GLOBAL AGRI CONNECT 2017

TECHNOLOGIES AND INNOVATIONS IN CLIMATE SMART AGRICULTURE (CSA): PRACTICE OR PARISH

PROCEEDINGS AND POLICY RECOMMENDATIONS

NATIONAL SKILLS FOUNDATION OF INDIA

WITH BEST COMPLIMENTS FROM:

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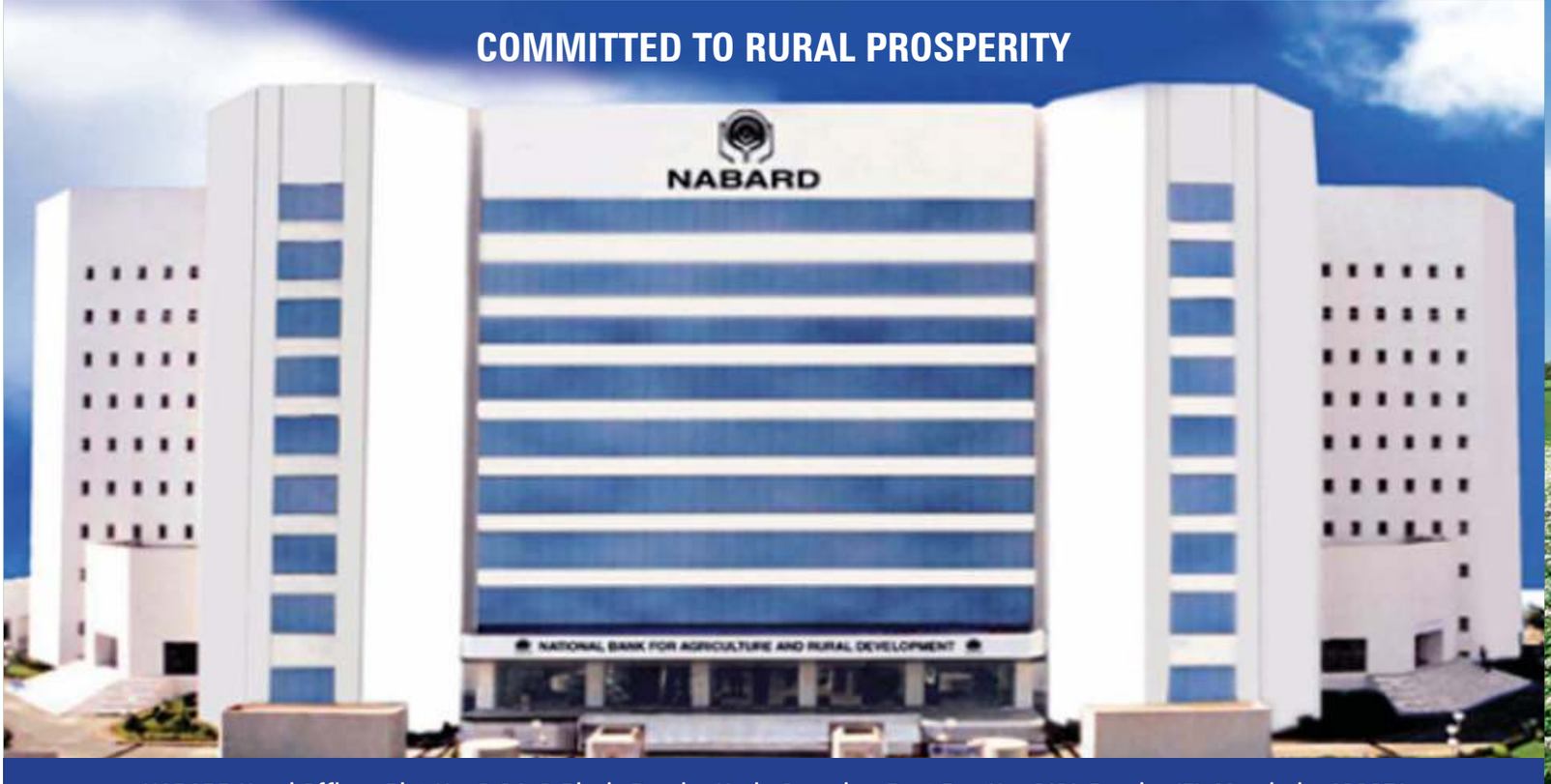

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NSFI Global Agri Connect 2017
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Proceedings and Policy Recommendations

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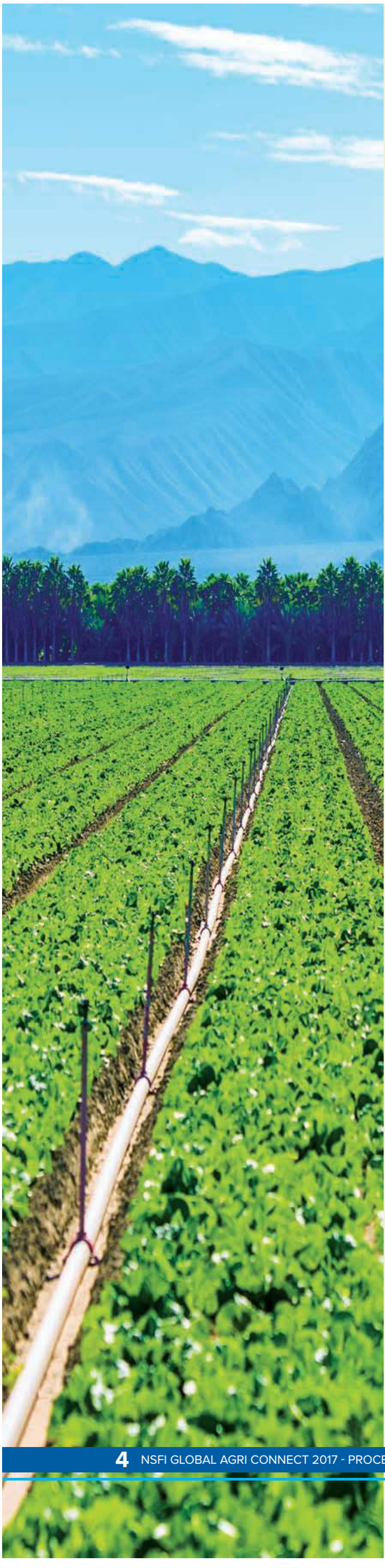

LIST OF ABBREVIATIONS

BMGF	Bill & Melinda Gates Foundation
CEO	Chief Executive Officer
CSA	Climate-smart agriculture
DG	Director general
DHAN	Development of Humane Action
FAO	Food and Agriculture Organization
GAC	Global Agri Connect
GHG	Greenhouse Gas
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GOI	Government of India
HLPE	High Level Panel of Experts
HYV	High-yielding variety
IAS	Indian Administrative Service
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and communications technology
IDRC	International Development Research Centre
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
IPM	Institute of Productivity & Management
IRRI	International Rice Research Institute
ISD	Innovation Systems for the Dry lands
IT	Information technology
MD	Managing Director
MUDRA	Micro Units Development and Refinance Agency Bank
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agriculture and Rural Development
NAPCC	National Action Plan on Climate Change
NHM	National Horticulture Mission
NSFI	National Skills Foundation of India
PMKBY	Pradhan Mantri Kaushal Vikas Yojana
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
SACCO	Savings and credit co-operatives
SAPCC	State Action Plan on Climate Change
SHG	Self-Help Group
SMS	Short Message Service
SNUSP	Support to National Urban Sanitation Policy
UNFCCC	United Nations Framework Convention on Climate Change
UPL	United Phosphorus Limited
US	United States of America
WHH	Welthungerhilfe

FOREWORD

MR. SANJEEV ASTHANA
Chairman, NSFI

Agriculture today is facing the triple challenges viz., food security, adapting to changing climate and contributing to climate change mitigation. The burgeoning population not only has be to be fed but the adverse impact / stress of the population on the natural resource endowment has to addressed for sustainability. Finding solutions to these uphill tasks, certainly is not possible by any single group of stakeholders in the agriculture ecosystem. Integrated and concerted effort is essential from all the stakeholders of public, private and civil society institutions to tinder over the situation.

From public funded research institutions to corporate bodies and various institutions representing civil society are making yeomen service to the mankind's response to changing climate. However, it is time these efforts are catalysed to not only scale up for greater good, but also ensure that such efforts are integrated into the prevailing markets, thus contributing to continuous adoption and thus sustainability.

Global Agri Connect has been bringing various technology and innovation representatives on to a common platform to deliberate on what can be best done to ensure that the hurdles in the way of adoption and scaling are overcome. Adoption and scaling up of Technologies and Innovations is certainly not merely a function of grants and subsidies. These technologies' or Innovations' relevance, appropriateness, frugality and their adoption enabled sustainability, are key for scaling up.

In addition to being a platform for deliberations, Global Agri Connect is being envisioned to act as an enabler of technology adoption and scaling up through promotion the technology's integration into various ongoing development projects by public and private stakeholders. On one front, various state and central governments do are opening up to adopt innovations in their effort to create lasting impact. On the other, the corporates through their backward and forward integrations and through their socially responsible activities, also offer a large avenue of technology / innovation adoption for social impact.

The proceedings and recommendations that have evolved from Global Agri Connect (GAC) 2017 are expected to contribute substantially to the evolving discourse of technology adoption and their scaling up on the theme of Climate Smart Agriculture. While we look forward to engage with various stakeholders to facilitate technology adoption and scaling up, we wish the recommendations to show direction to policy makers for the benefit of climate smart Indian Agriculture.

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EXECUTIVE SUMMARY

Climate change has already significantly impacted agriculture (Lobell et al, 2011)[1] and is expected to further impact directly and indirectly food production. Increase of mean temperature; changes in rain patterns; increased variability both in temperature and rain patterns; changes in water availability; the frequency and intensity of 'extreme events'; sea level rise and salinization; perturbations in ecosystems, all will have profound impacts on agriculture. (Gornall, 2010; IPCC, 2007a; Beddington, et al, 2012b; HLPE, 2012a; Thornton et al.., 2012)[2]. The extent of these impacts will depend not only on the intensity and timing (periodicity) of the changes but also on their combination, which are more uncertain, and on local conditions.

