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GLOBAL AGRI CONNECT 2016

TECHNOLOGIES & INNOVATIONS IN AGRICULTURE

Three Pillars of Agriculture Growth: Precision, Mechanisation & Communication

IDEAS - APPROACHES AND POLICY RECOMMENDATIONS



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NSFI Global Agri Connect 2016
Technologies and Innovations in Agriculture
Precision, Mechanisation & Communication: Three Pillars of Agriculture Growth
Policy Recommendations

Year of Publication: 2016

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Published by
National Skills Foundation of India
K-59, South City 1, Gurugram, Haryana - 122018
Tel: +91-124-4058848/49, Fax: +91-124-4058840
Email: info@nsfindia.org
Website: www.nsfindia.org

Designed by
Foxview Media
BA, 12F, Second Floor, DDA - MIG
Near Capital Court, Munirka, Delhi 110067
Tel: 011-65001407, Mob: 9911938844
Email: info@foxviewmedia.com
Website: www.foxviewmemedia.com

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LIST OF ABBREVIATIONS

APMC	Agricultural Produce Market Committee
FPC	Farmer Producer Companies
FPO	Farmer Producer Organisation
FPOs	Farmer Producer Organisations
GAC	Global Agri Connect
GDP	Gross Domestic Product
GIS	Geographic Information System
GVA	Gross Value Added
ICT	Information, Communication, and Technology
IDRC	International Development Research Center
IFC	International Finance Corporation
IVR	Interactive Voice Response
KCC	Kisan Call Centres
KVK	Krishi Vigyan Kendra
KYF	Know Your Farmer
NABARD	National Bank For Agriculture & Rural Development
NSFI	National Skills Foundation of India
NSSO	National Sample Survey Organization
PPP	Public-Private Partnership
SIM	Subscriber Identification Module
UNICEF	The United Nations Children's Fund
WTO	World Trade Organisation

FOREWORD

MR. SANJEEV ASTHANA
CHAIRMAN, NSFI



The development of a nation depends on the productivity of its people. Progress is possible only if the health of its populace is being secured.

The inter-dependent objectives of poverty alleviation, relief from inadequacy of the food, growth in rural employment and incomes can be accomplished by substantial expansion in food production. Thus, in national policy making, food production deserves very high priority. As multiple factors affect agriculture in India, it has reached to a turning point. Changing sector dynamics needs to be learnt and the affect of it on economy needs to be understood. We need deliberations those are directional in nature and could focus on policies. Though the government responsibilities to catalyse the growth cannot be denied, we need to understand the role of private sector, academics, farmer producer organisations (FPOs), research organisations, bilateral agencies, and other stakeholders.

We are witnessing the growth of outstanding technologies, innovations, business models in all the sectors but agriculture sector would only be successful through this Tech-innovations if it helps to sustain itself and grow beyond current trend. The sector has seen challenges in short term as shortage of pulses, edible oil etc which in turn affecting inflation, even as the non-cereal part of the Indian economy continues to grow. While the technological innovations has brought the solutions of major problems, still agriculture in India is today facing a cycle of problemsbe it farmers suicide, failed monsoons, or water shortages. With the clarion call of Indian Prime Minister to double the income of farmers, there is strong understanding that agriculture sector needs more on technology adoption as well as infrastructure to create impact in longer run, besides policy changes. India has a blend of great institutional structure that can raise the far reaching issues.

In the words of PM, Shri Narendra Modi, Until the farmer does not receive the benefits of scientific and technological developments, true progress is incomplete. Thus, India must transform the sector similar to the countries such as The Netherlands, and Nations in South America. Precision and mechanisation innovations of the sector would not only impact farmers but the whole supply chain which will be transformed.

Today the focus should be on inclusive participation of stakeholders, competitiveness of supply chain, information dissemination & communication models, equipment leasing, farm delivery techniques, farm input retailing models, longer shelf life or storage technologies, handling structures, to name a few. Consequently, sector needs policy interventions and regulatory changes to address the ground level challenges, to support the adoption of technology through capacity building, to create awareness programmes, to understand smallholder farming and to build the fortune of these farmers. Many nations have tied to bring in greater inclusivity in their growth process and India needs to do the same to prosper.

The financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD) towards publication of journal/ printing of proceedings of the Seminar is gratefully acknowledged.

INTRODUCTION

The State of Indian Agriculture

Facts and Figures – A Glimpse

- Second largest agricultural land in the world - 157.35 million hectares.
- Second largest producer of spices, pulses, milk, tea, cashew and jute.
- Largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oil seeds.
- With 20 Agri-climatic regions, all 15 major climates in the world and 46 of the 60 soil types exist in India.
- One of the largest manufacturers of various farm equipments like tractors, harvesters and tillers.
- Ranks 2nd in global production of fruits and vegetables, and is the largest producer of mango and banana.
- Manufactures one-third of tractors in the world.

Source: Ministry of Agriculture, Government of India, TechSci Research
*Note: * - 4th Advance Estimates*

It is remarkable that India is blessed with second largest of land that can feed millions of people. Agriculture is the principle means of livelihood for 58% of rural households (India in Business, 2016), and with its allied sectors (including forestry and fishing), agriculture remains the largest sector of Indian Economy.

Agriculture is the largest contributor in the Gross Domestic Product (GDP) and it has contributed 17.4 per cent share in 2015-16, registered 4.2 per cent growth in 2013-14, and projecting only 4 per cent growth by 12th Five Year Plans (2012-2017) (Economic Survey, 2016). Animal husbandry i.e. dairying, poultry, piggery, goatary and wool and fisheries comprising both inland and marine harvesting, also had significant contribution (NITI Aayog, 2015). Estimated total food grains production during 2014-15 was 252.68 million tonnes lower by 12.36 million tonnes than the record production of 265.04 million tonnes during 2013-14 (MAFW, 2016). As on August 17, 2015, Rice and wheat production in the country stood at 104.84 and 88.94 million tonnes, respectively (IBEF, 2016).

Annual Growth Rate of India GDP is averaged 6.08 per cent from 1951 until 2016[1] while agriculture share of the Gross Value Added (GVA) in 2015 was 15.35% (IBEF, 2016). Indias horticulture production also saw record growth of 280.5 million tonnes in FY 2015[2]. The key indicators (GDP or GVA) of agricultural growth depicts that the sector is growing at a constant rate of growth since independence of the nation (Economic Survey, 2016), however, this is matter of concern. The sector must employ innovative techniques to break this stagnant loop of growth.

In 1951, whilst population of India was 361 million, out of 140 million total working populations, the populace occupied in agriculture were approximately 98 million[3]. According to the employment data generated from National Sample Survey Organizations (NSSO) Rounds, the percentage of people engaged in agriculture has been constantly declining, from around 60% in 1999-00 to 49% in 2011-12 (FICCI, 2015). According to the report of FICCI (2015), close to 79% of this decrease has been contributed by the five states - Uttar Pradesh, Karnataka, West Bengal, Bihar, and Rajasthan. Additionally, country grows certain crops that are labour-intensive, likely to be affected by labour scarcity. Employment share declined from 64.8% to 48.9% during 1993-94 to 2011-12 (NITI Aayog, 2015). However, in spite of this fall, agriculture sector still employs 52 per cent of the population in India (FAIDA, 2013).

Agricultural export constitutes 10 per cent of the countrys exports and according to World Trade Organisation (WTO); India is among the 15 leading exporters of agricultural products in the world (IBEF, 2016). India has emerged as a significant exporter of commodities such as cotton, rice, meat, oil meals, spice, guar gum meal and sugar (Economic Survey, 2015-16) and grapes occupy the premier position in exports with 107.3 thousand tonnes valued at Rs.1,086 crores in 2014-15 (Planning Commission, 2016). On the other side, India has turned out to be the worlds largest importer of the pulses around 18 million tonne and increased consumption for oilseeds have led to the deficit of 3 million tonnes, necessitating a constant flow of imports in India.

Even after such remarkable progress, the agricultural sector is neglected[4] when compared to the rapid development and progress in the manufacturing and services sectors after liberalization and modernization. Though, the sector has competitive advantages over others due to high proportion of agricultural land (157 million hectares) (IBEF, 2016), and growing population would create more opportunities through agri-demands, it is prerequisite to shift focus on neglected areas. The relationship between agriculture employment and returns must be examined, taking into account that it is

1 *India GDP Annual Growth Rate, 1951-2016. (2016). Tradingeconomics.com. Retrieved 20 December 2016, from http://www.tradingeconomics.com/india/gdp-growth-annual*
2 *National Horticulture Board, Assorted Articles, FAO Stat, TechSci Research*
3 *Share of Agriculture in Employment in India. (2016). GKToday. Retrieved 20 December 2016, from http://www.gktoday.in/share-of-agriculture-in-employment-in-india*
4 *Neglected Agriculture Sector: The Curse of Wastage. (2016). Retrieved 20 December 2016, from http://www.mbaskool.com/business-articles/operations/279-neglected-agriculture-sector-the-curse-of-wastage.html*

a labour intensive industry. India must move forward to achieve self-reliance in the crops which is imported, furthering the countrys food security.

The focus of efforts must be made on enhancing the productivity so as to break the constant pattern and leap towards better growth, creating more avenues for labour to retain them in the sector, increase their income through better technological interventions and expanding the product line and entering into crops which are sustainable and would help in food security. The deliberations in the conference emphasised these focus areas and how information technology and communication techniques could strengthen the nation that will give an advantage to harness agricultural potential.

THE INDIAN AGRICULTURE - POLICIES & STRATEGIES

As previously highlighted that agriculture is the backbone of Indian economy, and will continue to be central to all strategies for planned socio-economic development of the country, for household food security, to bring about equity in distribution of income and wealth or so.

Three strong reasons are there at the core of such development and appropriate policy development for agriculture sector (Chand, 2006). First, agriculture constitutes largest share of countrys national income, second, more than half of Indias workforce is engaged in this sector and third, development of allied sectors. Thus, by and large economy depends on the performance of agriculture to a substantial extent.

