by selling fruits as well as grafted cuttings of these diverse varieties. He informed that one of the major challenges of fruit tree crops, such as mango, is the increasing vulnerability to climate change, especially the flowering and fruit-set stages, which could be very badly affected by off-season rains. Further, the year-to-year fluctuations in the market prices for fruits have made prediction of returns almost impossible. Farmers are not fully aware of the market chain; that is the biggest hurdle in marketing lesser-known local varieties and hence maintaining the higher on-farm diversity. He also urged that knowledge is being lost among the farmers about locally important varieties and efforts should

be made to immediately stop this. Bioversity International has recognized him as a custodian farmer of local fruit diversity.

Mr. Sultan singh, a farmer from Karnal, Haryana, owns the first private fish farm situated in Haryana and is recognized for supply of fish seed to Haryana Govt. His farm "SULTAN FISH SEED (SFS) FARM" is equipped with all the latest gadgets in aquaculture business and is in a position to supply any kind of quality and quantity of culturable carps. He is involved in developing and promoting sustainable aquaculture. He has demonstrated fish farming on scientific lines in village ponds including aeration of ponds, first Chinese fish breeding pools and hatchery system in Northern India, advancement of induced breeding by four months, breeding of Catfish in captivity, and culture of giant fresh water prawn. He requested for the support for better marketing of his products.

Recommendations

Based on in-depth discussions, the following recommendations emerged:

General

- Agrobiodiversity conservation must build upon and strengthen the acknowledged traditional role of women as conservers of knowledge and genetic resources and for supporting and strengthening agrobiodiversity conservation.
- Agrobiodiversity conservation must establish institutional partnerships that work both in the field and at policy level.
- At the community level, people's organizations need functionaries to help source and administer funds for agrobiodiversity activities.
- Though, there is some recognition, reward and support for the traditional agrobiodiversity conservation activities through Protection of Plant Varieties and Farmers' Rights Act 2001, through its National Gene Fund; but the National Gene Fund needs to be further strengthened to take up more awards, rewards and activities for agrobiodiversity conservation.
- Enhance access to local seed resources through community seed banks. This is the need of the hour to avoid further loss of plant genetic resources for food and agriculture (PGRFA), landraces, traditional and farmers' varieties.
- Agrobiodiversity conservation through community-based education for the youth should be promoted.
- Research and action require a holistic approach for understanding and reinforcing the spiritual and practical values of indigenous practices, dealing with the conservation of agrobiodiversity.
- Adopt ecosystem-based R&D approaches that emphasize on agro-biodiversity management of crops, trees, fish and livestock. This is in keeping with the

framework set by the Convention on Biological Diversity (CBD), which encourages conservation, sustainable use and equitable sharing of benefits.

- Recognize traditional cultivars by incorporating farmers' knowledge in formal seed laws and support grassroot-level informal institutions to institutionalize the activities.
- Biological control for pest management is not very popular amongst farmers. Entrepreneurship in integrated pest management practices can be of immense help in agrobiodiversity conservation.
- Conservation of native varieties is being done only by farmers. Hence, every farmer who maintains native varieties should be given good reward. Some direct cash transfer through postal insurance or local co-operative societies should be provided. This will lead to protection of native varieties which is an integral part of agrobiodiversity conservation.
- Nationwide campaign to register farmers' varieties through PPV&FR Authority needs to be undertaken. Further, promotion of important seed chain to provide seeds of Farmers' varieties is recommended.

Policy Issues

- There should also be some government funds for agrobiodiversity conservation programs and schemes to reward and award the agri-innovations.
- Establish an incentive structure, i.e. reducing tax levels to promote agro biodiversity or green products. Evolve gender-sensitive legislation to protect farmers' rights in addition to breeders' rights.
- Organize awareness campaigns on IPR in plant varieties and biopiracy and other related issues for local communities, NGOs and research institutions.
- Organize policymakers' workshops on issues related to agrobiodiversity conservation. Support networking with local institutions and conducting regular training and capacity building programmes on agrobiodiversity conservation.
- A register for documenting the innovations should be maintained through Biodiversity Management Committees (BMCs)
- There is need to develop course curriculum on conservation of agrobiodiversity for all levels of education system from elementary to higher level in schools, colleges and universities.
- Innovative farmers should be given grants and projects in addition to awards, so that they can upscale their innovations.
- There should be efforts from the government for making the farmer security first. If farmers are secured, there will be automatic food security.

SESSION IX: LIVESTOCK – CATTLE, POULTRY, GOATERY, FISHERY

This session was chaired by Dr. M.P. Yadav, former Director IVRI and Vice Chancellor, Sardar Vallabh Bhai Patel University of Agriculture & Technology, Modipuram (SVBPUA&T). Dr. Arpita Sharma, Principal Scientist, Central Institute of Fisheries Education, (CIFE), Mumbai was the convener.

The session started with the remarks of Dr. S. Ayyappan, Director General, ICAR, where he stressed upon the importance of livestock, cattle, poultry, goatery and fishery.