Climate Smart Agriculture (CSA) has emerged as a new framework that links climate change and agriculture development initiatives and aims to establish agriculture systems that simultaneously increase productivity, enhance resilience, and reduce Greenhouse Gas (GHG) emissions. Broadly, CSA focuses on developing resilient food production systems that lead to food and income security under progressive climate change and variability. Many agricultural practices and technologies such as minimum tillage, different methods of crop establishment, nutrient and irrigation management and residue incorporation can improve crop yields, water and nutrient use efficiency & reduce GHG emissions from agricultural activities.

Irrespective of the CSA technologies benefits, the current rate of adoption by farmers is reported to be low owing to multiplicity of factors. Many factors influencing the adoption of CSA technologies include socio-economic characteristics of farmers, bio-physical environment of a particular location, and the attributes of new technologies. The identification, prioritization and promotion of available CSA technologies considering local climatic risks and demand for technology are also the factors of importance, for adoption. While designing CSA implementation strategies at the farm level, one must consider adaptation options that are well evaluated and prioritized by local farmers in relation to prominent climatic risks in that location.

To deliberate on the challenges faced by successful technologies and innovations in the journey of adoption by end user and scaling up their operations across geographies and contexts, Global Agri Connect is set out with the theme 'Technologies and Innovations in Climate Smart Agriculture: Practice or Perish'.

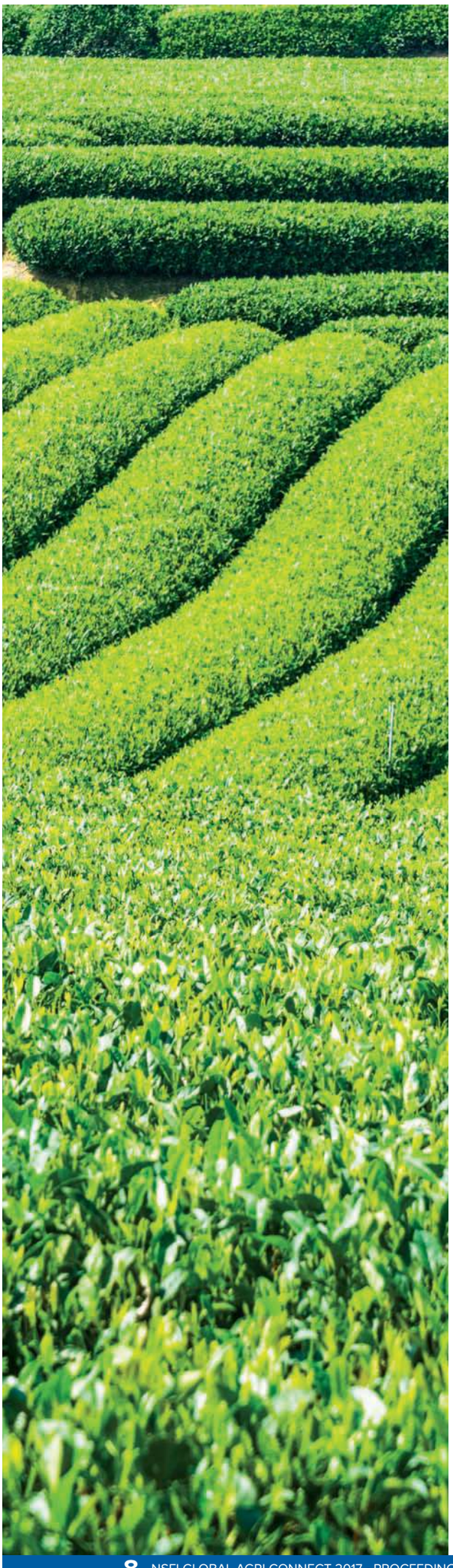
While Session I and IV formed the plenary sessions, a technical session and panel discussion each constituted, session II and III of the conference. 34 Speakers presented / deliberated in the conference on various dimensions of Climate Smart Agriculture. The conference was inaugurated by Smt. Krishna Raj, Minister of State for Agriculture, Government of India in presence of Dr. Harsh Banwala, Chairman, NABARD; Dr. Ashok Dalwai, Chairman, Committee on Doubling of Farm Income, and Mr. Salil Singhal, Chairman & Managing Director, PI Industries. Chief Guest of Valedictory Session Dr. SK Malhotra and Guest of Honour Dr. George Varughese, President, Development Alternatives, shared their valuable insights on various dimensions of Climate Smart Agriculture. 14 representatives of Technologies / Innovations have showcased the merits of their innovations and the challenges they faced in scaling them up. 20 distinguished panelists deliberated on the dimensions of Climate Smart Agriculture Technologies & Innovations and factors to consider for scaling up.

Salient Recommendations that emerged from the deliberations of the conference include:

1. Build the capacities of not only the users / farmers but also extension workers and service providers, to ensure larger scale.
2. Build evidence base and assessment tools to identify agricultural growth strategies that integrate necessary adaptation and potential mitigation of climate change challenges.
3. Design and develop strategies that help taking forward the existing and newly developed CSA technologies to the door steps of farmers by giving priority to the extension system.
4. Ensure inclusiveness among various technologies' adoption through bottom up approach in CSA planning.
5. Enhance financing options to support implementation by linking climate and agricultural finance.
6. Mainstream CSA with existing policies, programs of the Government.
7. Design policies that encourage the private sector to promote technologies through facilitating financing innovations.
8. Promote improved technologies in combination of traditional wisdom that has high potential for adoption and scaling up..
9. Build synergies and positive trade-off of the interventions beyond the farm level.
10. Promote policy of gender inclusion in climate mitigation and adaptation programs which need to be monitored and assessed regularly through gender sensitive indicators like ownership of land and other productive assets by women.
11. Leverage the strengths of ICT to make agriculture resilient and climate smart.

1 Climate Trends and Global Crop Production since 1980, Lobell et al 2011, Science 29 July 2011, Volume 333, Issue 6042, pp. 616 – 620

2 Implications of climate change for agricultural productivity in the early twenty-first century, Gornall et al 2010, The Royal Society, Philosophical transactions of the Royal Society Biological Sciences, 16 August 2010



INTRODUCTION

Climate change has already significantly impacted agriculture (Lobell et al, 2011) and is expected to further impact directly and indirectly food production. Increase of mean temperature; changes in rain patterns; increased variability both in temperature and rain patterns; changes in water availability; the frequency and intensity of 'extreme events'; sea level rise and salinization; perturbations in ecosystems, all will have profound impacts on agriculture. (Gornall, 2010; IPCC, 2007a; Beddington, et al, 2012b; HLPE, 2012a; Thornton et al.., 2012) . The extent of these impacts will depend not only on the intensity and timing (periodicity) of the changes but also on their combination, which are more uncertain, and on local conditions.

Agriculture has to address simultaneously three intertwined challenges: ensuring food security through increased productivity and income, adapting to climate change and contributing to climate change mitigation (FAO, 2010a; Foresight, 2011a; Beddington et al., 2012a; Beddington et al., 2012b; HLPE, 2012a). To address these three intertwined challenges, food systems have to become, at the same time, more efficient and resilient, at every scale from the farm to the global level. They have to become more efficient in resource use (use less land, water, and inputs to produce more food sustainably) and become more resilient to changes and shocks.

Climate-smart agriculture (CSA) contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars:

1. Sustainably increasing agricultural productivity and incomes;
2. Adapting and building resilience to climate change;
3. Reducing and/or removing greenhouse gases emissions, where possible.

CSA is not a single specific agricultural technology or practice that can be universally applied. It is an approach that requires site-specific assessments to identify suitable agricultural production technologies and practices. The scaling up of climate-smart practices will require appropriate institutional and governance mechanisms to disseminate information, ensure broad participation and harmonize policies.

Climate-smart interventions are highly location-specific and knowledge-intensive. Considerable efforts are required to develop the knowledge and capacities to make CSA a reality. CSA offers an opportunity to revitalize these efforts, overcome adoption barriers, while also adjusting them to the new realities of climate change. Organizations, educational establishments and other entities have started to fill these gaps, but information is still fragmented. Realizing this need, the 'Global Agri Connect 2017' has organized the conference to deliberate on pertinent issues relating to technologies and innovations in climate smart agriculture covering the impact of climate change on agriculture, role of adaptation technologies, mitigation technologies for sustainability and investments in agriculture technologies. ●

3 Climate Trends and Global Crop Production since 1980, Lobell et al 2011, Science 29 July 2011, Volume 333, Issue 6042, pp. 616 – 620
4 Implications of climate change for agricultural productivity in the early twenty-first century, Gornall et al 2010, The Royal Society, Philosophical transactions of the Royal Society Biological Sciences, 16 August 2010
5 State of the World's Forests, 2011, Food and Agriculture Organization of the United Nations

TECHNOLOGY ADOPTION IN CLIMATE SMART AGRICULTURE AND THEIR SCALING UP

Introduction

Climate change is expected to result in continued changes in temperature, precipitation, extreme events, and rising sea level, both globally and in Asia. Global temperature increase is foreseen to accelerate in the 21st century, with both seasonal and regional variations within Asia (Cruz et al. 2007).[6] Extensive efforts taken will only slow climate change, not avoid it. In above context adaptation is a necessity. A key component of adaptation is Technology. Adaptation technology can be defined as "the application of technology in order to reduce the vulnerability, or enhance the resilience, of a natural or human system to the [impact] of climate change" (UNFCCC 2005, page 5).