An equally crucial to the state and central government, agriculture policy is designed for elevating production, productivity, income levels, and the standard of living of farmers and is formulated for all-round growth of the agriculture sector.

Since, the launch of its first ever National Agriculture Policy[5] on 28 July 2000, India is envisaging a 4% annual growth through efficient use of resources and technology and increased private investment while emphasising on price protection to farmers in the WTO regime (NSFI, 2015).

The central government has launched many schemes in agriculture for the benefit of the farmers. There are more than 50 schemes for Microfinance, Financial Inclusion, Village Development, Credit Support, Institution Development, Rural Infrastructure Development, and Production Credit Support operated by NABARD (Abhay, 2016). Some of the government schemes are:

a) Pradhan Mantri Krishi Sinchai Yojana

The Government of India recognises the importance of micro-irrigation, watershed development thus allocated a sum of Rs. 5,300 crore (US$ 777.6 million) to every farm (Har khet ko pani) and maximising water use efficiency through drip irrigation.

b) Paramparagat Krishi Vikas Yojana

To address two major factors (soil and water) that are critical to improve agriculture production, this scheme support and promote organic farming and thereby improve soil fertility on a sustainable basis through the soil health card scheme. With a budgetary expenditure of Rs. 300 crore, the scheme aims to develop 10,000 organic clusters more than 500,000 acres nationwide (MAFW , 2016).

c) Pradhan Mantri Fasal Bima Yojana

The scheme envisage a crop insurance scheme under which farmers premium has been kept at a maximum of 2% for food grains and oilseeds and up to 5% for horticulture cotton crops. With this, government aim to support the farmer in financial crisis.

Since, the launch of its first ever National Agriculture Policy on 28 July 2000, India is envisaging a 4% annual growth through efficient use of resources and technology

5 *Salient Features of Indian Agriculture. (2016). YourArticleLibrary.com: The Next Generation Library. Retrieved 20 December 2016, from http://www.yourarticlelibrary.com/agriculture/8-salient-features-of-indian-agriculture/20959/*

Objectives of Agriculture Policyof India

01 Elevate the Productivity of Inputs

02 Increase Value-Added per Hectare

03 Protecting the Interest of Poor Farmers

04 Modernizing Agricultural Sector

05 Control Environmental Degradation

06 Agricultural Research and Training

07 Confiscate Bureaucratic complication

Source: http://www.yourarticlelibrary.com/agriculture/agricultural-policy-of-india-explained/62860/

d) Electronic National Agriculture Market (e-NAM):

The pan-India electronic trading portal with network of existing Agricultural Produce Market Committee (APMC) mandis (21 mandis from eight states) is designed to offer a single window service for all APMC related information and services. This includes commodity arrivals and prices, buy & sell trade offers, provision to respond to trade offers, among other services. The Centre aims to bring 585 mandis across India on to the platform by March 2018 in the long run.

The Government of India has started work on 99 major and medium irrigation projects, slated to be completed by 2019 and expected to bring 7.6 million hectares of land under irrigation in some of the most drought-prone regions of India (Livemint, 2016). Schemes such as Pradhanmantri Gram Sinchai Yojana would improve access to irrigation and enhanced water efficiency through `Per Drop More Crop approach. Continued support from Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) scheme and the creation of a unified national agriculture market to boost the incomes of farmers is also critical programme of the government. Budget 2016-17 proposed a slew of measures to improve agriculture and increase farmers welfare such as 2.85 million hectares to be brought under irrigation, Rs. 287,000 crore (US$ 42.11 billion) grant in aid to be given to gram panchayats and municipalities and 100 per cent village electrification targeted by May 01, 2018 (IBEF, 2016).

To ensure the growth, productivity, and better income level for agricultural community employed in the sector, government has designed and implemented various schemes, plans, and programmes. However, these schemes at the ground level must be more efficient in turning around the circumstances. There is need to critically analyse the complimentary plan to the existing ones and utilise the technological strengths to implement the programmes for the welfare of farmer community.

CHALLANGES CONFRONTING THE SECTOR

The dynamic revolution in the global economy is posing new confrontations to agricultural economy of the nation. At the moment, the agriculture policy encourages the unabated use of power, water and fertilisers. Further, huge subsidies from the government have accelerated the same front.

The sky-scraping population of India has put pressure on land and other resources to meet its food and development requirements. The contribution of small farmers to the national and household food security has been progressively escalating. The natural resource base of land, water, and bio-diversity for agricultural application has reached the critical level and deserves urgent attention towards natural resources management.

The focal point of the agricultural strategy has to now shift in the direction of developing innovative technologies, practices and yield varieties that consume fewer resources and are environment-friendly. The challenge of technological deployment especially in cutting edge yield improvement techniques, introducing mechanisation for small farm holders, innovative and scientific methodology for using fertiliser and pesticide is vital.

The weak integration of value chain systems to bring the produce from farm to the table indicates the need for an essen-

tial overhaul of the existing systems. Sector lacks the linkages which create futile and incompetent supply chain and thus bring trust barrier between farmers and industry (FAIDA, 2013). Additionally, inadequate aggregation and avenues to market place to farmers is extremely restricted.

By tradition, India is transferring farming practices and knowledge from generation to generation thus in the era of modern agriculture, this creates huge gaps in the demand and supply of farmers skill development. With the lower level of knowledge farmers becomes risk averseness towards innovative technologies and produce could be attributed to low incomes (NSFI, 2015).

Data analytics in agriculture sector is furthermore weak to get specific information on growth and development, investments areas, risk diversification in farming, and discover techniques of integrated farming. This is to note that traditional agriculture and agriculture in underdeveloped countries is starved of investment resources by and large because private capital is deterred by the agriculture risk (Schultz 1964) and institutional investment has also been meagre (Shonfield, 1960).

The distress added by two back-to-back droughts, the collapse of international prices for major agricultural commodities since late 2014, the slow response of the governments and inadequate financial allocation are also major challenges. The state governments have been criticised for not effectively using the funds allocated by the central government for drinking water projects, according to data from the Centres Rural Development Ministry (Shrivastava, 2016). This put in the picture that there is lack of Centre-State Cohesiveness.

Involvement of private sector is also limited in infrastructure and other technological advancement. Weak post-harvest infrastructure and techniques leads to waste and losses to the famers and supply of quality produce to exporters gets hampered. The rising tech entrepreneurs of current generation could build solutions to surmount challenges of information and logistic (FAIDA, 2013). However, the present generation of technocrats, entrepreneurs and researchers are not motivated to enter the sector.

To support and protect the farmer community from the forces of weather or market, designing a sustainable agricultural policy and also creating an enabling institutional structure is easier said than done. The overlooked agricultural universities, extension services and cooperative institutions have collapsed the enabling institutional architecture which is critical to support small and marginal farmers.

Though, Indian government is laying continuous support through schemes and policy frameworks, nevertheless, it is vision that needs robust actions on ground. Since the nature of agricultural production is shifting, conservative methods of increasing productivity need to amend. The highly fragmented nature of the land use in India demands a myriad of economical and appropriate solutions.

More endeavours are requisite to construct a well organized, efficient and result-oriented agriculture research and education system to introduce technological changes in Indian agriculture sector. More strength needed to be put to promote the agricultural education and its orientation towards uniformity in education standards, women empowerment in Agri, vocationalisation and promotion of excellence could be the characteristic of the new policy.

The next couple of chapters will feature the important highlights from the discussions and deliberations at GAC 2016, where entrepreneurs, government officials and researchers conversed about the challenges and potential solutions to the problems in Indian agriculture.

Challenges of Agricultural Sector

- Future Food Security
- Depleting Natural Resources
- Lack of innovation, technologies and communication
- Traditional farming methodology and low mechanisation
- Depleting Natural Resources
- Fragile Value Chain
- Education and skill development
- Risk averseness
- Low level of investments and private participation
- Quality assurance and exports
- Inadequate financial allocation
- Lack of Centre state cohesiveness
- Lack of research and data analytics
- Post Harvest Safety

Global Agri Connect 2016

The fifth edition of the Global Agri Connect 2016 was held at Hyatt Regency, New Delhi on 15 October, 2016. The theme of the 2016 Conference was **'Technologies and Innovations in Agriculture:** Precision, Mechanisation & Communication: Three Pillars of Agriculture Growth. 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: Pushing the Frontiers (2015), Transformational Changes in Indian Agriculture: The Next Decade (2011), Hi-Value Agriculture: A Gateway to Farm Prosperity (2012), Evolving Skill Dimensions: The Lever to Agricultural Growth (2013). 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 **'Innovations in Indian Agriculture: Select Case Studies,** October 2016 in association with YES Bank, the conference knowledge partner. A book on **'Emerging Innovations of 21st Century Indian Agriculture'** would be released during the conference for wider circulation and use.



Whos Who at GAC 2016

The fifth edition of the Global Agri Connect 2016 saw the presence of whos who of the industry. Delegates from different research and financial institutions, government authorities, private companies and entrepreneurs attended the interesting conference and shared their views and visions. The inaugural session saw the presence of **Mr. Siraj Chaudhary, Chairman, Cargill India,**the chief guest of the conference.There were two technical session each followed by one panel session and last valedictory was put to conclude the essence of the conference. The topics of the sessions varied from farm mechanisation to precision agriculture, information, and communication technologies towards the growth of the sector.



MR. NITIN PURI
Senior President, & Country Head - Food & Agri
Strategic Advisory & Research, Yes Bank



DR. H. S. GUPTA
Borlaug Institute of
South Asia (BISA).



MR. SIRAJ CHAUDHARY
Chairman, Cargill India

GAC 2016 - INAUGURAL SESSION

The conference was formally started by lighting ceremonial lamp by all key dig nitaries in inaugural session. The inaugural session of the one-day Conference was kicked off by Mr. Sanjeev Asthana, Chairman, NSFI. Special Address was delivered by Dr. H S Gupta, Borlaug Institute of South Asia (BISA). The chief guest of the conference Mr Siraj Chaudhary, Chairman, Cargill India, gave special keynote address. The session also saw the launch of the NSFI - Yes Bank Knowledge Report, which is a compilation of 30 case studies of various agriculture technologies and innovations from around the country. The Knowledge Report was briefed by Mr. Nitin Puri, Senior President, & Country Head - Food & Agri Strategic Advisory & Research, Yes Bank. Mr. Sai Krishna, CEO, NSFI presented the vote of thanks to all the participants.

