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**GES
2015**

5th Global Economic Summit HANDBOOK

19 20 21 November 2015, Expo Centre, World Trade Centre Mumbai

Agriculture & Allied Sectors Post-harvest Management Policy & Regulation Markets



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Disclaimer: The information contained in this journal has been reviewed for accuracy and is deemed reliable but is not necessarily complete and cannot be guaranteed. The views expressed in the articles appearing in this Journal are those of the author's and do not necessarily reflect the views of the Centre.

CH. Vidyasagar Rao
GOVERNOR OF MAHARASHTRA



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11 July 2015

MESSAGE

I am pleased to know that the All India Association of Industries (AIAI) and the World Trade Centre (WTC) Mumbai are jointly organizing the 5th Global Economic Summit on 'Enabling Food for All' during 19-21 November 2015.

The theme of the Global Economic Summit reflects the global concern for mitigating hunger and poverty around the world. It is gratifying to note that scientists, agronomists, farmers, policy-makers and agri-business practitioners from across the world will be deliberating on the challenge of sustainable development of agriculture, food security and emerging trends in food production, distribution and agri-business. India attaches high priority to agriculture, as nearly sixty per cent of its population continues to depend on agriculture for livelihood, directly or indirectly. I am glad to know that Conferences, Exhibitions, B2B meetings and visits to agri- and Food Park have been organized as part of the Summit.

I congratulate the organizers and convey my best wishes for the success of the 5th Global Economic Summit.


(Ch Vidyasagar Rao)

Message

मुख्य मंत्री
महाराष्ट्र



Chief Minister
Maharashtra

27th July 2015.

MESSAGE

I am highly pleased to learn that World Trade Centre Mumbai and All India Association of Industries are jointly organizing the Fifth Global Economic summit on the theme “Enabling Food for All” from November 19-21, 2015 at Mumbai.

Agriculture plays a key role in all our lives. Agriculture sustains life and livelihood and profoundly influences a nation’s growth and development. Feeding the growing populations and promoting a healthy nation is the prime responsibility of a State and it is the constant endeavor of every government to ensure that the agriculture sector is properly developed and nurtured.

The participation from a large number of countries from around the world will make this event a truly important and intellectual platform for exchange of ideas, share knowledge and best practices. I am confident the Summit will raise many pertinent issues and will provide answer to many of the problems facing this vital sector.

I congratulate the organisers for their initiative and wish the Summit great success.

(Devendra Fadnavis)

Vijay Kalantri,
President, AIAI



Subhash Desai
MINISTER
INDUSTRIES

GOVERNMENT OF MAHARASHTRA
Mantralaya, Mumbai 400 032
www.maharashtra.gov.in

Date

Message

I am very pleased to learn that the Fifth Global Economic Summit on “Enabling Food for All” is being organized by World Trade Centre Mumbai and All India Association of Industries from November 19-21, 2015 at World Trade Centre Mumbai.

It is encouraging to note that the Ministry of Commerce and Industry, Ministry of Micro, Small and Medium Enterprises and Food and Agriculture Organization (FAO) and International Fund for Agricultural Development (IFAD) have accorded their support to this important event elevating the prestige of this international Summit.

Industry has come to play an important role in transforming the farm sector. Industry supports the farm sector with new technologies, improved implements and provides a vital link between the farmers and the consumers. Food processing, preservation and distribution form an important value chain in sustaining and promoting the agriculture sector.

The participation from a large number of countries from around the world will make this event a truly important and intellectual platform for transfer of ideas, information, best practices and technologies.

I extend my best wishes to World Trade Centre Mumbai and All India Association of Industries for their excellent initiative and wish the event great success.



(Subhash Desai)



K. P. MOHANAN

Minister for Agriculture, Animal Husbandry,
Printing and Stationery



Date : 26/10/15



MESSAGE

I am very pleased to know that World Trade Centre Mumbai and All India Association of Industries (AIAI) have titled the 5th edition of their flagship event Global Economic Summit as 'Enabling Food For All' considering the significance of the agriculture sector in India's economy. It is encouraging to note that agriculture scientists, farmers' organisations, food policy experts, food processing companies, government officials, diplomats from over 30 countries would participate in the Summit.

The active involvement of organisations such as Food and Agriculture Organisation (FAO), International Fund for Agricultural Development (IFAD) and World Farmers Organisation (WFO) would add immense value to the event.

The role of industry in supporting the agriculture and allied sectors cannot be underestimated. Industry serves as a crucial link between the agriculture sector and end consumers as it processes the raw materials derived from the agriculture sector and delivers it to the consumers. Further, industry enhances the productivity of the agriculture sector by supplying cutting-edge farm technologies, agro-inputs, farm machineries etc.

The participation from a large number of countries from around the world will make this event a truly important and intellectual platform for transfer of ideas, information, best practices and technologies.

I extend my best wishes to World Trade Centre Mumbai and All India Association of Industries for their excellent initiative and wish the event a great success.

K.P. MOHANAN

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Kamal Morarka
Chairman

Agriculture plays a key role in all our lives. Agriculture sustains life and livelihood and profoundly influences a nation's growth and development.

Feeding the growing population and promoting a healthy nation is the prime responsibility of a country and it is the constant endeavour of every government to ensure that the agriculture sector is properly developed and nurtured.

Agriculture Sector in India has a strong linkage to the growth of the economy as it not only provides livelihood to farmers and farm labourers, but also provides raw material to the industry and supports all business units that provide inputs to the farm sector.

The challenges facing the Indian agriculture sector has changed since the days of the Green Revolution, when producing enough foodgrain for the population was a great concern. The emerging challenges in the agriculture sector are climate change, soil degradation, distorting price incentives, inadequate access to quality inputs, excessive dependence on monsoon, poor crop insurance etc.

The 5th Global Economic Summit 2015 has been aptly themed, 'Enabling Food for All' in order to focus on these emerging challenges which undermine the sustainability of the agriculture sector and threaten the food security of the country. The Summit will witness participation of over 400 delegates from 30 countries, with speakers from India and abroad who will deliberate and share their views on the topic. The speakers have also presented their views in articles featured in the Handbook.

These emerging challenges require an out-of-the-box solution which calls for an effective collaboration among policy makers, agriculture research institutions, farming community and the business sector.

Countries like the Netherlands have devised such optimal partnership among policy makers, agriculture research institutions and the business community to make their agriculture sector sustainable.

While India has a long way to go on that path, it has the required institutional apparatus to take that path. For example, the Indian Council for Agriculture Research (ICAR) has set up Krishi Vigyan Kendras (KVKs) across several districts in the country so that its scientists can offer knowledge support to farmers. Similarly, India's premier business conglomerate ITC used information technology to enable farmers access ready information in their local language on the weather and market prices, disseminate knowledge on scientific farm practices and risk management, facilitate the sale of farm inputs and purchase farm produce from the farmers' doorsteps. The Indian government, on its part, has been taking various measures to make farming competitive and profitable.

The Handbook highlights the role of various community-based organisations, non-profit-organisations, crop scientists, business enterprises, policy makers, in evolving a sustainable agrarian economy.

The Handbook has been designed in a manner to present the articles in four segments namely Agriculture & Allied Sectors; Post-harvest Management;

Foreword

Policy & Regulation and Markets. It brings to you a wide range of articles from experts in various fields.

The Handbook highlights the experience of Action for Agricultural Renewal in Maharashtra, an association of voluntary organisations in the State, in implementing the Livelihoods Enhancement Programme for dryland marginal farmers.

The National Institute of Food Technology Entrepreneurship and Management detailed its efforts towards promoting food processing, value addition, post-harvest management, product development, entrepreneurship development etc.

The Handbook documents how the social enterprise model in Madhya Pradesh contributed to biological diversity besides helping farmers earn better incomes with very low investments.

The Handbook also contains some interesting interviews one of which is on the need for an effective national policy on soil health in Australia.

A Canadian Farmer has written on how women have come to play a major role in the agriculture sector and more needs to be done to address the issues they face. The handbook discusses the emerging AgriFood capital region in the Netherlands.

The Handbook will serve as a useful reference guide as it has covered a wide gamut of areas which impact agriculture, food and nutrition.

I am hopeful that the information provided in this Handbook would serve as a source of information and inspiration to the farming community, extension workers, scientists, students, engineers, manufacturers, entrepreneurs and all stakeholders. This would help create awareness of the current situation in this vital sector paving the way for early adoption of corrective measures to strengthen linkages in the global value chain to 'Enable Food for All'.

Kamal Morarka
Chairman
World Trade Centre Mumbai

Preface



Vijay G. Kalantri
President

Agriculture and allied sectors play a dominant role in the Indian economy as over 50% of the labour force still depend on these sectors for their livelihood. Crop scientists and food policy experts in India have stressed on the need to improve productivity in the Indian farm sector and thereby enhance the income of millions of cultivators and landless farm labourers.

Along with improving the productivity of the farm sector, it is important to invest considerably in the food processing and logistics sectors to reduce post-harvest loss in food commodities. The Government of India has rightly included food processing sector in the 'Make in India' campaign in order to attract foreign and domestic investment in the sector.

The 5th edition of the Global Economic Summit on the theme 'Enabling Food for All' entails participation of eminent speakers and other participants representing a pool of over 400 delegates from 30 countries. The speakers at the Summit will discuss the core issues of soil health, farming practices, food and nutrition security, harvest and post harvesting best practices. The Summit would act as a catalyst to bring about the necessary transformation in the agriculture and food processing sectors to overcome the emerging challenges in these sectors. Specifically, the Summit aims to bring together farmers, crop scientists, agro-biotechnology companies, organic farming experts, precision farming technologists to explore ways to adopt the right blend of modern farm technologies and traditional Indian farm practices.

It is noteworthy to mention that several community-based organisations, farmer producer companies, agricultural research institutions, organic farming advocates, agri-business entrepreneurs are carrying out extraordinary activities in the food sector across several parts of India.

A compilation of the activities of these organisations along with the views of farm scientists and food policy experts featured in the articles and interviews is documented in this Handbook, for the benefit of all stakeholders.

The Handbook has been divided into four major segments namely, agriculture and allied sectors; post-harvest management; policy and regulation and markets, covering wide range of issues and providing a wide gamut of perspectives.

A lot of thought and efforts have gone into the making of the Handbook to help budding entrepreneurs, youth, agriculturists and all stakeholders to get a broad picture of the farm to food dynamics and operations.

I hope the book will enable all stakeholders to make informed choices in adoption of farming and agriculture best practices.

Vijay G. Kalantri
President
All India Association of Industries



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Harnessing the Potential of Indian Agriculture and Food Processing Sectors

Agriculture Sector

Agriculture and allied sectors are the backbone of the Indian economy as a substantial proportion of the population is dependent on these sectors. Cultivators and agricultural labourers constitute around 54% of the total labour force in India (Census 2011). Agriculture, forestry and fishery sectors together contributed 17% to the gross value added of the Indian economy in 2014-15 (provisional estimate of Central Statistical Organisation). India has 138.35 million operational farm holdings and 159.59 million hectare operated farm area (according to India's agriculture census 2010-11).

Of the 138.35 million operational holdings in the country, the highest one belonged to Uttar Pradesh (23.33 million) followed by Bihar (16.19 million), Maharashtra (13.70 million), Andhra Pradesh (13.18 million), Madhya Pradesh (8.87 million), Tamil Nadu (8.12 million), Karnataka (7.83 million), West Bengal (7.12 million), Rajasthan (6.89 million), Kerala (6.83 million) etc. with the lowest of only 714 operational holdings in union territory of Chandigarh.

Out of a total of 159.59 million hectare operated area in the country in 2010-11, the highest contribution was made by Rajasthan (21.14 million hectare) followed by Maharashtra (19.77 million hectare), Uttar Pradesh (17.62 million hectare), Madhya Pradesh (15.84 million hectare), Andhra Pradesh (14.29 million hectare), Karnataka (12.16 million hectare), Gujarat (9.90 million hectare) etc. with the lowest operated area of 923 hectare in the union territory of Chandigarh.

India ranks first in the world in the production of milk, pulses, ginger, bananas, guavas, papayas and mangoes. Further, India ranks second in the world in the production of rice, wheat, vegetable and horticulture products (Annual Report 2014-15, Union Ministry of Food Processing). According to the Fourth Advance Estimates of the central government, the country's total production of foodgrains stood at 252.68 million tonne in 2014-15. For the 12th Five-Year Plan Period (2012-17), a growth target of 4 percent has been set for the agriculture sector.

India ranks first among the world's milk producing nations since 1998 and milk production peaked at 137.97 million tonne in 2013-14 (Year-end Review of the Ministry of Agriculture for the year 2014-15). India has the largest bovine population in the world. The bovine genetic resource of India is represented by 37 well recognized indigenous breeds of cattle and 13 breeds of buffaloes. Indigenous bovines are robust and resilient and are particularly suited to the climate and environment of their respective breeding tracts. There is tremendous scope to increase India's contribution to the world food system by adopting an optimal blend of modern technologies, which includes information and communication technologies and organic farming.

While India's share in the world population is nearly 18%, its share in the world export of agriculture products is only 3% and its share in the world import of such products is only 1% [2012 data from the Food and Agriculture Organisation (FAO) indicates].

Data from the FAO also indicates that 14% of the world area under cereal crops is in India, while India produces only 11% of the global cereal output (2013 data). Similarly, 15% of the world area under vegetable crops is in India while India contributes only 11% to the world vegetable production (2013 data).

According to the Agriculture Census 2010-11, the total number of operational farm holdings in India was 138.35 million with average size of 1.15 hectare. Of the total farm holdings, 85 per cent are in marginal and small farm categories of less than 2 hectare. These small farms, though operating only on 44 per cent of land under cultivation, are the main providers of food and nutritional security to the nation, but have limited access to technology, inputs, credit, capital and markets.

However, according to the Vision 2050 document released by the Indian Council for Agriculture Research (ICAR), the size of an average farm holding would increase by 2035 led by negative growth rate of rural population. This would promote mechanization of agriculture, ICAR argues. By 2050, very few well-trained and

Introduction

farmer-cum-entrepreneurs will produce food. Their production systems are likely to be more commercial-oriented, operating at high productivity levels in a highly mechanized environment, the Vision document says. It is more likely that today's small holders will organize themselves into producer companies and will have more bargaining power, the document says.

In order to unleash the potential of the agriculture sector, there is a need for a vibrant policy regime, effective co-ordination with agriculture research institutions and an enterprising farming community. A sound policy regime must make farming competitive and profitable with the ultimate goal of attaining self-sufficiency in food commodities. In order to simplify the policy regime and make it more effective, the Indian government replaced the erst-while 51 schemes on agriculture with 5 missions and 5 schemes as under –

Mission	Schemes
1. National Food Security Mission (NFSM)	1. National Crop Insurance Programme (NCIP)
2. Mission for Integrated Development of Horticulture (MIDH)	2. Integrated Scheme on Agri-Census & Statistics (ISAC&S)
3. National Mission on Oil Seeds and Oil Palm (NMOOP)	3. Integrated Scheme of Agriculture Marketing (ISAM)
4. National Mission for Sustainable Agriculture (NMSA)	4. Integrated Scheme of Agriculture Cooperation (ISAC)
5. National Mission on Agricultural Extension & Technology (NMAET)	5. Secretariat Economic Service

Source: Press Information Bureau, Government of India

In order to ensure sustainable development of agriculture sector, the central government took a number of steps during the budget 2014-15. These steps include enhanced institutional credit to farmers, promotion of scientific warehousing infrastructure including cold storages and cold chains in the country for increasing shelf life of agricultural produce, improved access to irrigation through Pradhan Mantri Krishi Sichee Yojana, provision of Price Stabilisation Fund to mitigate price volatility in agricultural produce etc.

The central government is implementing the Rashtriya Gokul Mission, a project under the National Program for Bovine Breeding and Dairy

Development, to conserve and develop indigenous breeds in a focused and scientific manner. The mission aims to enhance the productivity of the indigenous breeds through professional farm management and superior nutrition, as well as gradation of indigenous bovine germplasm.

Some of the influential schemes announced recently by the central government are as follows

Name of the Scheme	Details of the Scheme
Paramparagat Krishi Vikas Yojana (PKVY)	Under this scheme, government would provide financial assistance for groups of farmers to take up organic farming. Fifty or more farmers will form a cluster having 50 acre land to take up the organic farming under the scheme.
Soil Health Card Scheme	Under the scheme, soil health labs across the country would collect soil samples, test them and offer guidance to farmers on the appropriate usage of fertilizers. The scheme also envisages building up a single national database on soil health for future use in research and planning.
Pradhan Mantri Krishi Sinchayi Yojana (PMKSY)	Central government allocated Rs 50,000 crore for a period of 5 years (2015-16 to 2019-20) to boost irrigation and water management infrastructure under this scheme. The scheme is intended to amalgamate all the existing schemes for irrigation.

Source: Press Information Bureau, Government of India

In order to ensure policy co-ordination at all levels of the government structure, the central government assists state governments in the overall development of agriculture sector. Effective policy measures are in position to improve agricultural production and productivity and address problems of farmers. State governments are also impressed upon to allocate adequate funds for development of agriculture sector in state plan, as well as initiate other measures required for achieving targeted agricultural growth rate and address problem of farmers.

Introduction

Food Processing Sector

In India, the food processing sector has been growing faster than the agriculture sector and consequently it contributes more to the national GDP (gross domestic product) as compared to agriculture and manufacturing sectors. The food processing sector registered an average annual growth rate of 8.4% between 2008-09 and 2012-13 compared to the average annual growth rate of 3.3% for agriculture in this period (Annual Report 2014-15, Union Ministry of Food Processing)

In India, there are 37,175 registered units in the food processing sector and these units are mostly in the business of grain mill, sugar, edible oils, beverages and dairy products. Food Processing

Industry is one of the major employment intensive segments constituting 13.04 per cent of employment generated in all Registered Factory sector in 2012-13 and there is an immense potential in this sector to generate employment in the country.

The time has come for India to leap forward and move up the value chain of the agro sector by strengthening its food processing industry, food warehousing and logistics industry.

Food Value Chain



India must strengthen its food processing and logistics industry not only to cater to the increasing demand for ready-to-eat food by its huge consumer base (whose disposable income is rising) but also to reduce the post-harvest loss of food items.

According to a study conducted by the Central Institute of Post-Harvest Engineering and Technology (CIPHET) for 2012-14, the extent of harvest and post-harvest losses varies from 4.58% to 15.88% in respect of fruits and vegetables and 4.65% to 5.99% in case of cereals.

The study finds that major reasons for wastage of food grain produce are poor farm operations like harvesting, threshing, storage, insect or pest infestation etc.

The central government, the state governments, and the Reserve Bank of India have taken various steps to encourage entrepreneurs investing in the food processing and food logistics sector (see below).

Central Government schemes and initiatives for food processing and logistics sectors
1) Scheme for Development of Infrastructure for Food Processing having components of Mega Food Parks, Integrated Cold Chain, Value Addition and Preservation Infrastructure and Modernization of Abattoirs 2) Scheme for Quality Assurance, Codex Standards, Research & Development and Other Promotional Activities. 3) Launching of Investors' Portal for promoting investment in Food Processing sector 4) Identifying APMC issues affecting food processing for appropriate amendments in APMC Act. 5) Enhancing allocation for Infrastructure Development schemes: 42 Mega Food Parks, 138 cold chain projects, 60 abattoirs 6) Regular interaction with industry and state governments for activating single window clearance 7) Excise duty on food processing and packaging machinery reduced from 10% to 6%. 8) Special fund of Rs 2,000 crore set up in National Bank for Agriculture and Rural Development (NABARD) to provide affordable credit to the food processing units to be set up in the designated Food Parks. 9) Application Forms of all the Schemes currently being implemented by Ministry of Food Processing Industries has been simplified. 10) Requirement of supporting documents such as affidavit, agreements etc earlier required to be submitted with the proposal reduced. 11) A Food map of India identifying surplus raw material has been prepared and uploaded on the Ministry website. Idea is to identify the surplus and deficient areas in the country of various agricultural and horticultural produce so as to plan processing clusters by means of setting up processing facilities under current schemes. 12) Sectoral Skill Council on Food Processing working in Federation of Indian Chamber of Commerce and Industry (FICCI).
State Government's role
In April 2012, the Centrally Sponsored Scheme National Mission on Food Processing (NMFP) was launched. This scheme has been delinked from Central Government support since the current financial year (2015-16) except the union territories.
Reserve Bank of India's initiative
Reserve Bank of India allowed bank loans to food processing units with an investment in plant & machinery not exceeding Rs 5 crore to be classified under priority sector lending. This enables food processing companies with the above investment limit to avail bank credit at concessional rate.

Introduction

The union government is implementing a Central Sector Scheme for Infrastructure Development for Food Processing having components of Mega Food Parks and Integrated Cold Chain, Value Addition and Preservation Infrastructure. Under the scheme, financial assistance is provided in the form of grant-in-aid to eligible entrepreneurs, including women entrepreneurs, @ 50% in general areas and @ 75% in North-Eastern Region and difficult areas, subject to a maximum of Rs 50 crore for establishment of Mega Food Park and Rs 10 crore for establishment of Cold Chain Infrastructure.

In order to promote food processing units in the country, Ministry of Food Processing Industries was implementing a Scheme for Technology Upgradation or Establishment or Modernization of Food Processing Industries under the National Mission on Food Processing (NMFP) through state or UT governments. However, the NMFP has been delinked from central government support with effect from April 2015.

These measures are expected to increase the level of processing of agricultural and horticultural produce, with particular focus on perishables, in the country and thereby to check the wastage.

The considerable post-harvest loss in food commodities, the rising income of the country's population and a vibrant policy environment present an excellent opportunity for entrepreneurs to invest in the food processing, logistics and infrastructure service sector

If the opportunity available in the food sector is utilized to the full extent, the food processing industry as a whole would grow at an annual rate of more than 15% projected by the KPMG Advisory Services in its report on Human Resource and Skill Requirements in the Food Processing Sector. In the report, the consultancy firm projected the food processing industry to grow at a compounded annual rate of 15% during 2012-17 (see the table below).

Sector	Compounded Annual Growth Rate in market size (2012-17)
Fruits and Vegetables	4%
Milk and Milk Products	11%
Meat and marine products	17%
Grain and Oil seeds	16%
Packaged Foods	15%
Beverages	15%
Food Processing Industry	15%

Source: Report on Human Resource and Skill Requirements in the Food Processing Sector by KPMG Advisory Services

Opportunities in India's food processing sector
Increasing demand for secondary processing and packaged food items.
Mandating contracts with organised retailers that may improve adherence to international quality standards, which could, in turn, encourage skill improvement for food processing players, leading to improved access to domestic and export markets.
Growing role of regional food processing players due to increased need for localisation and customisation of offerings by food companies to suit the Indian palate.
Extremely low processing levels especially in F&V sub-sector.
Gradual liberalisation of the retail sector leading to improved backward linkages with processors

Source: KPMG Advisory Services Report

Foreign Direct Investment

Indian government allows public, private and foreign direct investments (FDI) in the agriculture and allied sectors. However, FDI up to 100% is allowed under automatic route only in specified activities of the agriculture and allied sectors. According to the consolidated FDI policy circular 2015, the central government allows FDI in floriculture, horticulture, apiculture and cultivation of vegetables and mushrooms under controlled conditions. Further, FDI is allowed in

Introduction

Foreign Direct Investment

Indian government allows public, private and foreign direct investments (FDI) in the agriculture and allied sectors. However, FDI up to 100% is allowed under automatic route only in specified activities of the agriculture and allied sectors. According to the consolidated FDI policy circular 2015, the central government allows FDI in floriculture, horticulture, apiculture and cultivation of vegetables and mushrooms under controlled conditions. Further, FDI is allowed in the development and production of seeds and planting material, animal husbandry, pisciculture, aquaculture, under controlled conditions and services related to agro and allied sectors. Besides the above, FDI is not allowed in any other agricultural sector or activity.