Dr. Yadav welcomed all the panelists on the dais. Among them, Mr. Anil Saxena from Hoshanagabad, Madhya Pradesh was the first to make his presentation. He briefed about the efforts he has made in fisheries sector in the state of Madhya Pradesh. Mr. Saxena mentioned that with the intervention of Central Institute of Fisheries Education (CIFE), Powerkheda Centre, he was able to undertake scientific fish seed production in a sustainable manner. He mentioned that from 20 acre land, he has been able to produce 2.5 crore spawn with a turnover of Rs. 25-30 lakhs per year. He also mentioned that he was able to replace the use of cow dung with mustard and mahua oil cake to avoid excess organic load in the pond. Labour shortage was the major concern experienced in fish production in the area of operation.

The second panelist, Mr. Saji Chacko from Navsari Gujarat, shared his experience about marine shrimp farming. He reported that he was able to earn profit from his farms and he had shifted from *P. monodon* to *L. Vannemi* farming. He stressed on the importance of adopting scientific measures and shared that by practicing innovations he was able to achieve profits. Some of the innovations he introduced were partially lined ponds with high density polyethylene (HDPE) locally made aeration systems, solar powered auto feeder, and central drainage for sludge removal.

Mr. Rajbir Singh from Karnal was the third panelist who shared the innovations which he had practiced at his dairy farm and achieved profits. He stressed on the importance of scientific way of cattle breeding, feeding, hygienic milk production, disease management and all aspects of animal breeding and management. Stressing on the importance of vaccination in animals and feeding in scientific manner, he mentioned that feeding one gram of Vitamin E to each milch animal can reduce the occurrence of *mastitis* disease in cows. He also informed that one cow from his farm had produced 59.5 litres of peak milk, making it a national record, which was possible due to scientific management and practices.

The fourth panelist, Dr. M.K. Tamuli, Principal Scientist, NRC on Pig presented his views on the impact of artificial insemination (AI) in pigs and their propagation. The programme was innovatively implemented in a participatory community based approach. He mentioned that in 2009, the AI was started in pigs by a retired army *jawan* which spread further to other farmers and now other villages too have adopted the same. The demand of AI is increasing now. Other innovations Dr. Tamuli reported, were audio-visual reflex method, unique height adjustable dummy, global extraction production service (GEPS), and semen extruder. He opined that pig farming is profitable by adopting modern techniques, including AI.

Dr. Yadav, Chairman of the session presented his views on the importance of innovations in this sector and also shared that one of the progressive farmers, Mr. Baljit Singh Redhu from Jind, Haryana, who started with poultry and later progressed to dairy in a big way, has successfully established elite herds of cattle and buffaloes at his farm, as well as, modern dairy plant. His farm follows all the modern scientific practices, and is worth visiting by farmers as well as scientists. One of the suggestions put forth by Ms. Jaya Devi from Munger, Bihar, emphasized that storage facility should be provided to the self-help groups. The chairman of the session advised contacting NABARD or other suitable agency for funding support.

At the end, Dr. Arpita Sharma, Principal Scientist, CIFE, Mumbai, Convener of the session, gave a brief about all the presentations and added that CIFE has taken up a research project to compile innovations in fisheries sector. CIFE, Mumbai recently organised Research Convention on Innovations in Fisheries Sector on 10th July, 2013 and compiled more than 100 innovations. CIFE has also documented indigenous technical knowledge (ITK) in fisheries sector and published four books on the same. She also stated that shrimp culture in inland saline soil had been reported as a success story by CIFE, Rohtak Centre.

Recommendations

Based on the discussions, the following recommendations emerged:

General

- While documenting farm innovations, special importance needs to be given to livestock, cattle, poultry, goatery and fishery.
- Institutionalisation of innovations be done so as to mainstream the farm innovations in research, development and educational programmes.

Researchable Issues

- Farmer-led innovations in ethnoveterinary medicine should be identified, documented, refined and validated for livestock, poultry and fishery for the benefit of small holder farmers.

Policy Issues

- Inputs like fish seed, feed, mineral mixture, vaccines, diagnostics need to be supplied to small holder farmers at a subsidized rate.
- Minimum support price (MSP) should be provided for milk, eggs and fish production.
- Farm innovations should be protected by appropriate IPR protection mechanism.
- Wider insurance and low interest credit coverage should be provided for livestock, poultry and fish production to reduce risk in dairy, poultry and fish farming.
- Vermi-composting and biogas production from animal waste should be promoted through appropriate incentives and policy support.
- Creation of separate cadre of paravets/technology agents for AI, dairying, poultry and fishery for delivery of services at farmers' door-step.

SESSION X: POLICY AND INSTITUTIONAL INTERVENTION FOR OUTSCALING INNOVATIONS FOR SMALL FARMERS

The session was chaired by Dr. S.S. Johl, Chancellor, Central University of Punjab and convened by Dr. Suresh Pal, Head, Division of Agricultural Economics, IARI, New Delhi. The lead presentations were made by Dr Ramesh Chand, Director, NCAP, Mr Tushar Pandey, Country Head, Yes Bank, and Dr Anjani Kumar, Principal Scientist, NCAP.

This session discussed the socioeconomic and policy issues in outscaling of farm innovations with focus on small farmers. The chairman, in his opening remarks, mentioned that there could be many sources of farm innovations and these can take place in delivery of farm services, production, processing, product markets, etc. Also, wide-scale application of any invention, method or process is essential to qualify for innovation. Participation of small farmers in the innovation process is essential for both agricultural growth and social inclusiveness. This is more so for small and disadvantageous farmers in the remote and marginal production regions.