Major Highlights from Inaugural Session



MR. NITIN PURI
Senior President, & Country Head
Food & Agri Strategic Advisory &
Research, Yes Bank

- Build competitive advantages by entering in an additional product line (Pulses & Seed Oil)
- Procurement and marketing is a vital element in the value chain
- Boost the efficiency level by means of adopting mechanisation and precision farming
- Reduce the post harvest wastage and losses through Innovation, research and development



DR. H.S. GUPTA
Borlaug Institute of South
Asia (BISA)

- Focusing on food security and nutrition is as important as food production
- Critical challenge in terms of environment and climate should be planned - Less Resources, More Output
- Labour migration needs to be controlled through skill develop ment
- Data analytics in agriculture to understand pattern and directions

> Learning the precision farming and mechanisation as per the need of small farmers would improve the profitability, reduce the cost of cultivation, and enhance productivity per unit area and time"
>
> *- Dr. H S Gupta, BISA*

“In the Indian agriculture, which is a revered profession, farmer community should be encouraged to take the risk rather oppose along with policy and technological support from the government”

- Mr. Siraj Chaudhary, Cargill



MR. SIRAJ CHAUDHARY
Chairman, Cargill India

- Reward-risk equation is the prime reason for significant downfall in skilled labour
- Improve the risk profile through education and skill development
- Government should facilitate trade to enter the tripartite agreement
- Promote farmers to get rewards from market rather depend on governments



MR. SANJEEV ASTHANA
Chairman, NSFI

- Encourage private sector participation throughout the value chain
- Technological infrastructures is essential to be built for impact in long run
- Institutional structure are vital in addressing far reaching issues
- More focus must be given small farm inclusion



The experts in the inaugural session have touched upon all the issues critical to the agriculture sector and this section has enlightened on the same.

In India, agriculture is a lifestyle, a practice, which, for centuries, has formed the belief, the stance, the civilization, and the economic life of the nation. Agriculture, therefore, is central to each and every strategy for intended socio-economic progress. At present, Agribusiness of India has come a long way from just the importer to become net exporter and produce more than it consume on aggregate business.

Though, India has best of technologies or innovations but the problems are equally challenging in current scenario such as optimal resources utilisation, improve cost-benefit ratio of the sectoral activities and co-operative farming to name a few. Mr. Nitin Puri, Yes Bank explained that the country should focus on three pillars of growth to overcome productivity, first, food and nutrition; second, environmental security; third; profitability. There should be an understanding that productivity or efficiency is linked with mechanisation and precision farming techniques, application of Information, Communication, and Technology (ICT) in the entire agri-value chain. Its the holistic transformation of each component not just one in value chain, emphasised Dr. Sanjeev Asthana, Chairman, NSFI.

There may be historical reasons, policies, tight control, and role of private sector, at various levels that deter Efficiency, Productivity, and eventually Competitiveness. Innovation and technological development is the answer to realize efficiency and productivity. Dr H S Gupta, Borlaug Institute of South Asia (BISA) has suggested putting the proper application of precision and mechanisation in farming to reach the ultimate goal for profitability especially when the environment hazards and climate challenges are increasing, and becoming critical. Introducing line of produce (pulses and oil seeds) in the current portfolio and adopting new farming techniques from the west would give further advantage, he added.

Private sector has done remarkably great work in last decade and continuously working on the same across the value chain in agriculture. Private entities have entered to take part in the revolution through investments, technologies at the back end and consider Procurement and marketing in the value chain as crucial factor as pointed by Mr. Puri, Yes Bank. Effective storage techniques to improve shelf life of produce, use of renewable energy, linkage to the markets, transportation are those points of value chain that demands expertise from private sector.

Without underestimating the government responsibilities to catalyse the growth, Mr. Asthana stressed to understand the role of various stakeholders across the sector such as FPOs, research organisations, bilateral agencies etc. Mr Siraj Chaudhary, Chairman, Cargill India also suggested that Indian government should shift its role to act as merely the policy makers.

Speakers also shared concern over the Quality of produce and Nutrition value. India still provide home to the largest number of destitute people of the world which accounts for one-third - 400 million (Telegraph, 2016) (approximately 300 million are in extreme poverty), and nearly half of the poor are concentrated in five states (WEF, 2016). According to the report of UNICEF on child malnutrition, 61 million stunted children under five and 38 per cent of all stunted children in the world are part of Indian domicile[6]. Dr Gupta, BISA emphasised to improve the quality of food and nutrition and Benchmark the standard. In order to overcome the nutritional security, special efforts from input to output need to be redesigned. Institutional structures as stated by Mr. Asthana could strengthen the infrastructure for technology adoption.

The growth from the innovative technologies and business models can only be sought if public and private sector together participate and facilitate to make sure that the technology ultimately reaches to the beneficiaries, as highlighted by Mr. Puri during the speech. The ultimate goal of technology is to increase the profitability but the journey to accom plish that goal goes in the course of improving quality of produce, boost the nutrition value, benchmark the produce as per international standard,

6 *Malnutrition in India: Causes and Implications. (2016). GKToday. Retrieved 20 December 2016, from http://www.gktoday.in/blog/malnutrition-in-india-causes-and-implications/*

> Procurement and marketing, critical element in dairy supply chain, has transformed the payment mechanism through innovation and today todays farmer gets payment as early as 15 minutes the moment he pours milk into their pouring system
>
> *- Mr. Nitin Puri, Yes Bank*

and reduce the waste post-harvest till it reaches to the table amongst. Technology could transform the way existing practices of procurement and marketing mechanism. For developing countries, the use of the Internet (12%) in farm decision making is much less as majority of them use traditional technologies like radio (77.3%) and newspapers (11.3%) (Malhan, & Rao, 2007). Dr. Gupta, BISA also raised concern over technology transfer and communicating knowledge on agriculture to farmers through ICT.

From the Agricultural Research System to the farmers in the field, swift diffusion of technological information and reporting of farmers feedback back to the research system is one of the critical inputs in transfer of agricultural technology (Sharma, 2003), even after we have improved ICT front.

India has shown the great performance in production- agriculture and horticulture but productivity per unit area and time is not enough to control the migration of labour to other profession. Mr. Chaudhary, noted that the migration of labour has become concern after the collapse in international prices for major agricultural commodities since late 2014 and the droughts (Shrivastava, 2016). To promote and protect agriculture, skilled workforce must need to stay but this preference of labour depends on the rewards arriving from taking that risk, quoted Chairman, Cargill. The beautiful correlation explained by him between armed forces and agriculture workforces explains that both the professions are struggling with competence and poor rewards for their risks. Both of these professionals are required to balance their risk-reward equation and learn to manage risks through education and skill development programmes. Mr. Asthana stressed to strengthen the micro level of agri-farming in order to retain small farmers in the segment.

Agriculture is profession with the tripartite agreement between God, Government, and Farmer, where God determines weather pattern, government determines what to sell/sow and farmers follow as instructed. Because, such equation works only in perfect circumstances and not promising in dynamic world, Chairman, Cargill suggested adding another component i.e.

Trade in this relationship for better execution of policies and protecting the farmers interest. He also added that if government support farmers in improving the risk profile of farmers, farmer community will start getting reward from the market itself and eventually improve the potential in them.



SESSION 1

FARM MECHANISATION & PRECISION AGRICULTURE

Technical Discussion:

"Farm Mechanisation & Precision Agriculture -Solution Increased productivity and Adaptation to Transforming Agriculture"



Major Highlights from Technical Session

*(Chaired by **Mr. Rohitash Mal,***
Chairman, EM3 Agri Services Pvt. Ltd)



MR. ROHITASH MAL
Chairman, EM3 Agri Services Pvt. Ltd.

- Deployment of the technologies and its monetisation rather promoting technological development is crucial
- Scale up practices to enhance rupees per acre value for farmers

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DR. KEVIN TIESSEN
Senior Program Specialist,
International Development Research Center (IDRC)

- Promote growth and development at all level of production
- Focus on micro level farmers and secondary crops
- Utilize cooperatives in bringing people together so the farmers get the products/market share through sales
- Use of technology to save losses on shelf and transport through smart packaging





MR. DEVENDRA GUPTA
Co-Founder, Ecozen Solutions Pvt. Ltd.

- Prepare strategic marketing and sales approach
- increase farmers access to quality inputs



MR. SATISH K. S.
Founder, CEO, Flybird Innovations

- Improve irrigation to enhance cultivation
- Use approach of balance soil card for customised inputs & sustainable growth
- Promote custom hiring of machines to small farmers

MR. YOGESH MOHITE
Head of Food Chain, Bayer Crop Sciences

- Enable partnership with stakeholders to promote food sustainability
- Integrate solutions at each level of value chain





MR. RANJITH MUKUNDAN
CMD, Stellapps Technologies Pvt. Ltd

- Utilize smart service delivery in value chain
- Apply knowledge transfer technology through effective extension services
- Redesign intense research and data analytics approach to get accurate and timely information

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PANEL DISCUSSION

What works and what doesnt: Polices to promote development, promotion, and Adoption of precision & Farm Mechanisation technologies

Essence from Panel Discussion

*(Chaired by **Mr. Surendra Makhija,***
Strategic Advisor, Jain irrigation Systems)



MR. SURENDRA MAKHIJA
Strategic Advisor, Jain Irrigation Systems

- Each farm to be treated as production unit
- Transform the entire value chain by digitally connecting the production factors viz., water, energy, soil, seeds, fertilisers, crop advisor.