Year (Apr-Mar)	FDI (in Rs. crore)	FDI (in US\$ million)
2012-13	875.90	161.47
2013-14	559.66	91.01
2014-15	352.37	57.87
2015-16 Apr-May	37.64	5.99
Grand Total	1,825.58	316.34

Source: Department of Industrial Policy & Promotion (DIPP)

Marketing Reform

At present, there is no common unified market for the agriculture sector throughout India as agro-commodities originating at different states are traded in the respective state's Agriculture Produce Market Committee (APMC) market yards. In order to unify all these market yards and provide a common platform for trading of agro-commodities, the Central Government formulated a Central Sector Scheme for "Promotion of National Agriculture Market through Agri-Tech Infrastructure Fund (ATIF)". This scheme was to be implemented with a budgetary outlay of Rs 200 crore during 2015-16 to 2017-18.

This ambitious scheme aims to connect 585 regulated APMC markets across different states through an appropriate common e-market

platform by 2017-18. In addition, big private markets will also be allowed access to the software to enable better price discovery.

The central government would offer financial assistance to the state governments to meet expenses on software and its customisation and in addition will also give grant as one time fixed cost subject to the ceiling of Rs 30.00 lakh per market for related hardware including equipment or infrastructure.

Research and Development

The Central Government is laying emphasis on research and development in the agriculture sector to boost productivity, evolve climate-friendly, cost-effective farm practices, reduce post-harvest losses etc.

The Indian Council of Agricultural Research (ICAR) conducts and disseminates research in the sector through its 100 research institutes, 73 Agricultural Universities and 642 Krishi Vigyan Kendras (KVKs). The combined effort of these bodies is expected to enhance the competitiveness of Indian farming to make farming a viable, self-sustaining and internationally competitive enterprise.

ICAR is also taking efforts to generate quality human resource through effective agricultural education, need-based training in India and abroad, adopting information and communication technologies (ICT) in agriculture development, strengthening social science skills, promoting public-private sector partnership, strengthening policy analysis and vision-oriented market-led intelligence analysis skills, strengthening agri-business development and intellectual property regime (IPR) management.

Besides improving productivity, agriculture research also aims to generate best practices in processing of high value products, linking production with processing and marketing with focus on small and marginal farmers and farm workers, developing high yielding varieties combining with high protein content and other characteristics demanded by the importing countries.

The central government has been spending at least Rs 2,500 crore annually on agriculture research in recent years (see table below).

Introduction

Year-wise spending on agriculture research by Government of India

Year	Budget Estimates (Rs. in crore)	Revised Estimates (allocation) (Rs. in crore)
2012-13	3220.00	2520.00
2013-14	2415.00	2600.00
2014-15	3715.00	2500.00

(Source: Press Information Bureau, Government of India)

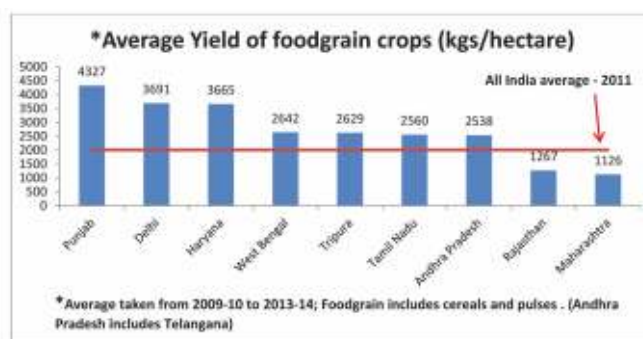
The Indian Council for Agriculture Research (ICAR) has re-oriented its research agenda to keep its work relevant to the changing needs of farmers and the agriculture system in India. Based on its analysis of the emerging scenario of the Indian agriculture sector, ICAR has carved out the following focus areas for its research.

ICAR Vision 2050: Focus Areas of Research

Genetic potential enhancement of agricultural commodities
Agricultural productivity, efficiency and profitability improvement
Resilience to climate change and abiotic and biotic stresses
Improve nutritional food, and health security
Risk management against climate change and market stressors
Agricultural value chains
Sustainability of natural resources base of agriculture
Valuation of ecosystem services
Agricultural markets, policies, and institutions
Bio-security, especially the one emerging from gene piracy and cross-border vector-borne diseases
New products and uses (eg., bio-energy, new crops, synthetic foods, special foods)
New educational and learning systems and environments

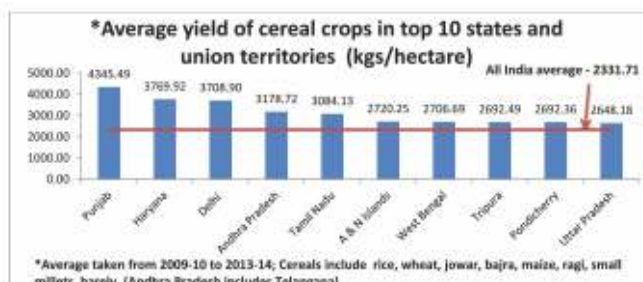
Performance of states

There is huge variation in the agriculture performance of different states in India as they fall under different agro-climatic zones. Owing to the diverse agro-climatic conditions in different states, productivity of crops also varies in these states. For example, yield of foodgrain crops (which include rice, wheat, maize, millets, pulses, jowar, bajra, ragi) is the highest in Punjab (at 4327 kg per hectare), followed by Delhi (3691 kg per hectare), Haryana (3665 kg per hectare). On the other hand, the yield is the lowest in Maharashtra (at 1126 kg per hectare), Rajasthan (1267 kg per hectare). Note that these are the average yield of the crops during the four year period from 2009-10 to 2013-14.



Source: Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Government of India

Specifically, yield of cereal crops, which include rice, wheat, jowar, bajra, maize, ragi, small millets, is the highest in Punjab (4345.49 kgs per hectare), Haryana (3769.92) and the lowest in Maharashtra (1299), Mizoram (1318).

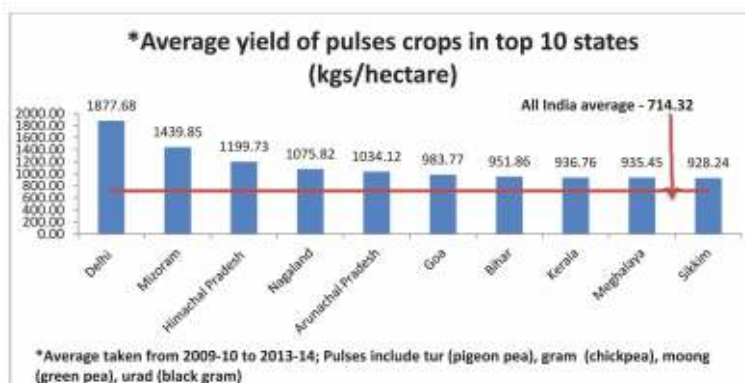


Source: Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Government of India

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Similarly, productivity of pulse crops [which include tur (pigeon pea), gram (chickpea), moong (green pea), urad (black gram)] is the highest in Delhi at 1877.68 kgs per hectare followed by Mizoram (1439.85), Himachal Pradesh

Source: Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Government of India



The following table gives a summary of the performance of some states in the agriculture, horticulture and food processing sector.

States	Andhra Pradesh	Bihar	Delhi	Gujarat	Goa	Haryana	Jammu & Kashmir	Karnataka	Kerala
Agriculture Sector									
Foodgrain*									
Area (in '000 hectares)	7390.00	6395.97	30.10	4378.00	50.94	4403.60	928.58	7538.00	202.53
Production ('000 tonnes)	19665.11	12905.79	122.12	9179.64	135.45	16974.05	1777.87	12208.87	512.37
Productivity (Kg per hectare)	2661.04	2017.80	4057.14	2096.77	2659.01	3854.58	1914.61	1619.64	2529.83
Productivity of oilseeds (kg per hectare)	928.61	1189.12	NA	2231.38	2544.40	1637.22	895.15	824.11	979.59
Productivity of sugarcane (kg per hectare)	80130.21	49915.84	NA	72126.44	54793.10	73519.61	1000.00	90250.00	100235.29
Farm area (excluding Forest Area) under Organic Certification (in hectare)	12325.03	180.6	0.83	46863.89	12853.94	3835.78	10035.38	30716.21	15020.23
Horticulture Sector									
Productivity of Total Fruits (tonne per hectare)	15.75	13.16	NA	21.58	7.21	12.37	4.3	17.04	9.05
Productivity of Total Vegetables (tonne per hectare)	18.56	17.18	17.45	19.96	11.38	15.48	22.13	18.5	24.97
Productivity of Total Plantation (tonne per hectare)	3.62	6.53	NA	5.75	1.47	NA	NA	6.43	4.2
Productivity of Total Spices (tonne per hectare)	4.58	0.96	NA	0.31	1.57	5.14	0.22	1.74	0.68
Food Processing Sector									
Number of Food Processing Units	5735	736	159	1923	90	608	156	2038	1501
Number of projects sanctioned for financial assistance under National Mission on Food Processing(NMFP)	0	0	0	1	0	9	8	14	2
Number of Mega Food Park Projects	3	3	0	3	0	1	1	1	2
Notes on Table									
Data on foodgrain (area, productivity, production) are for 2013-14. This data is sourced from the Directorate of Economics & Statistics, Union Ministry of Agriculture and Co-									
** Andhra Pradesh includes Telangana									
*Foodgrain includes wheat, rice, coarse cereals and pulses									
Data on farm area under certified organic farming is for 2013-14 and it is sourced from APEDA									
Data on productivity of total fruits, total vegetables, total plantation, total spices is sourced from Horticulture Statistics Division, Department of Agriculture & Cooperation.									
Data on number of food processing units is sourced from Annual Survey of Industries 2012-13. These units are the estimated number of factories in registered FPI (Food									
Every year, the central government provides financial assistance to projects under National Mission on Food Processing(NMFP). The number of projects mentioned here is									
Data on the allocated mega food park projects is given by the Union Minister of State for Food Processing Industries, Sadhvi Niranjana Jyoti in a written reply to a question in									

Introduction

The following table gives a summary of the performance of some states in the agriculture, horticulture and food processing sector.

States	Madhya Pradesh	Maharashtra	Odisha	Punjab	Rajasthan	Tamil Nadu	Telangana	Uttar Pradesh	Uttarakhand	West Bengal
Agriculture Sector										
Foodgrain*										
Area (in '000 hectares)	14332.90	11471.00	5143.29	6551.20	13417.12	3439.46	NA**	20142.00	890.63	6275.84
Production ('000 tonnes)	22977.99	13846.21	8359.42	29480.40	17899.55	8783.21	NA**	50027.51	1776.45	17078.92
Productivity (Kg per hectare)	1603.16	1207.06	1625.31	4500.00	1334.08	2553.66	NA**	2483.74	1994.60	2721.38
Productivity of oilseeds (kg per hectare)	858.10	1276.26	755.48	1334.72	1144.05	2362.32	NA**	809.95	1070.04	1181.19
Productivity of sugarcane (kg per hectare)	43415.40	82071.50	65905.00	75000.00	68988.59	103574.84	NA**	60452.70	56971.03	114273.07
Farm area (excluding Forest Area) under Organic Certification (in hectare)	232887.36	85536.66	49813.51	1534.39	66020.35	3640.07	NA**	44670.1	24739.46	2095.51
Horticulture Sector										
Productivity of Total Fruits (tonne per hectare)	27.85	16.08	6.55	22.15	16.03	23.5	15.02	18.46	3.75	14.45
Productivity of Total Vegetables (tonne per hectare)	20.74	13.82	13.98	20.63	7.56	31.39	16.58	22.35	11.9	16.96
Productivity of Total Plantation (tonne per hectare)	NA	1.76	1.36	NA	NA	7.59	10.32	NA	NA	5.59
Productivity of Total Spices (tonne per hectare)	1.59	0.9	1.47	3.71	0.82	3.34	4.11	3.96	5.08	2.13
Food Processing Sector										
Number of Food Processing Units	738	3077	931	2792	795	5161	NA**	2097	383	1624
Number of projects sanctioned for financial assistance under National Mission on Food Processing(NMFP)	0	4	9	1	31	0	0	0	0	21
Number of Mega Food Park Projects	2	4	2	3	1	1	3	0	2	1

Notes on Table
Data on foodgrain (area, productivity, production) are for 2013-14. This data is sourced from the Directorate of Economics & Statistics, Union Ministry of Agriculture and Co-ops
** Andhra Pradesh includes Telangana
*Foodgrain includes wheat, rice, coarse cereals and pulses
Data on farm area under certified organic farming is for 2013-14 and it is sourced from APEDA
Data on productivity of total fruits, total vegetables, total plantation, total spices is sourced from Horticulture Statistics Division, Department of Agriculture & Cooperation.
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Data on the allocated mega food park projects is given by the Union Minister of State for Food Processing Industries, Sadhvi Niranjan Jyoti in a written reply to a question in Lok Sabha

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State-wise production of oilseeds and sugarcane (in '000 tonne) in 2013-14

States	Andhra Pradesh	Bihar	Gujarat	Goa	Haryana	Jammu & Kashmir	Karnataka	Kerala	
Sugarcane	15385.00	12881.78	12550.00	47.67	7499.00	0.02	37905.00	221.52	
Oilseeds	1885.64	146.17	6.59	6870.43	899.00	58.82	1162.00	0.96	
States	Madhya Pradesh	Maharashtra	Odisha	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	Uttarakhand	West Bengal
Sugarcane	3173.67	76901.00	936.51	6675.00	362.88	32454.14	134688.62	5939.80	1945.04
Oilseeds	6634.87	5293.93	168.76	64.20	6033.76	964.23	895.81	34.07	909.86

Source: Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Government of India

India's Import of fruits, vegetable products, fish, meat, livestock, beverages, tobacco and other edible articles (in USD million) in 2014-15 (Apr-Mar)		
Commodity	2014-2015	% Share in total import of edible articles
ANIMAL OR VEGETABLE FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PRE. EDIBLE FATS; ANIMAL OR VEGETABLE WAXEX	10,670.01	53.81%
EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS	2,834.42	14.29%
EDIBLE FRUIT AND NUTS; PEEL OR CITRUS FRUIT OR MELONS	2,672.08	13.48%
COFFEE, TEA, MATE AND SPICES	729.43	3.68%
SUGARS AND SUGAR CONFECTIONERY	686.48	3.46%
BEVERAGES, SPIRITS AND VINEGAR	541.59	2.73%
RESIDUES AND WASTE FROM THE FOOD INDUSTRIES; PREPARED ANIMAL FODER	331.54	1.67%
OIL SEEDS AND OLEA. FRUITS; MISC. GRAINS, SEEDS AND FRUIT; INDUSTRIAL OR MEDICINAL PLANTS; STRAW AND FODDER	322	1.62%
COCOA AND COCOA PREPARATIONS	253.58	1.28%
LAC; GUMS, RESINS AND OTHER VEGETABLE SAPS AND EXTRACTS.	182.81	0.92%
MISCELLANEOUS EDIBLE PREPARATIONS	124.53	0.63%
PREPARATIONS OF VEGETABLES, FRUIT, NUTS OR OTHER PARTS OF PLANTS	75.07	0.38%
PREPARATIONS OF CEREALS, FLOUR, STARCH OR MILK; PASTRYCOOKS PRODUCTS	65.38	0.33%
FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUATIC INVERTABRATES	61.69	0.31%
PRODUCTS OF THE MILLING INDUSTRY; MALT; STARCHES; INULIN; WHEAT GLUTEN	61.4	0.31%
DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY; EDIBLE PROD. OF ANIMAL ORIGIN, NOT ELSEWHERE SPEC. OR INCLUDED	50.05	0.25%
TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES	48.66	0.25%
PRODUCTS OF ANIMAL ORIGIN, NOT ELSEWHERE SPECIFIED OR INCLUDED	37.15	0.19%
VEGETABLE PLAITING MATERIALS; VEGETABLE PRODUCTS NOT ELSEWHERE SPECIFIED OR INCLUDED.	22.55	0.11%
CEREALS	22.17	0.11%
LIVE TREES AND OTHER PLANTS; BULBS; ROOTS AND THE LIKE; CUT FLOWERS AND ORNAMENTAL FOLIAGE.	18.52	0.09%
LIVE ANIMALS	11.96	0.06%
PREPARATIONS OF MEAT, OF FISH OR OF CRUSTACEANS, MOLLUSCS OR OTHER AQUATIC INVERTEBRATES	3.28	0.02%
MEAT AND EDIBLE MEAT OFFAL	3.22	0.02%
Total	19829.57	

Source: Export-Import Databank, Ministry of Commerce and Industry, Government of India

While India may be the second largest producer of food grains across the globe, it has miles to go to achieve food security for all its citizens. According to 'The State of Food Insecurity in the World, 2015' report released by the Food and Agriculture Organisation (FAO), 194.6 million people (15.2% of the country's population) are undernourished in India. By this measure India is home to a quarter of the undernourished population in the world. Therefore, addressing the food security issues in India holds key for the overall achievement of food security in the world. India may be one of the fastest growing economies in the world. However, the higher economic growth has not been fully translated into higher food consumption, let alone better diets overall, suggesting that the poor and hungry may have failed to benefit much from overall growth, the

FAO report says. This indicates that food security is not only about the availability of enough quantity of food grains. Food security is a multi-dimensional issue requiring a concerted action from the government, agriculture research institutions, community-based organizations, farmers and agri-business enterprises.

India has implemented the first Green Revolution to increase farm productivity. Now, the next Green Revolution must focus on imparting climate-smart farming practices among small and marginal farmers, training farmers on appropriate value addition of their farm commodities, improving access to quality inputs, insurance, credit, market etc, reduce post-harvest losses of food commodities, creating a supply chain infrastructure etc.

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A Pathway for Rain-fed Marginal Farmers to Come out of the Agrarian Distress

Miserable State of farmers in Maharashtra: National Crime Bureau Record indicated that over 2, 50,000 farmers committed suicide all over the country during 1997 to 2014; 60 % suicides in Maharashtra, mainly in Vidharbha & Marathwada region. Main proximate reason came up in various studies was Indebtedness and its attendant economic distress. Indebtedness grew, resulting Farmers under economic distress, causing damage to their social status. Constant pressures from banks and the unauthorized moneylenders led to severe mental distress, compromising their dignity, resultant frustration drove the self respecting farmers to commit suicide.

Government Initiatives: On the backdrop of agrarian distress, National & State govt. taken various initiatives & implemented special packages for the benefit of farmers in the state over a decade. Even after implementation these govt. initiatives, there was no significant decline in the absolute number of farmers' suicide in the state.

AFARM Initiative: Based on experience gained from successful implementation of project for scheduled caste and tribal farmers from rain fed regions of Maharashtra, AFARM has undertaken Livelihoods Enhancement programme for Dryland Marginal Farmers in 39 villages from Amaravati and Yavatmal districts along with its four partner organisations to reduce the vulnerabilities of Rain fed marginal farmers in Vidarbha Region covering 5939 households.

AFARM conducted detailed study of Problems / challenges being faced by farmers & other marginalised communities. The major problem of identified communities was lack of knowledge, skills to use resources at their disposal efficiently and lack of bargaining ability in absence of their organization. The key findings were as narrated below.

- **Poor land Productivity** - Due to i) Lack of assured irrigation, ii) vagaries of nature, iii) Land degradation, iv) Lack of access to adequate extension services v) lack of access to good quality agri. Inputs & vi) small land holding,

- **Poor Resources** - Poor resources hampered the capacity of farmers to take risks & invest in improved technologies,
- **Low Profitability** - Increase in cost of cultivation due to heavy dependence on costly external inputs and borrowings from moneylenders at exorbitant interest rates.
- **Knowhow** - Poor application of knowledge and technology to reduce production costs, increase productivity and meet quality standards
- **Poor livestock Productivity** - Due to lack of access to improved inputs, technology, credit and marketing arrangements
- **Absence of Institutions of Poor** - Absence of vibrant institutions of poor at the village & cluster level to access and assure resources and other entitlements available from Government & other agencies
- **Marketing** - High costs of marketing and low profitability due to exploitative marketing systems.
- **Gender inequality** - Secondary status of women in agrarian society, Social pressures & Economic constraints faced by woman headed families, Inability to access and acquire Government Schemes

An Integrated Approach

AFARM has adopted Integrated Approach to address multitude of problems faced by the marginal farmers. AFARMs initiative for promoting Sustainable Livelihoods for the Poor & Marginalized Rural Households is a known solution that was applied in the distress districts of Vidharbha region in which it was not applied earlier.

The central theme of AFARMs initiative is to contribute to development of resilient production, sustainable and diversified households, on farm and off farm livelihoods allowing poor households to face production and market risk without falling back unto poverty and distress.

The purpose of the these initiatives is to improve the income of poor households through augmenting livelihoods basket by incorporating resilient organic and low-input farming,

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involvement of farmers in primary processing, quality enhancement and marketing, empowering women and landless households through micro-finance and micro-enterprises.

The innovative elements, solutions strategies in our initiative mainly includes following:

- Organizing small & marginal farmers, landless & women headed household, having higher proportion of SCs & STs through adoption of the participatory processes and empowering them to evolve into an organization of poor.
- These organizations were called as Setkari Vidnyan Mandal (SVMs) /Village Development Committees (VDCs), Joint Liability Groups (JLGs) & Self Help Groups (SHGs) depending upon their core activities and composition of



major stakeholders. Members of these organization were provided with the information of the available Govt. schemes and the process of preparation of the convergence plans, follow up support to ensure that the SVM/ VDCs mobilizes funds for livelihoods development in collaboration with Gram Panchayat (GP) from govt. line agencies.

- Hand holding and troubleshooting support to local CBOs (SVM Committees, JLGs SHGs) for the sustaining their groups and linking them with the long term objectives & other resource organizations.
- Inculcating LEISA practices through Organizing Livelihood literacy classes for women to enhance the knowledge and skill pertaining to the LEISA, micro enterprise and women rights.
- Participatory planning & execution of In-situ Soil Moisture Conservation Measures and Rain Water harvesting in the fields of small rain-fed farmers with his/ her contribution ranging between 10 to 50% of investment cost.

- Persuading farmers to adopt organic/ LEISA farming (through on-field demonstrations & trials, Organization of Farmers Trainings & Workshops, farmer's exposure visits & Farmers Field Schools) in lieu of the chemical farming (over dependence on expensive external inputs seed, fertilizers & pesticides) adopted by them



leading to agrarian crises.

- Establishment of Community managed Agricultural Implements bank to create the access, within the village to improved agri. Implements to small farmers.
- Facilitating Pro-poor marketing facilities through (i) orientation and training of producer groups and micro entrepreneurs on quality, grading, packaging, primary processing (ii) Establishing marketing link with the traders and wholesalers by the producer groups. (iii) Collective procurement of agri. inputs and marketing their produce, through the farmers group at the village level.
- Promotion of livestock based livelihoods for diversification of activities to reduce risk and cluster approach to ensure quality. Under this Dairy, Goat rearing and Poultry enterprises undertaken by landless, women, & other marginalized HHs by accessing credit from bank under JLG financing model.
- **Convergence of Government Schemes** Convergence is an important strategy to develop/promote diversified livelihoods with support from government development agencies. Efforts have been taken to coordinate Government schemes that result into implementation of schemes with comprehensive impact.

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This integrated approach can be illustrated as below.