Dr. Ramesh Chand highlighted the importance of small farmers in Indian agriculture. They dominate the agricultural scenario as indicated by ownership of holdings and realize a productivity level which is comparable to that of large farmers. But, many of the small farmers depend upon non-farm employment and, therefore, they may not have adequate incentive for outscaling of farm innovations. Also, it

may be difficult to reach all of them in a cost-effective manner and, therefore, use of information technology must be encouraged for this purpose. Secondly, it is extremely important that techno-economic feasibility of farm innovations is worked out properly before taking them for outscaling. Such an assessment should also involve private sector, so that possibility of venture capital or private investment can be worked out.

Dr. Suresh Pal emphasized that outscaling of the innovation process basically needs connecting the innovators with other farmers and supporting organizations. Therefore, these social skills must be developed at all levels in the innovation systems. The capacity in some of organizations, especially state line departments, to reach large number of stakeholders, is rather limited, due to inadequate resources and skills. This capacity strengthening deserves high priority. For outscaling of innovations, flexibility in the approach of different public service systems and coherence among local, regional and central agencies and activities is essential. A similar approach is needed for outscaling the innovations across different states.

Dr. Pal also mentioned that institutional innovations in improving access to the markets and credit like kisan credit card (KCC) are proving to be very effective. Such innovations must be outscaled. Another area could be natural resource and crop management, where innovations can contribute to cost reduction and sustainability of the production systems. There should be institutions to test, upscale and outscale these innovations. In this context, role of ATMA, KVKs, NGOs etc, who are directly working with farmers, assume greater significance.

Mr. Tushar Pandey spoke on the role of corporate sector and financial institutions in outscaling the innovations. Financial institutions will find it easy to finance large projects, managed by cooperatives or farmers' organizations. The possibility of interest subvention for unseen contingencies and distress situation must be made available. Access of small farmers to market often ensures adoption and sustainability of farm innovations. Innovative marketing models to link small farmers with markets, transparency of price discovery, flow of market information, innovations in input markets etc., are some of the issues needing special attention. Dr Anjani Kumar also emphasized the need for conversion and synergies among different actors and activities for outscaling the innovations. Also, a cost-effective mechanism for managing vulnerability of small farmers to various risks, should be in place, and such a mechanism should combine, both, social and government responsibility and arrangements. Reforms are, therefore, needed in the present marketing, credit, insurance, cooperative, and contractual regulations to make them responsive to the present needs.

Finally, the chairman in his concluding remarks underscored the need for higher public investment in development of basic infrastructure, markets, health and education in rural areas. This will help in development of capacity of Indian farmers and development agencies for innovations and their outscaling.

Recommendations

Based on the discussion, the following recommendations emerged:

- There is an urgent need to increase public investment in agriculture and rural development for infrastructure and human capital development.
- In view of increasing role of rural non-farm employment for small and marginal farmers, special efforts are needed to motivate them and build their capacity for adoption of farm innovations and technologies. In the absence of this, a large segment of the society and agricultural land will be deprived of benefits of innovations.
- Promote participatory techno-economic evaluation of farm innovations for assessment of institutional and financial requirements for their outscaling.
- There is a need for convergence and connectivity of different institutions and development programs for outscaling of innovations and development of necessary social skills.
- Innovations in markets, credit and processing are essential for outscaling innovations in the context of small farmers. There is scope of improvement within existing market regulations to adjust them to the changing market scenario.
- Innovations in dissemination of market information, input delivery, price discovery and risk management are needed for outscaling of innovations in production of high value commodities.
- Greater use of IT is necessary to reach millions of small farmers and link them with market and technology providers. Also, there is a need to build their capacity to innovate in conservation and use of natural resources.

Exhibition

The most striking feature of the workshop was the exhibition organized to showcase the successes of the farm innovations developed by farmers, institutions, KVKs, NGOs, etc. Twenty stalls were erected for depicting various innovations with the help of live demonstrations, photographs, charts in the areas of conservation agriculture,

crop diversification, micro-irrigation, protected cultivation, post-harvest technologies, value addition of maize, minor crops and horticultural produces, increasing milk productivity, speciality agriculture (mushroom, honey, baby corn), conservation of agrobiodiversity, farm implements, appropriate renewable energy technologies, etc. The idea behind organization of the exhibition was to highlight the innovations generated by the farmers and institutions via research for dissemination through extension, KVKs, NGOs and farmers. The innovators present during the workshop took keen interest to share their knowledge on their innovations for outscaling with the small holder farmers.