Impact of Climate Change on Agriculture

Climate change is emerging as a major threat on agriculture, food security and livelihood of millions of people in many places of the world.[7] Climate change can affect agriculture in a number of ways. Rise in / reduction of rainfall, timing and distribution of rain and salt water intrusion into freshwater bodies can affect crop productivity and alter the distribution pattern and population of insect predators and incidence of disease and fungal diseases on agriculture crops. For example, the impact of climate change on agriculture in the Indo-Gangetic Plain may have to deal with a shift in peak water supplies as precipitation decreases and snowmelt occurs earlier at high elevations (Morton 2007).[8] In addition, wheat and maize yield could be reduced by drought (Byravan and Rajan 2008).[9] Changing monsoon patterns are projected to reduce sorghum and wheat yield by up to 32% by 2080 (Ortiz et al. 2008; Srivastava, Kumar, and Aggarwal 2010).[10]

Climate Smart Agriculture

Climate Smart Agriculture (CSA) has

6 Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries, UNFCCC, retrieved 08 November 2017
7 Intergovernmental Panel on Climate Change (IPCC), 2014 – Climate Change 2014, Synthesis Report, Summary for policymakers
8 The impact of climate change on small holder and subsistence agriculture, J. F. Morton, retrieved on 8 November 2017, from *m.pnas.org*
9 The social impacts of climate change in South Asia, 2008, Byravan and Rajan, retrieved on 8 November 2017, from https://papers.ssrn.com/sol3/papers
10 Article on negative impacts of climate change, Ortiz et al, 2008, retrieved on 8 November 2017, from www.co2science.org/articles
11 Modelling agricultural production risk and the adaptation to climate change , Finger and Schmid 2007, Retrieved 8 November 2017 from https://mpra.ub.uni-muenchen.de/MPR
12 SACCO – Savings and Credit Co-operative Organization is owned, managed and run by its members who have a common bond with the primary objective of promoting the welfare and economic interests of its members.

emerged as a new framework that links climate change and agriculture development initiatives and aims to establish agriculture systems that simultaneously increase productivity, enhance resilience, and reduce Greenhouse Gas (GHG) emissions. Broadly, CSA focuses on developing resilient food production systems that lead to food and income security under progressive climate change and variability. Many agricultural practices and technologies such as minimum tillage, different methods of crop establishment, nutrient and irrigation management and residue incorporation can improve crop yields, water and nutrient use efficiency and reduce GHG emissions from agricultural activities.

Technology Needs in Agriculture Sector

Agriculture production systems require adaptation to technological changes to ensure the food and livelihood security of farming communities. Adaptation technologies can address climate change impact on the agriculture sector in a number of ways. Some of the examples of agriculture technologies for climate change mitigation and adaptation are mentioned in the below table.

Adaptation to Climate Change

In general, climate change impacts are likely to hit small-scale subsistence farmers hard because of their high dependence on rain-fed agriculture, coupled with low adaptive capacity. For the farmers to adapt to climate variability, while at the same time preparing for the future climatic changes, they must improve their adaptive capacities in terms of knowledge & skills. Livelihood diversification, on-farm and off-farm, is a key risk management strategy and can also increase farmers adaptive capacity. The implementation of CSA technologies individually or in combination has substantial potential to reduce climate change impacts on agriculture. For example, Finger and Schmid (2007)[11] projected that simple adaptation

Agriculture production systems require adaptation to technological changes to ensure the food and livelihood security of farming communities

Projected impact of climate change	Technology needs
Reduced crop yields resulting from higher temperatures	New crop varieties with greater heat tolerance.
Reduced crop yields in rain fed agriculture due to less precipitation	• New crop varieties with lower water requirements. • Improved water collection, storage, and distribution techniques • Improved irrigation techniques
Reduced crop yields in irrigated agriculture due to reduced availability of irrigation water	• Improved irrigation efficiency. • New crop varieties with lower water requirements • Real-time and remote-sensing capabilities to improve water management and efficiency of use (e.g., soil moisture, evapo-transpiration)
Reduced irrigation water availability due to saltwater intrusion	• Barriers to saltwater intrusion. • Increased sustainable aquifer recharge • New crop varieties with greater salinity tolerance Improved water collection, storage, and distribution techniques
Reduced crop yields from increased flooding or water logging	• New crop varieties with higher moisture tolerance • Improved drainage or flood control techniques
Increased incidence of crop pests and diseases	• New crop varieties with improved pest and disease resistance • Improved pest and disease management techniques
Loss of crops due to extreme weather events	• Improved extreme weather event prediction and early warning systems • Improved techniques to increase resilience of crops to extreme weather events

measures such as changes in crop sowing dates &adoption of irrigation technologies can result in higher yields with less variations than without adaptation. A meta-analysis of crop simulation under several climate scenarios found that farm level adaptations can increase crop yields by an average of 7–15% when compared to without adaptation.

Ecosystem of Adoption

Despite the increased interactions, dissemination and sharing of information about CSA practices among farmers, access to new CSA practices and their adoption in a given socio-economic backdrop, technical relevance and feasibility hold a large influence on the progress and pace of adoption of Technologies & innovations of climate smart agriculture. Such an adoption, in addition to the factors of relevance and appropriateness for a given context and user, is also influenced by linkages between technology users, advisory service providers, various input services of the production and marketing ecosystem. The combination of a changing climate and declining soil fertility is making farmers not only demand weather and agro-advisory services, but the investment of time and money to acquire the services.

Studies indicate that there is a high correlation between awareness and adoption of the Climate Smart Agriculture (CSA) technologies. While most farmers are aware of many CSA practices and innovations, only a small number of the farmers are adopting the practices. Most farmers indicated their willingness to use CSA practices, but are constrained by several factors including cultural practices, such as tenure and ownership rights, labour requirements, high investment costs, and lack of skills and knowledge on how to use the practices.

Experience reveals that belonging to a rural social or marketing group enhances social and financial capital allowing trust, idea, and information exchange. Thus, membership to a group (e.g., a SACCO in Africa[12]) can increase the uptake of a CSA practice. It is critical to ensure that information is shared within the entire household, since both women and men are often involved in the use of information.

Pathways for Information Sharing/ Dissemination

Understanding dissemination pathways involves horizontal (peer-to-peer through face to face interactions, word of mouth, farmer meetings) and vertical (upwards and downwards amongst farmers, extension providers, researcher to farmer, and use of radios or cell phones) pathways. Type of information sharing generally depends on farmers' skills, needs, and resources to receive and use the information. Effective dissemination pathway depends not only on how successful the pathway influences farmers' decision to adopt, but the number of people receiving the information.

Informal and formal institutions, such as village Self Help Group (SHG) and religious groups are the most common institutions for accessing information. They provide less formalized, but effective, methods of communicating information, as well as spreading the CSA practices to other neighbouring villages. Youth, who are potential future farmers, preferred the latest information and communication technologies, especially mobile phones and television.

Challenges in Scaling Up Technology Adoption

Technology used in CSA practises are generally reviewed in the context of following factors to scale up at larger level.

Experience reveals that belonging to a rural social or marketing group enhances social and financial capital allowing trust, idea, and information exchange

11 Modelling agricultural production risk and the adaptation to climate change, Finger and Schmid 2007, Retrieved 8 November 2017 from https://mpra.ub.uni-muenchen.de/MPR

12 SACCO – Savings and Credit Co-operative Organization is owned, managed and run by its members who have a common bond with the primary objective of promoting the welfare and economic interests of its members.

Organizations providing agro-advisory information needs to investigate and disseminate information on risks from weather variability that can cause yield and price volatility

- **Effectiveness:** How well a technology reduces vulnerability or increases resilience. Early warning systems are used throughout the world to save lives and are likely to be effective against the wide-ranging impact of climate change.
- **Cost of technology:** Varies according to the region and its potential for use in addressing the issue.
- **Co-benefits:** Refers to other benefits besides reducing vulnerability or increasing resilience the technology may provide, such as increasing ecosystem services or creating jobs.
- **Barriers to implementation:** Difficulties faced in the way of technology implementation, such as the need for infrastructure investment or a specialized set of skills.
- **Feasibility of implementation:** More specific to the contextual factors such as geophysical condition in the region, available resources and enabling policies in the region.
- **Scale of implementation:** For instance an irrigation system for a farm, are site specific, whereas early warning system, can be implemented to cover a wider region.
- **Potential resources for financing and marketing:** Who owns and advocates the technology, is it through private markets or an academic institution, or its use by other international organizations. Further the source of funding whether it is public or private and by established or emerging player influences the scaling up strategy.

Indian Agriculture of Subsistence and Way Forward

Irrespective of the CSA technologies benefits, the current rate of adoption by farmers is reported to be low owing to multiplicity of factors. Many factors influencing the adoption of CSA technologies include socio-economic characteristics of farmers, bio-physical environment of a particular location, and the attributes of new technologies. The identification, prioritization and promotion of available CSA technologies considering local climatic risks and demand for technology are also the factors of importance, for adoption. While designing CSA implementation strategies at the farm level, one must consider adaptation options that are well evaluated and prioritized by local farmers in relation to prominent climatic risks in that location.

In situations of subsistence farming, given its predominance in India, preparedness with long-term adaptive strategies those are inclusive and proactive at households and Agro-ecosystem level. Organizations providing agro-advisory information needs to investigate and disseminate information on risks from weather variability that can cause yield and price volatility. Access to information on climate adaptation, mitigation, and risk management, is vital to taking the necessary risk reduction measures. For example, farmers can minimize their risks and increase yields by adjusting planting dates and planting areas (hillside vs. valley bottom have differential soil moisture content) in response to seasonal forecasts.

INAUGURAL SESSION

Mr. Sanjeev Asthana, Chairman, National Skills Foundation of India (NSFI) welcomed all the delegates to the Global Agri Connect 2017. He stated that in India, the small and marginal farmers are deeply impacted due to the climate change. He stressed upon the need for India to adopt multi-sectorial and stakeholder approach in order to address the issues of climate change. He added that adoption of technologies and innovations in the field of climate smart agriculture will drive the change. He stressed the need to develop tools for policymakers, businessmen, researchers, academia, and civil society and other decision-makers to enable them visualize the sustainable outcomes of different agricultural strategies. He emphasized on the need to promote national-level policy and institutional changes to ensure that farmers have the resources and technical capacity.

Mr. Salil Singhal, Chairman and Managing Director, PI Industries stated that there are three major challenges in combating climate change in India which include constitutional challenge, policy and administrative challenges. He highlighted that climate action for agriculture is the mandate of states & union territories and that without consistent policy signals farmers may not be able to do enough to create a sustainable, productive and resilient agriculture sector. He added that high financial cost can come in the way of technology/innovation adoption by farmers.

He stressed upon the need to focus on conflict affected regions, which experience severe food crisis and famines. He emphasized that this issue cannot be addressed with a 'business-as usual' approach rather it requires a conflict-sensitive approach that aligns actions for immediate humanitarian assistance, long-term development and sustaining peace.