Impact:

- **Poor HHs facilitates to manage their resources** and counter vicious poverty cycle.
- Reduction in distress situation of farming community resulting in **absolutely no attempt of suicide in project villages.**
- **Improvement in economic condition (Rs. 40,000 / HH) of poor farmers & landless HHs** due to diversification of livelihoods options & by improving their access to quality inputs, technology, credit & marketing.
- Reduced forced migration leading to **reduction in school drop outs**
- Increased **social cohesiveness, communal harmony** in the villages
- Development process of poor farmers & landless HHs accelerated due to **increased convergence of govt. schemes.**
- Gender inequalities started lessening due to **empowerment of women.**
- **Reduction in cost of production by 30%** due to adoption of Sustainable Agriculture

Key Achievements:

Institutions of Poor formed, capacitated & nurtured	
No. of Shetkari Vigyan Mandals	2
No. of Village Development Committees	34
No. of Self Help Groups	194
No of Agriculture Producer Group	76
No of Joint Liabilities Groups	78
No of Farmer Producer organizations	4
Sustainable Agriculture Promotion	
No of Demonstrations of Agriculture Technologies	645
Farmer Field Schools	34 villages
Livelihoods Literacy Classes	20 villages
APGs/ FIGs members Trained	8050
Funds leveraged/ converged from Government, (Lakh Rupees) by CBOs	261.11
No of farmers benefited from agriculture production enhancement schemes of govt.	3700
Soil & Water Conservation Measures Undertaken	
Area covered under In-situ Soil moisture conservation (Ha)	3502
Water conservation Structures Constructed & revitalized	519
Increased area under Irrigation (Ha)	664.2
Funds leveraged/ converged from Government, (Lakh Rupees) by CBOs	746

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Agri-based & Livestock based Livelihoods Promoted	
Producers Trained	4268
Producers engaged in Agriculture-based Livelihoods activities (cultivation of Vegetable, Turmeric, Ginger, Potato, Baby corn, Organic inputs)	464
Producers engaged in Livestock-based Livelihoods activities (Dairy, Poultry, Goatry)	983
Funds leveraged from Government, Banks Private players by CBOs (Lakh Rupees) by CBOs	410.53
Producers Linked to Improved Inputs suppliers, Technology & Credit providers & Market Aggregators	2162

Recognition for Excellence in Innovative Approach

AFARM has been awarded by the State Government of Maharashtra for 'The Best Innovation Impacting Rural Livelihoods and for Its Invaluable Contribution in Improving the Lives of Rural Poor in Maharashtra State in the Maharashtra Rural Livelihoods Innovation Forum 2013-14.

AFARM has been felicitated by Government of India

AFARM has been felicitated with a CERTIFICATE OF RECOGNITION & MEMENTO by Honorable Mr. Chaudhary Birender Singh, Minister for Rural Development, Govt. of India in the NATIONAL WORKSHOP ON GOOD PRACTICES IN RURAL DEVELOPMENT (a Knowledge Sharing Event) on 23-24th September 2015 at Bhopal. The event was attended by more than 500 dignitaries including Members of Parliament, Senior Officers from State & Central Govt Line Agencies, Representatives of PRIs & Corporate CSRs from across the Country.

Ministry of Rural Development, GoI had organized National Workshop & Exhibition on Good Practices so as to bring best of grass root initiatives to the mainstream debate & provide a platform for their practitioners to interact & share their leanings with Adarsh Grams to be identified by Hon. Members of Parliaments.

Further, AFARMS initiative/work have been included in the Compendium of Good Practices released by the Ministry of Rural Development, Govt. of India.

It is expected that the recognized Good Practices will be replicated by the Members of Parliament in

the villages adopted by them under SAANSAD ADARSH GRAM YOJANA (SAGY) across the Country. SAGY was launched by the Hon. Prime Minister, Mr.NarendraModi, on 11th October 2014 with the vision to translate the comprehensive & organic vision of Mahatma Gandhi, of an Ideal Indian Village into a reality, keeping view the present context.

Possibility of Up scaling / Replication of demonstrated modal in other rainfed regions of Maharashtra State.

AFARM can facilitate the up scaling / replication of demonstrated modal in other rainfed regions of Maharashtra State by following ways & means.

- Developing dedicated workforce of NGOs for planning & implementation of Sustainable Rural Livelihoods initiatives through Conducting Certificate courses on Rural Livelihoods Development
- Technical support & handholding to NGOs for up scaling & replication of demonstrated innovation model in various rain-fed regions with necessary fund mobilisation by respective NGOs.
- Building cadre of CRPs /Krushidoots for Promotion of NRM based sustainable livelihoods for the poor from rain-fed area with focus on organic/ LEISA farming system.

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Aquaculture, an Enterprise for Augmenting the Economy of Farmers

Introduction

United Nations reported that the current world population of about 7.3 billion is projected to reach 8.1 billion in 2025 and 9.6 billion in 2050, with most of the population growth occurring in developing regions. Approximately 47.5 million additional tonnes of food fish will be needed to feed the population in 2050. Globally, fish represents about 16.6 percent of animal protein supply and 6.5 percent of all protein for human consumption (FAO, 2014). According to the latest information on global aquaculture production statistical report from FAO, the world aquaculture production attained an all-time high of 90.4 million tonnes in 2012, including 66.6 million tonnes of food fish and 23.8 million tonnes of aquatic algae (mostly seaweeds) worth USD 6.4 billion. On the other hand, world per capita apparent fish consumption increased from an average of 9.9 kg in the 1960s to 17.0 kg in the 2000s and 18.9 kg in 2010. According to World Food summit in 1996, Food security exists “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”. An estimate reveals that globally about 3.5 million children under age of five die due to starvation and malnutrition and over 18 million suffer from acute malnutrition. In India over 35% of the population is malnourished. If you consider all developing nations, an estimated 16% of the population was hungry as of 2010. Protein deficiency is one of the major factors in the diets of many in developing nations which based on cereal based and inaccessibility to nutritious food is a curse which needs to be wiped out. Although higher food production as a result of improved technology is realised, ever growing population is the biggest challenge met out in developing countries like India.

During the last three decades, capture fisheries production increased from 69 million to 93 million tons; during the same time, world aquaculture production increased from 5 million to 63 million tons. The proportion of assessed marine fish stocks fished within biologically sustainable levels declined from 90 percent in 1974 to 71.2 percent in 2011. Aquaculture is projected to supply more than 60 percent of fish destined for direct human

consumption by 2030. The industrial production of fish meal from whole fish has declined gradually since 2005; overall demand continued to grow, pushing prices to historic highs until January 2013, with an increase of 206 percent between January 2005 and January 2013. The global supply of fish meal declined by 12 percent during the 2000–08 period (FAO, 2014). In aquaculture, fish feed constitutes 70 percent of the total production cost and fish meal alone constitute 60 percent in the feed. Today’s Aquaculture industry is already facing a lot of challenges and wild fish stock exploitation for the aquaculture feed is one of the issues to be looked into from the perspective that a fish protein cannot be used to produce another fish protein. Therefore, research is on top gear world wide for replacing fish meal completely or partially with ingredients from plant sources.

Aquaculture impacts

Aquaculture in common with many other sectors uses natural resources and interacts with the environment. Major environmental impacts of aquaculture have been associated mainly with high-input high-output intensive systems (e.g. Culture of salmonids in raceways and cages) which effects the huge amount of suspended solids, and nutrient to recipient waters and resulting in build-up of anoxic condition, changes in benthic communities, build up of nutrients in the water causes eutropication, diseases and pathogen transmission in the wild stock fish population and other animals. Excessive collection of wild larvae, as seed stock for the aquaculture purposes may impact the locally available fish stock. Non target fish species are also affected during natural fish seed collection. Overfishing of local fish or invertebrates for aquaculture feed purpose another factor of concern to the sustainability of ecosystem. Large-scale shrimp culture development has an effect in physical degradation of coastal habitats, like the conversion of mangrove forests and destruction of wetlands, salination of agricultural and drinking water supplies. Misapplication and husbandry practices may lead to the release of antibiotics, pesticides, antifungal agents and pollutants to the environment. Integrated aquaculture is one of the best ways to combat all the above issues related to

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aquaculture and sure to augment the income to farmers when integrated ideally with other farming enterprises.

Why aquaculture is to be integrated with agriculture?

Agriculture is moving towards lower costs, higher production and larger markets, not only in the developed nations but also in developing nations like ours. The problem with modern food system is its very success. The producers are locked in a vicious cycle, the more they produce, the more they must continue to produce at lower cost of production. They either increase the area of production or increase technical input to boost production. University of Minnesota economist, Willard Cochrane named this “Technology Treadmill” as an emerging problem some 50 years ago. The farmers are faced with more problems now than ever before (Roberts, 2008). Shrinking farm lands, high input costs, scarce water, disputes in sharing water for various and between states and non availability of farm labour are some of factors restricting agriculture production in the country. This being the case, sharing water for aquaculture in place of agriculture is a daunting task, and very often, traditional farmers resist the idea of change to include other enterprises and more so, on change altogether.

Inter-Governmental panel on Climate Change has projected that by the end of this century global temperature is likely to increase by over 1.8°C that could potentially lead to scarcity of water and food resources. Water is going to be the most scarce resource in the coming decade and therefore a judicious and effective use of the resource has to be worked out to augment food production. In fact, the need of the hour is to enhance the “water use efficiency”. The best way is to go for using water sequentially for various enterprises to the best possible extent. “Integrated fish farming” systems refer to the production, integrated management and comprehensive use of aquaculture, agriculture and livestock, with an emphasis on aquaculture” or Integrated aquaculture is the concurrent or sequential linkage between two or more farm activities, of which at least one is aquaculture. Features of integrated farming include:

- Increase the productivity of water, land and associated resources while contributing to increased food fish production

- Recycling of waste or by-product in which the waste of one system becomes the input of another system.
- Efficient utilisation of farm space for multiple production.
- Efficient use of labour and work force.
- Less feed input or reduced feed
- The multiple use of farm water resources for aquaculture can result in many environmental benefits.

As aquaculture predominantly does not consume water, rather “borrows” it for “temporary” use; this practice can be integrated into a farming system before the water is used for its primary purpose, such as irrigating crops or pastures. In this way, nutrients are also added in organic form to the water before irrigation, which may subsequently reduce the need for additional inorganic fertilizer application. The multiple use of water in itself will mean that the farm is more efficient in terms of the value of production per unit of water used, and more environmentally sustainable. Combining fish culture with agri or horticulture therefore improves water use efficiency and reduces nutrient input in soil for crops. This reduces the cost and increases net revenue realized. Nasr-Alla et al (2012) has reported on the benefits of use of nutrient enriched aquaculture effluent water for agriculture in Egypt. He concluded that in intensive aquaculture integrated farming system, the added benefit to the farm revenue could be increased up to 88% where there is a savings on nitrogenous fertilizers input to the tune 100% and overall cost savings on fertilizers up to 40%. The total nitrogen enrichment in the water that is fed into crops from fish culture ponds was reported to be about 4 to 5 times higher than that of the source water. The addition of phosphate due to fish culture was about two times while there was only a marginal increase in potash levels from those of the source water. The benefits depended on the type of farming practice especially the stocking density of fish, and efficient husbandry practices. Additional benefits are provided to the farming community in that the day to day operational requirements are not gender, or age specific, thus allowing broad participation of the workforce - including more family members for smaller farming operations. Water authorities are also able to achieve benefits through higher value, more efficient use of land and water resources. This results in increased revenue without increased consumption, further offsetting existing

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management and maintenance costs.

Integrated farming is more feasible and sustainable in India

- Animal census (2012) indicates the following live stock resources available in India,
- The total number of Bovine population is 299.9 million
- The total number of sheep in the country is 65.06 million
- The total number of pigs in the country is 10.29 million
- The total number of goats in the country is 135.17 million
- The Total number of poultry in the country is 729.2 million

During 2011-12, there was a record production of food grains at 259.32 million tones. Total area of land under crop production in 2009-10 is 192.20 million hectares, of which food crops are cultivated in 141.06 million ha and non-food crops in 51.14 million ha. These put together produces more than 500 million tons of crop residues annually. Livestock manures represent a valuable resource that, it can replace significant amounts of chemical fertilizers.

The term “waste” has not been omitted because of common usage, but philosophically and practically it is better to consider wastes as “resources out of place” (Taiganides, 1978). The considered, waste of Live stock, poultry and agriculture byproducts would form a nutrient source or food for the integrated fish farming system. The following numbers of livestock required to fertilize one hectare fish pond. It is estimated that 40 – 50 kg of organic manure can produce 1.0 kg of fish in a system. The waste / excreta from 500-600 birds are adequate to produce manure for a hectare of water area under poly culture. Similarly, the waste from 35-40 pigs or 3-4 cows/buffaloes or 50-60 goats could ensure manuring of one ha water spread for sustaining plankton productivity to support fish culture. The advantages of organic manures can not be undermined from the environment point of view. It helps in maintaining C:N ratio in the soil and also increases the fertility and productivity of the soil besides improving the physical, chemical and biological properties of soil. Due to increase in the biological activity, the nutrients that are in the lower depths are made available to the plants.

Different types of Aquaculture systems

Extensive Culture: Fish production in extensive systems is based on the use of organic fertilizers. Fertilization of ponds promotes the growth of simple plants which form the base of the food chain in the pond. This type of production can be integrated with other types of crop or livestock production, using animal manure and agricultural by-products as sources to stimulate primary production. Stocking density is low (less than 1 ton per hectare per year). Consumer’s preference is higher because the product is in good quality.

Semi Intensive Culture: Semi-intensive aquaculture aims to increase the production of fish from pond systems beyond the level supported by food which is naturally available through the use of supplementary feeds. On an average 5 cubic meter water is used per kg fish

Intensive Culture: In intensive culture systems, there is a decreased dependence on the availability of natural food and greater dependency on the use of commercial feeds. Densities of fish kept within such holding areas are limited by species tolerance, ability to grow at raising stocking densities and maintenance of environmental parameters rather than the production of a natural food supply. Stocking density, in normal conditions, is 12- 18 kg per cubic meter. If liquid oxygen support is provided stocking density can be increased to 50 kg per cubic meter.

Success stories of Integrated farming in India

The Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar showed promising results and encouraging the integrated Agri aquaculture systems among farmers. Their demonstration system with Livestock-horticulture-grass-agro forestry-fish integration at Pokharbhinda Village, Kushinagar in Eastern Uttar Pradesh resulted in Integrating the different farming practices like fish, buffalo, duck, poultry, fruits, vegetables and teak plant in one farm provided multi commodities (spawn, fry, fingerling, yearling, food fish, milk, egg, duck meat, poultry meat, fruits, vegetables and wood) at one platform to meet local requirements. Buffalo dung has value added into biogas plant and provided slurry as an efficient organic manure for increasing pond productivity. Biogas generated was used for lighting farmhouse and cooking food. Recycling of duck droppings

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and poultry wastes in fish ponds reduced feed cost of fish. Use of fodder enhanced production of herbivorous fish and buffalo milk.

A farmer with the technical support of the CIFA has successfully produced 250 liter carp spawn, 2400 kg fry, 2480 kg fingerling, 3650 kg yearling, 7370 kg food fish, 8200 liter milk, 10500 eggs, 175 kg duck meat, 8400 kg poultry meat and adequate quantity of fruits and vegetables. The above different kinds of farming activities, he made a net earning of Rs.13,56,980/4.8ha/yr at Pokharbhinda, Kushinagar. Several farmers in Puri district of Odisha have adopted integration of fish and horticulture in their farms and augmented their revenue considerably.

One of the successful case involved construction of a fish pond of 0.56 ha area, leaving 0.29 ha area of pond embankments. Thus the water area and embankment ratio was 1.9:1 against recommended water and an embankment ratio of 10:1 or 5:1. For pond embankment an additional area was kept for growing horticultural crops. By utilizing of 0.29 ha pond embankments, farmer could make a net profit of Rs. 328,761 against an expenditure of Rs.92,289. The percentage net returns on the expenditure was computed to 356% with the profitability index of 3.56 and the cost benefit ratio of 0.28. Total fish production was 3899 kg/0.56 ha/yr (6963.66 kg/ha/yr), which was much higher than the National average fish production (2600 kg/ha/yr) of the country. The Farmer made a net profit of Rs.128015/- from the fish culture operation.

The Government of Tamil Nadu, through the assistance of World Bank has introduced the concept of construction of farm ponds to harvest rain water, use it for aquaculture and crop irrigation. As per the norms, the beneficiaries of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) who comes under the categories of small farmers (own below 2.5 acres), marginal farmers (own below 5 acres) and SC/ST farmers (no limit) are selected for this scheme. Farm ponds are dug in the size of 30 x 30 x 1.5 m with total subsidy by the Agricultural Engineering department and farmers are encouraged to go for fish culture with the assistance of the State Fisheries department. Although the current estimate on increased fish production through the scheme is not available, it surely would augment fish production and revenue of the farmers of the State

Conclusion:

As Paul Roberts (2008) has put it, the future of food depends on aquaculture. Several studies have proved beyond doubt that It is possible to increase water use efficiency through integrating agriculture and aquaculture, thereby reducing use of chemical fertilizers and increasing farm income through increasing productivity per unit of water. In rural agriculture integration of several components can help in producing affordable food sources of animal origin for surrounding residences. The need of the hour is to optimize water use efficiency in integrated farming systems by understanding the relationship between water requirements for both the fish ponds and crop irrigation for sustenance. Fresh water fish culture mainly from the traditional practices contributes most of the aquaculture production in the world. In India, our resources are not fully exploited towards sustainable fish production. If each agriculture farmer could convert 10 percent of his agriculture land for the use aquaculture, it would sustain the production and food security for the coming decades. In small farm holdings and in dry land farms, the concept of farm ponds integrated with agriculture has to be promoted for improving water use efficiency.

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Collective Action, Multiple Benefits: A Case of a Social Enterprise Model

Farmers in Madhya Pradesh are improving crop productivity and increasing their incomes by creating social enterprises using ecologically sound and sustainable practices. The social enterprise model has not only helped farmers to earn better incomes with very low investments, but has also resulted in building biological diversity.

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Khanpura is a small village of 100 households located in the Budhni Block of Sehore district in the state of Madhya Pradesh, India. The village is



Insects like lady bird beetles are back with the use of biopesticides.
Photo: Vritti

surrounded by dense forest with agriculture as a main source of livelihood. Till about a few years back, farmers in this area, having given up traditional agriculture practices, were

heavily dependent on chemical fertilisers and pesticides.

It was observed that small farmers were using pesticides indiscriminately for which they were spending around Rs 10003000/per acre.

Besides increasing costs of cultivation, indiscriminate use of chemicals and pesticides had led to problems such as development of resistance in pests, resurgence of pests, environmental and food safety hazards.

To help farmers reduce their costs of cultivation while adopting environmentally sustainable practices, Vritti started advocating the use of cow urine, neem and castor leaf based biopesticides, based on local knowledge. This was initially met with scepticism by farmers, who have been using chemicals since long, on the efficacy of these biopesticides.

Adopting systematic approach, Vritti succeeded in educating farmers on the benefits of using biopesticides. Also, Vritti encouraged farmers to create a viable business model around it.

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Shri Ram Kailash with his biopesticide production.
Photo: Vritti

Vritti helped village communities organise themselves into farmer clubs and Self Help Groups (SHG). Members of the farmer groups were taken on exposure visits to different farm fields to see and learn good agriculture practices like SRI, SWI, NPM and Organic Farming. Members also visited organisations like Krishi Vigyan Kendra, Agriculture Universities and other institutions and interacted with the staff to understand the working of Farmer Producer Organisations.

The lead farmers - the innovators and early adopters of good farm practices, having a positive attitude and acceptable by the communities, were selected as the Agri Business Development Service (BDS) providers. The role of BDS providers is to provide support to farmers at their door step and also facilitate linkages with government services, market players, extension services and the research and scientific institutions.

The Agri BDS providers were trained as Master trainers. They were also trained in motivating registered farmers in collecting cow urine and supplying to BDS for biopesticide preparations assessing the utility of cow urine and neem leaf based biopesticides.

Process

Case of an early adopter

One of the early adopters was Shri Ram Kailash Yadav, a farmer of Khanpura village and Agri BDS. He is 35 years, educated farmer having 5 acre land. He is curious, hardworking and has leadership qualities along with good entrepreneur skills. He has four cows.

With Vritti's association, Ram Kailash decided to try out production of biopesticide using cow urine. To start the enterprise, he first secured 18 drums of 200 litres capacity with NABARD's support.

He took 15 litres of cow urine and added 5 kg of neem leaves, 0.5 kg of custard apple leaves, and 0.5 kg of Calatropis gignata leaves. He left the mixture undisturbed for 21 days. The mixture undergoes anaerobic fermentation. After 21 days, 0.5 kg of the bio pesticide was mixed with 15 litres of water and sprayed on soyabean crop. The spraying was repeated at an interval of 15 days.

Ram Kailash noticed a marked difference in the crop. The growth of the plants had increased tremendously. The roots were strong and started spreading, a sign of a healthy plant. The disease attack was reduced. Plant became more resistant towards diseases and pests. The grain quality increased. The land became fertile due to the application of cow urine. There was an increase in yield. The seeds produced were much healthier compared to those produced without using biopesticides.

After noticing these positive changes he decided to produce the bio pesticide on a commercial basis. He prepared around 2200 litre of bio pesticide in the first year making a profit of around Rs. 17600/-. The profit earned by Ram Kailash is shown below:

Year	Input Cost per litre	Production (in litres)	Rate Sold	Amount	Profit
2013	Rs. 4	5700	Rs 12	Rs 68400	Rs 45600
2012	Rs. 4	2200	Rs 12	Rs 26400	Rs.17600

Preparation of bio pesticide does not require labour and can be prepared easily. The input cost for making the bio pesticide is negligible as he collects the leaves of neem, custard apple, and Calatropis gignata from the forest and cow urine is collected from the cows he owns. Infact, Ram Kailash started his business with Rs 200 only.

The entire process of biopesticide production takes place at three levels.

Cow urine is collected at SHG/Farmer Club level.

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More than 400 households are involved in the collection of cow urine. The agri BDS providers collect the cow urine from the SHG/farmer groups and take it to the processing centers. Every day around 500 litres of cow urine is collected from all the households. Farmers are paid Rs.5 per litre of cow urine.

Processing is done at three units located in Khandawar, Khanpura and Ondia Village. The cow urine collected is put in 200 litres plastic drum. To this, around 20 kg of neem and custard apple leaves are added. The drum is kept closed for 21 days for fermentation.

After filtering the leaf, the solution is used as biopesticide. Each unit has a capacity to produce around 3000 lts. of biopesticide. Now, some SHGs are showing interest to prepare biopesticide at the village level and market it within the village. Marketing is done by Narmadanchal Farmer Producer Company (formed by 1000 no of farmers) which purchases the biopesticide. Narmadanchal is a community organization registered under the companies act as Producer Company. The biopesticide is sold under the brand name Brand Ejecta.



Inauguration of bio pesticide Unit
by Mr Deepak Kumar, GM.
Photo: Vrutti

Benefits

Bio pesticides are being used by around 500 farmers in different crops like paddy, wheat, soybean etc. They perceive a lot of benefits by using biopesticides.

There is 20 to 25% crop growth appreciated by the farmers the number of tillers has increased, there is no yellowing of leaves and fungal disease infections, plants are healthy, the ear length has increased with increased grain weight. The seeds are bold having good colour and appearance.

Farmers have reduced using chemical pesticides. Of the total, around 25% of the farmers have totally stopped using pesticides, 50% have reduced the usage by half and 25% have used

biopesticide at least one time during the crop growth. This has considerably reduced costs of production.

While cost of using chemical pesticide is around Rs. 1800/acre, cost of producing bio pesticide is about Rs.1000, thus saving around Rs. 800/acre.

Overall, with reduced costs of production and increased yields, farmers are able to increase their net incomes by about Rs.5000 per acre.

With continuous use of biopesticides, farmers have observed lady bird beetles and earthworms, thus enhancing ecological diversity. There is an enormous saving of water too which was earlier used in the application of chemical pesticides.

Scaling up the initiative

At present about 500 farmers are using cow urine based bio pesticides in their farms in different crops like Paddy, Wheat, Soybean etc. The positive results has encouraged Vrutti in scaling up the enterprise with the support of National Bank for Agriculture and Rural Development (NABARD).

NABARD under the Environment Promotional Assistance Programme supported Vrutti in setting up two bio pesticide units in the tribal areas of Yardnagar and Kanndawar villages in Budani block of Sehore district in Madhya Pradesh. This is being jointly run by farmer groups /federations and Vrutti.