PLENARY SESSION

The Plenary Session was co-chaired by Dr. R.S. Paroda, Chairman, TAAS and Haryana Kisan Ayog and Dr. S. Ayyappan, Secretary, DARE and DG, ICAR. Recommendations of each session were presented by the conveners of the respective sessions followed by discussion. Dr RS Paroda, in his concluding remarks, thanked the organizers, speakers and participants, and summarised major issues which emerged from the discussions. He emphasized that a lot of very useful information is locked up in localized pockets as a result of innovations made by farmers. There is strong need of exchange of this knowledge. All innovations cannot be outscaled, and therefore, a pragmatic assessment of these innovations has to be made before picking up the ideal ones for outscaling. Scientists have to work with farmers. Technology for specific areas needs to be identified and the best one outscaled. Innovation like protected cultivation and micro-irrigation in water deficient areas need to be promoted. Farmers need knowledge and ICAR is doing a great service in this regard, through KVKs and their extension departments. A very important role can be played by the youth in knowledge dissemination, and for success in such activity, work has to be taken up in mission mode. A good example of success of hybrid seed is through seed mission. There is great scope of promotion of hybrid seed in maize. In China, 16 mha is grown under hybrid seed, while in India it is

only 2 mha. Similarly, oilseed mission has helped us cut down our oil imports. Suitable means of small farm mechanization, agro-processing and use of bioenergy need to be promoted for achieving these goals. Our extension system needs to be strengthened. Vocational training at undergraduate level could be one way to augment our efforts to disseminate relevant knowledge. Self-help groups and involvement of private sector can further add to our efforts. For this farmers' produce must fetch adequate economic return to him, which is possible through market reforms. Mechanism of ensuring support to deserving farmers is essential. In this context, ICAR's program of "Farmer-First" is important. Besides, a Farmer's Innovation Fund needs to be created to help innovative farmers. Haryana Government has set up a fund of Rs. 5.0 crore for capacity building. Scientists and farmers should come together and work to promote useful findings. KVKs should be given targets for their performance.

Dr. S. Ayyappan complimented the delegates on the success of the workshop. He cited some examples of interesting innovations presented by farmers in this workshop, particularly, the example of a Himachal Apple grower developing method of producing large number of saplings in short span of time. He highlighted the important role played by women innovators. He stressed upon the need to give voice to farmers. He indicated that ICAR has planned to organize farmer-scientist interaction through training programs for students on farmers' fields.

Dr. N.N. Singh, Organizing Secretary, proposed a vote of thanks at the end of the program. He expressed his happiness on the successful completion of the workshop. He thanked Mr. Ashish Bahuguna, Secretary, Agriculture, Government of India, for inauguration of the workshop. He mentioned that the gracious presence of Mr. Bahuguna was a great source of encouragement for all the farmers and participants. His offer of immediate implementation of the workshop recommendations was highly motivating.

The organization of workshop could be possible due to clear vision, concept, direction and day-to-day guidance provided by Padma Bhushan Dr. R.S. Paroda, Chairman, National Organizing Committee, as well as TAAS and Haryana Kisan Ayog. This workshop was an outcome of earlier three workshops conceived and organized by him on farmer-led innovations and was aimed at outscaling farm innovations. With deep sense of gratitude, Dr. Singh expressed his heartfelt thanks to him.

The guidance, support and close monitoring of all activities provided by Dr. S. Ayyappan, Secretary, DARE and DG, ICAR and co-hair of National Organizing Committee was duly acknowledged. Dr. Singh also thanked all the members of National Organizing Committee, namely, Dr. J.S. Samra, Dr. R.R. Hanchinal, Dr. H.S.

Gupta, Dr. R.S. Dalal, Dr. K.D. Kokate and Shri Ajay Vir Jakhar for their guidance to organize this workshop.

Dr. Singh expressed sincere thanks to Dr HS Gupta, Director, IARI for his help in organizing technical program of the workshop, and to Dr. K.D. Kokate, DDG (Extn), ICAR for his keen interest to firm-up the technical programme of the first day of workshop and organizing an exhibition to show case the innovation of farmers, NGOs and institutions.

The occasion was also marked by the presence of several dignitaries, including Dr M. Mahadevappa, former Chairman, Agricultural Scientists Recruitment Board, Dr. P.L. Gautam, Vice Chancellor, CPU, Dr. S.A. Patil, Chairman, Karnataka Krishi Mission, Dr S.N. Puri, Vice Chancellor, CAU, Imphal, Padmashri Dr K.L. Chadha, President, Horticulture Society of India, Dr Gurubachan Singh, Chairman, ASRB, Dr. K M L Pathak, DDG, Animal Sciences, Dr S.S. Johal, Chancellor, Central University, Punjab, Dr M.P. Yadav, Ex Director, IVRI, Dr. A.K. Srivastava, Director, NDRI, Dr. Bhag Mal, Consultant, APAARI, Dr. Narendra Gupta, Trustee TAAS, besides, several other scientists and Zonal Project Directors of AED, ICAR. Dr. Singh expressed his sincere thanks to all of them.

Dr. N.N. Singh expressed his sincere gratitude to all Chairs, Co-Chairs, Convenors, Lead Speakers and Panelists for their guidance and technical inputs provided by them. The workshop could not have been a success without the active participation and interaction of the large number of innovative, progressive farmers, NGOs, scientists and policy makers.

The workshop was organized by TAAS, ICAR and APAARI and co-sponsored by National Rainfed Area Authority (NRAA), Protection of Plant Varieties and Farmers Rights Authority (PPV&FRA), Haryana Kisan Ayog, Bharat Krishak Samaj and Global Forum on Agricultural Research (GFAR). Dr. Singh thanked each of these organizations, and all others who helped in organization of the workshop.