MR. HARSH VIVEK
Agri Business Advisory Lead, IFC

- Increase the rate of technology adaptability and the role of financial institutions for small farmers
- Empower farmer with risk management and identify benefits of innovation in shorter and longer run

DR. KEVIN TIESSEN
Senior Program Specialist, International Development Research Center (IDRC)

- Enhance the nutrition value of produce for growing nation and create opportunities in allied business fields.
- Promote entrepreneur that support farmers with custom hiring solution to mechanisation of farms that will improve efficiency.





MR. KRISH SIYENGAR
Executive Director, NCPAH

- Replace the hard task with machines and tool
- Adopt technology with the ownership of farmer to get maximum benefits

MR. DEVARAJAN CHATTANATHAN
Joint GM, ICICI Bank Ltd.

- Support the present innovation & technology through investments,
- Create new model and directions by banks and government for investment credit flow





Bayer's Food Chunk Partneship

Bayers Bio Cro p Science follows Business model – "Food chunk partnership" and follow strategy of integrated crop solutions towards agriculture sustainability. Bayer use Agri-inputs services efficiently at farmer level through PPP model where it has partnered with the players of food industry. As technology provider and facilitator, Bayer brings stakeholders at one platform and this approach has interconnected needs of the food value chain - where Producer (>118,000 growers) have got Safe yields and high-quality crops as well as extended and market opportunities in domestic and export markets.

For household food security and self reliance at national level, it is imperative to grow at fast pace in agriculture and build ourselves for global competitiveness. But, before we put together all the innovations and technologies that could strengthen the Mechanisation and Precision in farming, we need to understand customised need at each level for each farmer. Food consumption in India is set to rise by 4 per cent per annum till 2030 (FAIDA, 2013) and it is of the essence to recognize that elementary articles for nation will not be stopped producing even if not advantageous. Thus, to feed the future population, India need approx 400 metric tonnes of grain approximately, clarified Mr. Devarajan Chattanathan, ICICI Bank Pvt. Ltd.

In most of the developing countries, micro-level farming is the dominant agricultural activity, in the hands of millions of peasant households and a bulk of which comprise tiny landholdings with preponderance of owner cultivation, predominantly in the least developing nations (Chand, 2006). There is hardly any direct government intervention in the production and investment decisions of the farmers but the government does influence the legal, material, and economic environment in which farmers operate (Vaidyanathan, 1996).

Indian agriculture is comprised of 95.1% marginal, small, and semi-medium farmers (TOI, 2016) who are more affected by policy change, natural disasters, or innovation and technology according to the 2011-12 agriculture censuses. Most technologies if not relevant to the micro level farmers, there would be adoption issues.

This community of farmers, highly impacted by climate change do not adopt even a low cost technology and look forward to zero cost technology, Mr. Krish Iyengar, NCPAH pointed out.

Further, fragmentation of landholding in the country is at large scale. Mr. Chattanathan insisted for thoughtful review to comprehend if this micro level community of farmers could invest or have such credit absorption. End to end solution, subsidies, handholding, and self-sustaining models would support micro farmer to lower down their risks and improve profitability.

The agriculture sector would emerge when the focus will be on generating net rupees per acre value. Mr. Rohitash Mal, Chairman, EM3 Agri Services Pvt. Ltd. explained the concept of Rupees per acre as one step towards managing the business professionally with applying practices of precise measurement, decisive actions; quality assurance; inventory regulation; industry management like a private entity.

Mr. Devendra Gupta, Ecozen Solutions, supported the thought that more land per unit resource inputs should be made the standard of cultivation in the background of poor average incomes per acre.

Speakers emphasised the need for research and data analytics in the agriculture knowledge generation. Data analytics tool would support farmers to identify pattern; nutrition values; timings for inputs and outputs, explained Mr. Ranjith Mukundan, CEO, Stellapps Technologies Private Limited. The research has become necessity to create better models, schemes for famers either in investment or customised local crop plans. Dr. Kevin Tiessen, International

Development Research Center (IDRC) proposed to enhance student training in the research and extension services and this practices of building knowledge would make apparent the strategies for next 5 - 10 years. The research would also ensure the current agriculture credit flow happening in banking system and expected need for future investment in innovation, positively.

Mr. Chattanathan quoted that agriculture policy is required to change its directions to Enhance investment Credit and b anks should analyse and create a new model for the same.

Mr. Surendra Makhija, Strategic Advisor, Jain irrigation Systems emphasised that Indian agriculture community must get the advantages from exponential technology era especially to embark upon the future insecurities through a holis - tic approach to the Agri-Business rather only infusing science and technology to make larger impact. As the number of technological innovations is growing and significant investment demand is rising, agriculture sector must get financial assistant from institutions such as International Finance Corporation (IFC), a body that invests in private companies and provides advisory services.

The speakers emphasised to translate technology in rupees per acre and support scaling up of operations, rather develop technology for the sake of technology. If scientists want buy-in from producers, they must ensure that new technologies are practical. There is some disconnect between what works well in a lab or research plot, and what works in a commercial application where a larger bottom line must be respected.

Further, FPOs must be encouraged to use innovative methods of precision/ mechanised farming integrated with Geographic Information System (GIS) and ICT technologies. In such scenario, government must set up for viability gap funding model to support small farmers to manage sky-scraping cost of such technologies (e.g. laser based land levelling).

Mr. Harsh Vivek, AgriBusiness Advisory Lead, IFC recommended applying a model of smart subsidy where bank can convert capital subsidy to risk sharing. He proposed that if government use money as risk guarantee fund with bank, it would reduce interest rate on farmers rather just government giving financial aid to farmer to buy technology used by farmers, would create the ecosystem to employ the assets extensively and give higher return to entrepreneurs.

Ecozens Storage & Market Solution

Ecofrost, a Mobile Storage Facility was innovated to resolve storage and market challenges and could be used for number of different products. The technology is to install and commission through mobile application and comes in various models. Farmers reaped benefits of 3 Rs/kg/day in the harvest of Marigold by saving the crop post harvest by using the technology and amplified profits. Even model of custom hiring has supported farmers to store the commodity for 8-10 days by paying close to 2 Rs/ kg at the convenience and safety of his produce.

IOTs Smart Service Delivery System

Internet of Things (IOT) & Big data is a Smart Service Delivery Platform in Dairy Agri-Business. Through Cloud Computing, sensors, and information technology, IOT provides End to end dairy solutions. SmartMoo collects data automatically and supports Real-time Data Dissemination & Payment System. The technology is used in extension, service delivery and linking farmers to markets. The technology optimises milk supply chain and generates more milk with less expense. Easy to use and scalable technology for other crops minimises middleman thus resulting more profits to the farmer.

IDRCs Research Investment

A key part of Canadas aid program, International Development Research Center (IDRC) supports research around the world to improve Agriculture and Food Security through focus on small-scale farmers, secondary crops, gender and environmental sustainability along with other research domains. IDRC promote nanotechnology and hexanal in South Asia as an innovative model to reduce post harvest food waste especially in fruits. The technology boosted life of mangoes on trees itself up to 3-4 weeks and doubles shelf life. Moreover, 10-15 % reduction of post-harvest losses through smart packaging systems has been observed through the application of technology.

Linking partners from seed to shelf and creating impactful Food Chain Partnership Model of Bayer (Processor / Exporter / Retailer (> 40 partners)) is another innovative model that saw consistent and controlled quality of harvested goods having large variety disclosed by Mr. Yogesh Mohite, Head of Food Chain, BayerCrop Sciences. The scale up and integration of technology with other is also another critical element. Scaling-up of Automations through Financial Support e.g. use of drones for crop cultivation due to the unavailability of labours, bulk storage etc requests national policy redesigning, added Mr. Chattanathan.

As the application of technology is important, Mr. Vivek recommended that while adopting the technology, four aspects must be considered as vital: improvement in the efficiency level, increase in profitability or competitiveness, resilience to climate change or stability with time is must. Plasticulture tool is a good example of the same where, use of plastics in agriculture to harnessing available natural resources such as water and sunlight in improving the productivity and quality of the produce is promoted by NCPAH.

Consumer companies will have key opportunities as well as concerns in the upcoming 10 to 15 years (Bové & Swartz, 2016). Some 1.8 billion people are likely to be part of the global consuming class by 2025, a 75 percent boost over 2010 (MGI, 2012). Also, sustainability impact can interfere with supply chains consumer companies. This was also reported that Unilever would lose some 300 million per year as worsening water scarcity and declining agricultural productivity lead to higher food costs (Unilever, 2014). Thus, it becomes critical to save environment and conserve water efficiently in agriculture especially in developing country like India where approx 83% water is used in irrigation (Gupta, 2015).

Mr. Satish KS, Flybirds Innovations mentioned that by means of irrigation technology, the farmers would be informed about exact water requirement in cultivation, but these farmers need to learn to optimally utilise this saved water for other purposes. Technology must compliment the agenda of More with less and farmer should be encouraged to grow crops that require less water or value added crops, praised, Mr. Makhija.

Another concern of India is wastage of food. India wastes more food as much food as the whole of United Kingdom consumes (Rs. 50,000 crore worth of food every year)[7] which need to be controlled through proper mechanism and strategy. Estimate shows that India looses high post-harvest approximate 35-40% of annual production (Rs 40,000 crores per year)[8]. Dr. Tiessen called attention to adopt new approaches for small size of landholdings, cold storage, and poor infrastructure.

Among all these, role of farmer becomes very critical in decision making, thus today communication of agriculture intelligence, faster technology transfer and extension services need significant improvement. Historically, agricultural service delivery in developing countries started with production-oriented limited extension services for export crops and later diverted to food production and improved farming techniques(Xiaolan, & Akter, 2011). Today, mobile phone technology enhanced service delivery system on agricultural extension services delivery in India and Stellapps Technologies is one of those examples.