The social enterprise model has not only helped farmers earn better incomes with very low investments, but also resulted in soil fertility enhancement while safeguarding the environment.

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Promotion of sustainable and equitable agriculture and rural development through effective credit support, related services, institution development and other innovative initiatives.

MAJOR ACTIVITIES

- Credit Functions : Refinance for production credit (Short Term) and investment credit (Medium and Long Term) to eligible Banks and financing institutions
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 - ✓ Watershed Development Fund (WDF)
 - ✓ Rural Infrastructure Development Fund (RIDF)
 - ✓ Tribal Development Fund (TDF)
 - ✓ Cooperative Development Fund (CDF)
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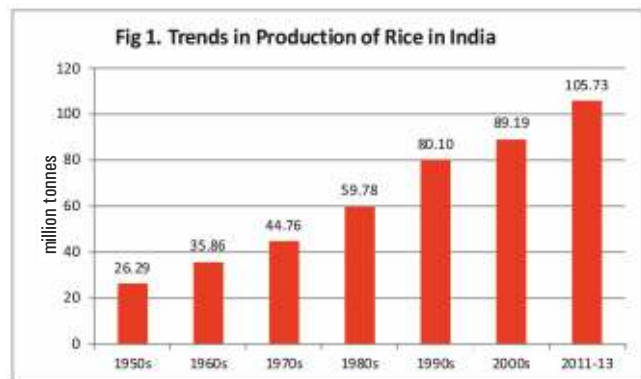
National Rice Research Institute in Service of Mankind

Technological change and favourable government policies has helped in increasing rice production in India during the last 68 years through the National Agricultural Research System and made India not only self sufficient in rice production but also the largest exporter of rice in the world. The growth experience in production of rice over decades and the recent past is depicted in figure 1. The production has increased by 4.9 times (21.59 million tonnes during the triennium average ending 1952-53 to 105.73 million tonnes during the triennium average ending 2013-14). It is due to growth in productivity and expansion in area. While productivity of rice has contributed 3.5 times (0.72 tonne during the triennium average ending 1952-53 to 2.46 tonnes during the triennium average ending 2013-14), the area expansion has contributed 1.4 times to production growth during the last 68 years. The area under rice has reached maximum during 2000s and thereafter started declining. Therefore, future expansion in production has to come from productivity increase only through technological advancement. India will need 137 million tonnes of rice to feed its growing population by the year 2050 besides export demand. The problem before us is how to feed millions of new mouths and hungry people in the face of shrinking land frontiers, diminishing per capita irrigation water, deteriorating soil health, increasing biotic and abiotic stresses and changing climate.

National Rice Research Institute (formerly CRRI) is in the forefront of technology development on rice and is in the 69th year of its existence. The institute was established in the year 1946, by the then British government as an aftermath of the great Bengal famine, where millions of people perished, to look into a holistic approach to rice research in India. The administrative control of the institute was subsequently transferred to the Indian Council of Agricultural Research (ICAR) in 1966.

The Institute has two research stations, one at Hazaribag in Jharkhand, and the other at Gerua in

Assam. The NRRI regional substation, Hazaribag was established to work on the problems of rainfed uplands, and the NRRI regional substation, Gerua for the problems in rainfed lowlands and flood-prone ecologies. Two Krishi Vigyan Kendras (KVK) are also functioning under the National Rice Research Institute (NRRI), one at Santhapur in Cuttack district of Odisha and the other at



Jainagar in Koderma district of Jharkhand. One more regional research station has been planned to be established in Andhra Pradesh during 12th plan.

Goal and Mission

The goal of the institute is to ensure food and nutritional security of the present and future generations of the rice consumers and producers. Therefore, the mission of the institute is to develop and disseminate eco-friendly technologies to enhance productivity, profitability and sustainability of rice cultivation.

The Broad Mandates

- Conduct basic, applied and adaptive research on crop improvement and resource management for increasing and stabilizing rice productivity in different rice ecosystems with special emphasis on rainfed ecosystems.
- Generation of appropriate technology through applied research for increasing and sustaining productivity and income from rice and rice-based cropping/farming systems in all the

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ecosystems in view of decline in per capita availability of land.

- Collection, evaluation, conservation and exchange of rice germplasm and distribution of improved plant materials to different national and regional research centres.
- Development of technology for integrated pest, disease and nutrient management for various farming situations.
- Characterization of rice environment in the country and evaluation of physical, biological, socioeconomic and institutional constraints to rice production under different agro-ecological conditions and in farmers' situations and develop remedial measures for their amelioration.
- Maintain database on rice ecosystems, farming situations and comprehensive rice statistics for the country as a whole in relation to productivity and profitability.
- Impart training to rice research workers, trainers and subject matter/extension specialists on improved rice production technologies and rice-based cropping and farming systems.

Research Programs

Presently, the institute has 41 research projects, which are classified under five broad research programs. The five programs are:

- Programme 1: Genetic improvement of rice (15 projects).
- Programme 2: Enhancing the productivity, sustainability and resilience of rice based production system (12 projects).
- Programme 3: Rice pests and diseases - Emerging problems and their management (7 projects).
- Programme 4: Biochemistry and physiology of rice in relation to grain and nutritional quality, photosynthetic efficiency and abiotic stress tolerance (4 projects).
- Programme 5: Socio economic research and extension for rice in development (3 projects).

Varietal Development

NRRI has developed 113 varieties (including three hybrids for different ecosystems till date. The names of the varieties are listed ecosystem wise in the following table.

NRRI varieties suitable for different ecosystems

Sl. No	Ecosystem	Name of the varieties
1	Upland (20)	Bala, Sattari, Kalinga-III, Neela, Annada, Heera, Kalyani-II, Tara, Vanaprabha, Sneha, Vandana, Dhala Heera, Anjali, Sadabahar, Virender, CR Dhan 40, Sahbhagidhan, Phalguni, Satyabhama, CR Dhan 101
2	Irrigated (41)	Padma, Kiron, Krishna, Ratna, Vijaya, Saket-4, Jayanti, Kalinga-I, Kalinga-II, Shakti, Supriya, Vani, Naikichili, Indira, Pallavi, Narendra-1, Khitish, CR 138-928, Sarasa, Udaya, Kshira, Shaktiman, Radhi, Tapaswini, Shatabdi, Hazaridhan, Abhishek, Geetanjali, Naveen, Rajalaxmi (Hybrid), Ajay (Hybrid), Satya Krishna, Hue, Improved Lalat, Improved Tapaswini, CR Dhan 300, CR Dhan 303, CR Dhan 305, CR Dhan 304, CR Dhan 306. CR Dhan 307
3	Aerobic (6)	Pyari, CR Dhan 201, CR Dhan 202, CR Dhan 205, CR Dhan 203, CR Dhan 206
4	Boro / Summer (3)	Chandrama, Chandan (CR Boro dhan 2), CR Dhan 601
5	Shallow rainfed lowland (22)	Anamika, Ramakrishna, Samalei, Savitri, Dharitri, Moti, Padmini, CR 1002, Seema, Pooja, Ketekijoha, Nua kalajeera, Nua Dhusara, Swarna Sub1, Reeta, Nua Chinikamini, CR Dhan 701 (Hybrid), Sumit, Poorna Bhog, CR Sugandh Dhan 907, CR Dhan 407, CR Dhan 408
6	Medium Deep Water (11)	Utkalprabha, CR 1014, Gayatri, Kalashree, Panidhan, Tulasi, Sarala, Durga, Varshadhan, Hanseswari, CR Dhan 501
7	Deep Water (4)	CR Dhan 500, Jalamani, Jayanti Dhan, CR Dhan 505
8	Coastal Saline (6)	Lunishree, Sonamani, Luna Suvarna, Luna Sampad, Luna Barial, Luna Sankhi

Figures in parentheses indicate number of varieties

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Besides the above varieties released for different states of India, NRRI developed varieties are also popular in other countries. Eight varieties (CR 44-1, Padma, Vijaya, Savitri, Khitish, CR-123-23, Annada, Krishna) developed by NRRI are released in nine countries (Afganistan, Burkina Faso, Burundi, Malawi, Mali, Nepal, Pakistan, Paraguay and Tanzania). The indica-japonica hybridization programme sponsored by Food and Agriculture Organisation, which was launched in 1952 at NRRI yielded varieties like ADT-27 (released in Tamil Nadu), Malinja and Mahsuri (released in Malaysia) and Circna (released in Australia). Mahsuri was later released as Ponni in Tamil Nadu, Pajam in Bangladesh and Masuli in Nepal. NRRI was first to report the existence of cytoplasmic male sterility (during 1954), which has been used for development of hybrid rice worldwide. The institute identified *Oryza longistaminata* as a source of bacterial blight resistance, which was subsequently used elsewhere to isolate Xa21 gene. The institute perfected the anther culture technology and pioneered to develop and release two high yielding indica rice varieties namely Satyakrishna and Phalguni through this technique. Integrated marker assisted selection technique was used to transfer three bacterial blight resistance genes to the popular varieties Lalat and Tapaswini and released their improved versions as new varieties by the institute. Work on specialty rice at NRRI has resulted in identification of eight high protein rices with 10% protein in milled rice. One such rice in Naveen background (CR 2829-PLN-37) has been identified by variety release committee for release. Rice cultivars with high iron/zinc have also been identified. The rice variety Kalinga III with long slender grains grown in upland ecology was found to be high in protein and zinc content. The rice variety Kalabhat with high antioxidant content has also been identified. The rice varieties Banskathi and JP-73 were found to have good popping quality and hence good for Mudhi making. The rice variety Aghoni Bora was identified to be soak and eat rice. Work on low glycemic index rice continues to identify varieties for diabetic patients.

Crop Management Technologies

- Integrated Nutrient Management (INM) - Combined use of various sources of nutrients

viz., chemical, organic and bio-fertilizers have been formulated to increase crop production and the productivity in different ecosystems.

- Resource Conservation Technology - Incorporation of Dhaincha at 25-30 days after sowing by cono-weeder if standing water is available. Alternatively, knock down of dhaincha by 2,4-D at 25-30 days after sowing if standing water is not available.
- Leaf Colour Chart - It was customized and found useful (increase N efficiency by 10%) for need based nitrogen management in rice and reducing nitrogen use and reduction in cost of production.
- Management of Acid Soils - Liming to increase pH, base saturation, CEC, inactivating Al, Fe, and Mn, reduce acidity and P fixation (needs regular application due to reserve acidity). Management of acid soils involves organic manuring (FYM, Compost, GM, etc.). Reducing P fixation by using less soluble P sources such as rock phosphate. Selection of crops, cropping systems and varieties helps in reducing acidity.
- Aerobic Rice - Growing rice with aeration or under non-flooded condition is termed as aerobic rice. With this technology reasonably good yields can be obtained with only 2-3 irrigations, thus saving 30-40 per cent of irrigation water. So far, six varieties have been developed by the institute for the purpose.
- Direct seeding - Direct seeding, using a drum seeder, is one of the methods of crop establishment of rice which has potential to increase production with reduction in cost of cultivation.
- Azolla - The aquatic fern Azolla is promising nitrogen-fixing bio-fertilizer for rice. One crop of Azolla produces 10-20 tonnes of fresh biomass and supplies 20-40 kg of N/ha. NRRI has identified a strain of *Azolla caroliniana* with tolerance to major insect pests in comparison to *Azolla pinnata*, which has been commonly used.
- Rice-fish-horticulture based farming system models for increasing farm productivity, income, employment, sustainability and household food and nutritional security were developed.
- Several implements / machineries / devices have been developed for small farmers as they constitute 85% of the total holdings available in

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India. They are: a) CRRl drum seeder, b) CRRl manual rice transplanter, c) CRRl two row manual seed drill, d) CRRl animal drawn seed drill, e) CRRl tractor drawn seed drill, f) CRRl animal drawn disc harrow, g) CRRl rice husk stove, h) CRRl power operated paddy winnower cum cleaner, i) CRRl mini parboiling unit, j) RCC ring bin, k) Variable capacity paddy dryer.

- Management of biotic stresses depends on proper pest surveillance/monitoring and fixing of economic threshold level. The surveillance is generally done by fixing light/ pheromone traps and regular sweeping by net in the field for insect pests and also visual observation for both insect pests and diseases. Eco-friendly pest management forms a major option and need based with emphasis on bio-intensive IPM in rice. Integrated Pest Management technologies covering different ecosystems has been developed.
- ITK-based botanicals such as Neem (*Azadirachta indica*), Karanja (*Pongamia pinnata*), Kochila (*Strychnos nux-vomica*), Water Pepper (*Polygonum hydropiper*), Parasi (*Cleistanthus collinus*) and Wild Sugarcane (*Saccharum spontaneum*) etc. were validated in tribal areas and refined for higher efficacy and user-friendly applications. These are mainly recommended for tribal areas.

Linkages and Partnership

The NRRI has linkages with several national and international organizations such as the Council for Scientific and Industrial Research (CSIR), Indian Space Research Organization (ISRO), State Agricultural Universities, Indian Institute of Rice Research, State Departments of Agriculture, and the institutes of the Consultative Group for International Agricultural Research (CGIAR), such as the International Rice Research Institute (IRRI), Philippines and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad. NRRI also has strong linkages/collaboration with several institutes/universities of National Agricultural Research System for technical cooperation and development of technologies for the farmers. The institute has partnered with more than ten private companies for commercialization of its products

and technologies. Partnership with farmer organizations and a rice milling firm has been established for participatory seed production and commercial production of high-quality milled rice for providing remunerative price to the farmers and also to have a win-win situation to all the stakeholders..

Outreach Programmes

The institute has been conducting frontline demonstrations and on-farm trials through KVK's, and various other collaborative projects with institutes like National Centre for Integrated Pest Management, New Delhi, International Rice Research Institute, Philippines, and Government of India projects like National Initiative on Climate Resilient Agriculture and Tribal Development project and other institute projects etc.

The State-of-the-art Facilities

The insitute obtained the ISO-9001:2008 certification for quality management system. The facilities available in the institute are:

- Oryza museum
- Gene bank
- Transgenic laboratory
- Biotechnology laboratory
- High temperature wind tunnels
- Salinity screening facility
- Open top chambers for CO₂ enrichment study
- Maintains more than 30,000 accessions of rice germplasm including nearly 6,000 accessions of Assam Rice Collection (ARC) and 5,000 accessions from Odisha.
- Data base on various aspects of rice

Challenges and Future Thrusts

The major challenges to future increase in rice production are declining profitability from rice cultivation, shortage of irrigation water due to diversion to other sectors of the economy and declining ground water table in some areas, changing climate, plateauing yields in irrigated areas, constraints in input delivery, drudgery reduction in rice farming and other infrastructural bottlenecks in storage and marketing.

Therefore, the future thrust areas should be a)

Development of super rice including super hybrids, b) Development of climate resilient varieties tolerant to multiple abiotic stresses, c) Changing crop management practices, which reduce Green House Gas emission and support environmentally sustainable rice production, d) Enhancing input use efficiency, e) Breeding high quality rice for enhancing the nutritional value, f) Development of more efficient machineries and

implements for small farm mechanization, g) Addressing socio-economic constraints and infrastructural bottlenecks.

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Indian Livestock: An Asset for Sustainable Growth and Livelihood Security in India

India a country of villages, has about two-third of its population living in villages. Animal husbandry has been an integral part of Indian agriculture providing livelihood and nutritional security to rural masses. The livestock rearing has been a vital component of smallholder's production system comprising landless, marginal, small and semi-medium farmers. Majority of these animal keepers are below poverty line and livestock rearing provides nutritional and social security to these livestock keepers against natural calamities. The marginal, small and semi-medium farmers are rearing 87.7% of total livestock (Table 1). The number of holdings owned by these farmers constitute 95% of total holdings, while they have only 68% of total operational area. The distribution of different species of livestock amongst the various categories of animal keepers reveal that marginal, small and semi-medium farmers on an average has about 89% of cattle, 85% buffaloes, 87% sheep, 89% goats, 92% pig and 94% poultry (Table 2). It indicates that compared with distribution of land, the livestock resources are more equitably distributed. Hence, livestock plays pivotal role for sustainable growth, livelihood and nutritional security of smallholder farmers. It is evident that these smallholders are playing significant role in the animal production scenario of the country and contributing to the national gross domestic product.

Livestock Production Scenario

Milk, eggs, meat and wool have been the major livestock products in our country (Table 3). Milk

tops in contribution to total livestock output as per the current prices during 2011-12 (Rs.305484 crores, 66.55% of total livestock output). The contribution of meat to the total livestock output was 18.22% followed by dung (6.94%) and eggs (3.88%). The milk production in the country has increased from 17 million tons during 1950-51 to 127.9 million tons during 2011-12 (Table 4). The corresponding increases in egg and wool production are 1832 to 66450 million eggs and 27.5 to 44.7 million kg wool, respectively. The meat production has increased from 1.9 million tons during 2000-01 to 5.5 million tons during 2011-12. The compound decadal growth rates of milk production increased drastically from 1.15% (1960-61 to 1973-74) to 4.51% (1973-74 to 1980-81) attributed to 'Operation Flood'. During 1990-1996, this program fostered a smallholder oriented, village based dairy cooperative movement and overcame infrastructural, market and institutional challenges in production, procurement, processing and marketing of milk, managing to link large urban centers with dairy cooperatives all over India (Cunningham, 2009). It is a matter of satisfaction that milk production sustained this growth and subsequently increased at a rate of 4-5% during the last five decades. Similarly, the decadal growth rate of egg production in the country has been encouraging ranging from 4.63% (1950-51 to 1960-61) to 7.91% (1960-61 to 1973-74). The compound decadal growth rate in wool production has not been so encouraging in the past.

India has witnessed a white revolution in seventies

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and eighties of the last century which is largely due to manifold increase in milk production contributed largely to crossbred cows. India is world topper in milk production. Estimated milk production in the country is 127.9 million tons during 2011-12 (Basic Animal Husbandry, Fisheries Statistics, 2013). About 38 million buffaloes produce about 51% of milk, while 34 million cows produce about 45% of total milk. Out of 45% of total milk produced by cows, 21% is produced by indigenous cows and 24% by crossbred cows. Further, about 28% of crossbred cattle are producing nearly 54% of total cow milk. The impact of crossbreeding is more pronounced under field conditions in most of the progressive states of the country. This was attributed to higher milk production of crossbred cattle as compared to local cattle and is evident from milk yield/cow/day (6.97 versus 2.27 kg) during the year 2011-12. The performance of crossbreds in terms of milk yield is about 3-4 times more than that of local cows in majority of prosperous states (Gandhi and Singh, 2006). Average milk production of cattle in India is 1172 kg/lactation, which is about half of the global average (FAO, 2011). Lower production of our cattle is mainly attributed to the poor genetic make-up of majority of animals, which needs to be genetically improved. Feeding, breeding and health management is another aspect needs to be improved to enhance productivity. Though in majority of the states, Indian cattle breeds are draft in nature, still a slight improvement in their productivity will considerably increase the total milk production of the country. The latest statistics of cattle population in India is revealing clearly that the number of low and unproductive non-descript cattle especially males is declining over the years and that population of breedable females and crossbred cattle is increasing.

Livestock Boom: An Instrument for Higher Productivity

The higher number of livestock (512 million) and poultry (729 million) has been the strength of the country to cater the needs of livestock produce and products of about 1.27 billion population on India. It is a matter of rejoice that India is number one in milk production, third in egg production and fifth in poultry meat production. The livestock

production system in India has shown a paradigm shift from low productivity to higher productivity, sustainability to profitability, low input system to higher input system, extensive to intensive and routine chorus to commercial venture. Majority of major livestock species have shown increased trend over the years from 1951 onwards. The highest increase of 892.12% has been witnessed in poultry (73.5 million in 1951 versus 729.21 million in 2014). The corresponding increase in other livestock species were 222.92% in cattle, 150.46% in buffaloes, 66.41% in sheep, 186.37% in goats and 133.86% in pigs, respectively. The comparison of population of different species of livestock of 19th (2012) versus 18th Livestock Census (2007) revealed negative compound annual growth rates in cattle (-4.10%), sheep (-9.07%), goat (-3.82%), and pig (-7.54%), The compound annual growth rate in poultry during the period 2003-07 has been highest (12.39%) followed by buffaloes (3.19%).

The share of livestock to the total GDP has increased from 59 billion rupees during 1980-81 to 3278 billion rupees during 2011-12 at current prices. It ranged from 3.92% (2011-12) to 6.45% (1990-91) of total GDP. On the other hand, the share of agriculture and allied sectors to the total GDP has decreased from 34.72% during 1980-81 to 15.18% during 2011-12. It revealed that over the decades the contribution of livestock to the total GDP has fluctuated least as compared to agriculture and allied sectors providing higher degree of livelihood and social security to the livestock keepers in comparison to farmers depending on agriculture alone. It is a matter of delight that the share of livestock sector to the agriculture sector has increased from 13.88% during 1980-81 to 25.85% during 2011-12, while on the contrary share of agriculture and allied sectors to the GDP has decreased over the years.

Resilience of Indigenous Livestock to Climate Change - An Innate Potential

Indian livestock has special adaptive mechanisms to deal with extra thermal stress of tropics. The mechanisms that facilitate easy dissipation of heat from body without much loss of moisture are unique in tropical livestock species in addition to mechanisms that conserve energy for body

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maintenance at high temperatures. Adaptive mechanisms to deal with heat gain/loss include coat color, length of hair, skin pigmentation, number of sweat glands and its secretion. The small body size with low energy requirement for maintenance and capacity to use poor quality feeds and fodders make Indian livestock superior to many breeds of livestock in feed conversion efficiency. The water recycling and economy in these animals is more efficient giving them higher capacity to dehydrate and withstand higher thermal stress. Body appendages and higher body surface area per unit of weight help them in heat dissipation. Some of the zebu breeds (Rathi, Tharparkar, Ongole, Nagori and Sahiwal) well adapted to hot dry conditions are able to minimize their metabolic requirements and conserve energy for production (milk and/or work) without extra energy expenditure.

The climate change has produced detrimental effect on Indian cattle production system directly and indirectly contributing to economic losses. However, the impact of climate change was more pronounced in crossbred/exotic cattle as compared to indigenous cattle. About 6-9 months (60-75% of days) in a year are either stressful or not congenial for optimum milk production in most of the parts of the country. Further, the THI ranges from 75-85% during noon (2:00 PM) at more than 85% places in India during summer months (April – June). The various studies have shown that the rate of decline in milk production was higher in crossbred cattle (Shindeet al., 1990; Kulkarni et al., 1998; Mandal et al., 2002a) as compared to indigenous cattle (Lalet al., 1987; Mandal et al., 2002b). The crossbred cattle perform better at 5-25 °C temperature, while indigenous cattle feel comfortable even at a temperature of 38 °C. Indian breeds from Rajasthan and Gujarat have the innate potential to tolerate desert conditions and temperature up to 50 °C. The major challenge for the high producing crossbred cattle is the heat stress under Indian conditions. As per one of the estimates, the milk yield of crossbreds decrease by 100 liters/cow/lactation, while for indigenous cattle the decline was five folds lesser merely 20 litres/cow/lactation. According to another estimate, the negative impact of climate change on milk production in India would be to the tune of

1.6 million tones by 2020 and 15 million tones by 2050 (Mishra, 2014). The reason is that our indigenous cattle have been evolved over the generations of natural selection under the stressful environment of tropics under low-input system. The dry matter intake is comparatively lower in Indian cattle as compared to crossbred cattle (2 kg versus 8 kg) as the average size of local cattle is small and hence indigenous cattle produce lesser green house gases as compared to crossbred cattle and cattle from developed countries.