MAJOR RECOMMENDATIONS

1. There is an urgent need for a paradigm shift in AR4D to address the needs of small farmers and place renewed emphasis on “Farmer First” through participatory approach, better knowledge sharing and enabling policy environment to ensure food and nutritional security on a sustainable basis.
2. Outscaling of innovations based on their techno – economic feasibility, relevance and utility would be the key for inclusive growth of small farmers. Hence, identification of such innovations like happy seeder, laser leveler, zero-till drill, paddy transplanter, conservation agriculture, protected agriculture, new varieties/hybrids, etc. and their faster adoption or use will benefit considerably the small holder farmers.

3. Mission mode programmes on small farm mechanization, protected cultivation, low cost rural based agro-processing for value addition, livestock development, promotion of hybrid technology, micro-irrigation, etc. would go a long way in increasing both productivity and income of farmers. Hence, greater policy support for promotion of these innovations will be needed.
4. Farmer led innovations relating to new crops, new areas, new on-farm/off-farm based secondary agriculture, etc. must be identified, tested, refined and advocated for large scale adoption for greater benefit to our farming community. Some examples are: rabi maize in Eastern India, spring maize in northern region, summer moong in rice – wheat cropping system, boro rice in West Bengal, direct seeded basmati rice, vegetable production in plastic tunnels, polyhouses, micro-irrigation, fertigation, organic farming, etc.
5. Integrated farming systems involving high value crops and livestock should be developed and encouraged for different agro-ecosystems. This would help in increasing income of small farmers.
6. Market reforms should be given high priority for promoting farmer-led innovations. Revision of Agricultural Produce Marketing Committee (APMC) Act especially to delink horticultural produce (vegetables and fruits), provision of kisan bazars/huts, cool chain and credit linked trade/marketing options, and linking farmers to markets will be required to benefit both farmers and consumers.
7. Convergence and connectivity of different institutions and development programs for outscaling of innovations and development of necessary social skills is necessary. The innovations in use of renewable sources of energy, like bioenergy and solar energy should be improvised and outscaled by convergence of programs and activities of different government departments and private sector.
8. Market innovations should ensure greater share of farmers in the transparency in price discovery, better delivery of quality inputs, flow of market information and risk management.
9. For open access knowledge sharing, there is a need for more effective and rather efficient extension mechanisms like ICT, smart phones, radio and television (dedicated channel exclusively on agriculture). Creation of a cadre of young technology agents for custom hire services in specialized areas will help in reducing dissemination losses while out-scaling farm innovations.
10. Incentives and rewards to innovative farmers will be needed to promote useful technologies on farmers' fields. For this, central and state governments must create "Farm Innovation Fund" so as to ensure their sustained interest in creating and promoting new initiatives for enhanced productivity and income.
11. Incentives and venture capital funds should also be provided to the entrepreneurs for upscaling and outscaling farm innovations and technologies, which need

substantial investment in producing material (planting material, machine, seed, feed, etc.) for outscaling the innovations.

12. There is an urgent need to have institutional reforms especially for better coordination, convergence and efficiency. Linkage between KVK and ATMA, linking schemes under MNREGA, RKVY, NFSM, etc. with outscaling of useful farm innovations, each KVK to act as an ATIC, promotion of self-help groups (SHGs), establishing co-operatives and farmers' company, etc. will help in having greater impact of new innovations. Also, successful public-private-partnership models will have to be replicated by creating enabling policy environment.
13. Innovative farmers, so identified must be rewarded and given incentives, as well as, recognition as "Farm Professors", so as to share their knowledge and experience, while imparting training to others for much needed capacity development. Farmer to farmer training will have much greater acceptability and generate confidence for outscaling new innovations.
14. Availability of credit at low interest rates and provision of insurance schemes for promotion of activities by SHGs, cooperatives, farmers, companies, especially for processing, grading, storage and primary value addition will encourage small holder farmers in out-scaling their innovations, since, such provisions will reduce risk factor and build much needed self confidence to promote farm innovations.
15. Farm innovations in livestock and other high value products are, rather, less documented and outscaled. There are many innovations relating to low cost medicinal and nutritional products in livestock sector. These need verification, improvement and outscaling.
16. There is also a great need to provide adequate visibility to protection of farmers' innovations and sharing of benefits from their commercialization. These should go beyond plant varieties. Special programs must be supported to promote innovations in on-site conservation of genetic resources.