Further, he referred to the examples from other countries, wherein the Government promised a steady and long term policy in order to encourage the technology developers recover their cost of technology production and thus ensuring sustainable impact on the ecology and ecosystem. He stressed on similar support from Government Agencies in India to encourage technology developers and their users for the scaling up of successful cases of climate smart agriculture technologies and innovations.

Dr. Ashok M R Dalwai (IAS), CEO, National Rain-fed Area Authority, Department of Agriculture & Cooperation, Government of India stressed upon the need to change the crop production system and crop geometry in India, where the land under field crops can be reduced and more land allocated for tree crops, which can help in reducing greenhouse gases. He added that fragmented approach of agriculture cannot be continued anymore. He emphasized on the need to disseminate knowledge fast, without much lag between the first practitioner and the last practitioner, taking advantage of ICT. He added that climate change impinges more on the small holder farmers and it affects not just agriculture but the entire social system of mankind given the implication on food safety & security.

Mr. Harsh Bhanwala, Chairman, National Bank for Agriculture and Rural Development (NABARD) informed that NABARD has been implementing a number of development

There are three different kinds of challenges in addressing the issues of climate change. They include constitutional challenge, policy challenge and administrative challenge. There is a need to focus on conflict affected regions with a conflict-sensitive approach that aligns actions for immediate humanitarian assistance, long-term development and sustaining peace.

Government of India is committed to make Indian agriculture more science based with innovations and new technologies and making it climate smart. There is need to change the production system that aligns with the prevailing climatic conditions and more efficient in use of resources. The challenges of adoption and scaling up can be addressed on the basis of scientific, behavioural and psychological techniques.

Mr. Sanjeev Asthana

Mr. Salil Singhal

Dr. Ashok M R Dalwai

Mr. Harsh Bhanwala

Smt. Krishna Raj

programs and the foremost amongst these are the watershed development and tribal development programs which have a significant focus on conservation of water. He emphasized that the adversities of climate change can be overcome with water efficient technologies and increased forest cover through tree based cropping.

He stressed upon the need to focus on enhancing productivity as resources like land, water are limited, while the population is increasing. He suggested that a possible solution is to reduce the crop duration to increase their chances of escaping climate variability and extreme events. He highlighted the need for the Indian innovations to be more disruptive enough and urged to adopt a bottom-up approach in agriculture and crop planning.

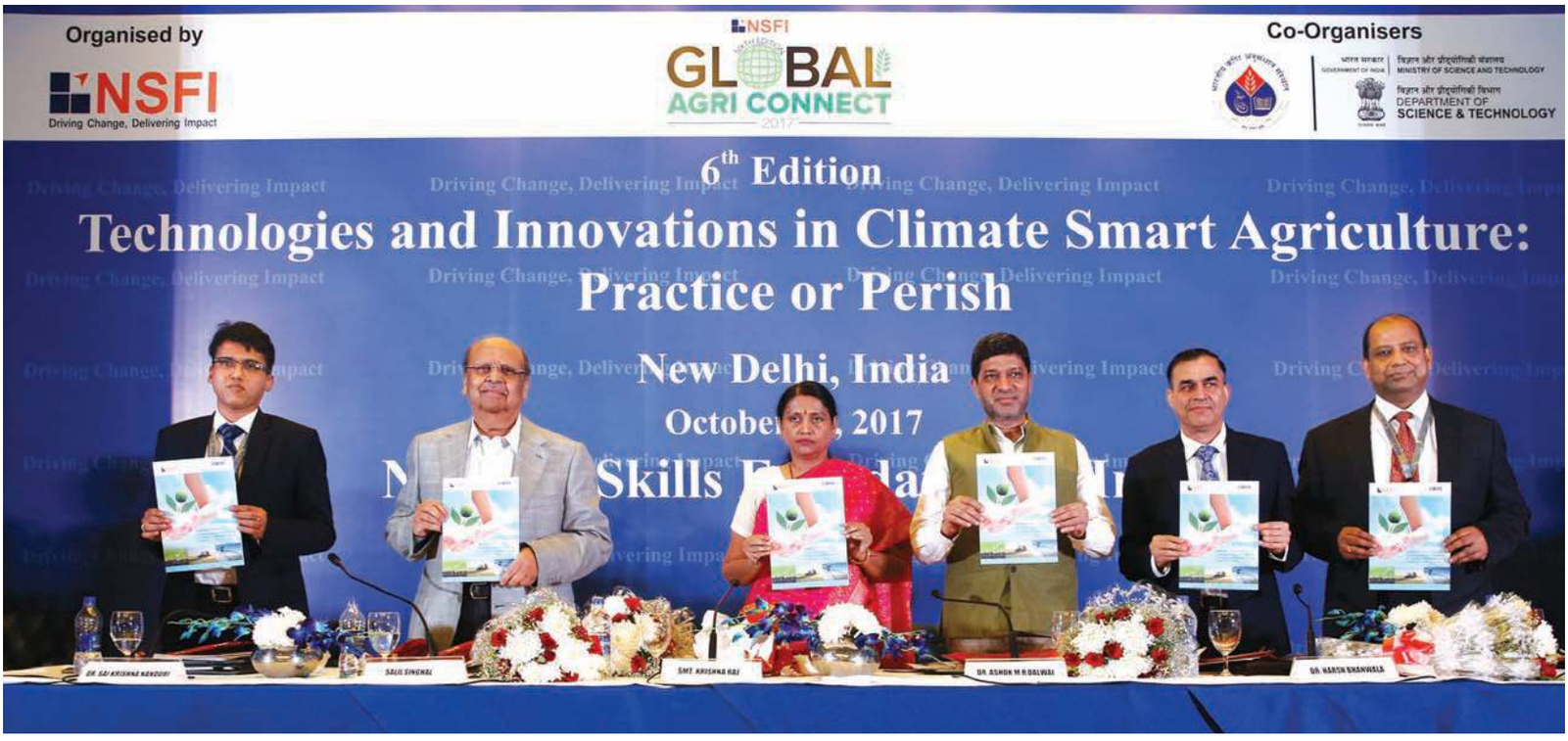
Increasing foliage and forest cover and water conservation technologies can help in making our agriculture become climate smart.

India has a bundle of opportunities; there is a need to work on weather smart, water smart, energy smart, carbon and nitrogen smart and knowledge smart ideas and technologies.

Mr. Sunjay Vuppuluri, Group Executive Vice President, Yes Bank briefed the audience on the highlights of the knowledge report on innovations and technologies in Indian agriculture. He stated that it was a pleasure and privilege to Yes Bank, to partner with the 'National Skills Foundation of India (NSFI)' in organizing the annual theme based global conference on agriculture. He informed that the current report brings to light 34 innovations in Indian Agriculture on the theme of Climate Smart Agriculture. He explained that the technologies captured in this report cover a broad spectrum of areas, grouped into four major themes;

1. Farm management and enhancing productivity
2. Application of IT for enhanced access to inputs and production
3. Green energy use innovations
4. Climate change adaptation technologies

Smt. Krishna Raj, Honourable Minister of State for Agriculture, Government of India stated that climate change is a major issue faced by all countries across the world; However, India is in limelight and focus since a majority of her population, as much as 70 percent of the total population, is dependent on agriculture. She added that the Government of India is implementing a number of programs to support and make agriculture become more resilient which includes promotion of organic agriculture and natural farming, introduction of robust crop insurance, promotion of technologies, skill development and scientific research. She informed that there is an increasing trend in India for adoption of ideas and technologies by farmers, which is resulting in the growth and development of the country. She wished that the conference to help in disseminating best practices and new technologies from across the globe to the Indian farmers.



PLENARY SESSION - I

Pace of Changing Climate & Mankind's Endurance: Impact on Agriculture in the Past, Present & Future

Dr. Narendra Singh Rathore, Deputy Director General (Education), Indian Council for Agricultural Research (ICAR) questioned if India can sustain the trend of good production of food grains and other agricultural commodities as that of the current year in order to meet the demand from the increasing population. He stated that India has a number of indigenous technologies in agriculture that are more suitable for her ecosystem. He added that India is open to new technologies from outside the country as well, provided they are easy and simple enough to support adoption by the farmers. He emphasised that knowledge and skills of the technology / innovation users are vital in enabling the Indian agriculture cope up with the climate change and other evolutionary changes.

Dr. Anthony Whitbread, Research Program Director, Innovation Systems for the Dry lands (ISD), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) stated that farmers in semi-arid tropics have been traditionally practising many technologies that are climate smart. He stressed upon the need deploying these technologies and making them more farmers specific; the need for crops that are specific to the agro-ecological conditions and the need to promote resilience that is more tuned to that specific region. He added that markets play a dominant role in deciding the crops and technologies. He reiterated the need for a policy framework that is more enabling with higher investments by the Governments, particularly for co-planning and co-financing along with the farmers and other stakeholders.

He emphasized that farmers need more support in the form of incentives and technologies that are specific to their farm conditions and crops. He highlighted the need for research on efficient energy use in crops, radical changes in physiological aspects of crops, re-engineering resilience etc. which have to be specific to a given area.

Dr. Patrick Cortbaoui, Academic Associate & Program Director, McGill University-Institute for Global Food Security, Montreal, Canada opined that many technologies can be viewed as climate smart, but it is important to see if they are people smart as well. He underlined that they should be relevant, useful and specific to the needs of the farmers. He added that there is a complete disconnect between organizations involved in technology developments and the end users. He stressed upon the need to involve all the stakeholders - market players, academia, financial institutions and more importantly the farmers, who are the end users - right from the stage of designing through the complete development cycle.

He also emphasized on the need for more applied research that focuses on core problems of the end users. He added that there is a need for institutions such as the market institutions, cooperatives, and customer

To cope up with climate change, there is a need to understand and work in terms of time, resilience and adoption of agricultural technologies and innovations.