Assets for Livestock Production:

- Significant growth in livestock (3-5% in different species) and poultry sectors (>7%).
- Higher rate of contribution of livestock sector to agriculture sector during last many years (25.85% during 2011-12).
- Enhanced spending power of urban and rural consumers.
- Enhanced literacy rate of rural population over the years.
- Higher demand and consumption of animal produce and value added milk, meat and egg products.
- Mega livestock biodiversity encompassing almost all major domesticated farm animal species.
- Large number of breeds of almost all livestock species well-adapted to the specific agro-climatic conditions.
- Diversified draft, milch and dual purpose cattle breeds contributing to milk and draft power besides providing bio-fuel and bio-fertilizer.
- Potential to adapt to diverse changing climatic conditions of hot arid, humid tropical and temperate climates and better resistance to internal and external parasites and diseases.
- Higher innate potential to survive and produce on coarse, poor quality feed and fodder resources under zero input system (Acharya, 2011).
- Availability of best breeds of buffaloes, a multipurpose farm animal species.
- Gigantic network of Research Institutes, State Agricultural/Animal Science/Veterinary Universities, State Animal Husbandry Departments, Livestock Development Boards and NGOs engaged in livestock development.

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- Vast infrastructure in terms of livestock farms of various species (161 cattle, 33 buffaloes, 63 goat, 82 sheep, 127 pigs, 5772 poultry), 4355 gaushalas, 54 semen production centres, 191 frozen semen banks, 77765 AI centres, 10217 veterinary hospitals/polyclinics, 22713 veterinary dispensaries, 24794 veterinary aid centres and 464 hatcheries.
- Availability of large amount of ITKs with livestock keepers/pastoralists for rearing and management of different species of livestock.
- Seasonal migration of nomadic pastoralists to overcome adverse climatic conditions during winter and rainy seasons to sustain and multiply the breed population of their choice.

Constraints Livestock Improvement:

-
- Shrinking land holdings especially of marginal, small and semi-medium farmers.
- Scarcity of water resources.
- Limited growth in crop production and productivity.
- Acute nutrient mining from soil due to intensive crop production.
- Scanty mapping of soil minerals to design area specific mineral mixtures for livestock.
- Shrinkage in grazing land affects 82% of livestock kept under crop-livestock production system and 2% under pastoral system in India (Ahlawat, 2009).
- About 34% of the rural population in India is below poverty line having insufficient resources to rear quality livestock.
- No increment in fodder production area of the country over the last many years.
- Poorer quality of feed/fodder resources with lower energy and protein content. Apart from energy and protein, deficiency of minerals is the major limiting factor for reproduction.
- Lesser availability of feed/fodder under field conditions. India is deficit by 10% in dry fodder, 33% in concentrate and 35% in green fodder.
- Lack of authentic breed wise livestock census data.
- Lower milk production and breeding efficiency of indigenous livestock.
- Lack of performance recording under field conditions.
- Insufficient number of superior/proven bulls/bucks/rams/semen for AI and natural service.

- Lack of effective quality control mechanism in semen producing labs.
- Higher proportion of dry cows (46%) than desirable level of 30% in indigenous cattle. Besides this, 8.7 million breedable indigenous cattle (15.4%) are unproductive.
- Inadequate infrastructure for delivery of livestock services including veterinary and AI services at the doorsteps of the farmers. Only 29000 veterinarians are available against the requirement of 76000 veterinarians in the country.
- Lack of knowledge about scientific management of livestock among farmers especially women folk.
- Smaller herd/flock size under field conditions.
- Lower conception rate from AI and higher inter-calving interval attributed to lower breeding efficiency.
- Inadequate funding for conservation and breed improvement programs for livestock.
- Non-availability of credit and financial support to animal keepers in the face of natural calamities, diseases of accidental loss of livestock.
- Inadequate local institutions like breed societies or herders groups/associations.
- Poorer marketing system for animals, animal products and by products.
- Negligible insurance coverage of livestock and poultry.
- Lack of legal support for protection of farmers/livestock keepers' rights.
- Lesser clarity for defining IPR issues in case of animal genetic resources.
- Lack of effective linkages and coordination among different stake holders involved in livestock development.

Futuristic Approach:

- Treat livestock sector as a main sector and allocate budget to livestock sector proportional to its contribution to agriculture sector/GDP.
- Allocate community funds for pastoralists and micro financing facilities for smallholders to promote livestock production.
- Creation/provision of national fund for conservation of animal genetic resources.
- Allocate more funds for infrastructure

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development, livestock policy reforms and IPR issues.

- Develop a roadmap for breeding and conservation of indigenous livestock including characterization, sustainable use & development, conservation and formulating framework for policies, legislation, institutions and capacity building.
- Conduct breed-wise livestock census.
- Establish and/or strengthen nucleus farms in the breeding tract for each breed to produce genetically superior germplasm for genetic improvement and conservation. The available Govt. and private farms of various livestock species should be used effectively for this purpose.
- Effective use of more than 20 lac cows maintained in 4355 gaushalas.
- Declare all the livestock farms of state/centre govt. as in-situ conservation and breeding centres for indigenous breeds.
- Enhance milk production of indigenous cattle from present 2.27 to 4 kg/cow/day in a time frame of 10 years.
- Increase the population of recognized indigenous breeds from present 11 to 20 million in phased time frame.
- Registration of livestock keepers and identification of farmers having elite livestock.
- Provide economic advantage to animal keepers for conservation and multiplication of indigenous livestock.
- Unravel the unique genes and bio-prospecting the special utility traits, biomolecules, products etc. of indigenous livestock for enhanced net economic worth using emerging biotechnological tools.
- Developing branded animal products from indigenous livestock available with pastoralists and smallholders and creation of niche markets for these products.
- Selection and use of bulls with A2A2 type beta-casein genes in cattle breeding programs.
- Give more emphasis on small ruminant production systems considering their importance for under-privileged communities living in remote areas under harsh climatic conditions.
- Develop climate risk management strategies ensuring forecasting of livestock diseases which may be aggravated by climate change.
- Improve veterinary care and AI services for

smallholder livestock keepers.

- Producing more number of semen doses from bulls of indigenous breeds. About 41 million semen doses per annum are required to cover 40% population through AI of indigenous cattle. For production of these semen doses about 6000 indigenous bulls of well-recognized breeds would be required.
- Enhance coverage of cattle and buffalo population of the country through AI from 25 to 40% by 2020. Provide AI services at the doorsteps of farmers.
- Effective use of reproductive biotechnologies like ET, ONBS, Ovum Pick-up and IVF under field conditions (Mishra, 2010).
- Develop infrastructure for semen sexing of indigenous cattle breeds (to start with) to save male wastage amounting to about rupees 10000 crores annually.
- Strengthen fodder seed development program to provide quality fodder seeds to stakeholders.
- Strengthen market infrastructure in rural areas and resource support mechanisms for smallholders.
- Enhance R&D support to improve digestibility of agricultural by-products and other foliage to address shortage of fodder.
- Impart training and increase the number of awareness programs for smallholders especially women to ensure adoption of new technologies for enhancing operational efficiency.
- Strengthen preventive health care to minimize incidence of diseases by developing pen side diagnostic kits and infrastructure for effective delivery of animal health services under field conditions.
- Minimize the demand - supply gap in livestock vaccines to better control livestock diseases.
- Start community-based awareness programs for pastoralists, reverse feedbacks and preventive programs for timely diagnosis of animal diseases.
- Design capacity building programs for providing higher numbers of veterinary and para-veterinary professionals.
- Explore inter-country collaboration for breed improvement programs for indigenous livestock with neighboring countries.

Conclusions

Livestock has been a source of sustainable growth and an insurance to livelihood security in the face of natural calamities to livestock keepers. Smallholders have played a vital role in contribution to national economy as majority of livestock is reared by them. Milk, eggs, meat and wool are the major livestock products. Further, the contribution of livestock to the agriculture sector has increased significantly over the years revealing that this sector would play an important role in the future to improve the economy of the country besides providing employment generation, livelihood and nutritional security to landless and smallholders. Further, mining of unique genes and bio-prospecting of special utility traits, biomolecules, products etc. of indigenous livestock would enhance the net economic worth of Indian livestock. Developing branded animal products from indigenous livestock available with pastoralists & smallholders and creation of niche markets for these products would empower these stakeholders in general and rural women in particular to ensure livelihood security as well as to boost overall animal production scenario of the country. Conducting breed-wise livestock census, developing a roadmap for breeding & conservation of indigenous livestock and creation of national fund for conservation of animal genetic resources should be given priority. Higher allocation of funds for R & D is required for disease diagnostics & effective delivery of health services at the doorstep of the farmers, improving digestibility of agricultural by-products/other foliage and sexing of semen.

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Table 1: All India level distribution of operational holdings (2010-11)

(Source :Basic Animal Husbandry & Fisheries Statistics,2013, Ministry of Agriculture) *Based on provisional results of Agricultural Census 2010-11 (Phase-I)

Category of land holdings	Distribution of livestock (2006-07) %	Number of holdings* ('000 No.)	Operated area* (000 ha)	Area per holding (ha)	Livestock per holding	
					Cattle & Buffalo	Sheep & Goat
Marginal (below 1.00 ha)	50.1	92356	35410	0.38	1.31	0.74
Small (1.00 to 1.99 ha)	21.6	24705	35136	1.42	2.23	1.39
Semi - medium (2.00 to 3.99 ha)	15.9	13840	37547	2.71	3.05	1.93
Sub Total	87.7	130901	108093	0.83	1.67	0.99
Medium (4.00 to 9.99 ha)	9.6	5856	33709	5.76	4.43	2.91
Large (10.00 ha & above)	2.8	1000	17379	17.37	6.06	4.98
Sub total	12.3	6856	57088	7.45	4.67	3.21
All size classes	100	137757	159181	1.16	1.82	1.10

Table 3. Value of output from livestock sector during 2011-12 (at current prices)

(Source :Basic Animal Husbandry & Fisheries Statistics,2013, Ministry of Agriculture)

Item	Output (Rs. in crores)	% share
Milk group	305484	66.55
Meat group	83641	18.22
Eggs	17803	3.88
Wool and hair	452	0.10
Dung	31847	6.94
Others	19824	4.31
Total	459051	100.00

Table 2: Distribution of Livestock according to Size of the Holding during 2006-07 – All India
(Source :Basic Animal Husbandry & Fisheries Statistics, 2013, Ministry of Agriculture)

Category	Cattle		Buffaloes		Sheep		Goat		Pig		Poultry	
	No. (million)	% age	No. (million)	% age	No. (million)	% age	No. (million)	% age	No. (million)	% age	No. (million)	% age
Marginal	80.51	50.44	40.73	44.79	27.55	45.57	54.81	56.66	4.34	55.71	142.35	64.25
Small	35.46	22.22	19.55	21.50	14.77	24.43	18.77	19.40	1.76	22.59	41.33	18.65
Semi-medium	25.62	16.05	16.64	18.30	10.13	16.76	12.88	13.32	1.06	13.61	24.78	11.18
Medium	14.56	9.12	11.41	12.55	5.61	9.28	7.53	7.78	0.50	6.42	9.06	4.09
Large	3.47	2.17	2.60	2.86	2.39	3.96	2.74	2.84	0.13	1.67	4.05	1.83
All classes	159.62	100.00	90.93	100.00	60.45	100.00	96.73	100.00	7.79	100.00	221.57	100.00

Table 4 : Production of major livestock products in India

(Source :Basic Animal Husbandry & Fisheries Statistics,2013, Ministry of Agriculture)

Year	Human population (millions)	Milk (mt)	Eggs (million nos.)	Wool (million kg)	Meat (mt)
1950-51	359	17.0	1832	27.5	-
1960-61	434	20.0	2881	28.7	-
1968-69	518	21.2	5300	29.8	-
1980-81	679	31.6	10060	32.0	-
1990-91	839	53.9	21101	41.2	-
2000-01	1019	80.6	36632	48.4	1.9
2010-11	1186	121.8	63024	43.0	4.9
2011-12	1210	127.9	66450	44.7	5.5

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Women in Agriculture and Mentorship – A Global Perspective

As we face a global shortage of access to food: complicated by an exploding population, reduced land access and urbanization - women farmers and indeed all farmers, will know unprecedented stress and challenge in the procurement and development of agricultural products. A failure to improve infrastructure and address policy that is enabling for women to access the same level of education, technology, credit and land ownership has not prepared rural women for the current and future complexities in farming, including the increases in input costs and the challenges of marketing. Indeed, women farmers in all culture are facing added stress without the support of systems that make much needed capital, knowledge or empowerment readily accessible.

As rural economies are drained, the role of women in agriculture takes on urgency. In March of 2011, *Earth Times* reported that *“hungry people could be reduced by 150 million persons per year if women had the same access to land, technology, education, financial security and markets.”* This is a call for gender equality that resonates worldwide. The *Dairy Women’s Network of New Zealand* has stated that *“Gender equality is not just a lofty idea. It is critical for agricultural development and food security.”* Agriculture remains a family business. Issuing a standing invitation for girls and women to the farm will be imperative to either maintain or grow an agricultural economy.

Overall, the global production and processing of food is in the hands of women. Women make up the majority of the world’s farmers, up to 80% in some regions and 50% to 90% of the agricultural and agri – food workforce, region dependent. In Canada women own and operate 30% of all farms with the exception of the province of British Columbia, where women own and operate 40% of all ranches and farms.

The research for mentorship programs for women in agriculture was driven by the statistical need for more engagement in the mentorship of women in agriculture, the creation of a safe platform for women in all areas of agricultural production and processing, the lack of recognition for women in agriculture and the changing demographic of world residence, food patterns and future hunger challenges.

Although leadership and management programs exist in many of the countries of the world for women, agricultural mentorship models implemented on a national or international scale are scarce. This is reflective of the unmeasurable aspect of mentoring, *which is the empowerment of an individual*, and therefore difficult to fund. Most funding bodies have a desire or requirement to “tick off the box” of the measurable achieved. The personal nature of mentoring does not fit into this restrictive and thus the lack of nationally funded mentoring models for women in agriculture.

When asked, women in agriculture are firm that they are not a special class or a special needs category. They seek equality in the production, processing, marketing, preparation and presentation of food. They do however have strong views on how mentorship programs should be delivered and why they are of vital importance. In the global survey (*Schoepp 2013*) of 3,900 women farmers aged 14 – 73 years, 51.3% of respondents indicated that the reason for a mentor was for personal growth and 48.7% responded that the role of the mentor was for business growth. All respondents expressed that the overarching reason for mentorship was to optimize production and efficiencies on the farm. Women clearly understand the farm and are deeply committed to the functionality and profitability of the farm.

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The overarching reason for mentorship was to optimize production and efficiencies on the farm.

Access to land is the most relevant handicap to agriculture worldwide. It is not that the land is not available; it is that it is so *uncertain*. Short term leases dominate agricultural production and in this, men and women, but especially women, face specific challenges particularly in cultures where land can be lost or taken away for reasons such as the death of a spouse or in times of political conflict. In many countries women may face physical harm going to and from their fields and must carry water to ensure plant and animal survival. Women have continuously asked for safe, long term access to land through ownership or lease.

A true lack of access to credit often hinders growth in what could be a thriving agricultural practise. Women continue to be tied to their husband's financial performance even when they are solely responsible for the production of food for family use and as income. Breaking the cycle of intergenerational poverty and developing financial independence for a woman, her family and her community - starts by putting money in the hands of women. The *World Bank* reports that one dollar loaned to a woman had a greater development impact than one dollar loaned to a man (with a higher repayment rate and lower credit risk). Even in developed countries, 58% of all equally eligible loans applied for by women were approved and at a higher interest rate. (Erman et al 2006) Economic empowerment is achieved through acknowledging the gifts that women bring to the business of food and addressing the challenges they face.

Credit is often dependent on literacy and specifically financial literacy. This resounds as a compelling argument for literacy worldwide for all boys and girls and in particular for females. Children should be taught commerce and financial literacy starting at a very early age. With a full knowledge of business and a business plan, the outright refusal to loan to or the conditional acceptance to loan to women is discriminatory in every way.

Before we can advance women in agriculture anywhere in the world, there must first be gender equality from banks and local or village credit.

Gender equality is not about separating men and women. It is standing up for the excellence of the other so that both may contribute in a way that they are gifted. Research has shown that given a level playing field in terms of access to credit, land and technology, production increases by 20% - 30% on land owned and operated by women.



When discrimination against women workers and managers is eliminated, productivity per person increases by 25% - 40%. In the boardroom a gender balanced board increases ROE by 40%. Yet globally women in agriculture earn 50% of their male colleagues and are a tiny percentage of agri-managers and board members.

While men and women are equally capable, governments are not.

Demographic shifts dictate that by the year 2020, 80% of the world's population will live within 60 km of a shore. The massive urbanization in almost every nation has resulted in complexities with delivery and waste infrastructure. While urbanization has ignited cities this transition has parched rural landscapes of valuable labor. Women worldwide are taking on greater workloads and responsibilities in agriculture without the support of marketing channels to increase income. All women interviewed identified the loss of labor as a critical point in maintaining or growing their farms.

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In the mentorship survey, all respondents also sought a safe and accessible platform that included 50% face time and 50% interaction through modern technology. Mechanisms to bring mentees and mentors together was a point of struggle for all women and further research indicated that although safe platforms were essential, the mentor was the critical point of success. A national study of current successful and past mentorship programs in a variety of agricultural sectors, including academia, revealed that the conduct of the mentor was pivotal to achievable outcomes. Mentorship programs repeatedly failed when there was a lack of process for screening and matching and training the mentor. In addition, it was important that the mentee have an avenue to terminate the relationship at any time. (Schoepp 2013)

The gender of the mentor was not a significant factor as women were open to male and female mentors. Mentorship programs that took into account the safety and security of the mentee had a good success rate with 70.3% of the women still involved in a mentorship relationship. Respondents indicated that mentorship was “critical” to personal and business growth.

Moving forward, 70% of participants in this research project indicated that government should support the development of mentorship

programs for women in agriculture. They do not, however, see themselves as a “diverse” group. They recognize that they already are the front line of food security in the world and are seeking equality in access to education, credit, land, technology, training, labor, mentoring and markets. Mentorship is one of the tools to help them achieve their personal and business production goals.

Brenda Schoepp is a Canadian farmer who has explored and worked with food systems around the globe. As the recipient of Canada’s Nuffield Scholarship in Agriculture, Brenda researched mentorship program development for women in agriculture. The full report is published at <http://brendaschoepp.com/wp-content/uploads/2014/07/The-Development-of-Mentorship-Programs-for-Women-in-Agriculture.pdf> As an International Mentor, she works with young entrepreneurs in eight countries. Brenda is a published author and professional speaker. She may be contacted through her website at www.brendaschoepp.com or directly by email at brenda.schoepp@cciwireless.ca

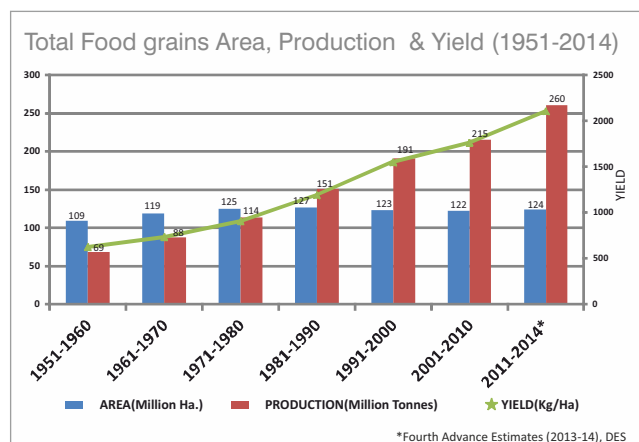
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Alberta, Canada

Food Security Inclusiveness of Nutritional Security of India

India ranks second in population after China. To-day India’s population is around 1.25 billion and likely it will cross China’s population by 2030. It is prime duty of any government to provide food security to their fellow citizens and India has distinction to provide the access of food to 2/3 population of country at subsidized rate from home grown food. The government of India enacted “National Food Security Act” in 2013 and that ensures to provide rice at Rs. 3, wheat at Rs. 2 and coarse grain cereals at Rs. 1. It reminds that India in early 1960s till mid 1970 was importing

large quantity of food grains to meet the domestic demand. To-day India is not only self-sufficient in food gains but also become a major exporting country of rice and wheat. The progress of food grains production is presented in the following graph. India, yet to achieve the self-sufficiency in pulses. Every year 3.5 – 4.0 million tons of pulses are being imported to meet the domestic demand in spite of production of pulses has substantially increased in last few years. Ever highest production of 19.25 million tons pulses was achieved in 2013-14.

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India, by adopting a path of science-led growth of its agriculture, developed improved technologies for diverse agro-ecologies to enhance the food, feed and fuel for general masses in sustainable manner. Due to sustained efforts of R&D in agriculture and cutting edge research by constituent units of **Crop Science Division** of Indian Council of Agricultural Research (ICAR) and partnering SAUs in the National Agricultural Research System and Consultative Groups of International Agriculture Research, India made remarkable progress.

India is in comfort zone in cereals production and now efforts are needed to develop new varieties/hybrids which are better in nutritional value and low/free from anti-nutritional traits. It is best way to achieve food security inclusiveness of nutritional security to the poorest of poor who cannot afford diversified foods. In this direction a humble beginning has already been made and developed a number of new nutri-rich varieties/hybrids. In maize, quality protein maize high in essential amino acids composition, a number of hybrids namely HQPM-1, HQPM-5, HQPM-7, HQPM-4, Pratap QPM Hybrid-1, Vivek QPM-9, Vivek QPM-21 and Shaktiman-5 are developed. In rice, DRR Dhan 45, a new variety identified having 18.8 ppm zinc and 3.85 ppm Fe. Similarly, CR Dhan 310, other new rice variety possessing more than 10.0% protein content in polished grains has identified and an old rice variety, Heera is an excellent source of vital nutrients. Its white milled kernel has 11.5% protein, 5 ppm of iron and 23 ppm of zinc. Besides, three genotypes viz., Sampada, Lalat, BPT-5204 have been developed with low glycemic Index which is boon for diabetic people.

In addition to food grains, the quality

improvement work for several oilseeds crops have also been taken up with regard to designing better and desirable fatty acid profiles. In rapeseed-mustard, with improved nutritional and storage quality of oil and seed meal possessing low saturated fatty acid (< 6%), high oleic acid (> 60%), moderate linoleic acid (20-25%), and low -linolenic acid (about 9%) are in the process of development. Three double zero (zero erucic acid and zero glucosinolates) varieties of gobhi sarson (GSC-5, GSC-6 and Teri Uttam Jawahar) and seven single zero (zero erucic acid) varieties of Indian mustard (Pusa Karishma, Pusa Mustard 21, Pusa Mustard 22, Pusa Mustard 24, Pusa Mustard 29, RLC-1, RLC-2) have been developed.

In soybean, gene specific molecular markers for kunitz trypsin inhibitor (Tilocus) and lipoxygenase free soybean (lox2) have been validated and employed for development of food grade soybean. Consequently, Kunitz trypsin inhibitor free soybean genotypes viz. NRC 101 and NRC 102 and high oleic acid soybean genotype NRC 210 have been developed and commercialized. Besides, NRC 109 and NRC 110, the first ever two Indian lipoxygenase-free soybean genotypes have also been developed. A biofortification programme under the Consortia Research Platform has also been launched to develop nutri-rich varieties/hybrids in almost all the food crops including enhancement of methionine content in lentil. Under this programme, besides enhancing the contents of important minerals, low in anti-nutritional factors like phytate, etc. are being also looked into. It is a way forward to provide the nutritional security to poor masses living in remote areas who can afford diverse food items and on other, these development offer business opportunities to promote made in India. This conference will be an important platform to interact on:

1. Emerging strength of India in various sector of food grains production
2. Better business opportunities while segregating new nutri-rich varieties/specialty products.
3. Interaction with various stakeholders in orientation research strategy to develop demand driven products.