This is to note that farmers are very comfortable with their cultural practices and dont want to see great benefits of technological shift. External financial support may enhance the chances of adoption, but, it is necessary to educate the farmer about the benefits of technological change, speakers agreed. Education also mitigates the risk factor through removing the communication gap between scientists and producers and helps farmers to manage risks from disasters and to ensure sustainability in agriculture that will lower down the risk of labour migration in the words of Mr. Makhija. Likewise, a growing economy such as India requires a large pool of

India wastes more food as much food as the whole of United Kingdom consumes which need to be controlled through proper mechanism and strategy

skilled workers and the labour force is projected to grow by close to 2 per cent; adding over 7 million per year for the next few years (IBEF 2013).

As the workers migrate from the rural and predominantly agricultural sector to other urban sectors, India realises that it has the necessitate for a well deliberated and executed strategy to supply a novel set of skills through vocational training in order to efficiently absorb this additional workforce and sustain economic growth, report highlighted.

Thus, the challenge comes in the form of skilling the labour through technology, through awareness and educational programmes.

The labour market data indicates the low level of education of labour force wherein about 80 percent has education up to secondary with about 29 per cent as illiterates (Sanghi, & Srija, 2015).

The session highlights that India has progressed in technological advancement in Agribusiness, however, a strategic approach in implementation of those technologies at the ground level is required, supported by government policies and regulatory mechanisms. Private companies could boost farm mechanisation and precision through deployment, awareness, scaling up of technologies and support the agricultural transformation.

Flybirds Smart Irrigation System

Flybirds lo w cost innovative and smart irrigation system encounters challenge of water scarcity, erratic power, excess irrigation/Fertigation and reduce high labour cost. The tool SIRI - Smart Irriga - tion controller controls water and fertilizer flow precisely by measuring: Soil moisture, Soil temperature, Air temperature and humidity, Rain Sensor. The tool features Solar and wireless model with inbuilt systems for remote monitoring and controlling, history in a graphical display, data analytics, and 3G mobile / wireless sensors. The tool has supported in terms of water saving 25% to 30%, crop yield / productivity improvements 10 to 15%, improvising the livelihood of farmers, less dependent on manpower and no human errors.

7 *Food Wastage In India A Serious Concern. (2016). Retrieved 20 December 2016, from http://www.thecsrjournal.in/CsrPages/ViewContent/225?pageName=HLT&conttitle=Food%20Wastage%20In%20India%20A%20Serious%20Concern*

8 *Horticulture: Post Harvest Management. (2016). Nistads.res.in. Retrieved 20 December 2016, from http://www.nistads.res.in/indiasnt2008/t6rural/t6rur13.htm*



SESSION 2

INFORMATION & COMMUNICATION TECHNOLOGIES

Technical Discussion:

"Technologies from extension to decision making tool – need for ICTs evolution to be more relevant to end users"



Highlights from Technical Session

*(Chaired by **Dr. Vishnu Chandra,***
DDG, National Information Centre)



DR. VISHNU CHANDRA
DDG, National Information Centre

- Digital GIS Assets, location base services and Maps are vital for effective knowledge trans - fer and communication
- Seamless integration of topographical data and scalable platform is important for effective delivery of knowledge

DR. T. S. ANURAG
Senior Research Scientist Media Lab Asia

- Push and Pull technology for easy communica- tion is essential
- Expand the outreach of agriculture universities or extension services
- Personalised or customised feedback and consul- tation yield better results





MR. ELLIOT ROSENBERG
VP - Business Development, Awaaz De

- It is essential to use replicable and scalable model
- Empower farmers with right information at right time is challenging and could be effectively ensured using ICT



MS. SHILPA MEHTA

Senior Consultant (ICT), NeGP-A, Dept of Agriculture Cooperation and farmers Welfare

- Must provide single platform in simplest form to avoid confusion among farmers
- It is essential to facilitate farmers about the government schemes, insurance plans, credit need etc through technology
- Educate farmers to use mobile applications through digital literacy

MR. PRANEETH KUMAR

Manager, Strategy & Innovation, AgroStar

- Distribution channels in rural areas must be reformed
- Use IT to create digital sales mechanism to minimise hassles in procurement
- Farmer-level insights must be analysed to create long-term operational benefits for them





MR. AMIT BHARDWAJ

Co-founder & CEO, Level A Commodity Services Pvt. Ltd.

- Educate farmers about new technologies and their benefits
- Creating the data bank for better consulting and advisory is must
- Have to focus on reach-ability, scalability and sustainability of ICT technologies

PANEL DISCUSSION

What works and what doesnt: Polices to promote development, promo - tion, and Adoption of precision & Farm Mechanisation technologies

Highlights from Technical Session

*(Chaired by **Mr. Radha Krishnan,***
Co-Founder, GrocerMax)



MR. RADHA KRISHNAN
Co-Founder, GrocerMax

- Information technology to facilitate rural (sellers) to urban (buyers) commodity / information movement
- It is of the essence to improve connectivity between producer and consumer with digital technology

MR. SANDEEP MALHOTRA
CEO, Iffco Kisan Sanchar Ltd.

- Strong policy framework and regulatory mechanism is imperative to enable growth faster in the sector
- ICT must reach to masses and change the mindsets towards adoption





DR. SUNIL KUMAR
General Manager, NABARD

- Increase the promotional funds to scale up information technology
- Minimise the communication gap through creating farmer clubs, federations or other such forums



MR. NAVIN HORO

National project Coordinator, GIZ India

- Exchange knowledge rather share collected data with farmers for better output
- Integration of local marketing agencies for effective value chain is significant

MR. RANTEJ SINGH

Practice Lead Digital Innovation, MF Strategy Gurugram

- Promote digital marketplace and create aggregation points for better execution
- Activate the sleeping FPOs and enhance the communication and knowledge transfer





MR. MANISH TRIPATHI

AVP NCDEX Spot

- Trade must be facilitated to control the quality
- Standardisation of quality as per international standards is essential to enter in the global market



We are deliberating for decades towards the paradigm shift in the traditional agriculture functioning in order to bring revolution in enumerating the existing resources for amplified productivity and economy. In agriculture, ICT has arrived at far beyond necessity and it has large scope to disseminate the information to the agriculture community efficiently and prudently.

Present state of affairs necessitates agriculture extension services and emphasises Transfer of Knowledge rather Transfer of Technology to enable the system to enrich its vigour and rejuvenate with changing agro-climatic scenario (Murthy & Tara, 2013). Information technology has changed the way business has worked traditionally and gave growth in exponential number. Pervasive and widespread application of the ICT has become an important tool of agricultural extension. Various approaches of delivery of e-enabled services have been envisaged under the National e-Governance Plan Agriculture (NeGP-A) such as internet, touch screen kiosks, Agri-clinics, private kiosks, mass media, Common Service Centres, Kisan Call Centres (KCC), and integrated platforms[9].

Moreover, India is blessed with innovative ideas, technologies, and business models and even agriculture sector is getting benefitted with lots of such innovations. Dr. Vishnu Chandra, DDG, National Information Centre, admired that plenty of schemes and initiatives have been launched by the government especially Digital India i.e. a program to transform the nation into a digitally empowered society.

Mr. Radha Krishnan, Co-Founder, GrocerMax started the session while raising one of the most important and critical point i.e. Digital Trend.

9 *mKisan Portal Mobile Based Services for Farmers. (2014) (1st ed.). Retrieved from http://mkisan.gov.in/images/Detailed%20Writeup%20on%20mKisan.pdf*

He pointed out recent online sales figures during Indian festival Diwali which were eye-opener in terms of choices, patterns, and reach. He informed that the numbers of orders for online sales were significantly higher from the cities of Tier 2, and Tier 3 and this reflects the reach of information technology from urban to rural was exponential[10]. Calling it a Hourglass problem where one side of producer is not able to reach to the other side of consumer, Mr. Krishnan suggested to improve the Rural to urban connect which is pertinent from decades.

Todays innovators have brought technologies that are enabling small vendors to trade their product to the end consumer at minimum cost from rural to urban, mentioned Mr. Rantej Singh, MF Strategy, thus making possible to make this shift. Additionally, NABARD is also investing huge number of promotional funds to support innovation and technologies.

The agriculture sector is more of a substantial nature thus, its issues and confrontation could not be realised without visiting fields, pointed out Mr. Manish Tripathi, AVP, NCDEX Spot.

Spot. Besides, farmers face multiple challenges in procuring inputs for their farming needs. These inputs are subject to frequent unavailability due to demand and supply mismatch, substandard locally manufactured products, duplication, adulteration and black-marketing of key products. Mr. Singh, also mentioned that the developing an ecosystem for business becomes significant in agriculture sector where the economies of sales must compliment the logistics.

Subsequently, what should be the role ICT to enhance this relationship where farmers need experts for advisory and different stakeholders in the entire value chain? There are systems such as Interactive Voice Response (IVR), extensions system as Krishi Vigyan Kendra (KVK), Mobile Apps, which are of merit however, Mr. Navin Horo, GIZ India explained the challenge of these platforms in transferring just the information not intelligence. He reasonably mentioned that multiple source

The agriculture sector is more of a substantial nature thus, its issues and confrontation could not be realised without visiting fields

Level A Commodities Pvt. Ltd

Level A clubs IT and commu - nication with Agri-Business to provide Agriculture Knowledge through their vast knowledge banks & real time market intelligence. Valuable analytics are made available to stakeholders ensuring an edge in a volatile market environment and advisory on Agriculture Value Chains, Trade and Investment and International Trade & Analytics to clients worldwide. This timely & accurate information is critical of business operations to various sector players such as Trading Houses - Domestic & International, Food Processors, Hedge Funds, and Central & State Government Bodies.

Awaaz De

They develop inclusive mobile solutions (with capabilities in IVR, SMS, mobile apps, and web) that enable business to achieve last-mile connectivity for social impact. With over 680,000 users in 12 countries globally, they have developed customizable mobile technology solution. They overcame basic barriers of literacy and language to both disseminate content as well as collect data in ICT platforms in India, driven by basic phones and medium of voice. Their system, one of the most referenced in the ICT4D space impacted rural communications approach highly. With 1000% ROI, +26% Yield, 10,000 questions submitted, 12 lakhs farmers targeted, Awaaz. De is promoting Digital Green in the nation.