Technical Program

3 SEPTEMBER, 2013

09:00-09:30	Registration
	INAGURAL SESSION
	Chief Guest : **Shri Ashish Bahuguna**, Secretary, DAC, MoA
	Special Guest : **Dr. R.S. Paroda**, Chairman, TAAS & HKA
	Chairman : **Dr. S. Ayyappan**, Secretary, DARE & DG, ICAR
09:30-09:32	**Lighting of Lamp**
09:32-09-37	*Welcome Address* : **Dr. K.D. Kokate**, DDG (Extn.), ICAR
09:37-09:42	*About the workshop* : **Dr. H.S. Gupta**, Director, IARI
09:42-09:47	*Remarks* : **Dr. R.R. Hanchinal**, Chairperson, PPV&FRA
09:47-09:52	**Shri Ajay Vir Jakhar**, Chairman, BKS
09:52-10:02	*Special Remarks* : Dr. R.S. Paroda, Chairman, TAAS & HKA
10:02-10:12	*Chairman's Remark* : **Dr. S. Ayyappan**, Secretary, DARE & DG, ICAR
10:12-10:22	*Address by Chief Guest* : **Shri Ashish Bahuguna**, Secretary, DAC, MoA
10:22-10:30	*Vote of Thanks* : **Dr. P.L. Gautam**, Vice-Chairman, TAAS
10:30-11:00	**Tea**
11:00-13.00	**Session I : Sharing of Knowledge on Innovations and Technologies for Outscaling**
	Chairman : **Dr. K.D. Kokate**, DDG (Extn.), ICAR
	Conveners-cum-Lead Speakers : **Dr. A.M. Narula**, ZPD, Zone-I, Ludhiana **Dr. A.K. Singh**, ZPD, Zone-II, Kolkata
	Panelists : 1. **Mr. Sudhir Saxena (Prolinnova)** Sharing Knowledge, Prolinnova Experience

2. **Sardar Surjit Singh**, Fatehgarh Sahib
   Residue management technologies
3. **Sardar Gurpreet Singh Shergil**, Farmer, Punjab
   Diversified farming
4. **Dr. B.S. Sohal**, Chief Agriculture Officer, Patiala, Punjab
   Transferable technologies for diversified farming
5. **Shri Lambodar Darwe,** Farmer, Jharkhand
   Water lifting from dry river bed
6. **Shri Vijay Bahadur,** Farmer, Bihar
   Preventing blue bull menace in Rohtas district
7. **Smt. Jaya Devi,** Farmer, Bihar
   An outscalable model of farm women empowerment in Bihar
8. **Mr. Jata Shanker Choudhary**, Director (SAMETI), Jharkhand

13:00-14:00 **Lunch**

14:00-15:30 **Session II : Experiences of Farmers, KVKs and State Governments in Knowledge Sharing and Commercialization of Innovations**

Chairman : **Dr. S.A. Patil,** Chairman, Karnataka Krishi Mission

Conveners-cum-Lead Speakers : **Dr. A.K. Gogoi,** ZPD, Zone-III, Barapani
Dr. A.K. Singh, ZPD, Zone-IV, Kanpur
Dr. Sudhakar, ZPD, Zone-V, Hyderabad

Panelists :
1. **Mrs. Sketina Kharbani**,
   Off-season vegetable and flower cultivation
2. **Shri Laljon Misao**, Farmer, Nagaland
   Pineapple production and processing
3. **Shri Rajmohan Debnath**, Farmer, Tripura
   Production and promotion of TPS
4. **Shri Savior Chisim,** Deputy Director (Hort.), West Garo Hills, Meghalaya
   Promotion of commercial production of horticultural crops in Meghalaya

5. **Shri Jitendra Pal Singh**, Farmer, Muzaffarnagar
   Floriculture, vegetables and ornamental plants for commercial production
6. **Shri Habib Khan**, Farmer, Lucknow
   Production and marketing of tissue cultured planting material of banana
7. **Dr. S.K. Singh**, Pr. Scientist, IIPR Kanpur
   Achievements of technology dissemination for harnessing pulse productivity
8. **Dr. M.P. Singh**, Prog. Coordinator, KVK, Champawat
   Innovations for integrated farming systems in hills
9. **Shri Satyaveer**, Dy Director (Agril) Muzafarnagar, U.P.
   ATMA-KVK convergence experiences for technology outscalling
10. **Shri Gyaneshwar Bodke**, Farmer, Maharashtra
    Innovative experiences of Abinav Farmers Club
11. **Shri C. Venkata Reddy**, Farmer, Secunderabad
    Innovative methods of improving the soil fertility and grape cultivation
12. **Shri P. Premanand**, Farmer, A.P.
    Entrepreneurship development through value added products of millets
13. **Shri K.V. Deshmukh**, Director (ATMA), Pune
    Linking farmers to market

15:30-16:00 **Tea**

16:00-18:00 **Session III : Outscalling of Innovations and Technologies and Convergence Models**

Chairman : **Dr. S.N. Puri**, VC, CAU, Imphal

Conveners-cum-Lead Speakers : **Dr. Y.V. Singh,** ZPD, Zone-VI, Jodhpur
Dr. Anupam Mishra, ZPD, Zone-VII, Jabalpur
Dr. S Prabhu Kumar, ZPD, Zone-VIII, Bengaluru

Panelists :