There are four vital institutional functions that are required to make CSA successful, which include:

- To provide information on climate change and its effect and the possible responses to those.
- To foster innovations that develops knowledge and practices to enhance coping capacities
- To encourage investments to establish physical infrastructure for building coping strategies and adaptive capacities
- To provide insurance that can mitigate the risks of farmers

Dr. Narendra Singh Rathore

Dr. Anthony Whitbread

Dr. Patrick Cortbaoui

Mr. Sagar Kaushik

Mr. Vinay Kumar

Mr. Wouter Verhey

Along with the productivity of agricultural crops, India needs to focus on the post-harvest losses of those crops. To overcome the losses, all stakeholders in the value chain including both the public and the private sector should come together to make the available technologies adopted at scale.

institutions etc. that play a vital role in building the capacity of the farmers, especially the small holders in transforming their coping capacities into adaptive capacities.

Mr. Sagar Kaushik, Chief Operating Officer, United Phosphorus Ltd (UPL) emphasized on the need for India to focus more on process and market systems as against the production system, which has been the focus in the past decades. He added that the issue is not about availability of technologies, but is rather about scaling up. He quoted the examples of rice cultivation using hybrid varieties and water efficient direct sowing technology, which are still not scaled up. He highlighted that there is a potential to reduce area under rice cultivation while being able to achieve the same level of production as before, thus freeing more than 10 million hectares for tree cultivation. He also highlighted that post-harvest technologies is a major thrust area for India and most developing countries globally. It can potentially increase Indian farmers' incomes by about 12 percent. He concluded by stating that technologies are available, but they have to be taken to the level of large scale adoption by bringing together all the stakeholders in the value chain.

Introduction of Zero budget farming is more of natural farming technology with no chemical fertilizers or pesticides. This has been quite successful in enhancing the production. In some cases it has doubled the production and thereby the income of the small holder farmers.

Mr. Vinay Kumar, Regional Director for Asia & Global Initiatives, emphasised the need to reduce the cost of inputs, enhance the net farm income, enhance resilience of small holder farmers and sustainable agriculture through technologies of 'zero budget farming', which avoids the use of chemical inputs and promotes the use of locally available bio-inputs.

Mr. Kumar highlighted that the adoption rate of technology by women is nearly 65 percent, which is encouraging. He explained about the pilot initiative where farmers are aggregated and supported to market their produce as a collective, which is enabled through the use of Information Technology. Farmers receive their payments through the digital platform. More than 7000 farmers are part of this project, which has already achieved a business turnover of US $ 2 million.

Mr. Wouter Verhey, Agricultural Counsellor for India and Sri Lanka, Embassy of Kingdom of Netherlands expressed that India is one of the hotspots where the impact of climate variability will be very high. He highlighted that there are a number of advanced farming technologies like the precision farming, vertical farming, hydroponics etc. which are available in India, but it is important to focus on technologies for the small holder farmers. He quoted many examples where there is a need for more technologies - enhancing water use efficiency, enhancing productivity in horticulture and animal husbandry. He emphasized that farmers can be reached more effectively for adoption of new technologies only through a value chain approach.

Dr. Narendra Singh Rathore concluded the session by stating that there are number of technologies that already exist to foster climate smart agriculture. But they are not as visible and tangible as they should be. Therefore, there appears to be big gap in the demand and supply in terms of CSA technologies. There is a need to bridge this gap by broadening the scope of our work. There is a need to promote more sensible policies that bring all actors together to achieve this. There is a need to focus on dissemination of information on technologies, innovation of new practices and technologies and on enhancing the coping capacities of the farmers through mitigation instruments such as crop insurance. There is also a need for us to focus on post-harvest losses linking productivity and production to profitability at the farm level. There is a need to promote sustainable farming technologies such as the 'zero budget natural farming'. ●

TECHNICAL SESSION - I

Adaptation Technologies to Address Climate Change Risks: Strength of the Weak Ties

Mr. Rajeev Ahal, Director – Natural Resource Management, Deutsche Gesellschaft fürInternationale Zusammenarbeit (GIZ) GmbH expressed that the farming system in India is complex, where on one hand, there are small holder subsistence farmers whose resources are defined and limited; and on the other hand, the large farmers have surplus resources. He added that technology shall only be promoted to improve the farming sector and to provide solutions to individual farmers.

Mr. Abhay Gandhe, Agricultural Development Professional, Tata Trusts, Mumbai highlighted the initiatives Tata Trusts have taken up in the Himalayan region to promote climate smart agriculture where the interventions focussed on understanding the rainfall patterns. The major agenda of their interventions include reduced costs of cultivation, improved water management and green environment. They have collaborated with NABARD to convert the water starved district into water surplus district in 5 years. The 'Lakhpati Farmers Program' aims at taking improved technologies to the farmers and helping them to enhance their farm incomes.

Dr. Kevin Tiessen, Senior Program Specialist, International Development Research Centre (IDRC), New Delhi informed that Nano technology presents a huge opportunity for climate smart agriculture and that they are considering two major areas for technology development and application. They are;

1. Reduction of post-harvest losses
2. Analysis of value chain of crops

He stated that among many other areas, they are currently working on mango value chain.

Mr. Raghuram Lanka, Principal Program Manager, Microsoft Digital India team opined that artificial intelligence in agriculture can become an important technology for climate smart agriculture. He stated that this technology can be used to know when to sow the crop with the prevailing weather conditions and the moisture conditions of the soil, which can help the farmers, time their sowing much better and thus reduce crop failures due to inadequate moisture during the sowing stage, which is a critical stage for most of the crops. He reiterated that this technology becomes very handy for the vast tracts of rain-fed agriculture in India benefitting the small holders and shared their experience of catering to the needs of farmers in Andhra Pradesh through offering the service of suggesting sowing dates.

Mr. Ashish Bhardwaj, Head Corporate Communication, CLAAS Agricultural Machinery informed that the major issue affecting capital city of Delhi in the recent days is the smog

From the point of India, technology and innovation promotion need to consider

- Small Holder farmers whose resources are defined and limited
- Predominant large farmers whose resources are surplus and have various irrigation methods.

- "Promoting climate smart agriculture for small farmers" program in the Himalayas of Uttarakhand is based on the understanding on the change in rainfall patterns.
- Tata Trusts are working on converting the water deficit district into water sufficient (surplus) district in the next 5 years.

Artificial intelligence has a major role to play in precision farming. They can help the farmers in determining the most appropriate time of sowing based on the weather conditions and soil moisture level.

Mr. Rajeev Ahal

Mr. Abhay Gandhe

Dr. Kevin Tiessen

Mr. Raghuram Lanka

Mr. Ashish Bhardwaj

Ms. Swati Nayak

Mr. Sachin Nandwana

Mr. Sanjib Dey

Technologies are available to convert paddy straw as cattle feed and to convert paddy straw as bio-fuels. Both help in reducing the pollution level, thus also contributes to the reduction of green house gases responsible for climate change.

Climate resilient rice varieties developed IRRI enhances the resilience of the farmers against climatic stresses. The rice varieties are tolerant to drought, stressful conditions, flooding and submergence.

GIZ endeavours to address the skill gap in agricultural sector by promoting 'Green Innovation Centres'. As part of Innovation Centres, 15 Green Colleges are providing skills to rural youth blending traditional occupations with modern technologies and innovations.

and rising pollution level. One of the major causes for this is the burning of the crop residues in Punjab and Haryana. He briefed about the technology that promotes the use of paddy straw as cattle feed leading to decline in the pollution level while contributing to enhanced incomes of the farmers. In this technology, paddy straw is collected and sent to bio-fuel plants.

Ms. Swati Nayak, Lead Scientist, International Rice Research Institute (IRRI) informed that IRRI has developed rice varieties that are tolerant to climate variability. She said that there are drought tolerant varieties and varieties tolerant to stress-like conditions, floods and submergence in water. IRRI has promoted technologies that enhances water use efficiency and make the crops more resilient. She added that the challenges are that the needs are so diverse in terms of crops and type and nature of farmers.

Mr. Sachin Nandwana, Co-Founder & Director, BigHaat informed that BigHaat-Digital is a technology that identifies the issues of farmers in accessing agricultural inputs & markets. Farmers in general don't have the knowhow of their products, their end use and the markets they reach. Therefore, BigHaat-Digital platform provides solutions to some of their problems through helping them in finding the right vendor for the products they need and the right buyers for their produce.

Mr. Sanjib Dey, Sr Project Coordinator, Welthungerhilfe (WHH) stated that the farming community lacks skills in the transfer and adoption of the technology, which is emerging as a major gap. Realizing this, GIZ is implementing a program by name 'Green Innovation Centre', also called 'Green Colleges'. The Green Colleges provide training to the farming community in rural areas on a range of subjects such as Integrated Agriculture, Poultry, Fisheries, Babui Grass products, Sal Leaf Plate making etc. The duration of the training programs range from one month to eight months.

Mr. Rajeev Ahal concluded the session by stating that there is a need for both product and process innovations to promote climate resilient technologies in agriculture. He added that the farmers can be shifted from burning crop residues to conversion into bio-fuels using technologies. The technology of climate resilient rice varieties is an interesting development helpful to farmers. He urged an ecosystem and environment to promote start-ups is needed such that the farmers can be provided with technologies to reduce costs, enhance incomes and make their crops more resilient.

PANEL DISCUSSION - I

Achilles Heel of Policy-Praxis interface: Is it Technology or Policy?

Dr. Ms Srivalli Krishnan, Senior Program Officer-Global Development, Bill and Melinda Gates Foundation (BMGF) opined that technologies should be developed keeping in view of the issues and concerns of farmers and end users. She expressed that most often, the reasons for lack of adoption of technologies is that they are not user-centric and relevant to the end users. Therefore, it becomes critical for innovators and technology developers to adopt a bottom-up approach. She urged that they need to start the process from the farmers trying to understand their problems correctly.

Mr. Dirk Walther, Project Director - Support to National Urban Sanitation Policy (SNUSP), Deutsche Gesellschaft fürInternationale Zusammenarbei (GIZ) stated that there is a need to strengthen our research in agriculture which will help in better understanding of the issues faced by farmers. Often, we don't have data or evidence that can highlight different issues. He added that in the absence of such data or evidence, finding appropriate solutions also becomes difficult. He suggested that to develop adaptation capacity of the farmers, there is a need to develop a mechanism to understand the farmers' issues.

Dr. Ch. Srinivasa Rao, Director, National Academy of Agricultural Research Management (NAARM), Hyderabad expressed that technology solutions are often specific to the location and the context. It may be difficult just to adopt these technologies in other contexts. Mere copy paste approach will not work in such cases. He emphasized the need for adaptation in such cases. Therefore, without appropriate adaptation, the implementation of these technologies in other areas is not feasible. He added that the other two important parameters are cultivating suitable crops and market intelligence to enable climate Smart agriculture.