10 *Five e-commerce trends this festive season. (2016). Retrieved 20 December 2016, from https://yourstory.com/2016/10/e-commerce-trends-festive-season//*

of information in fact generates more uncertainty especially, for the farmer who only needs consultation as per tailored need. ICT could be the middle path of technology transfer to farmers such as soil health card, micro irrigation systems, integrated pest management, farm mechanisation through training and demonstration, digitization of land records, rainwater harvesting, and financial inclusion of farmers. Mr. Sunil Kumar, GM, NABARD believed that the communication gap must be minimised either application like mKisan or through creating farmers clubs, federation and similar forum to disseminate the knowledge.

Though, the use of internet and mobile is growing at fast pace and can be a medium for resolving agriculture problems, still traditional extension services are preferred i.e. voice, said Mr. Elliot Rosenberg, Awaaz.De. Thus, platform adopting the model of IVR or voice transmission of knowledge will be more preferable. Dr. T S Anurag, Senior Research Scientist, Media Lab Asia trusted that the model of Push and Pull Information System would empower the farmer with exchanging feedbacks, queries, innovations, deployment techniques while promoting digital literacy at ease, ease of communication, increase in services and awareness simultaneously. Integrated platform such as mKisan would also help farmer to get notified about government schemes as Fasal Bima Yojna, insurance companies in the sector, application tracking, updates on market price with all digital support.

ICT, with bundle of innovative communication tools have broadened the scope for farmers to get accurate and personalised information on real time and resulted dependency on information from 92% to 56% explained Ms. Shilpa Mehta, Senior Consultant (ICT), NeGP-A, Dept of Agriculture Cooperation and farmers Welfare. From simple methodology of query drop or missed call to getting expert call where technology supports the mechanism of assigning the questions to the right expert for better output is not only replicable but good means of productivity in upcoming Digital Green revolution

Farmer community also faces significant challenges in procuring input needs and government is obliged to reform the rural distribution channels which is decades old and has not seen any form of disruption, put the supply and demand side challenges in Agri-Retail Chain, mentioned Mr. Praneeth Kumar, Manager, AgroStar. Similarly, post harvesting phase of farming is crucial in order to save the efforts and give returns for those efforts. Transformation in shelf life safety, transportation, packaging techniques, marketing and buyer connect would enable farmers to get the best price for their produce. Though, experts suggested that digital marketplace for agricultural need can revolutionise the sector however without integrating physical model of aggregation points in rural India, it would be challenging, pointed out.

Mr. Singh. He suggested utilising self helps groups of NABARD, FPOs, SFAC of Ministry of Agriculture as aggregators while ensuring the efficient activity level. Additionally, the digital sales mechanism may have high impact if technology helps to use Insights to Make Data-Driven Decisions as product customisation, local need pattern, purchasing mindsets as indicated by Mr. Kumar, AgroStar. Additionally, Public-Private Partnership (PPP) would strengthen the extensions services through organising scattered farmers and get connected with markets, Mr. Kumar, NABARD suggested.

Mr. Tripathi, stated that although we have enough of information with us, application of that knowledge to determine pricing, aggregators, quality is non-existent. For logical deployment of technologies and application of knowledge in Agribusiness, sector requires apt data analytics and intelligence on information on agriculture through on/off-field surveys, data mapping, and other such tools. Ecosystem of data analysis would support the system towards sensitivity.

The knowledge created should facilitate trade to control and guarantee the

Farmers Portal

The challenge of availability of extremely detailed huge data (800 websites, 80 DAC websites, 8 organizations) on agricultural on the web in the form of departmental websites, portal and forum in English Language, Farmers Portal has been created. A farmer will be able to get all relevant information on specific subjects around his village/ block /district or state and in the form of text, SMS, emails, and audio/video in the local language using the portal. It is a one stop shop for meeting all informational needs relating to Agriculture, Animal Husbandry and Fisheries sectors production, sale/storage without sifting through maze of websites created for specific purposes.

mKisan Mobile App

It is portable version of Farmers Portal to get information/advisories as per preferences in the form of text/voice messages and getting access to numerous databases even without internet. The Department of Agriculture & Cooperation conceptualized, designed, and developed in-house to disseminate information, give advisories and to provide advisories through mobile telephones. Since its inception in 2013 nearly 50 crore messages or more than 152 crore SMSs have been sent to farmers throughout the length and breadth of the country. With nearly 3000 officers and experts from the Government of India and States and its organisations down to Block level, SAUs, KVKs and AMFUs, in 12 different languages, opted by 70 lakh farmers, this unified portal is making dent in agricultural advisory services.

Agrostar m-Commerce platform

This direc t-to-farmer platform aims to transform Agri-business for farmers in rural India in procurement of Agri-Inputs. Farmers with just miss call can procure desired crop inputs or using mobile app. An entire range of good quality and branded inputs like seeds, crop nutrition, crop protection, and Agri-hardware products are delivered to doorstep. Agrostar completes the entire transaction cycle within 10-16 days to procure or buy all what farmers needs and capture and analyzes deep farmer-level data, socio-economic status, preferences, demographics, Buying-behavior patterns across seasons and customer retention via marketing programs that supports customer satisfaction.

NABARD

As an apex development bank of agriculture, it works for the welfare of farmers. It supports the banking sector through credits, refinancing, short & long term credit, investment credits, finance to state government for rural infrastructure and so.

Through total loan asset of 3 lakh crores and 28% of which for green investment, highlights that focus on environmental sustainability. Nabarad give emphasis to the conservation and optimal utilisation of depleting natural resources, mitigate the distress of farmer community, linking to market through collection / meeting of producer FPO, promote the investment credit to support innovation.

quality of the product and must act as guide for the farmer to standardise product packaging and quality, proposed Mr. Tripathi. Whereas, Mr. Amit Bhardwaj, CEO, Level A Commodities Pvt. Ltd. recommends that communication will facilitate in developing the right farming decision, information dissemination via reaching farmers/ dealers / distributors / company stakeholders. Capturing and analysing deep farmer level insights, enables the company to create long-term operational benefits for the farmers, added Mr. Kumar, AgroStar.

Seamless Integration of Topographic Data over Satellite Imageries with attributes from various domains through multi-layer GIS would also change the communication in this context as informed by Dr. Vishnu Chandra, DDG, National Information Centre. He added that integration of dynamic model created by government will not only update newly formed villages automatically, but will connect all Panchayats and even blocks that would facilitate getting answer to most delicate questions.

Consequently, leveraging technology to build scalable systems at every node of the value chain is a requisite with consistency of synergic approach. Further, integration with other applications or platforms is key matter for future permanence and steadiness in the words of Ms. Mehta. Integration as crucial element of ICT space and if system is able to integrate knowledge and expertise in one place for an example, aligned with the weather data because even short term variation in weather information would impact the food security, it would be help in getting significant advisory about weather forecast, stated, Mr. Horo. He also empathised that these platforms could take advantages of local marketing agencies to strengthen the marketing output for agriculture.

India is blessed with great number of technologies and technocrats. As discussed earlier, numbers of farmers using mobile application as well as internet is not significant in India because they are still resistant to adopt new technology and eventually ended up with lower inefficiency and the productivity. The farmer community must be trained to understand the technological advantages for instance the forecasting model of weather or yield model that could guide for better cultivations techniques. A personalised Agro-advisory and information services in local language as per the customised need of each farmer should provide personalised solution through KYF (Know Your Farmer) approach, emphasised Dr. Anurag. Understanding the need and interest of farmers would sustain the quality delivery of services. Initiative of IFFCO Kisan Sanchar Ltd (IKSL) and Airtel, Green SIM card for farmers provided voice-based agricultural information in regional languages with an aim to use Information Communication Technology (ICT) to empower farmers in the rural villages and strengthen the cooperative network across the country[11]. In August 2014, IKSL reported 3.1 million Green SIM users[12], however, the target number of farmers is larger than 100 million. Mr. Sandeep Malhotra, CEO, Iffco Kisan Sanchar Ltd. stated that these figures shows that farmer must get education to change its mindset towards dynamic changes happening around and prepare oneself to avoid risks.

The session witnessed deliberation that motivated the thought to utilise the power of ICT as an enabler rather create business model around it. Developing an eco system of business model where technology should enable the business to grow must be encouraged. It is difficult for ICT alone to get into Agri-transformation but it is just a pillar that could support the ecosystem guided and regulated by strong policies and transparency.

11 *IKSL distributes 1.5 lakh Green SIMs to farmers. (2016). Business-standard.com. Retrieved 20 December 2016, from http://www.business-standard.com/article/companies/iksl-distributes-1-5-lakh-green-sims-to-farmers-109120900078_1.html*

12 *Case study Airtel Green SIM. (2015) (1st ed.). London. Retrieved from http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/03/GSMA_Case_IKSL_web2.pdf*

VALEDICTORY

***Mr. Sanjeev Asthana**, Chairman, NSFI*
***Dr. SK Malhotra,** Agriculture Commissioner, DOA, CFW*
***Dr. KK Singh ADG,** Process Engineer, ICAR*
***Dr. Sai Krishna,** CEO, NSFI*
***Dr. KK Upadhyay,** Advisor NSFI*



The valedictory session highlights the essence of all deliberations and discussions done by all the eminent speakers from different fields and expertise.

Since the origin of the humankind, agriculture has been an element of individual life and the necessity for agricultural information is perhaps just about as old as agriculture itself (Malhan, & Rao, 2007). Half of the Indian workforce is still dependent on agriculture while output share from agriculture in countrys GDP has fallen to 14.4 per cent and even in the rural households depending on agriculture, over 40 per cent of income is from non-farming economic activities[13]. Furthermore, agriculture sector is in transition with more challenges and more concern to increase its full potential in terms of yield, processing, and exports. In the game of huge future demand and supply, all efforts would be successful if India ensures sustainable supply to consumer and drives farmers to meet the demand using innovation and technology. In this state of affairs, foremost confrontation is to make certain food security. Thus, India must overcome supply side barriers and make certain seamless end-to-end linkages to comprehend the factual demand prospect (FAIDA, 2013).