1. **Shri Jai Singh Rana**, Rajasthan
   Apiary as entrepreneurial activity in mustard grown areas of Rajasthan
2. **Shri Ganpat Lal Nagar**, Rajasthan
   Safed musli processing – A potential option for livelihood security in Baran District
3. **Dr. U.S. Tank**, Program Coordinator, Kutch, Gujarat
   Experiences on outscaling of date palm technology in Kutch region
4. **Dr. I.J. Mathur**, DEE MPUAT, Udaipur
   Technologies of MPUA&T for large scale adoption and sustainable agricultural production in Rajasthan
5. **Shri Ramesh Kumar Jaroli**, Dy. Director Agril. Extn., Udaipur, Rajasthan
   Initiatives of agriculture department on large scale dissemination of technologies in Rajasthan
6. **Shri Roshan Lal Vishwakarma**, Narsinghpur, M.P.
   Outscalling of sugarcane bud chipper
7. **Shri Sangeet Mohanti**, Puri, Odisha
   Mushroom production and marketing for higher income
8. **Dr. R.K.S. Tomar**, Prog Coordinator, KVK, Datia, M.P.
   Outscalling of technologies through KVK-ATMA linkage
9. **Dr. J.S. Urkurkar**, Director Extn. IGKV Raipur
   Convergence models for outscaling of innovations in Chattisgarh
10. **Dr. Ajay Koshal**, PD, ATMA, Chhindwara, M.P.
    Promotion of sweet corn and *kharif* potato
11. **Shri Sadananda,** Bangalore
    Integrated farming system
12. **Shri V. Samikannu**, Tamil Nadu
    Farmers' corporate through precision farming
13. **Dr. N.V. Nair**, Director, SBI, Coimbatore
    Outscaling of sugarcane varieties
14. **Dr. B. Mohan**, Prog Coordinator, KVK, Namakkal, TN
    Promotion of fodder production in Tamil Nadu

4 SEPTEMBER, 2013

09:30-11:00 **Session IV: Conservation Agriculture and System Based Diversification**

Chairman : **Dr. J.S. Samra**, CEO, NRAA

Co-Chairman : **Dr. Alok K. Sikka**, DDG (NRM), ICAR

Convenor : **Dr. M.L. Jat**, CIMMYT

Panelists :

1. **Dr. B.S. Sidhu**, Agricultural Commissioner, Govt of Punjab
   Conservation Agriculture for sustainability: why, how and what next?
2. **Dr. B.P. Bhatt**, Director, ICAR Complex for Eastern Region, Patna
   Sustainable intensification in Eastern India: where and how to act for accelerated adoption of innovations to achieve BGREI targets?
3. **Dr. B. Gangwar**, Project Director, PDFSR, Modipuram
   Viable farming systems under major ecologies of India: what we have and how to out-scale them?
4. **Col. Deshwal**, Progressive Farmer, Sikanderabad, Bulandsahar, UP
   A success story of farmer led horticultural diversification: Farmers' perspective on what is required to replicate such innovations
5. **Mr. Vikash Choudhary**, Progressive Farmer, Taraori, Haryana
   Outscaling NRM innovations through farmer cooperatives: A young farmers perspective
6. **Major (Retd)** Manmohan Singh, Amritsar
   Crop residue management is a must: Farmers perceptions on outscaling

11:00-11:30 **Tea**

11:30-13:00 **Session V: Protected cultivation / Micro-irrigation**

Chairman : **Dr. K.L. Chadha**, President, Horticulture Society of India

Co-Chairman : **Dr. Gorakh Singh**, Commissioner, Horticulture

Convenor : **Dr. Brahma Singh**, New Delhi

(A) Protected Cultivation

Panelists : 1. **Dr. Balraj Singh**, Director, NRCSS
Protected Cultivation—Technology Perspective

2. **Dr. A.K. Saini**, Additional Director, Horticulture (Haryana)
Protected Cultivation- Outscaling Opportunities

3. **Mr. M Mustaq**, MD, Classic Agricon, Chandigarh
Protected Cultivation - Input availability scenario and future perspectives

4. **Shri Dattu Dhage**, Farmer, Maharashtra
Protected Cultivation – Large scale production of vegetable seedlings under low cost polyhouse

(B) Micro irrigation

Panelists : 1. **Dr. TBS Rajput**, WTC
Micro-irrigation-Technology Perspective

2. **Dr. P. Soman**, Vice-President, Jain Irrigation
Micro-irrigation-Outscaling perspective

3. **Mr. Ajay Jakhar**, Chairman, BKS
Micro-irrigation-More than water saving

13:00-14:00 **Lunch**

14:00-15:30 **Session VI : Energy: Solar, Biogas, Wind, Agroforestry**

Chairman : **Dr. Gurbachan Singh**, Chairman, ASRB

Co-Chairman : **Dr. Gajendra Singh**, Former DDG (Engg.)

Convenor : **Dr. Pitam Chandra**, Director, CIAE

Lead Speaker : **Dr. B.S. Pathak**, Ghaziabad

(A) Solar Energy

Panelists : 1. **Dr. M.M. Roy**, Director, CAZRI

(B) Biogas

Panelists : 1. **Dr. Sarabajit Singh Sooch**, Director, School of Energy Studies in Agriculture, PAU

(C) Wind Energy

Panelists : 1. **Dr. Rupendra Kumar Pachouri**, Department of Electrical Engineering, GBU, U.P.

2. **Dr. A. Jagadeesh**, Wind Energy Expert, A.P.
3. **Shri Dilip Nigam**, Scientist 'F', Ministry of New & Renewable Energy Sources, New Delhi

(D) Agro-Forestry

Panelists : 1. **Dr. S.K. Tiwari**, Jt. Director, Agro Forestry Research Centre, GBPUAT, Pantnagar

2. **Dr. V.K. Jain**, Scientist 'F', Ministry of New & Renewable Energy Sources, New Delhi

15:30-16:00 **Tea**

16:00-17:30 **Session VII : Post-Harvest Technology, Value addition & Speciality Agriculture** (Mushroom, Honey, Organic, Babycorn)

Chairman : **Dr. H.S. Gupta**, Director, IARI

Co-Chairman : **Dr. Nawab Ali**, Former DDG(Engg.)