Smt. T.S. Raji Gain, Chief General Manager, National Bank for Agriculture and Rural Development (NABARD) articulated that there are two major gaps in the field of technology development in agriculture, which include:

- Lack of market intelligence
- Availability of smart technologies

She stated that there is a need for smart technology in various segments of agriculture, especially for storage, processing infrastructure, and risk of farmers and in enhancing farm income. She expressed that solar energy can be smart technology which can help in enhancing farmers' incomes, besides leading to integrated farming. Smt Gain also added that there is a need for appropriate policies on export of crops with high level water foot prints. Example – pulse crops. She recalled that in the recent years, farmers are aggregated into a collective in the form of farmers' producer organizations, which can help them in the uptake of farm mechanization.

Mr. Rajeev Varshney articulated that there is a discerning need in agriculture for climate resilient crops. He added that there is a need to focus on developing such crops with a non-GM (genetic modification) approach. Farmers need to be trained and linked to the market so that high yielding and climate resilient varieties reach them. He stressed upon the need to focus on doubling of farmers' income as envisioned by the Government.

Mr. Rajeev Varshney

Dr. Ms Srivalli Krishnan

Mr. Dirk Walther

Dr. Ch. Srinivasa Rao

Smt. T.S. Raji Gain

TECHNICAL SESSION - 2

On the way to Climate Smart World: Costs-Benefits and the adoption of technologies sans financial viability

Criyagen has developed 'Zen capsules', which is an innovative plant growth nourishing bio-fertilizer. These are low cost, eco-friendly inputs for sustainable agriculture. These capsules reduce carbon foot print and develop carbon neutral energy for better tomorrow.

Hydroponics can grow more crops per year, high yielding varieties, high nutritional value, without heavy metal or nutrient residues. In this technology, there is no need for tractors and tillers and there are no weeds to pull out.

Men still continue to have much of the decision making space at the farm level. This has been a big hurdle in providing access to technology for small holder farmers, particularly for the women farmers.

Dr. Basavaraj Girennavar, Managing Director, Criyagen presented on their innovation wherein they have introduced bio-fertilizers in a capsule form called 'Zen Capsules', which have pharmaceutical accuracy. He said that each capsule has 100 crores of micro-organisms and the technology behind these capsules is very robust – in terms of efficacy, storability and the concentration.

He added that they have launched a series of bio-fertilizers that enhance nitrogen fixation with the objective of bringing ecological sustainability and economic viability by maintaining soil health and enhancing productivity. He expressed that there is a need for a favourable policy that promotes their efforts to scale up these products in the market and launch many more such products.

Lt. Cdr CV Prakash, CEO, PetBharo Project discussed about hydroponics, the technology of soil-less cultivation. He opined that it is going to be the next-gen technology in agriculture. He stated that they piloted this in India in 2008 and they have been practicing since then. He added that the soils are often burdened by a number of problems such as over fertilization, lack of nutrition, lack of adequate water etc., which can be overcome through hydroponics.

He explained that this is a climate smart technology that is far more superior to many of the conventional cultivation practices. It reduces the water requirement, reduces labour and farm machinery, reduces the need for chemical pesticides as it uses Integrated Pest Management (IPM) practices and reduces the carbon emission. He lamented that in India, there is no research so far on hydroponics. He felt that the produce through hydroponics can be branded as it is attempted in developed countries.

Dr. Joska Gerandaz, MD, K+S Fertilisers India Pvt Ltd presented about the pilot program they are implementing in Alwar region of Rajasthan, where they work closely with the farmers and guide them to provide inputs and adopt practices as recommended by them. He informed that the project covered 10 villages and included about 70 to 125 small holder women farmers who cultivated pearl millets and mustard. He added that the adoption level is so low despite very good results on the farmers' plots with 30 percent increase in yield in pearl millet and three years of implementation. He said that this is

Dr. Basavaraj Girennavar

Lt. Cdr CV Prakash

Dr. Joska Gerandaz

Mr. Kartikeyyan Muniappan

Mr. Aditya Sethi

Dr. Soumitra Das

Dr. Kevin Tiessen

mainly because women are not the ultimate decision makers for their farming. He concluded that they have made small changes in their approach now, reaching out to farmers only with about 2 - 4 hectares of land, who would pay attention to our technical inputs and adopt them.

Mr. Kartikeyyan Muniappan, Program Leader, Dhan Foundation discussed about the development of impact type hulling machinery for processing small millets by DHAN Foundation with the technical collaboration of Tamil Nadu Agricultural University, IDRC and Global Efforts, Canada. He explained that it is superior to those existing in the market by many ways – it gives 10 percent more grains than the other machines; it gives more nutritious millets by retaining the bran, which increases the fibre and the micro nutrients content in the millet food.

It is versatile and is suitable for a village level operation or at a commercial scale operation by a medium sized enterprise. He opined that the scaling up of the technology can be achieved through financial support for the manufacturers; support for further research and support for resource agencies for diffusion and dissemination; and finally financial support for the adopters.

Mr. Aditya Sethi, Director of Technology, Digital Green presented on a technology entitled 'Loop App' which DG has developed to help farmers, particularly the vegetable cultivators to aggregate and use mobility solutions enabled by the use of information technology. As of today, they have reached 7000 farmers collecting and marketing about 13000 tonnes of vegetables in Bihar, Maharashtra and Andhra Pradesh.

He informed that the value propositions included very less infrastructure needs; community driven model; real time data availability for the farmers and the potential to integrate other value added services like financial inclusion, access to market information and connecting to suppliers. The technology platform includes an App, SMS services and digital payments. Farmers are able to enhance their income up to 15 to 20 percent by way of better negotiation with traders, savings in transport and timely market information.

Dr. Soumitra Das, Director, South Asia International Zinc Association discussed on the importance of zinc and the roles it plays in agriculture. He highlighted the facts that 50 percent of global soils and 40 percent of Indian soils are deficient in zinc. Among all micro nutrients deficiency, zinc deficiency is more prominent. He also informed that there is also a correlation between zinc deficiency in soils and the same in human beings. Zinc deficiency in human beings has greater ramifications for mankind resulting in weakening of immune system and deaths of more than 8 lakh people annually.

He stated that some of the possible solutions include genetic bio-fortification of soils with zinc through specially developed varieties of crops and fortification of fertilizers with zinc. He opined that there is a need for favourable policies that encourage more use of micro nutrients. There is a need for adequate research and development for development of Nano-zinc fertilizers and to enhance the quality of available micro nutrients.

Dr. Kevin Tiessen, the moderator of the session concluded by highlighting that scaling up adoption is possible if the innovators make the users understand the key value propositions. He quoted an example of improved hybrid cotton varieties after the introduction of Bt cotton. He said that at the end of the day, farmers need enhanced income from agriculture and to adopt technologies for climate smart agriculture.

The Impact Type Small Millet Huller Assembly is innovative, superior and versatile. It is suitable for all small millets with husk; it provides about 10 % more rice recovery and offers more nutritious product than the existing abrasive mills in terms of fibre and micronutrients through better retention of bran.

The mobile app technology 'LOOP APP' aims at increasing farmers' income from sale of their perishable produce at scale. This is a technology application for aggregation, transportation and digital payments and enhances transparency in the system.

Zinc plays a vital role in Climate Smart Agriculture. Zinc deficiency limits plant growth & development, reduces yield and quality, especially in arid and semi-arid regions. Zinc when applied through foliar spray increases water use efficiency and thereby reduces the drought stress.

PANEL DISCUSSION - 2

Enabling Start Ups vs. Facilitating Technology Adoption: Role of Policy Support for Scaling Up Agenda

Mr. Maanav Yashroy

Women shall be brought in to the forefront of policy making and programs as they play a major role in agriculture. Women have far more knowledge on the family and its needs than their men.

Mr **Maanav Yashroy,** Director – BoP Business, Philips Lighting stated that ecosystem, environment and extension system are facilitating the adoption of technologies. He said that the Government is supporting the process with an enabling policy environment keeping in view of the end users. He stressed that education becomes imperative to adopt climate smart agriculture, which is a podium to provide income for the farmers. He also added that the policies should focus more on women since they have far more knowledge.

Mr. Atin Tyagi, Manager- Sustainability & Climate Change, Jain Irrigation Systems articulated the need for producing more from less, with depleting resources and increasing population. He informed that his company, 'Jain Irrigation' has been promoting efficient use of water and energy for the past four decades, reaching more than five million farmers. He expressed that there is a great potential for scaling up the technology of micro irrigation in India.

He explained that of the 40 percent irrigated land available, there is a potential to bring about 42 million hectares of land under micro irrigation system. However, only about 5 million hectares have so far been brought under this system. He informed that scaling up adoption can be achieved through extension and support services. He suggested that there is a need for the policy makers and technology providers to work further on the aspect of tools and farm machinery that can reduce the drudgery of women.

Mr. Atin Tyagi

For technology adoption to be successful, two things are essential. These are:

1. Training and capacity building on high end technologies

2. Hand-holding support by the extension team

PLENARY SESSION - 2

Increasing the Odds of Success: Integrating Investment opportunities into the User Ecosystem

Ms. **Anuradha Bhavnani**, Regional Director, Shell Foundation initiated the panel discussion by stating that there is a need to raise funds for growth stage enterprises in food and agriculture. She expressed that while doing so, there is a need to know the strength of revenue generation potential for the enterprises. But, profits alone shall never be a consideration for investments in innovations and technology development. Investors look for the following aspects for taking decisions;

1. Scale of operations
2. Sustainability
3. Value proposition and
4. Revenue model

Mr. Hemendra Mathur, Venture Partner, Bharat Innovation Fund articulated that entrepreneurs need to understand the market, the customers that they intend to serve, and the market size available for them. He said that a mature market will have 7 – 8 players and will still be growing, perhaps at 20 percent. They can explore the option of B2B channel than directly selling to farmers. He informed that 'Bharat Innovation Fund' supports lab scale innovations, which can be validated at the field level and taken to the market. It focuses on technology oriented firms in agriculture sector.