Both the numbers and the proportion of economic reliance are at declining stage for

13 Technologies and Innovations needed to increase Farmers Income. (2016). Agri Nation Farming is a way of life. Agrination.org.in. Retrieved 20 December 2016, from http://agrination.org.in/technologies-and-innovations-needed-to-increase-farmers-income/#sthash.z78de7q6.dpuf

the manpower dependence on agri culture, stated Mr. Sanjeev Asthana, Chairman, NSFI.

There is need to enhance the income level of these exodus of manpower that is going away from agriculture that can protect Indias food security.

The valid concern is if the manufacturing and other service sectors would be able to absorb this exodus from agriculture. Mr. Asthana proposed to develop new eco-system around the value chain from supply to production and to market where expected exodus workforce may get protection. Dr. KK Singh, ADG, ICAR emphasised that education and research must move through various technologies especially extension services. He stated that lack of skilled and illiterate labour could be minimised through proper knowledge transfer and up skilling.

Any technology or innovation that can bring direct or indirect benefit to farmer especially improving the income level, is worth focusing and promoting

Various researches gave evidence that private participation still need to take off in India. Dr. Malhotra also emphasised that private companies should come up with solutions to walk together towards the nation of our dream. In various stages of agriculture farming such as processing, branding and marketing, private capital participation has become crucial e.g. model of custom hiring of machines and tools for precision farming.

Dr. Malhotra stated that in spite of the achievements in agriculture and horticulture, India must continue infusing Mechanisation and the Precision especially in specific areas such as nutrient management or fertigation or micro irrigation in order to meet the high quality demand of near future. More crop per drop and protecting the income from agriculture is the only means of ensuring Indias food security. While maintaining the dignity of farmer, mechanisation also solves the problem of labour scarcity and manages risks from nature through timely completion of work. Dr. Malhotra was very positive about sensor based technology that could help Indian farmers with accurate information. Innovative technologies such as solar power driven systems, hydroponics interventions and hybrid technology to get more yields or sensor integration for irrigation (Sprinkle system drip irrigation) to control water misuse must be considered.

To support farmers with ICT revolution and mechanised models of farming, government must create policies that attract technological investments and sustainable approaches in sector. Dr Singh informed that harmonisation of standards for a machine at international level is an obligation which manufacturer must adhere to. Though, government is also boosting the manufacturing in the country through its various missions, it is imperative that central and state government must work in cohesive manner to attract foreign investment in agriculture sector suggested, Chairman, NSFI. In fact application of mechanisation and precision would not only help producer in retaining superior quality nutritious food but with competitive advantage in the sector, it could make India one of the top five exporters of agriculture and food products (FAIDA, 2013).

Towards the mission of doubling the income level of farmer by Prime Minster Shri Narendra Modi, India must create balance where rising income could enhance the lives of millions of farmers. As a result of the agricultural produce, processing and export growth, the sector could possibly grow at 5.2 to 5.7 per cent (in real terms) over the next 20 years which may aspire to perk up income of farmer by over four times (real terms) (FAIDA, 2013). Any technology or innovation that can bring direct or indirect benefit to farmer especially improving the income level, is worth focusing and promoting.

While wrapping up and presenting the vote of thanks, Dr. KK Upadhyay, Advisor, NSFI emphasized that technology must boast last mile connectivity as technology and innovations are the principle driver of development at the moment. He highlighted that production technologies are the most critical and the building blocks to ensure India achieve self-sufficiency. Dr. Upadhyay highlighted that NSFI over a period of time has explored various innovations and technologies on the parameters of their value proposition, impact and scope to scale up. Through the deliberations, GAC 2016 attempted to present the merits of these successful technologies and innovations before a large congregation of agriculture stakeholders. He aspired to take forward the mission to the next level of discussion towards growth and glory of the country.

POLICY RECOMMENDATIONS

Several million small farming families, which form the backbone of Indian agriculture and economy, have helped the nation to achieve remarkable growth in agriculture during the last three decades. In this period, food grain production got doubled from 102 million tons to nearly 200 million tons but this production increase was achieved from yield gains rather than expansion of cultivated area (Planning Commission, 2016). The growing population is expected to amplify overall food consumption of India by 4 percent per annum to reach USD 483 billion in 2030 from USD 242 billion in 2010 while the current average income of farmer is 30 to 40 percent of Indias per capita income according to FAIDA report. Thus, it becomes pertinent to intervene in the existing agricultural model for enhancing income, food quality, and export. All-round development and economic feasibility of agriculture must be accelerated by the national agricultural policy through support, encouragement and incentives.

In the backdrop of depleting natural resources and challenging climatic conditions, it is imperative that technologies and innovations help the farmer in not only decreasing his cost but also increase his income to enable him to serve the growing population. Further, the manpower exodus from agriculture necessitates not only more crop per drop but also more crop per unit of labour. Various dimensions of Indian Agriculture and the recommendations that emerged in the conference deliberations are summarised below:

Optimal Use of Natural Resources

The scarcity of natural resources and climate issues would not only impact India but the world itself. The policy must ensure scientific inputs towards sustainable agriculture such as soil and water testing services that would eventually help to maintain nutrients and water supply. Promoting manual manure and micro-nutrients support to farmers through seed quality, while using methods of irrigations such as drip irrigation combined with fertigation would significantly save the water and other crop losses. Policy must support such innovative entrepreneurial concepts through financial assistance and other structural support and besides educating these farmers to do more with less in order to conserve natural resources and protect the environment. For optimal use of natural resources, there is a need to develop and deploy technologies that provide scope for customised and onsite solutions with high input-output ratio for the benefit of small farms.

Soil Potential & Yield Improvement

India has vast untapped potential of soil and water resources which needs to be focused to improve efficiency and competitiveness. Shift in the consumption patterns would also challenge the producer to diversify and adopt high value crop as per the future demand. Policy framework must push conventional practices to increase genetic yield across the agri-product line and develop hybrid varieties. India should promote Agronomic and soil researches to identify local soil health problems among others. To improve yield, the structural constraints such as fragmented land and the farm technology and techniques apart from high quality input availability ought to be looked into. It must remove inadequate decades conventional farming practices, and exercise evenhanded and systematic use of inputs, plant fortification, agronomical practices, etc. to accelerate sustainable yield. This essentially requires intervention from technological solutions especially to offer customized, localized and precise soil management solutions. This however, would need technology adaptation with farmers ownership, if we were to see wider deployment and adoption of appropriate technologies / innovations. In the age of technology enabled data aggregation from farmers, it is imperative that data analytics provide meaningful scope to offer customized farm advisory services to the farmer at their door step.

Building Research and Data Analytics Models

It was also obvious throughout the discus-

In the backdrop of depleting natural resources and challenging climatic conditions, it is imperative that technologies and innovations help the farmer in not only decreasing his cost but also increase his income to enable him serve the growing population

sions that automated techniques in farming would be highly important and useful for better execution and productivity augmentation. National policy framework must focus on collecting on/offline Agri-Data & develop Agricultural Intelligence to support innovations, business models, and related farming needs. Through data analytics, players in value chain would be able to redesign business model and bring customised solutions on the table. While the prevailing trends indicate prevalence of push technologies (that push the applications for farmers use), there is pressing need for pull technologies (that collect/aggregate data from farmers) to facilitate data analytics that can churn out meaningful decision facilitating information transfer to the farmers that sheer transfer of data to the discomfort of farmer.

Current technology interventions of commodity marketing would not suffice, if the farmers and their collectives are not able to access and make relevant and timely use of them

Further, in the backdrop of several failing start ups in the country, there is a clear emerging need to support not only the farmers through various schemes, but also several other technology entrepreneurs who are supporting the farmers through developing decision making tools.

Supply Chains and Markets

The policy framework must consider improving the efficiencies of agriculture value chains and markets. Similar to the magic of information technology in various sectors (say health, education, industry), IT offers immense scope to reform the prevailing physical markets (APMCs) and integrate them with innumerable local hats and also online platforms in the interest of better price realisation by the farmers. However, current technology interventions of commodity marketing would not suffice, if the farmers and their collectives are not able to access and make relevant and timely use of them.

Use of IT has grown exponentially and is now connecting consumers and producers sensibly under Rural to Urban Mission. This certainly can enable farmers in choosing whom to sell and where to sell and can also directly connect them to processors, aggregators and merchants, provided the prevailing infrastructure is robust which can offer seamless and cost effective services in a timely manner.

Private sector or entrepreneurs creating digital platform as well as Centralised Retail Outlets for input needs must be encouraged to diminish procurements hassles. Technological interventions from private sector can minimize post-harvest losses and further can enable adherence to quality standards through integration of farmers and their collectives in respective agriculture value chains. Thus, the policy framework in the country should necessarily enable integration of farmer collectives and corporate to the betterment and efficiency of the supply chains.

Integrate ICT and Extension services

Agriculture Policy must open up the path to bring that expertise and innovation to accomplish Indias potential. This very much requires Integration through its enabler that is ICT. The policy framework should uphold infrastructure needed to deploy the existing technologies and refine the capabilities to bridge the gap of technology transfer for the benefits of the farmers. Deployment of Digital GIS Assets, location base services, facilitate use of Maps amongst others would facilitate personalised consultation and advisory to the farmer.

Further, extension services are of the essence to bring in and put together science and technology into the farming system. Policy must encourage both top-down and bottom-up stream of communication and knowledge dissemination. Use of Push & Pull System of information transfer, integrating IVR system to get feedback/responses for the questions raised or submitted and effective use of mobile application would support the farmer with timely and accurate information. PPP models in extension services could also strengthen the contribution in farmer empowerment and KVKs may possibly facilitate the whole process for better implementation.

In the current times, extension systems need to focus on rupees per acre as against production per acre as the principal value proposition put forth to a farmer. Thus, each farmer to be treated as a production unit and thus the forward and backward linkages are to be enabled through technological interventions.