Dr. J. S. Sandhu

Deputy Director General

Crop Science, ICAR, New Delhi

Influence of Tissue Culture in Promoting Agriculture and More Organic Outputs

Genewin Biotech:

Genewin Biotech was established in 2007 at Hosur, Tamil Nadu, India and is recognized by Department of Biotechnology (DBT), under NCS-TCP, Ministry of Science and Technology, Government of India. ISO 9001:2008 certified concern. We are one of the major producers of good quality and disease free Grand Naine (G-9) variety of Banana plants (Export Quality) on a large scale, 5 million per year, 3 million Bamboo plants and 1 Million Pomegranate through Tissue culture Techniques and sell at the lowest price throughout India. Tissue Culture is a technology used for mass propagation of elite and high yielding mother plants (through explants) that are carefully Virus Indexed which gives rise to disease free, uniform, genetically Pure and highly potential plants in large scale in the shortest period of time.



Management Team:

1. **DR.V.PALANI, Ph.D., PDR (USA)** - Managing Director
2. **Mrs. USHA PALANI, M.A., M.Phil.,** - Director
3. **Mrs. MANASA SATHEESH, M.Tech., (Ph.D),** - Director and CTO

PROFESSIONAL RECORD for Author:

- 1984-85 : Awarded JUNIOR RESEARCH FELLOW by FOREINSIC SCIENCE DEPARTMENT, NEW DELHI.
- 1985-2005: Head, Dept. of Biochemistry, Islamiah College, Vaniyambadi.
- 1995-Till date : Secretary, Maniam Murugappa Duraisamy Educational Trust, Vaniyambadi.
- 1998-2005: Member, Environmental Committee attached to Tamil Nadu pollution control board, Vellore district.

- 2001-2005 : Coordinator, Dept. of Biotechnology (UGC supported), Islamiah College, Vaniyambadi.
- 2003-2005 : Post Doctoral Investigator under Dr. Tim C McQuinn, Dept. of Pediatrics (cardiology), MUSC, Charleston, SC, USA.
- 2005- Present- Managing Director, Genewin Biotech, Hosur, Tamil Nadu.
- Has signed MOU with many leading Universities and Colleges for the Academic Industrial relationship for updating the research possibilities.

Infrastructure:

- Tissue culture Laboratory- Class 10,000
- Explant Initiation Chambers-Class 100
- Strain Improvement techniques
- Laminar Air Flow capacity- 5 Million per year- Class 100
- Plant growth rooms- Class 1,00,000
- 2 Green Houses capacity (3.25 lakh net pot plants and 3 lakh at a time)
- Virus Indexing and subculture fingerprinting for identifying mutations.
- Media Preparation Lab and Sterilization

R&D Division:

In India, no private sector has R&D division since it is non-profit based, Genewin Biotech has R&D Division where Research works will be carried out for standardizing a product. We provide recommendations, inspect lands and guide farmers and customers in plantation by analyzing the soil, water, fertilizers and compost being used throughout the plantation and suggest the fertilizers to be applied. We are very keen in encouraging the farmers to use Biofertilizers rather than chemicals for the fixation of nutrients, for the development of healthy roots, for increasing the banana bunch size and for improving the yield. Biocompost such as Coir compost and Vermicompost will be procured by the farmers from us as those do not disturb the growth of the plants.

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Brands:

1. Genewin Biotech – takes care of the Production of Quality Tissue culture plants
2. Genewin R&D Division – takes care of the analysis
3. Genewin Bioproducts – takes care of the production of Biofertilizers, Biopesticides, Organic pesticides
4. Genewin Agro Tech – takes care of guidance on plantation for farmers, inspection of farmer's land, recommendations for the crop
5. Genewin Equipments – takes care of the manufacture of equipments for Tissue culture lab such as Laminar Air Flow chamber, Autoclave, Steripots.

Awards:

Genewin Biotech was awarded with the **Zonal Winner** in "Think Big"- moneycontrol.com in CNBC TV 18.

We also received **World Quality Commitment award**- Gold category for the Total Quality Mangement (TQM 100) by B.I.D in Collaboration with University of Madrid at Paris in October 2015.

Tissue Culture as Emerging Technology:

'Plant and tissue culture is the science of growing plant cell, tissues or organs isolated from mother plant, on artificial media. As an emerging technology, the plant tissue culture has a great impact on both agriculture and industry, through providing plants needed to meet the ever increasing world demand. It has made significant contributions to the advancement of agricultural sciences in recent times and today they constitute an indispensable tool in modern agriculture [5].



Biotechnology has been introduced into agricultural practice at a rate without precedent. Tissue culture allows the production and propagation of genetically homogeneous, disease-free plant material

Demand for Tissue Culture:

Healthy plants are the first line of defense against diseases. The demand for micropropagated plants in agriculture, horticulture and in social forestry is growing by the day, since the traditional methods of propagation do not yield sufficient quantity and in some crops they are cumbersome.

There was a dramatic increase in their application to various problems in basic biology, agriculture, horticulture, and forestry from 1980s. The demand for tissue culture plants increased for the following broad areas, namely:

- (1) cell behavior,
- (2) plant modification and improvement,
- (3) pathogen-free plants and germplasm storage,
- (4) clonal propagation, and
- (5) product formation

Women in Tissue Culture:

Remarkable contributions have been made by women scientists in plant tissue culture. Important breakthrough results in the field of plant tissue culture are perfection of ovule culture, production of somatic embryos, in-vitro flowering in Bamboo. Eminent women scientists working in the research field of plant tissue culture, proficient women entrepreneurs have aroused in this industry producing different plant species for domestic and export market.

Most significant fact is that, this industry has given women employment of about 85%. The kind of working environment available to the staff is more suitable to the womenfolk. Besides, this industry demands lot of involvement, patience, dedication, and commitment, which is why women are chosen. The industry is poised to synchronize with the interest of women empowerment that has been greatly contributing to the success of this industry in India.

Preference for Tissue Culture Plants:

Farmers consider tissue culture for two reasons:
(1) Mass production

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(2) To establish or maintain "virus-free" stock.

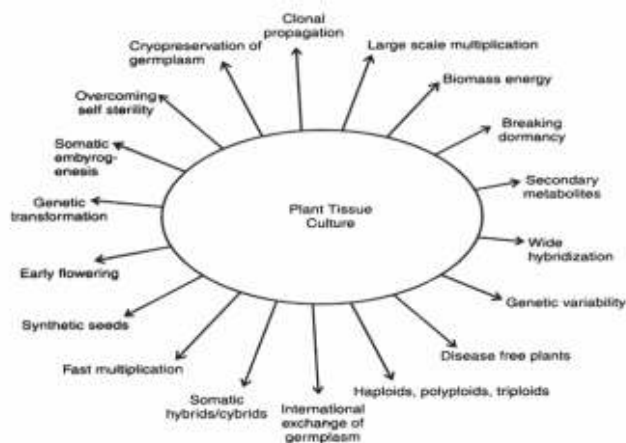
Every year, excessive amount of grower time, labour are spent on unproductive seeds, cuttings and grafts, young plants are prone to viruses, bacteria, fungi, insects or other environmental factors. Derivation of disease free plants can retrieve time now lost by growers because of the higher percentage of clean, viable, mature plants produced. Tissue culture plantlets are not immune to attack but by the time they are hardened off, are well started plants with a good root system and nutritious.

Outcome of tissue culture plants is the plants with uniformity in their shape and output, plants with better flowers, odors, fruits or any other properties of the plants that are beneficial to the human beings. Plant tissue used (explant) is free from pathogen and is stored in-vitro, enabling safe exchange of plant genetic material between nations. Tissue culture makes it possible to produce plants anytime we want although the climates are not appropriate to produce a plant. The connectivity between tissue culture producers and farmers helps them in plantation; inspect their land; suggest fertilizers; encourage organic farming finally leads to increased yield.

Farmers Choice:

Switching to tissue culture technology from conventional suckers requires different skills and knowledge for both nursery operators and farmers. For nursery operators, training in agronomic and technical know-how, while important, is not sufficient; nursery owners also need business and marketing skills to turn their nursery into a profit-making business. For farmers, the potentially higher production and more uniform harvesting times of bananas will require good business and marketing skills for them to fully benefit. Working together in groups has been shown (in Kenya and Southern Uganda) to strengthen the position of farmers within the banana value chain; however organizing into groups takes additional skills.

Applications of Tissue Culture:



Organic Output:

With the increase in population, need for improving agricultural production also increased. Farmers have realized that the 'Green Revolution' with high input use has reached a plateau. Thus, a natural balance needs to be maintained for existence of life and property. The obvious choice for that would be more relevant in the present era, when these agrochemicals which are produced from fossil fuel and are not renewable and are diminishing in availability. It may also cost heavily on our foreign exchange in future.

The Characteristics Of Organic Farming

Protecting the long term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention

- Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms.
- Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures.
- Weed, disease and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, resistant varieties and limited (preferably minimal) thermal, biological and chemical intervention.
- The extensive management of livestock, paying full regard to their evolutionary adaptations, behavioural needs and animal welfare issues with respect to nutrition, housing, health, breeding and rearing.

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- Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

Transition Period

- The first few years of organic production are the hardest. Organic standards require that organic lands must be managed using organic practices for 36 months prior to harvest of the first certified organic crop. This is called the “transition period” when both the soil and the manager adjust to the new system. Insect and weed populations also adjust during this time.
- Cash flow can be a problem due to the unstable nature of the yields and the fact that price premiums are frequently not available during the transition since products do not qualify as “certified organic.” For this reason, some farmers choose to convert to organic production in stages. Crops with a low cost of production are commonly grown during the transition period to help manage this risk.

Success of Organic Farming with Tissue Culture Plants

- In organic production, farmers choose not to use some of the convenient chemical tools available to other farmers. Design and management of the production system are critical to the success of the farm. Select enterprises that complement each other and choose crop rotation and tillage practices to avoid or reduce crop problems.
- Yields of each organic crop vary, depending on the success of the manager. During the transition from conventional to organic, production, yields are lower than conventional levels, but after a three to five year transition period the organic yields typically increase.
- Cereal and forage crops can be grown organically relatively easily due to comparatively low pest pressures and nutrient requirements. Soybeans also perform well but weeds can be a challenge. Corn is being grown more frequently on organic farms but careful management of weed control and fertility is needed. Meeting nitrogen requirements is particularly challenging. Corn can be successfully grown after forage legumes or if manure has been applied. Markets for organic feed grains have been strong in recent years.
- Fruit and vegetable crops present greater challenges depending on the crop. Some managers have been very successful, while

other farms with the same crop have had significant problems. Certain insect or disease pests are more serious in some regions than in others. Some pest problems are difficult to manage with organic methods. This is less of an issue as more organically approved biopesticides become available. Marketable yields of organic horticultural crops are usually below non-organic crop yields. The yield reduction varies by crop and farm. Some organic producers have added value to their products with on-farm processing. An example is to make jams, jellies, juice, etc. using products that do not meet fresh market standards.

- Organic produce can usually qualify for higher prices than non-organic products. These premiums vary with the crop and may depend on whether you are dealing with a processor, wholesaler, retailer or directly with the consumer. Prices and premiums are negotiated between buyer and seller and will fluctuate with local and global supply and demand.
- Higher prices offset the higher production costs (per unit of production) of management, labour, and for lower farm yields. These differences vary with commodity. Some experienced field crop producers, particularly of cereals and forages, report very little change in yield while in some horticultural crops such as tree fruits, significant differences in marketable yield have been observed. There may also be higher marketing costs to develop markets where there is less infrastructure than for conventional commodities. Currently, demand is greater than supply for most organic products.

Farmers and Organic Output:

High Premium: Organic food is normally priced 20-30% higher than conventional food. This premium is very important for a small farmer whose income might only be sufficient to feed his/her family with one meal.

Low Investment: Organic farming normally does not involve capital investment as high as that required in chemical farming. Furthermore, since organic fertilizers and pesticides can be produced locally, the yearly costs incurred by the farmer are also low. Agriculture greatly depends on external factors such as climate, pests, and disease. Furthermore, most of the small farmers are dependent on natural rain for water. Therefore, in

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cases of natural calamity, pest or disease attack, or irregular rainfall, when there is a crop failure, small farmers practicing organic farming have to suffer less as their investments are low. It should be noted that while shifting from chemical farming to organic farming, the transition might be costly.

Less Dependency: Many small farmers worldwide commit suicide or suffer from intense economic crisis due to increasing debt. Since chemical inputs, which are very costly, are not required in organic farming, small farmers are not as dependent on money lenders. Crop failure, therefore, does not lead an organic farmer into enormous debt, and does not force him to take any extreme steps.

Synergic Life: Organic farming involves synergy with various plant and animal life forms. Small farmers are able to understand this synergy easily and therefore find it easy to implement the

organic farming techniques.

Gain of Traditional Knowledge: Small farmers have an abundance of traditional knowledge with them and within their community. Most of this traditional knowledge cannot be used for chemical farming. However, when it comes to organic farming, farmers can make use of this traditional knowledge. Furthermore, in cases of organic farming, small farmers are not dependent on chemicals.

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‘Safe to Eat Food’ Project in Kerala

A case study on production and marketing of ‘Safe to Eat’ branded vegetables through government outlets in Kerala State

The "Safe to Eat" project implemented jointly by the Kerala Agricultural University and State Department of Agriculture, is a plan scheme fully funded by the Government of Kerala in the pesticide residue lab at Vellayani, Trivandrum, Kerala. The scheme was proposed in 2012 based on the specific request received from the Secretary, Agriculture, Govt, of Kerala to explore the possibility of marketing a "Safe to Eat" brand of vegetables through Government outlets and the scheme was started on 01-01-2013. The idea was to impart training on Good Agricultural Practices to selected cluster farmers, to monitor status of pesticide residues in farm gate samples collected prior to harvest and to give premium price to farmers producing vegetables without any pesticide residues or residues within safe limits. Second objective was to provide information on status of pesticide residues in vegetables and fruit samples collected from markets and to provide the results in public domain so as to guide the consumers to choose

"Safe to Eat" types of vegetables. The test reports of analysis under this project, are regularly published in Malayalam in the official web portal (www.kerala.gov.in) in the link "Reports and Manuals" on a tri-monthly basis and 14 such reports were published from 2013 onwards.

1. Certification of vegetables as "Safe to Eat" and providing incentive to producers:

As directed by the Honorable Minister of Agriculture, samples received from farmers adopting organic farming and recommended by the concerned agricultural officer, were tested free of cost and the results were communicated to the Agricultural Officer and farmers in the form of a product testing certificate (Annexure. 1). A letter with instructions for sampling for such test was sent by the Director of Agriculture to all PAOs to make use of this facility. Samples received from organic farmers in the districts of Idukki, Calicut, Palakkad and Trivandrum were tested and about

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100 test certificates were issued to farmers producing vegetables and banana under "Safe to Eat" standards.

- The vegetable farmer clusters registered under the Rural Agricultural Wholesale Market, Nedumangad were certified as "Safe to Eat" vegetable producers based on the test reports. They were benefited by the incentive given in the form of 15 extra of the amount corresponding to the highest bid (sale price) for each vegetable. Details on "Safe to eat" vegetables from Rural Agricultural Wholesale Market, Nedumangad, produced by cluster farmers adopting Good Agricultural Practices are reviewed by the secretary of the market for sale through HortiCorp outlets in separate demarcated "Safe Vegetable" counter. Twenty farmers registered in Rural Agricultural Wholesale Market, Nedumangad has got a total

benefit of Rs. 359370/- during the project period (April 2013 to March 2014).

- People in Kerala are more aware of pesticide related issues than in any other state mainly because of the endosulfan tragedy in Kasargode, role played by NGOs, environmentalists and a very powerful media exposure. In every session of the Legislative assembly, 5 to 10 questions/submissions on pesticide related issues come up seeking solutions for the same. As recommended by the National Human Rights Commission, the government is also planning to start more pesticide residue testing facilities in the state to generate pesticide residue datasets and to create awareness on the status of residues and remedies to manage the issues.

Report on Farmgate samples collected from Kerala farmers during January 2013 to December 2014

Year	Total No. Of samples taken	Pesticide free (Safe to eat)	Safety %	No. Of samples with pesticide detected	Percentage of samples with pesticide detected	No. Of samples with pesticides above MRL (FSSAI)	Percentage of pesticides above MRL (FSSAI)	No. Of samples with pesticides below MRL (FSSAI)	Percentage of pesticides below MRL (FSSAI)	No. Of samples with pesticides without MRL (FSSAI)	Percentage of samples with pesticides without MRL (FSSAI)
2013	444	371	83.5%	73	16.4%	11	2.47%	35	7.8%	27	6%
2014	456	420	92%	36	7.8%	9	1.97%	8	1.7%	19	4.1%
Total	900	791	87.8%	109	12.1%	20	2.22%	43	4.78%	46	5.11%

#	Year of detection	Total No. Of samples (commodity wise)		Samples above pesticide limit fixed by FSSAI		Pesticides detected	Range	Limit
1.	2013	Amaranthus(red)	23	3		Chlorpyrifos	0.24 - 1.14 ppm	0.2 ppm
		Bitter gourd	45	2		Chlorpyrifos	0.24 - 1.02 ppm	0.2 ppm
		Melon(Oriental pickling)	42	1		Chlorpyrifos	0.22 ppm	0.2 ppm
		Snake gourd	68	1		Chlorpyrifos	0.44 ppm	0.2 ppm
		Vegetable cowpea	96	6		Chlorpyrifos	0.27 - 2.103 ppm	0.2 ppm
2.	2014	Amaranthus (red)	9	1		Chlorpyrifos	0.20 ppm	0.2 ppm
		Bitter gourd	37	2		Chlorpyrifos	0.42-0.96 ppm	0.2 ppm
		Chilli(big)	7	1		Chlorpyrifos	0.72 ppm	0.2 ppm
		Mint leaves	1	1		Chlorpyrifos	3.29 ppm	0.2 ppm
		Snake gourd	40	1		Chlorpyrifos	0.29 ppm	0.2 ppm
		Vegetable cowpea	40	3		Chlorpyrifos	0.37- 0.8ppm	0.2 ppm

2. Testing facility under KAU (Vellayani) to certify pesticide residue levels in farmers' samples for establishing a "Safe to Eat" vegetable marketing strategy in Kerala

- The Pesticide Residue Research and Analytical Lab (PRRAL) Vellayani centre under the Indian

Council of Agricultural Research is the only accredited lab under Govt. sector in Kerala which has secured accreditation by National Accreditation Board for testing and calibration Laboratories (NABL) under ISO: IEE 17025 w.e.f

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February 2012 for performing pesticide residue analysis in different food commodities in conformity with the national and international standards. The State Department of Agriculture has further extended a support to KAU with nearly 7.5 Cr during the last financial year under RKVY scheme, to strengthen the lab by capacity building and instrumentation in order to declare it as a State Referral Lab.

- Three more pesticide residue testing labs have already been started in Kerala State under KAU on an intra- state network mode during 2015-16, utilizing the plan funds of the state and central departments of agriculture through Kuttanad Project, RKVY and State Department (KSPB) funded schemes, in Kumarakom (Kottayam), Trichur (Vellanikkara) and Kasargode (Padnekkad) campuses respectively. PRRAL at Vellayani is now functioning as the State Referral Lab in order to co-ordinate residue testing in other sub-centres, eventually building their capacity and technical competency for getting accredited by NABL in due course.
- A very strong linkage could be established between PRRAL, KAU with other stakeholders in the state government, especially with the Food Safety wing of
- Health Ministry and the sister institutions in agriculture, soil conservation, animal husbandry etc. As the capacity of Govt. Analysts Labs under the Health Ministry is not sufficient to start full fledged testing for pesticide residues, samples from FSSAI are being tested in PRRAL for the time being.
- Improvement of public health being the primary duty of the state as provided in section 47 of constitution of India, action was initiated by the government to address pesticide related issues suspected to cause risk to public health and to plan short and long term strategies to resolve them. Since the issue on suspected misuse of pesticides by farmers in other states came up for discussion in consecutive sessions of the legislative assembly of Kerala, KAU also intensified research on monitoring and management of pesticide residues in agricultural commodities. Technical expertise of the University and its laboratory facilities were spared to generate specific classified data on pesticide residues and technical support of KAU scientists was also extended for taking appropriate policy decisions. As the Food Safety wing has not yet completed capacity building of their laboratories, our reports under

"Safe to Eat" plan scheme formed the basis for initiating state level actions.

3. Abstract of pesticide residues detected in market and farm gate samples tested under 'Safe to Eat' scheme in KAU

Among the total of 2651 vegetable samples analysed during January 2013 to December 2014, 323 samples (12 of total) had pesticides, of which only 49 samples (1.8 of total) were found under unsafe category based on FSSAI MRL prescribed for the pesticide-commodity combinations. Ninety three samples were found under the below FSSAI MRL limit category and one hundred and eighty one sample analysed came under the category without any MRL limit (No MRL) prescribed by FSSAI. Fifteen types of vegetables showed presence of insecticides at varying levels viz. Mint leaves (16 of mint samples with insecticides detected) > Cabbage violet(14.2%)> Curry leaves(6.6%)> Amaranthus red (5)>Vegetable cowpea (4.2%)> Bitter gourd (3.5%), Amaranthus green (2.2%)>Cabbage ordinary(2%), Coriander leaves (2%) , Chilli big(2%), Green chilli(2%)> Carrot(1.3%)> Oriental pickling melon(1.2%) and Snake gourd (1.2%). Except amaranthus and vegetable cowpea, all the above crops are imported from neighbouring states.

However, fruits and dry fruit samples sold in Kerala markets were found relatively safe with very few exceptions. Of the 172 fruit samples tested, only 12 samples showed presence of pesticides. Among 25 different types of fruits analyzed, pesticides were detected only in one type of fruit. Grapes (green)(12.5)was found under unsafe category based on the FSSAI limit. Among the total of 80 dry fruit samples tested for residues, only 6 samples of yellow raisins>black raisins (8 of total) showed presence of different kinds of pesticides none of which has MRL fixed by FSSAI.

Among the various raw and processed food commodities tested for pesticide residues, samples of spices, condiments and their branded powders had the highest percentage of samples containing pesticide residues. Of the total 708 spices and spice powder samples tested under safe to eat project during January to December 2014, 113 samples (16 of total) showed presence of different types of pesticides of which 9 samples had residues exceeding MRLs fixed by FSSAI. One hundred and four samples came under the

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category without MRL, which include cumin seed (50% of cumin samples detected with pesticides), cumin powder (60%), chilli powder (15%), kashmiri chilli powder (24%), pickle powder (43%), coriander seed (100%), dried curd chillilkondattam (23%), dry ginger powder (100%), fennel seed (21%), curry masala (6%) and rasam powder (4%). Samples of three types of spices and branded powders detected with pesticide residues above FSSAI MRL limit were cardamom (39%), dry red chilli (7%) and garam masala (3%).

Thirty eight samples of different types of processed food products viz. Oats, Atta, Rawa, Maize flour, Rice flour (Appa podi), Wheat flour and Soy bean flour were tested and all of them were found absolutely safe without any presence of pesticides.

Studies have also been initiated by KAU to assess the effect of cooking on various pesticides detected in food commodities and also to see whether there is any cocktail effect of different pesticides when different types of vegetables are mixed in staple dishes like sambar, aviyal etc and to study the effect of cooking on each pesticide independently and in combination in cooked food samples.

4. Consumer level actions for reducing the risk of pesticide contaminated food commodities:

- In addition to providing data on the quality of agricultural/food commodities consumed in the state, simple methods to remove pesticide residues at kitchen level were also standardized and popularized under this scheme. A package of home remedies to reduce the pesticide contamination from different groups of risky vegetables for easy adoption by homemakers was also published in the Official web portal of Govt. of Kerala. As per the specific directive from the Hon'ble Chief Minister, this package was published as a half page advertisement in all English and Malayalam News papers by the FSSAI, Ministry of Health through the Public Relations Department. VFPCCK has made use of this technology and developed a strategy to market fresh cut vegetables after decontamination using vinegar wash. Within a short period, cut vegetables became popular among urban homesteads owing to the easiness to cook and also the value addition by making pesticide free. Many private vegetable

traders are also attracted to this new business to market fresh and safe, whole or cut vegetables in different brand names such as Fresh N Safe vegetables, Savour Depestified vegetables etc.