Mr. Nilotpal Pathak, I-Farms Venture Capital Pvt. Ltd expressed the need for flexibility in the product mix. He added that the conventional venture fund models will not help us. There is a need for catalytic seed fund, which should be linked with incubation fund. There is a need for enhanced private sector participation to work along with the Government for establishing infrastructure and funding mechanism to foster innovations and technology development in agriculture.

The discussion also centred on the need for policy like 'param para yojana', which supported the traditional livelihoods and micro entrepreneurs. The policy shall enable small and marginal farmers to access micro credit in order to purchase cows or other livelihood assets. Let us aim for transparency and accountability in our enterprises and not let profit alone is the sole determinant.

Dr. Basavaraj Girennavar, Managing Director, Criyagen emphasised that agriculture sector as a whole is evolving continuously in India. Low cost and high quality eco-friendly products and technologies are available to promote climate smart agriculture (CSA) practises with focus on sustainable development. But the biggest challenge faced today is technology dissemination and adoption at farmer's level mainly due to their diversity

There is a need for enhanced private sector participation to work along with the Government for establishing infrastructure and funding mechanism to foster innovations and technology development in agriculture

Ms. Anuradha Bhavnani

Mr. Hemendra Mathur

Mr. Nilotpal Pathak

To bring about a productive change and develop new enterprising initiatives, Government institutions should focus on infrastructure development and facilitation of funding support

Dr. Basavaraj Girennavar

Mr. Jatin Singh

Ms. Ritu Verma

and specific requirements. To bring about a productive change and develop new enterprising initiatives, Government institutions should focus on infrastructure development and facilitation of funding support to develop products that are more flexible and adaptable in diverse situations with focus on domestic and global market.

Mr. Jatin Singh, Founder and CEO, Skymet Weather Services Pvt. Ltd. He highlighted the challenges in attracting investors to help build a technology for the farmer. Unless it is fool proof and financially viable it is difficult to generate the revenue. Many investors focussing on profit only believe it is the duty of Government of India leaving aside the social contribution of the investment. Prediction of rainfall and weather reports contributes significantly to the agriculture sector. For instance it creates a win-win situation for farmers and Insurance companies who are able to settle their crop insurance and farmer get the money without any hassle.

Ms. Ritu Verma, Co-founder, Ankur Capital focussed on discussing the huge investment opportunity available in technologies that address post harvest losses, better irrigation practises and market that connects farmers with end users (Consumers). Investors are attracted to technology / models that have potential for scaling up to wider population with sustainable output. Farmers when they realise and recognise the impact of the technology they adopt the practise in the farm irrespective of its additional cost for instance adoption of HYV high yielding varieties. ●

VALEDICTORY SESSION

Mr. George C Varghese, President, Development Alternatives stated that there is a high possibility to address the challenges of our farmers through aggregation. Aggregation can be used to address a challenge and also to scale up the solution. He added that any solution shall have three characteristics – shall promote diversity, address the issue and scale up adoption and provide incentives to farmers. He articulated the five potential growth stages in agriculture which include:

1. Application of remote sensing technology and GIS to enable water security, energy security and food security.
2. Use of ICT
3. Chain of inputs in order that diversity of agriculture is maintained
4. Reduction in post-harvest losses through cold storage and its chains
5. Retailing

Dr. SK Malhotra, Agricultural Commissioner, Department of Agriculture Cooperation and Farmers Welfare, Government of India noted that climate change is hampering the overall ecosystem around the world. Development of smart technologies and innovations is important to address the challenges that will help mitigate the overall effect. Innovations focussing on development of tolerant varieties (salinity, water stagnation), water efficient and climate smart crops (tuber) are in progress in different agriculture research stations in India. Above will help address the risk faced by the farmers and ensure food and nutritional security of the country.

In recent decade, Climate change has resulted in drought and flooding in many parts of the country. In above context Government of India is committed and given high priority to water conservation / efficient management of water resources. Under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) efforts are taken to develop protected cultivation – end to end solution on source creation, distribution, management, field application & extension services. Under this initiative about 5000 hectare of land is to be adopted under protected cultivation.

Further to address the huge post harvest losses in the country; cold chain initiatives are taken by GOI.

Mr. George C Varghese

Dr. SK Malhotra

GOVERNMENT POLICIES AND PROGRAMS SUPPORTING CLIMATE SMART AGRICULTURE

The context

The key to developing appropriate policies, strategies and actions to enhance CSA adoption is to understand the barriers to adoption of CSA practices, including the trade-offs between short-term costs and longer-term benefits, the mix of private and public benefits, institutional and financial barriers and lack of access to inputs or markets (FAO, 2012).[13] The main requirements for a policy environment capable of promoting CSA are greater coherence, coordination and integration between climate change, agricultural development and food security policy processes.

CSA needs to be mainstreamed into core government programs with appropriate priority given to public support of CSA. It should include vulnerable economic sectors and ecosystems. A gender-sensitive approach is also crucial to achieving CSA. The roles, responsibilities and capabilities of men and women need to be well understood to ensure that both men and women have access to and benefit from CSA practices and policies.

Synergies with Other Policies

National CSA policies are affected by developments at the international level, particularly in terms global agreements and mechanisms to support climate change adaptation and mitigation. This process should be developed consistently with on-going national climate-resilient long-term visions, such as the National Adaptation Programmes of Action (NAPAs), National Appropriate Mitigation Actions (NAMAs) and United Nations Framework Convention on Climate Change (UNFCCC) National Communications. The most effective way of supporting resilient agricultural systems and rural communities is to incorporate adaptation into other policies (IISD, 2006).[14]

Financing CSA

There is a strong need for coordination for expenditure and planning between concerned agencies at the national and local levels. In addition, cross-sectorial CSA strategies need to take account of current legislation and regulations and be incorporated into legal and regulatory frameworks if they are to be implemented. There are many areas where synergies can be created with CSA, including social safety nets, energy & land-use regulations and disaster risk management.

Regulations for Adoption of CSA

National regulations need to be tailored to the country's particular environmental conditions and accompanied by other supporting incentives. For CSA to take hold, a mix of regulations and incentives is often needed. For decades, in the highly populated, densely farmed areas of Central and Western Kenya, where land rights are clear, there has been a requirement to plant trees and tree crops on 10 percent of the land. Many of the farmers exceed this percentage because of the income earned from the trees and the ecosystem services they provide.

Role of local institutions and participatory approaches

CSA policies and programmes, as with any cross-sectorial development programme, need to be aligned across various levels

13 FAO, WFP and IFAD 2012. The State of Food Insecurity in the World, 2012, Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition, Rome, FAO.

14 Global Environmental Governance: A Reform Agenda, 2006, Adil Najam, Mihaela Papa, Nadaa Taiyab, IISD, Retrieved on 08 November 2017.

of government. Developing CSA policies and programmes demands an understanding of the structure and functioning of different levels of government. Participatory approaches, which are more likely to build lasting results than top-down approaches, need to be adapted to local circumstances.

Promotion of CSA Adoption in India

The government is doing all efforts to make Indian agriculture sustainable and climate resilient. The following are some of the major initiatives of GOI.

- The umbrella program, namely, 'Krishonnati Yojana' covers various development programs viz. soil health card, integrated scheme on agriculture cooperation, agriculture marketing, agriculture census & statistics, horticulture, sustainable agriculture, National Project on Agro-Forestry etc.
- To minimize the impact of climate variability, government has developed contingency crop plans based on models on projected climate conditions for about 600 districts taking into account 126 agro-ecological zones of the country.
- Government of India (GOI) has launched the National Food Security Mission to address the production and productivity with respect to major crops viz. rice, wheat and pulses.
- For increasing productivity as well as encouraging economic returns from the wasteland, dry and degraded lands, GOI has encouraged horticulture plantations under the scheme of National Horticulture Mission (NHM).
- Lack of reliable climate information at local level is one of the primary challenges that affect decision-making at the farmer level. To fill thus critical void, GOI has established a network of 'Automatic Weather Stations' in 31 districts across nine states in India.
- To further mitigate risks, GOI is also promoting farmers to purchases crop insurance through its 'Pradhan Mantri Krishi Bima Yojana (PMKBY)' program for addressing the concerns of farmer due to crop damage and extreme climate events.
- GOI has launched the country's first National Action Plan on Climate Change (NAPCC) in 2008. India is now better prepared to deal with the multi-faceted nature of climate change.
- The State Action Plans on Climate Change (SAPCC) are intended to support India's environmental policy at the state level by integrating climate change concerns into policies, plans and programmes. They also help to build adaptive capacities at the local level.

Conclusion

Investment in CSA brings long-term gains in productivity, builds resilience, reduces GHG emissions and increases carbon sequestration. Incentive measures need to focus on overcoming barriers to adoption of CSA practices. Price and non-price measures are needed to support transition to CSA. Behavioural change is also an important element. Price support certainly has a role to play in countries affected by climate change, but often other forms of support (regulations, incentives, capacity development, investments in technology, innovation, efficiency gains and infrastructure, connectivity or the broader enabling environment, social protection and safety nets, and use of social capital) are more effective in paving the way forward. ●

There are many areas where synergies can be created with CSA, including social safety nets, energy & land-use regulations and disaster risk management

POLICY RECOMMENDATIONS – GAC 2017

We need to design and develop strategies that help taking forward the existing and newly developed CSA technologies to the door steps of farmers by giving priority to the extension system

Agriculture and allied sectors remain the most important livelihood source for more than three-fourth of the world's poor living in rural areas. In spite of the attention paid to agricultural development and food security over the past decades, there are still about 800 million undernourished and one billion malnourished people in the world. Food and Agriculture Organisation (FAO) estimated that taking care of the world population will require a 60 percent increase in total agricultural production. Research across agro-ecological zones note that climate risks are expected to increase in coming decades, particularly in low-income countries where adaptive capacity is weaker. Climate change impact on agriculture threatens both food security and agriculture's pivotal role in rural livelihoods and broad-based development.