Most critically, the extension systems should now evolve from information dissemination mandate to decision support mandate.

Funding the enabling systems in addition to Production Systems

Though, schemes and programmes to provide production technologies and their adoption, has been the main focus in independent India, it is time to recognise the importance of various enabling systems on farm income. Infrastructure the principle enabler, in agriculture needs improvement through investments and innovations.

Further, infrastructure in terms of collection, harvesting, packaging, storage, and transportation from the farm is the critical piece that calls for invigorated attention. Attracting entrepreneurs and supporting them with structured help to scale up initiatives apart from subsidies should be the principal ingredient of the current agricultural policy. Government must promote and create systems to mitigate inherent risks in agriculture and improve the adoption of new technologies. Government should facilitate investments from angel and venture capital funds in high priority areas that can clearly enhance farmers income. To support the present innovation & technology requiring investment, banks and government should create new model and directions for investment credit flow. Government should revisit stock limits, favourable tax regimes, and incentives for value chain sectors or enabling viability gap funding.

Climate change

From ancient times Indias agriculture has been dependent on monsoons. Any change in monsoon trends drastically affects agriculture. Even the increasing temperature is affecting Indian agriculture. The impacts of climate change will be more on rain-fed or un-irrigated crops, which are cultivated on nearly 60 percent of cropland. In view of drastic environmental changes taking place it is necessary for farmers as well as for the Indian government to adapt to changing situation as soon as possible. It was pointed out in GAC 2016 that all stakeholders should assist farmers in coping with current climatic risks. Farmers can adapt to climate changes to some degree by shifting planting dates, choosing varieties with different growth duration, or changing crop rotations. Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity. To cope with the impact of climate change on agriculture and food production, India will need to act at the global, regional, national and local level



Convergence in resources and competencies

Apt policy framework and legislations could strengthen the association between industry and farm and lead to efficiencies. It is not possible to implement each and every solution right away. Removing barriers of infrastructure, scaling of mechanization and application of precision systems if made affordable for small farmers, will improve quantity and quality of the produce and, in turn, multiply returns for the farmers in the long run. This would require harmonization among diverse stakeholders, policy coherence across sectors and collective efforts in knowledge creation and application. Growth of innovations & technologies in consonance with their adaptation taken up by research and farming fraternity, is vital to any agriculture development strategy.

We believe that the above recommendations derived from the deliberations of GAC 2016 in addition to the knowledge created by research and academic institutions would support the policy makers to outline a stronger framework towards the betterment of farmer community and fulfil the vision of doubling the farm incomes.

Attracting entrepreneurs and supporting them with structured help to scale up initiatives apart from subsidies should be the principal ingredient of the current agricultural policy

EPILOGUE

A decade into 21st Century Agriculture, Government, Private Sector and Farming Community has made substantial inroads into development, dissemination and deployment of various technologies and innovations. While the mandate of agriculture development and access to huge public funded infrastructure is motivating the public sector to offer relevant and meaningful technological solutions to the people engaged in agriculture, profit making through innovative technological and business solutions is pulling the corporate bodies and the individual entrepreneurs (read as start ups) towards agriculture.

Technologies developed and deployed in the last 1.5 decades of the century appears to be broadly catering to four segments of Indian agriculture viz., a) access of agriculture sector stakeholders to information on production, agriculture inputs, markets and advisory, b) resource use efficiency through sensor based technologies, c) technologies that facilitate adaptation to change or mitigation of risk associated with variability in production factors associated with climate change, and d) reduction in post harvest losses.

Technology enabled information access to agriculture stakeholders, so far has been one way focussing more information transmission to farmers and other stakeholders through largely SMSs, Videos to a small extent. The agriculture extension systems that is so far limited by the movement of its extension workers, is now able to reach out to innumerable small holding farmers at virtually no cost. This is a substantial improvement over what the situation was 2 decades ago. However, the farmers are now flooded with several messages in the name of weather forecasts, market prices, availability of inputs etc, without requisite facilitation in decision making. The challenge of multi-criterion decision making for a farmer given the information overload is understandable. However, these technologies having great scope to bring in the feedback loop viz., farmers feeding back to the subject matter specialists (mKrishi, Cropin), input dealers (Agrostar) other value chain players, on their needs and requirements contextual to a given time and location. It is time to move towards data analytics (AwaazDe, AgroStar, Ecozen) that can capture farmers needs and thus offer advisory for effective results.

While the country is aggregating the information on various technologies that can help the country tide over the wave of climate change associated challenges, it is time to take a closer look at the preparedness and ability to face these challenges

Technologies facilitating resource use efficiency (ecozen solutions, flybird innovations etc.,) and addressing the issues of crop losses (nano technology of IDRC), are here to stay and contributing to the agriculture economy more and more. Manpower involved in their development, dissemination and deployment is bound to increase in the coming years essentially also calling for large scale capacity building efforts to enable the farmers adopt and utilise such technological developments.

Efforts of mankind in general and agri-stakeholders in specific to cope with the change in climatic conditions, however, are bound to throw dynamic and complex challenges in times to come. While variability of challenges / issues is comprehensible in other segments of agriculture value chains, lack of clear understanding on climate change factors and their influence on agriculture, altogether is posing more complex challenges not only to meet the food security needs of the country but also to the livelihoods of innumerable small holder farmers in India.

While the country is aggregating the information on various technologies that can help the country tide over the wave of climate change associated challenges, it is time to take a closer look at the preparedness and ability to face these challenges. It is time to take stock of the contribution of public and private sectors in challenging the risks associated climate change to agriculture. Reaching out to the large majority of small holding farmers, the worst affected among different agri-stakeholders, and gearing up their preparation to face the challenges posed by variability in climate, is the need of the hour. Climate Smart Technologies and innovations appears to be the principle means to facilitate this outreach and impact given the extension system limitations and large ground to cover, in the country.

In Global Agri Connect 2017, NSFI looks forward to bring together various Technologies and Innovations that offer solutions to the challenges looming large on the country owing to the climate change.

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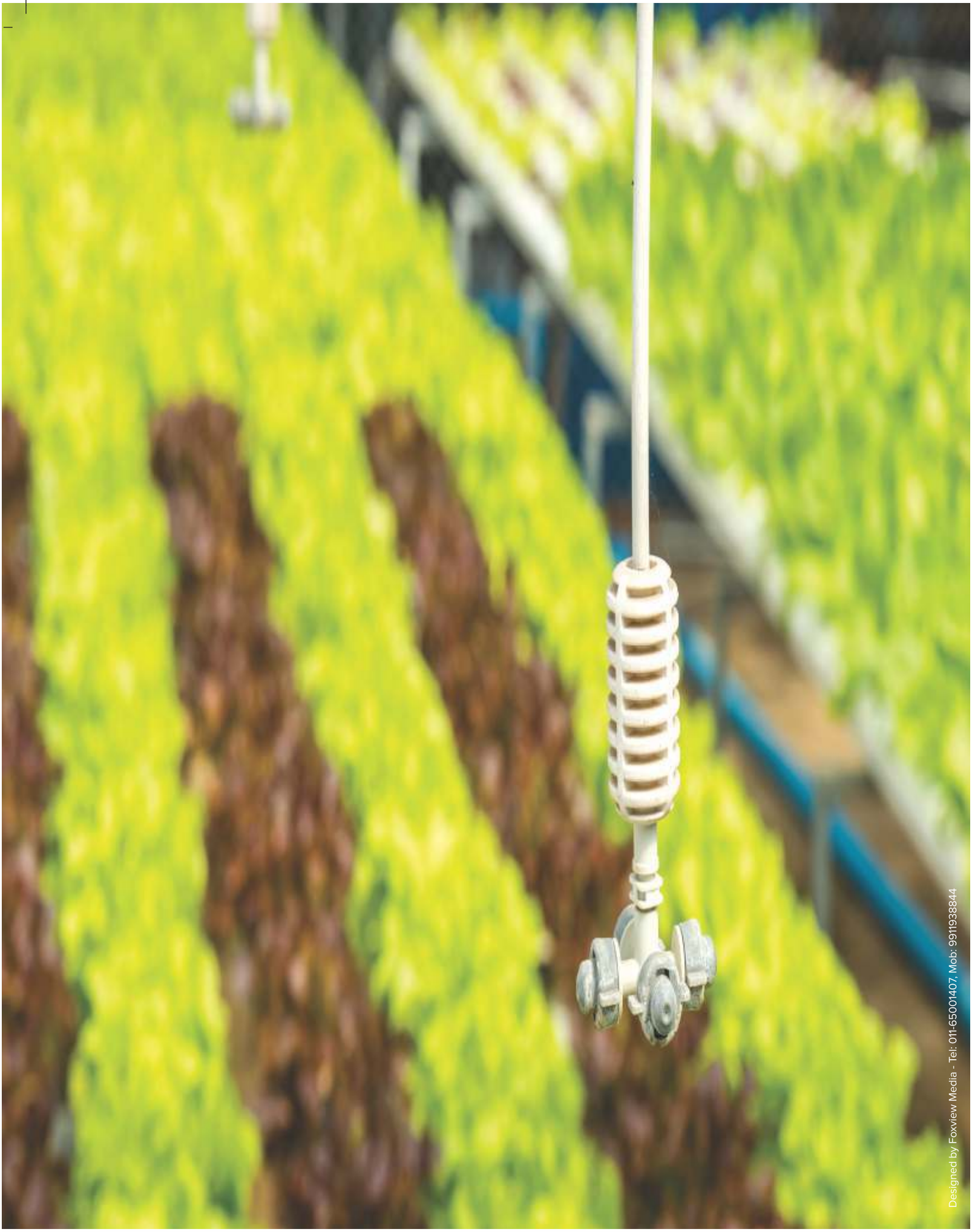
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NSFI National Skills Foundation of India
..enabling sustainable livelihoods

National Skills Foundation of India
K-59, South City - 1, Gurgaon - 122018, Haryana, India
Tel: 0124-4058848-49, Fax: 0124-4058840; info@nsfindia.org

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