- Further R&D work done in the lab led to the development of a formula of "Veggie Wash" to cleanse vegetables and fruits from pesticide residues. This technology was transferred to 38 entrepreneurs on MoU with the University who are marketing the product in different brand names throughout Kerala. The product is intended to decontaminate vegetables imported from neighboring states at consumer level, since about 40 types of vegetables are not cultivated in our state for which we have to depend on other states.



Vice Chancellor Dr. P. Rajendran addressing entrepreneurs in Transfer of Technology (Veggie-Wash) workshop at Co A, Vellayani



Veggie Wash products in different brand names available in markets of Kerala

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References

Pesticide Residue Research & Analytical Laboratory,
College of Agriculture, Raipur, Orissa
Pin-495 022
Ph. No. 0671-238867

Plan scheme:

*Production and Marketing of 'Safe to Eat' (Pesticide free) vegetables for sale through Government outlets

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Дополнение 2

TRAINING cum-DEMONSTRATION OF VEGETABLE IPM

Several training programs were conducted on Good Agricultural Practices (GAP) to selected farmers in Nedumangad and VFPC, Pappanchan (Fig. 1-4). Results of testing of farm gate samples were communicated to the clusters immediately after analysis. Interactions were held and follow-up meeting and discussion organized to advise farmers to regulate their plant protection operations, mainly by substituting conventional insecticides with safer ones.



Fig. 1 Interaction with amaranth farmers about safe use of pesticides and avoidance of red labeled pesticide



Fig. 2. Yield from Good Agricultural Practices (Cow pea and amaranthus)



Fig. 3. District Manager and Assistant Manager Vegetable and Fruits Promotion Council of Kerala, Pappanchan, Trivandrum



Fig. 4. Interaction with registered farmers under Rural Agricultural Wholesale Market (RAWM), Nedumanoor

MAJOR ACTIVITIES:

Field demonstration of Good Agricultural Practices and Safe use of pesticides in vegetables was organized for registered farmers of VFPC, Pappanchari (Palapoor). The program was recorded by Kisan Krishi Deepam which was telecast in Asanet channel for 5 days.



Telecasting of Safe to Eat program in Khasan Krishideepam on Asianet



Fig. 5. Interactions on Good agricultural Practices at VFPC Pappanchani

Field demonstration on Good Agricultural Practices and Safe use of pesticides in vegetables was organized for registered farmers of RAWM, Nedumangad.



Fig. 8. Demonstration of Good agricultural Practices at RAYM, Nedumangudi

Training on Good Agricultural Practices (GAP) in vegetables was conducted to 80 participating farmers attached to Rural Agricultural Wholesale Market, Nedumangad, entitled "Triksha" (अनुसंधान) "Wholesale Market" with resource persons from College of Agriculture, Vellayani.



Fig. 7. One day training program conducted to farmers of RAYM, Nedumangad

A training on Good Agricultural Practices (GAP) in vegetables was conducted to 100 participating farmers attached to Vegetables and Fruits Promotion Council of Kerala, in SKS (Vipari) of Kalliyoor (Kovvada), Palappur (Pappancheri), Venganoor, Palichai and Perumpazhuthoor entitled 'Vilavil Kuzh' (Vegetables) in 1998. In 2000, 'Vilavil Kuzh' was held at Palappur.



Fig. 8. One-day training program conducted to farmers of VFPC, Pappanchavil

During the course of discussions and interactions, those farmers who had samples with pesticides above safe limits were identified and advised to regulate their pesticide application schedule by substituting with safer alternatives. It was decided to conduct season long demonstration – cum – training programmes in the next year (2014-15) in selected farmers' fields in Kailashy (Kovindha, Nadrali, Nallivilla, Vennur etc.) As a result, pesticide usage in the two high risk vegetables (amaranthus and vegetable cowpea) cultivated in the state is expected to be minimized for production of 'Safe to Eat' vegetables, as evident from test reports

Dr. Thomas Biju Mathew
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Integrated Farming Systems for Sustainable Agriculture

The performance of the agriculture sector influences growth of the economy. Despite advances in technology, agriculture still is the only source of food and a vital source of fibers and other products. Notwithstanding the major diversification in the structure of the economy over the last few years, the dependence on agriculture continues unabated. The pulls and pressures in the agricultural sector continue to exert their influence on the overall cause of economic activity, although the relative dependence of the economy on the agricultural sector has registered a marked decline. With the decline in farm size, it would be increasingly difficult to produce enough food, modern technology however has been restricted to favorable farming situations, since there is no further scope for horizontal expansion of land for cultivation, the only alternative left is vertical expansion by increasing the productivity, using the available resources properly.

Although there is a gradual investment in agriculture by corporate investors, small and marginal farms remain predominantly family-owned-and-operated around the world. Sustaining house-hold food security has been an issue of prime importance to majority of these small and marginal farmers. These farmers are economically poor, work in diverse, location specific, risk prone environment and invite attention to develop technologies for interdisciplinary enterprises. The need for diversity in income streams for family operations is high. Single enterprise operations are vulnerable to both price and production fluctuations. These risks are often outside the control of the operator, in turn an integrated system creates a buffer against economical and biological risks.

During the last five decades, agricultural research has emphasized mainly component and commodity based research involving development of crop varieties, animal breed, farm implements and machinery, fertilizer use, and other production and protection technologies mostly conducted in isolation and at the institute level which enabled the farmers to grow more but at the same time over exploited the resources.

This has resulted in decreasing factor productivity, resource use efficiency and ultimately less farm productivity and profitability. To tackle such problems, integrated farming system approach has been widely recognized and advocated as one of the tools for harmonious use of inputs and their compounded response to make the production system sustainable.

An integrated farming system is a complex interrelated matrix of soils, plants, trees, animals, birds, fish, bees, implements, labour, capital and other inputs controlled by farming families and influenced to varying degrees by political, economical, institutional and social forces that operate at different levels. The farming system conceptually is a set of elements or components that are interrelated which interact among themselves. At the centre of interaction is the farmer exercising control and choice regarding the type and results of interaction. The type of farming systems(crop based or tree based or animal based) is also determined by the class of land.

IFS activity is focused around a few selected inter-dependent, inter-related and inter-linking production systems, based on crops, animals and related subsidiary professions. In all the ecosystems, IFS approach with location specific models offer gainful employment and are highly profitable and sustainable. The decision of enterprise mix on a farm will be conditioned by overall welfare of the family. In describing Farming Systems and their characteristics, we start therefore with the assumption that they did not come about by chance and that there is always a reason why farming in a specific case is carried out in one way rather than another.

Integrated farming systems have many distinctive features including, small size of most farms, diversification in the use of production resources, reduction in and spread of risk, large populations of ruminants (buffalo, cattle, goats and sheep) and non-ruminants (chicken, ducks and pigs), integration of crops and animals, multipurpose roles of crops and animals, low use of inputs and traditional systems, location in the different agro-ecosystems. Synergistic interactions of the subsystems have a greater total effect than the

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sum of the individual effects. Ecological and economic sustainability is achieved when the natural resources of land, crops, animals and water are used to reinforce each other.

Integrated farming practices have developed as a response to environmental dictates, especially temperature, rainfall, altitude, type and intensity of animal production and human intervention. Diversification of resource use spreads risk and provides stability. Farmers consciously diversify the use of the resources to produce a mix of activities that are economically rewarding. Within this broad variety of agricultural activities, opportunities are created that enable switching of practices within and between crops and animals. The inclusion of animals is based on the consideration that they provide power, food, a supplementary income, insurance and a safe investment. Diversification rather than specialization is the primary consideration.

The relevance and potential importance of integrated systems is associated with the complementarity of the crop and animal subsystems resulting in increased total productivity. In this context the major advantages of integrated systems are : diverse and efficient resource use, reduced risk, better use of farm labour for higher productivity and increased income, improved use of space, efficient use of biological and chemical energy in the system and less dependence on external inputs, development of sustainable systems that use recycling, involve no pollution and are consistent with environmental protection, increased economic output; and development of stable farm households.

Integrated farming systems are location specific and driven by market forces; they tend to differ across the different situations. Farming systems in the irrigated areas may be different from those in rain-fed areas, similarly the farming systems in nearby urban areas will be different from those in the remote areas. An integrated farming system aims at utilizing the locally available resources efficiently and offers a better scope for sustainable production. It also insures the farmers against the probable risk and uncertainties in agriculture.

Research carried out in Dharwad and Belagavi districts of Karnataka have showed that in the case of peri-urban areas of Dharwad, farming system

consisting of crops and dairy components, in rural areas of Dharwad farming system consisting of crops, plantation and dairy components, in peri-urban areas of Belagavi farming system consisting of crops, vegetables, dairy and poultry and in rural areas of Belagavi farming system consisting of crops, dairy and goat components were found to be not only profitable but also risk efficient farming systems. Diversification of enterprises and especially inclusion of vegetables, livestock and other activities in the farming system not only helps to increase farm income but also generates employment.

Farming systems aim at utilizing the farm produced resources like fodder and dung and provides gainful employment to family labour particularly during off seasons. The farming systems have great potential to contribute to the welfare of the farmers at the micro-level and economic development at macro-level. Farming systems involving animal component would reduce burden on external inputs such as chemical fertilizers. Hence, farmers may be encouraged to include animal component by providing subsidies and soft loans.

In general, holistic research on mixed farming systems involving crops and animals is weak and most past research has been on cropping systems. Some progress has been made in the development of methodologies to understand the interactions between subsystems but much of the work has been sporadic and has not yet been tested on a large scale. Observations relevant to research on integrated farming systems are:

- There is a paucity of information on methodologies and results, there has been limited work focused on specific agro-ecological zones,
- There are inadequate methodologies for crop-animal systems compared to crop systems and mixed systems research is relatively new,
- Non-ruminants (Chicken ducks and pigs etc.) have had less attention in integrated systems because of the priority given to ruminants by most governments;
- Strong multidisciplinary efforts are a prerequisite to research and development of mixed farming systems,
- Increased focus needs to be given to rainfed agro-ecological zones in view of the complexity of these areas and the natural resource management issues,

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- Increased investments for research on mixed farming systems in priority agro-ecological zones will provide major benefits and contribute to development of sustainable agriculture.

Key institutional requirements for development of Integrated farming systems are:

- Commitment to interdisciplinary research, a systems approach and sustainable development, these being especially important for integrated research and development in specific ecosystems
- Formulation of research programmes with production and postproduction components and community based participation in response to the real needs of farmers;
- Institutional and structural commitment that are programme-led and programmes that are needs-led; and

- Promoting effective inter-institutional coordination and collaboration for decision making, management, dissemination of practical technical information and resolution of feedback issues.

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Technological Innovations in Agriculture

Agriculture has been a way of life and continues to be the single most important livelihood of the masses in many countries. This sector has primarily been acting as a driving force for the economy as it generates employment, national income, foreign exchange, food for people, feed for livestock and contributes significantly to sustainable economic development of a country. India, with its billion plus population, has put agriculture at the heart of its economy and food security at the centre of its agriculture policy. India's record of progress in agriculture over the past decades has been quite impressive. Despite the demographic pressures and limited land, there has been an effective use of agriculture technologies and innovations, invested substantial resources (both human and capital). The recent technological advances in agriculture have enabled this field to move forward in great leaps and bounds, particularly, the breakthroughs in molecular biology, plant genomics and crop science have brought a paradigm shift in this field and have lead to the development of new varieties of food crops with more improvements in agronomic traits of crops such as disease resistance, pest-resistant, drought tolerance, abiotic and biotic stress resistant and also with improved nutritional value and other useful characteristics. Moreover, the development

of transgenic crops and use of genetic engineering studies for gene insertion; gene silencing; molecular farming; functional genomics, comparative genomics, marker-assisted breeding; and the use of current crop databases have helped in achieving improvements in both quality and quantity in a sustainable manner. Even though, the adoption of new technologies has been uneven throughout the country, it has accumulated valuable agricultural development experience and is now in a position to identify, scale up, and share these proven agricultural development practices, technologies, and innovations across India and beyond. Therefore, diffusing these proven agricultural innovations can contribute significantly to overcome the challenges including low agricultural productivity and chronic poverty, while bringing cost-effective development solutions to other countries facing food insecurity. Also, there is a need to address the concerned environmental, security and ethical issues for providing considerable benefits to the society at large and for a comprehensive growth of a country.

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Utilization of Bio-control Agents for Sustainable Agriculture

Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. Sustainable agriculture, in terms of food security, rural employment, and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection, are essential for holistic rural development. Indian agriculture and linked activities have witnessed a green revolution, a white revolution, a yellow revolution and a blue revolution from time to time. However, productivity of crops grown for human consumption is at risk due to the incidence of pests, especially fungi and insect pests. Crop protection measures can be helpful for the reduction of these crop losses (Oerke, 2006). Several crop protection methods have been implemented together for the management of such pests. Such methods include cultural, mechanical, physical, biological and chemical which together have been compiled in the form of integrated pests management approach. However, the indiscriminate use of pesticides has created several problems, like pest resistance to pesticides, resurgence of pests, toxic residues on food, water, air and soil, elimination of natural enemies and disruption of the ecosystem and minor pests assuming major status (De Waard et al., 1993). On the other hand, microbial biocontrol agents such as microbial biopesticides offer a good alternative to manage the insect pests and diseases in an ecofriendly way. Because, mostly they are naturally occurring, they have high specificity to target pests, no or little adverse effect on beneficial insects, resistance development to them is slow or less common, have no unknown environmental hazards, have less residual activity and are effective against insecticide/fungicide resistance species of insects. Due to the above reasons the role of biopesticides is considered as a potent and reliable tool in Integrated Pest Management Programme (IPM) to manage pests. Biological Control or microbial biocontrol is the use of an invasive plant's natural enemies - agents (chiefly insects, parasites and pathogens) - to reduce its population below a desired level. It is the long-term, self-sustaining treatment method for managing invasive plants.

Biocontrol can be also read as the biological control of insects as the control of insect populations by the actions of their introduced enemies. However, widely accepted definition is "the reduction in the amount of inoculums or disease-producing activity of a pathogen accomplished by or through one or more organisms". The basic mechanisms involved during the reduction of fungal and insect population are antibiosis, predation, parasitism, pathogenicity or competition (Campell, 1989). The detail practices of biocontrol methods have been given by Vasudevan et al. (2002). The major concepts involved in the biological control are introduction of microbes in the phylloplane, rhizosphere or soil, stimulating indigenous antagonists, induced resistance and biorational approaches.

The microbial bioagents universal in nature are *Trichoderma* (*T. harzianum*, *T. viride*), *Verticillium* (*Lecanicillium*) *lacani*, *Pseudomonas* *fluorescens/putida*, *Beauveria* *bassiana*, *Paecilomyces* *fumosoroseus*, *Metarhizium* *anisopliae*, *Nomuraea* *rileyi*, *Bacillus* *subtilis*, *Glomus* *aggregatus*, entomopathogenic nematodes (EPN) etc. and they are frequently used in the agriculture for the management of the soil borne and foliar diseases as well as insect pests. Among them formulations of *Trichoderma* and *Pseudomonas* are being use for the management of soil borne (wilting, damping off, root rot) and foliar diseases (blight, leaf spot, powdery mildews) of several pulses, cereal and fruits crops (Shaigan et al., 2008). *Paecilomyces* is use against the nematodes and whitefly affecting the farmers' crops (Ehtesham-ul-Haque et al., 1995; Altre et al., 1999). *Beauveria* *bassiana*, is used against major arthropod pests like caterpillars, borers, beetles as well as against sucking pests like aphids (Willoughby et al., 1998; Chen et al., 2008). Genus *Verticillium* is uses against whiteflies, aphids and mites and some soil borne foliar pathogens like damping off and rust, powdery mildews pathogens as well as against nematode (Godoy et al., 1983; Benhamou & Brodeur, 2001; Miller et al., 2004). Bioassays carried out with *Metarhizium* *anisopliae* shows that it is very effective against several insect pests like borers and weevils (Castrillo et al., 2011; Reddy

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et al., 2014). *B. subtilis*, is also an important bacterium and being used against *Colletotrichum gloeosporioides* and other leaf spot pathogens. *Steinernema riobravo* is an entomopathogenic nematode is capable of infecting and establishing in the last instars of *Galleria mellonella* as well as other root grubs and termites (Grewal et al., 1994). In the conjunction of commercial pesticide these bioagents are found to be very effective for managing the incidence of pests and pathogens (Gaugler & Kaya, 1990).

The achievement of a biocontrol agent relies largely on the aptitude of the agent introduced to establish itself in the new environment and maintain a threshold population on the planting material or rhizosphere. Commercial production and application of biocontrol agents at farm level demands a few prerequisites like their long shelf life, and they need to be tolerant to variable weather conditions and physiological stresses associated with transportation, storage, and application. Fungal and bacterial antagonists can be as wettable powder, granular or powder using some non reactive substrates such as talc powder. Gram positive microorganisms such as *Bacillus* sp. and actinomycetes offer heat- and desiccation resistant spores that can be formulated into stable, dry-powder products (Emmert and Handelsman, 1999). The gram negative microorganisms which are not desiccation tolerant, traditionally formulated into various solid carriers such as wettable powder. Liquid formulations with either aqueous or mineral oil are user friendly.

In developing countries the challenge facing is to increase productivity without causing ecological damage. Indiscriminate use of chemical pesticides has affected humans and their environment in several ways. So far in this regards biological control of plant diseases and insect pests is identified as the best option for the ecofriendly management and it is emerged as a very important part of integrated pest management worldwide in the sustainable agriculture. However, commercialization and popularization of biocontrol agents are still to be strengthened. So far, extension workers and farmers need to be educated on their use.

In the north India due to indiscriminate use of commercial fertilizers/pesticides there are several cases of human diseases like cancer, heart stroke, diabetes are being noticed. Besides, continuous use

of commercial pesticides is also affecting the productivity of the crops and fertility of the cultivated lands. So, organic based farming system is required. Bio-control agents are also a part of organic farming and helpful for managing the pests and pathogens as well as provide the insoluble nutrients from the soil in soluble form to the plants. Currently several ICAR Institutes, Agricultural Universities and NGOs are working on the aspects of biological control of insect pests and pathogens. So, in this context our corporation also will be useful for the mass production of bioagents and their supply to the farmers. The main goals of our corporation are to increase crop production, reduce input cost and environmental pollution by limiting use of chemical pesticides and maintain agro-ecological equilibrium. The main objectives of our corporation will be:

1. To mobilize farmers into groups of between 15-20 members at the village level (called Farmer Interest Group or FIGs) and building up their association to an appropriate federation point i.e. Farmer Producers' Organization (F.P.O) so as to plan and implement proper backward and forward linkages including material and scientific inputs in the form of training, etc and also facilitate the farmers in all the ways to increase crop productivity and enhance remuneration of their produce.
2. To add primary and secondary value to the produce of farmers to increase their shelf life and better remuneration to them.
3. To mobilize the farmers into member - owned producer organization, or FPOs to enhance productivity and profitability of agriculturist, especially small and marginal farmers in the country.
4. To strengthen farmers' capacity through agricultural best practices for enhanced productivity.
5. To provide and facilitate linkage between farmers and Producer Company to coordinate supply and demand and to access key business development services such as market information input supplies and transport services.
6. To promote export of agricultural produce for better remuneration to the farmers.
7. To promote / provide / encourage and co-

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ordinate the development and advancement of agricultural engineering of all its branches.

8. To promote and facilitate management of post-harvest activity including storage, warehousing, processing, manufacturing units and transportation for benefit to the farmers.

9. To promote and provide innovative technology and marketing support for the development of rainfed and drought prone areas.

10. To promote industries such as the manufacture of fertilizers, pesticides, chemicals, bio-fertilizer and bio-pesticides for better crop production and protection.

11. To promote Dairy farm, milk processing unit and establishment of bio-mass refineries.

12. To facilitate suitable crops on the basis of their agro climatic conditions and market availability.

13. To promote plantation crop, medicinal and herbal plant to raise the income of farmers.

14. To promote and provide revitalization of land and modern irrigation system for increasing cultivated areas.

15. To strengthen a sustainable agriculture sector by promoting and supporting member-owned producer organization that enable farmers to enhance their productivity.

16. To provide village/farms methods for practicing modern farming techniques such as different types of cropping methods including intensive farming, contract farming and organic farming.

17. To undertake any welfare measures or provide facilities for the upliftment of women and child by linking government schemes related to their welfare.

Recently, we have organized training to transfer the knowledge of bioagents and its low cost production technology as well as IPM in Kharif crops to the farmers at village Sarol of Block-Tappal, Dist. Aligarh UP, in collaboration with CIPMC, Faridabad, Haryana during October 3-4, 2015. 50 farmers participated in the training.



Company members with IPM team at Sarol Village, Block-Tappal, District- Aligarh.



During the training programme Dr. K.S. Kapoor, Deputy Director (Entomology) discussed how to identify the insect.

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Mr. S.N Singh, (Plant Protection Officer) discussed with farmers about disease losses of paddy.



Notable guest Mr. Ram Asre, (Additional Plant Protection Adviser) with farmers discussed how to trap insect in domestic way during training programmes.

Endnotes:

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Micro Enterprises for Agriculture: Emerging Scope and Need

1. Backdrop

In a developing economy like India, about half of the population is primarily dependent on agriculture for livelihood. This also translates into more than two third of total area which is predominantly rural. India presents the case of a developing nation in transition with increasing dominance of the service and industry sectors over agriculture. This is a natural phenomenon in the pathway to development. However, what needs to be emphasized is the dependency of its population on agriculture for both livelihood and food. While agriculture presently contributes below 20% to the GDP, it provides employment to more than 48% of the population¹. While growth in agriculture has to be maintained there also has to be a greater absorption of rural youth in remunerative agri-based enterprises.

2. Importance of micro enterprises in agriculture

In the above context, it is evident that agriculture sector has to transformed into a vibrant sector providing decent means of livelihood to a vast section of population. Agriculture inherently falling under the primary sector, it is obvious that terms of trade compared to other sectors will not be in its favor in its original form. Increased fragmentation in land holding has further reduced the viability of agriculture as sole source of livelihood. With climatic factors playing a decisive role, agricultural production is unpredictable and volatile.

The potential solution lies in enhancing the value proposition by integrating complementary initiatives. Related diversification can result in resilient and stable livelihood opportunities. Micro enterprises can provide the much needed robustness and dynamism to agriculture by enriching various stages of the sector. Moreover, the sectoral efficiency can be further improved by supplementary off-farm and non-farm activities.

One of the major highlights of micro enterprises is that it has an income distribution and equalizing effect. Stakeholders in such enterprises are not limited to land holders but also include landless, agriculture laborers and women. When compared

with agriculture, such enterprises offer higher returns, greater marginal labor productivity and more output per unit of capital. Characterized by small size and run by households or coherent, homogenous, small groups, management becomes easier. Labor mobility is observed to be higher in rural enterprises since these can absorb un-skilled or semi- skilled agriculture workforce. This is possible on account of these entities being less technology intensive.

Growth of rural enterprises can be either due to demand-pull factors like higher profits, productivity etc. or distress-push factors like resource constraints, crop failure etc. While pull factors result in complementary association with a strong positive correlation between farm and off-farm / non-farm enterprises, push factors lead to the sub sector being an alternate livelihood source. Profits can be ploughed back into cultivation by investing in technology and better inputs therein yielding higher returns. Similarly, growth of enterprise can stimulate the rural economy with its linkages and better household incomes.

3. Conventional enterprises

The genesis of rural micro enterprise promotion lies in increasing the livelihood avenues of rural households alongside their primary engagement with cultivation. Livelihood initiatives in developing economies have focused on enterprise development with the aim of rural poverty alleviation. Micro enterprises can broadly be divided into off-farm and non-farm entities. Off-farm enterprises include dairy farming - processing, agri-processing, agri-business, organic manure production, nursery raising, farm implement manufacturing, honey processing, floriculture, medicinal plant cultivation etc. Non-farm ventures include artifacts making, eco-tourism, carpentry, eatery, textile etc.