Convenor : **Dr. Indra Mani Mishra**, Professor (Ag Engg. Div.), IARI

Lead Speaker : **Dr. K.K. Singh**, (ADG, Process Engg.) ICAR

Panelists : 1. **Dr. Usha Singh**, RAU, Pusa Bihar

2. **Mr. Arvind Beniwal**, Palla, Delhi
3. **Mr. Lal Kishan Yadav**, Sun Rise Veg. Pvt Ltd., Bulandshahar, UP
4. **Mr. Ajit, Patoda**, Gurgaon, Haryana
5. **Mr. Kanwal Singh Chauhan**, Sonipat Haryana
6. **Dr. S.K. Jha**, IARI, New Delhi
7. **Smt. Krishna Yadav**, (Krishna Pickles), Delhi
8. **Mr. Kundan**, KAD Bio-resources Pvt Ltd., Ahmedabad, Gujarat

17:30-19:00 **Session VIII : Agrobiodiversity**

Chairman : **Dr. P.L. Gautam**, Vice-Chancellor, CPU

Co-Chairman : **Dr. R.R. Hanchinal**, Chairperson, PPV&FRA

Convenor : **Dr. R.C. Agrawal**, Registrar General, PPV&FRA)

Lead Speaker : **Dr. Mahadevappa**, Director, JSS Rural Development Foundation

	Panelists : 1. **Shri P. Narayanan Unny**, Kerala
	2. **Shri Dattatreya Hegde**, Karnataka
	3. **Shri Sundaram Verma**, Rajasthan
	4. **Mr. Sultan Singh**, Karnal, Haryana
19:00-19:30	**Exhibition**
19:30 Hrs	**Dinner**

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09:30-11:00	**Session IX : Livestock - Cattle, Poultry, Goatery, Fishery**
	Chairman : **Dr. M.P. Yadav**, Ex-VC, SVBPU, Modipuram
	Convenor : **Dr. Arpita Sharma**, Pr. Scientist, CIFE
	Panelists : 1. **Mr. Anil Saxena**, Hoshangabad, M.P.
	2. **Mr. Saji Chacko**, Nawsari, Gujarat
	3. **Mr. B.S. Redhu**, Jind, Haryana
	4. **Mr. Bipin Raturi**, Nawsari, Gujarat
	5. **Mr. Parvez Khan**, Lucknow
	6. **Mr. Shahnawazul Haque Khan**, Lucknow
	7. **Shri Rajbir Singh**, Karnal
	8. **Dr. M.K. Tamuli**, Pr. Scientist, NRC on Pig, Guwahati
11:00-11:30	**Tea**
11:30-13:00	**Session X : Policy and institutional intervention for outscaling innovations for smallholder farmers**
	Chairman : **Dr. S.S. Johl**, Chancellor, Central University of Punjab
	Convenor : **Dr. Suresh Pal**, Head, Agricultural Economics, IARI
	Panelists : 1. **Prof. Ramesh Chand**, Director, NCAP
	2. **Dr. Anjani Kumar**, ICRISAT
	3. **Dr. Suresh Pal**, IARI
	4. **Mr. Tushar Pandey**, Yes Bank
	5. **Dr. T. Haque**, Former Chairman, CACP

13:00-14:00	**Lunch**
14:00 Hrs	**Plenary Session**
	Co-Chairman : **Dr. R.S. Paroda**, Chairman, TAAS & HKA
	Co-Chairman : **Dr. S. Ayyappan**, Secretary, DARE & DG, ICAR
	Presentation of recommendation by conveners of various sessions

List of Participants

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- Brainstorming Workshop on "Emerging Challenges before Indian Agriculture - The Way Forward", March 6, 2009 - Proceedings & Recommendations.
- Brainstorming Workshop on 'Strategy for Conservation of Farm Animal Genetic Resources' 10th – 12th April, 2009 – Ranchi Declaration.
- Brainstorming Workshop on "Climate Change, Soil Quality and Food Security", August 11, 2009 – Proceedings & Recommendations.
- Millions Fed: Proven Successes in Agricultural Development, January 19, 2010 (Translation in Hindi jointly published by IFPRI, APAARI and TAAS)
- National Seminar on "Quality Seed for Food Security through Public-Private Partnership", April 13-14, 2010 – Proceedings & Recommendations
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- The Sixth Dr. M.S. Swaminathan Award Lecture on "Challenges and Opportunities for Food Legume Research and Development" by Dr. M.C. Saxena, January 25, 2012
- Proceedings and Recommendations of Farmers' Led-Innovation. December 23-24, Hisar, Haryana, 2011
- Proceedings and Recommendations of Global Conference on Women in Agriculture. 13-15 March, 2012 New Delhi; India.
- The Seventh Foundation Day Lecture on "Ensuring Food and Nutrition Security in Asia: The Role of Agricultural Innovation" by Dr. Shenggen Fan, DG, IFPRI. January 11, 2013
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