CSA technologies can improve crop yields, increase input use efficiency and overall income of the farm and reduce greenhouse gas emissions. Identification, prioritisation and promotion of available CSA technologies considering local climatic risks and demand for technology are major challenges for scaling up the CSA technology in other agro- ecological zones. The 'Global Agri Connect 2017' conference has enabled the participation of stakeholders from all walks of life including the academia, research institutions, industries, Governments, NGOs and farmers, who deliberated on the subject and have put forth the following recommendations for all us to work together.

Capable farmers with skills and capacity

Technology adoption requires adequate capacities not only with farmers but also with extension workers and service providers. We need to train and build the capacity of farmers, extension workers, and service providers on CSA technology to highlight the effectiveness and efficiency of technology adoption. Extension workers need to create awareness and interest to adopt, which can start with small trials, then adoption and subsequently practice at scale.

Building Evidence / Documentation

There is a need for us to build on evidence base and assessment tools to identify agricultural growth strategies that integrate necessary adaptation and potential mitigation of climate change challenges. We need to identify through research the effective ways and means for dissemination of available technology which is proven in other similar agro ecological zones.

Environment with favourable public policy and stakeholder involvement

The policy framework needs to provide space for incentivizing research institutions for development and promotion of location specific technologies. We need to design and develop strategies that help taking forward the existing and newly developed CSA technologies to the door steps of farmers by giving priority to the extension system.

We can take advantage of the existing community based organizations especially the farmers' producer organizations and field partner organizations to build consensus within and among the community and support adoption of technologies and implementation at scale. We need to foster inclusiveness in our approaches.

We need to enhance financing options to support implementation by linking climate and agricultural finance. There is a huge potential to leverage resources and access co-financing options by building interest among stakeholders to get involved.

There is also a strong need for strengthening national and local institutions to enable farmer management of climate risks and adoption of context-suitable agricultural practices, technologies and systems.

There are a number of Government policies and programs that offer huge potential to connect with the adaptation capabilities of climate change. There is a strong case for mainstreaming CSA with existing policies,

programs and schemes. Example - Start-up India, MUDRA etc.

Market players can play a significant role in enabling the development and adoption of technologies. They are not only innovators of technologies but also help in dissemination and adoption. Examples - drip irrigation, plastic pond, green house structure etc.

There has to be a robust monitoring and evaluation system of programs that promote CSA technologies. There has to be a continuous process of feedback and feed forward such that the contextual requirements are fully satisfied with the technologies.

Increasing Institutional Effectiveness for Capacity Building

Large scale adoption of CSA technologies and other interventions requires capacity building among farmers, mostly small and marginal farmers who are typically risk averse and have low capacity to adopt and practice. We need to design policies that encourage the private sector to promote technologies through facilitating financing innovations and expanding the availability of custom-hire facilities. We need to create incentives to adopt climate smart interventions. The socio economic and environmental benefits would exceed these costs in terms of higher incomes, resource savings and improved environmental services.

Enhanced Productivity linked with Profitability

CSA technology or practises developed should directly or indirectly contribute to productivity enhancement, resilience improvement and reduce Green House Gas emission. Technology that is a combination of traditional wisdom and improved technology (knowledge smart); crop insurance (weather smart); that reduces greenhouse gases (carbon smart); practises that improve nutrient use efficiency (nutrient smart), improves energy use efficiency (energy smart) and water use efficiency (water smart) are important and have the potential for adoption at scale by the farmers.

Development of Climate Smart Agriculture (CSA) plan

A bottom up approach in CSA planning is the need of the hour. With facilitation of field partner agencies and support of technical institutions CSA plans are to be developed taking village or cluster of villages as unit. CSA plan consists of four major components (1) situation analysis; (2) targeting and prioritizing; (3) program support and (4) monitoring, evaluation and learning. CSA plans developed act as an operationalizing guide for execution and monitoring of the technology interventions at scale. Simple interventions like guidance about crop rotation, optimal planting times, harvesting times and soil management, efficient use of water resources can be introduced and implemented at large scale.

Building synergies and positive trade-offs

Outcome of CSA technology and practises developed and introduced should result in building synergies and positive trade-off of the interventions beyond the farm level. Importantly the positive trade-offs that exist between productivity, adaptation and mitigation, as well as the interactions that occur at different levels including wider socio-ecological implications are to be considered before up scaling the CSA technology.

Women friendly CSA Technologies

CSA technologies that are appropriate and satisfying the women interest, resources and demands can drive crucial change in adoption and up scaling of technology at large level. It is important to promote policy of gender inclusion in climate mitigation and adaptation programs which need to be monitored and assessed regularly through gender sensitive indicators like ownership of land and other productive assets by women. High political will is needed to enforce gender parity and inclusion in the climate deal.

Use ICT to Promote Precision Farming

Precision agriculture refers to an approach to farm management that uses information technology to ensure that the crops and soil receive exactly what they need for optimum health and productivity that ensure profitability, sustainability and protection of the environment. There is a huge potential to leverage the strengths of ICT in many spheres of agriculture that can strengthen the farmers in terms of access to technical inputs, farm inputs, market information etc. and enable them reduce costs, enhance production and productivity and augment farm incomes, thus making agriculture more resilient and climate smart.

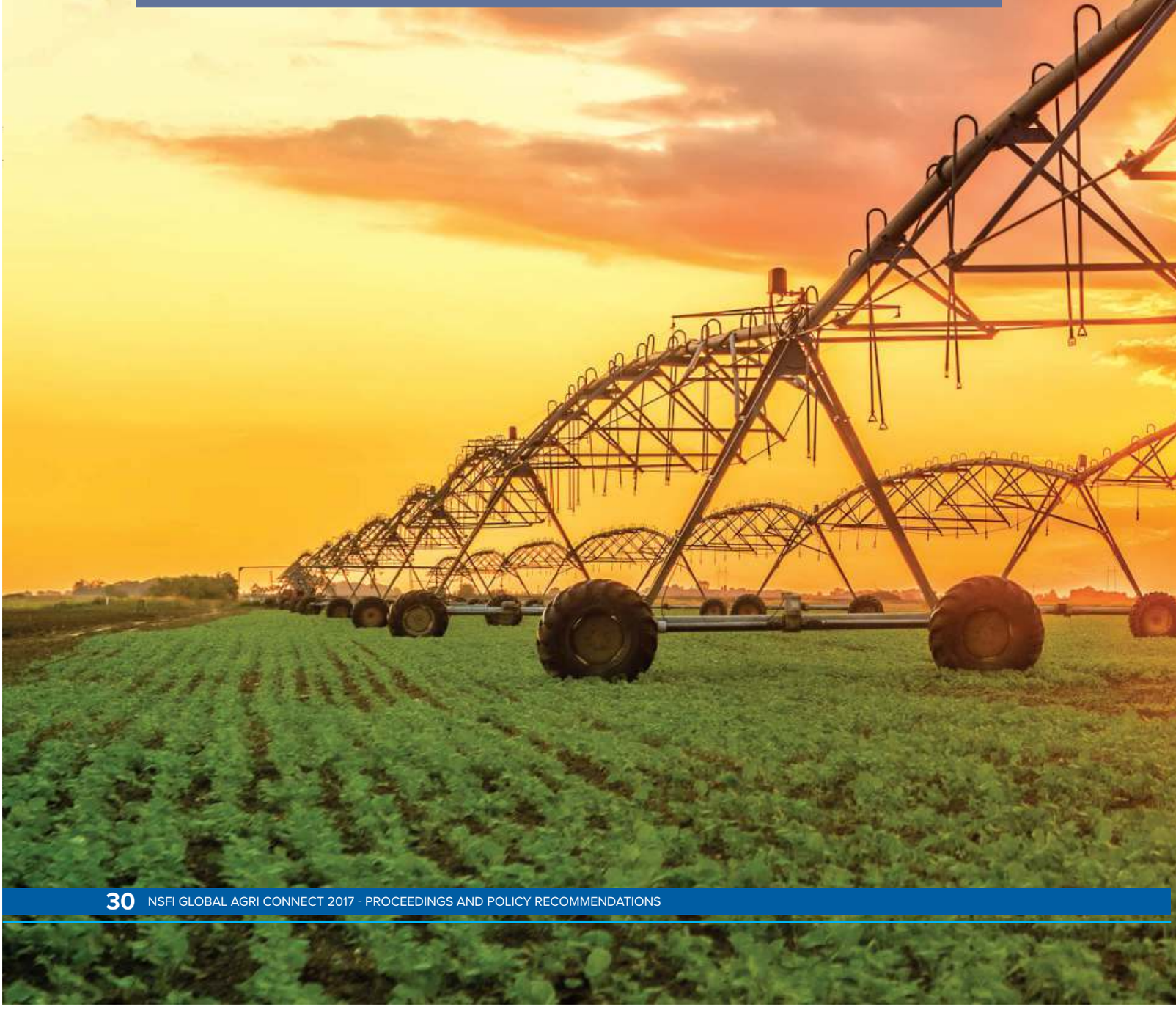
There is a huge potential to leverage the strengths of ICT in many spheres of agriculture that can strengthen the farmers in terms of access to technical inputs, farm inputs, market information etc

GLOBAL AGRI CONNECT 2017

The sixth edition of the Global Agri Connect 2017 was held at Hotel Le Meridian, New Delhi on 12 October, 2017. The theme of the 2016 Conference was 'Technologies and Innovations in Climate Smart Agriculture: Practice or Perish". Global Agri Connect is the flagship programme of the National Skills Foundation of India (NSFI), which is being organised since 2011.

The earlier themes were: Technologies and Innovations in Agriculture: Precision, Mechanisation and Communication: Three pillars of Agricultural Growth (2016); Technologies and Innovations in Agriculture: Pushing the Frontiers (2015); Evolving Skill Dimensions: The Lever to Agricultural Growth (2013); Hi-Value Agriculture: A Gateway to Farm Prosperity (2012); Transformational Changes in Indian Agriculture: The Next Decade (2011);. Every year, NSFI brings various stakeholders in agriculture such as government bodies, corporate bodies, research and financial institutions, departments of agriculture at the state and central levels, experts and scientists to discuss and deliberate on various perspectives of agriculture that can protect the country from the trends of declining production & productivity of small farms.

In addition to the discussion and deliberations, GAC 2016 also saw the release of a report on 'Technologies & Innovations in Climate Smart Agriculture', on 12 October 2016 brought out by the Knowledge Partner - YES Bank.



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