Micro enterprises complement agriculture with forward and backward linkages. Backward linkage can be in the form of farm input supply and technology input induces efficiency in cultivation operations. Forward linkages like agri-horti processing units that add value to the primary

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sector. While the above linkages are production based, there can be significant financial linkages too wherein income from farm flows into micro enterprises as consumption expenditure and profits from micro enterprises can be ploughed back as investments / inputs.

4. Recent initiatives and emerging ideas

Rural micro enterprises have been undergoing transformations in line with technological developments in other fields and emerging trend of enterprising farmer groups. These enterprises have the potential of sustainable operations and at the same time addressing a core theme in line with the need. Various new / emergent ideas for such rural agri-based enterprises can provide newer opportunities for rural youth. BAIF has been working on developing various such enterprise ideas. Some of these are illustrated as under:

a. Solar enterprise

There are many rural areas in India where more than half of the households depend on kerosene as primary lighting source. There is immense scope for making available affordable and durable solar lighting products. When assembling, selling and servicing are undertaken locally, the sustainability and replication potential multiplies manifold. The product manufacturing can be run on revenue model wherein solar products competitively priced can be sold in local markets through retailers.

b. Vegetable / fruits drying with solar dryer

Dehydrated vegetables and fruits have good demand in the market. The pre-requisites are assured supply, quality and hygiene. Solar dryer based drying ensures quality and cleanliness. Decentralized drying at households and aggregation at village / cluster level followed by packing and vendor supply can make the initiative cover a larger base and share costs.

c. Community water purification plant

Providing drinking water at affordable rates to households is a promising activity in areas with poor quality water. Community managed water purification plants can be a profitable social venture.

d. Farm implements hiring centre and Common facility service centre

Farm mechanization is relevant to the small

holders at a different scale from the perspectives of labour saving, efficiency and drudgery reduction. Initial cost of implements prevents many small holders from adopting these. Moreover, the usage is seasonal and the farmer is not inclined to invest in assets remaining idle for most part of the year. Hiring centre with a set of implements can lease the same to member farmers for a nominal charge. The implement hiring centre can also incorporate additional activities like agri-input supply and warehousing. The service can also be extended to include activities like pesticide spraying, driving tractor, milking with machine etc.

e. Silage making

Green fodder shortage after monsoon is a common phenomenon in many rainfed areas. The demand – supply mismatch can be overcome by fodder cultivation in conducive areas followed by densification, silage making & supply to needy areas.

f. Complete feed and mineral mixture production

Availability of quality feed and mineral mixture is a concern in many areas. This in turn hampers dairy farming's sustainability. Decentralized feed and mineral mixture production can solve this problem with source of livelihood.

g. Solar pump entrepreneur

Use of solar pump for irrigation does not directly result in revenue but it can pay back within two years when compared to diesel pumps. A self-financing revenue model is possible wherein a farmer / group provide water lifting service using portable solar pump.

h. e – information centres

Information dissemination is significant in enabling farmers to hedge risks and adapt to shocks. Information asymmetry is one of the major obstacles in empowerment of rural areas. There is good scope for setting up real time information dissemination and allied service centres updating farmers about weather, market, practices etc. Enterprising individuals can run such services catering to a cluster of villages. The network can also be leveraged to enable farmers to market their produce or access products without spatial constraints. e-choupal initiative of ITC is a step in this direction.

I. Bio-energy and Bio-inputs Production

Integrated units for Renewable Energy and

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Sustainable Agriculture inputs (IRESA) can enable simultaneous production of biogas, enriched manures, bio-fertilisers and bio-pesticides. These can serve as power-houses for rural development.

BAIF has helped in the establishment of many units of the above enterprises.

5. End Note

Micro enterprises can go hand in hand with agriculture, at the same time enriching the associated value. It is an effective initiative aimed at poverty reduction and providing a stable income source in the face of volatilities in farming. The enterprising households can become resilient to fluctuations which in turn results in improved livelihoods.

The concerns about labor trade-off are unfounded since cultivation activities are seasonal. While there is no negative impact on agricultural labor, it definitely helps in arresting distress migration during lean seasons. It has also been observed from experience of different developing economies that conventional micro-enterprises contribute to about a third of rural household income. The new-age enterprises described above have the potential of contributing

substantially higher to rural incomes. Hence there is sufficient encouraging factor for spreading such enterprises. Successful establishment of micro enterprises also require certain support initiatives like technical inputs (skill development, technology), financial linkages (credit, incentives) and marketing (market access, management). These have to be put in place to create a facilitative eco-system.

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2. Economic Survey 2014-15, Ministry of Finance, Government of India

Vicious Circle of Resource Degradation: Eutrophication in Rainfed Agriculture

Background

Agricultural intensification is on the rise in most of the developing countries since the onset of green revolution technologies. The ever increasing crop intensities coupled with high and imbalanced chemical fertilisers and pesticides application is adversely affecting the soil fertility. Soil degradation is compensated with more and more fertiliser application at the farm level. Number of studies have shown cost of production (inputs) is growing at a faster rate than output (value) growth, though yield rates are either stabilised or growing marginally. Much of this applied fertilizer is washed into the river and groundwater systems. Of late, imbalanced and high chemical input use is

on the rise even in the rainfed regions due to increase in the groundwater exploitation. In fact, chemical fertiliser use is being promoted aggressively in the rain fed regions in order to enhance productivities (for instance second green revolution in rainfed regions). In these regions eutrophication tends to grow at a geometric pace due to groundwater irrigation i.e., recycling of eutrophication or degradation of one resource (water) feeding into another (land) forming a vicious circle. Continuous use of such nutrient loaded water for irrigation could potentially turn the soils sodic and barren in medium to long run.

Land Degradation appears to be most rapidly growing concern for sustaining agriculture

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productivity and food security in most of the developing countries. It is observed that in order to maintain a healthy growth of 3 to 4 percent agriculture needs investment to the tune of 12 percent of the GDP. But the recent experience indicates that even a higher investment (above 15 percent) is not able to sustain the growth due to resource degradation (land and water) (Alagh, 2013).

Eutrophication

While water and wind erosion are part of natural process, imbalanced input use and the related eutrophication are human induced that need to be addressed. Eutrophication is the process by which damaging quantities of nutrients accumulate in water bodies (Fleming, Hufschmidt and Hyman, 1982). Nutrients, mainly nitrogen and phosphorus, come from a variety of sources, including agricultural fertilizers, municipal sewage (human activities), grazing in riparian areas (livestock activities), and sediment from eroded watersheds. Although nutrients from natural sources are needed to keep the ecosystem productive, excess amounts from human activities can overload rivers and lakes, causing algal blooms and reduced water quality. High concentrations of algae consume the oxygen dissolved in water while they decompose, causing anoxic conditions that are toxic to aquatic life. Fish cannot survive in water with little or no dissolved oxygen, and many lakes, reservoirs, rivers and estuaries have lost valuable aquatic resources through eutrophication. Several species of algae are unfit for human and livestock consumption". (FAO, 2006)

In regions of intensive agriculture, inappropriate application of fertilizers and pesticides may result in chemicals being washed out of the fields into rivers or aquifers, where they become concentrated and pollute the water sources of downstream users. Cattle feed lots, which are now recognized as a major cause of pollution, are also usually considered as non-point-source pollution, usually at a more localized scale.

A recent study in the rain fed Anantapur district (about 600 mm rainfall) of Andhra Pradesh has reported disturbing water quality indicators (Ahemad and Sridevi, 2015). It is observed that irrigation water in some of the groundwater dependent regions has high concentration of electro conductivity (EC); sodium (Na); magnesium (Ma); nitrates (NO₃) and fluorides (F)

beyond maximum permissible limits. Some of the villages have experienced their soils turning sodic in recent years. Most of these regions are dependent on groundwater for 90 percent of their irrigation needs. Such an intensive use of groundwater can put farming at risk if policies are focused on quantities to the neglect of quality of water. Such an intensive recycling of soil pollutants could destroy the soils at any scale. Nutrient leaching is a far more important issue to farmers than farm soil erosion. In rainfed agricultural land, the leaching volume at 45 cm depth in the soil profile is significantly higher than surface runoff.

Eutrophication persists even as scale increases (watershed / basin). Soil is the main carrier of nutrients, and erosion control is one of the most effective mitigation measures. While in small watersheds, upstream conservation (e.g., leading to reduced erosion) can have an immediate and substantive downstream impact (e.g., leading to reduced sedimentation and eutrophication in reservoirs and lakes). As watersheds increase in size, the impact of land use on the hydrological regime becomes insignificant compared with that of natural factors (intensity of extreme rainfall events). At larger scales, however, land use does have an impact on water quality, and the cumulative effects of pollution, for example, can be observed in large river basins. Eutrophication in the rainfed and groundwater dependent regions is more serious and less prioritised.

Further Research

Increasing dependence on groundwater coupled with agricultural intensification is likely to exacerbate the problem of soil degradation that in turn affect agriculture production adversely. The problem appears to be universal, especially in developing countries where input use regulations are not in place. Hitherto the problem of eutrophication has not received policy attention due to the reason that the problem is not alarming in terms of scale and intensity. But its presence in the groundwater dependent rainfed regions is a cause for policy concern. For, the process could be very fast in these regions due to low rain fall and leaching due to heavy runoff. The present interventions in these regions, in fact, emphasise on run off. This results in recycling of nutrients at a small scale.

Further research is required to assess the

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following aspects: i) the extent and impact of irrigation water quality (eutrophication) on land degradation and agriculture production; ii) how far the impacts differ between groundwater irrigated (rainfed) and surface irrigated situations; iii) relation between land use (crop systems) / livestock intensity and eutrophication and its impacts and iv) relation between bio-physical (including hydrogeology) characters of the location and eutrophication.

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"Post-Modern Agriculture": An Italian Model

Over the past decade Italian agriculture has been at a crossroad: on one hand is at what is commonly referred to as "modern agriculture", developed since the years after World War II; and on the other a new model that could be called "post-modern agriculture" or better still "quality rural development."

Schematically, we can say that in modern and industrialized agriculture, whose paradigm is mass production, farms tend to simplify the production systems and remain within the periphery of mere farming; simultaneously outsourcing an increasing number of manufacturing operations. The guiding principle is the research of maximizing yields and efficiency of scale, to be achieved through increases in size (quantity). The reference model is the US agricultural system (but also the Soviet one) based on large estates, large-scale production for the export market, intensive use of chemical additives such as fertilizers and pesticides and, in recent decades, the use of genetically modified organisms.

The above-mentioned agricultural system has been widely adopted by Italy too, with a peak that was recorded more or less in the mid-eighties.

While the model has resulted in an increase of

productivity in terms of quantity, it also brought with it a decrease in cultivated varieties with loss of agricultural biodiversity, ecosystem stress due to the use of chemicals and the intensive exploitation of soil and water resources. It also caused a reduction of the workforce employed in the sector, but not only due to this obviously, by favoring the large capitalist companies to the detriment of family farms (the active population employed in agriculture fell from 45% in the sixties to less than 4% now, the consequent depopulation of rural and mountain areas, the related growth of urban areas and excessive human pressure on coastal areas).

This kind of model that has been extremely successful in countries such as the US, Canada, Brazil, Argentina etc. where in terms of morphology and availability of cultivatable land the system of monoculture has adapted well. In Italy however it is compared with another model that is rooted in the traditional agricultural system, represented by family farms.

In Italy 85% of companies are family-owned, most small with no employees apart from family members. The average area for a farm is close to 7 hectares - for 85% is less than 10 and 47% of this share is less than 2; only in 2.2% of cases, the extension is above 50 hectares. For comparison,

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an average farm in US covers 175 hectares.

The second obstacle in approaching the "modern agriculture" model is to be found in simple ratios of magnitude: in fact this model is designed for large areas that produce huge amounts of products of mass consumption (agricultural, livestock and industrial) and for export. An ideal system for the American corn belt or the Brazilian plantations, but poorly applies to Italy, a small country (the size of California or the State of Maharashtra) and predominantly mountainous.

Just looking at these two factors, and there are many others, it can be inferred that Italy, by adopting outright "modern agriculture", can never compete with the giants mentioned above, and cannot rely entirely on the merits of quantity.

It is here then that the need arose to rethink the Italian agricultural system looking for a new way, more congenial to the development of the country while preserving identity, the ecosystem and culture.

Over the last few years a "post-modern" model has been proposed which we have already defined at the beginning as "quality rural development".

The biggest difference between the previous model, which aims to simplify the business and standardize production processes, is the will of promoting the multi-functionality of agricultural activities that can be attributed to the following features:

"- Promote the socio-economic development of rural areas, ensuring sufficient vitality and quality of life, with particular reference to the more marginal areas at risk of economic, social and cultural erosion;

- Ensure food security, which in advanced countries such as Italy is concerned not so much about the satisfaction of basic food needs, but the availability of safe and healthy food in terms of sanitary and quality from the nutritional point of view;

- Meet the needs of quality and variety of productions in the face of increasing standardization of food resulting from the industrialization and globalization of production processes and consumption patterns;

- Maintain and reproduce the natural resources available, helping to reduce the impact on the

environment, climate, biodiversity, landscape, etc. "[Belletti, Marescotti]

This new model has also led to a change of perception of society towards the figure of the farmer: "The loss of contact with the consumer and social visibility that had characterized the previous period is attenuated by the activation of direct relations: the direct sales farm or close circuits, agri-tourism, educational farms, are all examples of activities that reactivate direct production-consumption and give rise to new professional needs and skills. The farm also increases relations aimed at synergistic use of the resources in the area (artistic, cultural, environmental, natural, and with other local handicrafts), building connections with local operators (public and private, individual and collective) on an equal level [Pacciani, Belletti and Marescotti Scaramuzzi, 2003]."

These changes offer new employment opportunities on the farm, not only in terms of the amount of labor hours required to meet the new activities undertaken, but also in terms of quality of work, given the different skills to carry out activities in the new and more complex tasks required (marketing and communications, quality production subject to certification, management of the agri-tourism structure, provision of environmental services, etc.).

Under the new model of development there is therefore the emergence of new forms of connection, involving change in the performance of "traditional" activities of production and exchange of products in the market, and expanding the specter of the "production" business to include the provision of innovative services.

Therefore farms under this model determine at least three factors for an agricultural model alternative:

1. an increase in the level of differentiation and quality of production by farms (quality);
2. a recovery of direct exchange channels with the consumers (short chains);
3. a growing extension of farmers into new activities of production of goods and services (multi-functionality).

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Finally an example of a new model of agriculture (rural development quality) which, pivoting on companies small / medium, has gained a leading role in the global market: the wine industry.

Italian wineries have an average area of less than 6 hectares and approximately 400 grape varieties are cultivated throughout the Italian territory. We are therefore in a perspective diametrically opposite to other countries such as the USA, South Africa or Australia (the so-called "New World" wine producers) where you are betting on large scale companies and on the cultivation of a few select grape varieties. In this scenario you have on one side a big fragmentation and centralization on the other, and would immediately think that the second should be the most efficient and productive system. Instead it seems to be just the opposite. This year (and in 2013), Italy is the largest producer of wine in terms of liters: 48.9 million hectoliters, France ranked second with 46.6. However, it is important not to dwell only on the amount, otherwise it would fall on the side of "modern" agriculture and not "postmodern". Therefore it is necessary to point out that 75% of the wine product is included in denominations IGT, DOC, DOCG, therefore represent a product of medium / high quality bound by certain disciplinarys of European significance. How has it come to this state of affairs?

From the second half of the eighties the vine grower has turned from a mere farmer to entrepreneur, improving his social status. This resulted in a significant increase in the average quality of the wine with strong performances such as Barolo or Brunello, that have become ambassadors of the Italian agricultural model worldwide. But the vine grower, in addition to focusing on the quality of the wine produced, has been able to innovate and develop the multi-functionality of the company mentioned above: many wineries have implemented accommodation structures becoming holiday farms, for example. Other vine growers, spurred by a growing market, have repopulated areas previously abandoned ensuring the preservation of the landscape. The entire sector, reviving its relations with the social fabric, was also instrumental in the development of a recent phenomenon that is becoming an increasingly important economic factor in local economies: wine tourism. And finally, just in the name of diversity against the standardization of "modern agriculture", the increase in production of organic and biodynamic wine or "forgotten" grapes bear witness to the search for an identity and a sense of responsibility in the company towards the surrounding ecosystem.

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Zero Budget Natural Farming Save Farmer and Save Earth!

Even as the world started finding the problems with Chemical Farming brought as the Green Revolution, Organic Farming is proposed as the alternative system to rescue the plights of the farmers committing suicides. It is not too late to realize how the proposed processes of organic farming is again a big mistake at the stake of the farmers.

Processes in agriculture involves both chemical and organic and to make a distinction as organic and chemical farming are just making a mockery over the science. Plants prepare organic nutrients and store the same in their plant bodies in chemical form. When we make a study of the plant bodies it looks like the plant is having some

chemicals as its ingredients and yet the processes are always organic. So how do we distinguish them as Chemical and organic?

A best way is to find out whether the processes are natural or unnatural.

In the first place we humans need to understand that we are dependent on plants and not the other way round. Forest existed even before the humans came into existence on earth. Agriculture is not a process of creating plants but to choose what we want to grow. Man has never been able to invent any plant so far. His whole research and discovery was just about how best he can utilize the nature and make the best use of the natural processes.

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Anything done against the processes and the principles of nature will lead to dangerous situations endangering life on earth. Global warming is one such natural disaster created by human intervention with nature. Manipulation of nature is the worst crime committed by the modern science. It is time to awaken the mankind about the crimes committed on nature.

Even as the United States government continues to push for the use of more chemically-intensive and corporate-dominated farming methods such as GMOs and monoculture-based crops, the United Nations is once again sounding the alarm about the urgent need to return to (and develop) a more sustainable, natural and organic system.

That was the key point of a new publication from the UN Commission on Trade and Development (UNCTAD) titled “Trade and Environment Review 2013: Wake Up Before It’s Too Late,” which included contributions from more than 60 experts around the world.

According to the new UN report, major changes are needed in our food, agriculture and trade systems, with a shift toward local small-scale farmers and food systems recommended.

Diversity of farms, reducing the use of fertilizer and other changes are desperately needed according to the report, which was highlighted in this article from the Institute for Agriculture and Trade Policy.

Zero Budget Natural Farming (ZBNF) is a method of agriculture that counters the commercial expenditure and market dependency of farmers for the inputs like fertilizers and pesticides. The method involves locally obtainable natural bio-degradable materials and combine scientific knowledge of ecology and modern technology with traditional farming practices based on naturally occurring biological processes. Zero budget farming methods are promoted by agriscientists like Subhash Palekar[1] and Masanobu Fukuoka (Natural Farming).

Zero Budget spiritual Farming means that the production cost for all the crops will be zero. All the things required for the growth of the plant are actually available around the root zone of the plants. In the Zero Budget Natural Farming nothing has to be purchased by farmer from

outside. Our soil is abundant with nutrients. There is no need to add anything from outside. Only 1.5 to 2.0 % of nutrients are taken from the soil by the plants. Remaining 98 to 98.5% nutrients are taken from air, water & solar energy. If science says that 98% crop body is constituted by air and water, then where is the need to add the fertilizers from outside?

All these elements constituting 98% body of the plant are available free of cost from nature. Remaining 1.5% nutrients taken from the soil are also available free of cost as it is taken from the abundantly enriched nutrients existing naturally in the soil.

The results of the scientific study made by the world famous soil scientists Dr. Clark and Dr Washington in year 1924 shows that as we go deeper in the soil, the nutrients needed for the growth and production of the plant are in the increasing quantity. Hence soil is abundantly enriched with the nutrients.

There is no human existence in the forest, even then the trees in the forest are having enormous number of fruits. That means nature had supplied all the nutrients needed for the plants to grow. We need to study and understand how nature is working and adopt it in our farm without disturbing the natural eco system. This is the fundamental principle in Natural Farming.

But the nutrients in the soil are in the unavailable form. Plant roots cannot take them directly in the form available there. Hence, the soil testing report says that it is in the unavailable form. This non-available form of nutrients in the soil are converted to available form by the millions of micro-organisms. In the forest, these micro-organisms are present in huge amounts (One crore or lack per gram soil) which convert these non-available form nutrients into available form for the plants. That is why in the forest there is no need to add any fertilizers from outside.

However, in our farm these nutrients are not available because the micro-organisms which convert these non-available form of nutrients into available form are destroyed by means of poisonous chemical and organic fertilizers, insecticides, weedicides and cultivation by the tractor.

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We have to now re-stabilize these micro-organisms in the soil. It can be done by applying the cow dung of our local (Desi) cow. The cow dung of the local cow is a miraculous culture. Just as our mother or wife add a spoon of curd (culture) to the pot full of milk and then overnight the whole milk is converted into curd, the local cow dung is also a culture. One gram of cow dung contains about 300 to 500 crore beneficial effective microbes. After 6 years of research, Sri Subhash Palekar has found that a culture of cow dung prepared by name Jeevamrutham meets all the needs of the soil to enrich it as the most fertile soil.

Is Organic farming more dangerous?

All these techniques are called in general term as organic farming are unnatural and non-scientific techniques. Because, all these techniques are not in existence in the nature. All these alternative exploitive organic farming techniques are manmade. Organic farming has launched the surface feeder worm **Eisenia Foetida** of the **class oligochata** and **family Cumbricidae**, imported from Europe and Canada in India. They destroy the all dried biomass on the soil, to destroy the animal casting and add in their castings poisonous heavy metals like Cadmium, Arsenic and Mercury in the soil which destroy the soil health and human health.

This foreign variety of *Eisenia Foetida*, unlike the local Indian earth worms, cannot burrow the soil; cannot maintain physical and chemical properties of the soil; cannot cultivate the soil; cannot harvest rain water; cannot improve the soil ecosystem, cannot loose soil compaction, cannot maintain aeration in the soil, cannot maintain biodiversity and microbial activities in the soil, cannot feed those pathogens in the soil, which cause diseases to the crops; in contrary they release these pathogens through their cast, remains on the soil and damage the crops. (Dr. Murti, Dr. Nikhil Kumar). There is no Government agency to test the pathogenic concentration in the vermicompost and agricultural produce, which causes diseases to human being. Gish and Christensen (1973) reported the amount of heavy toxic metals up to 331 ppm of Lead and 670 ppm of Zinc in the body of these worms. It is observed that, there is a correlation between residues of heavy metals quantity in the bodies of these surface feeder worms and decreasing atomic weight of the soil. There is a straight relation of the

quantity of the heavy metals in the soil and used vermicompost quantity.

Hogg 1895, Gish & Christensen 1973, Hartenstein 1980, Beyer 1981 & Ireland have reported accumulation of Lead, Cadmium, Chromium, Copper, Nickel, Mercury and Zinc, hazardous toxic heavy metals in the vermicompost & these worms body tissues. They reported again, that worms seem to tolerate large concentration of these metals in their tissues. They reported that these worms accumulate poisonous agro chemicals also and feed the soil this poison through vermicompost.

Farmyard manure:

When we add one ton (two bullock cart load) of farmyard manure, cost of that one ton F.Y.M. is Rs. 300 to 400 and one ton of vermicompost (*Eisenia Foetida* Excreta) is from Rs. 4000 to 5000, in big cities, it is Rs.10000 per ton. Organic farming is 10 to 20 times more expensive than chemical farming. Cost of production of each crop is multifold higher, in organic or biodynamic farming than chemical farming. Moreover by dumping farmyard manure we are inviting the weeds through the unprocessed dung produced by cattle which ate the grass and seeds of the weeds.

Observations and Inferences

Visit to fields where Palekar's Zero Budget Natural Farming has been adopted and interaction with farmers whose profile has been furnished by **R.Yogananda Babu** in annexure revealed that all of them were raising crops using modern technology of improved seeds, fertilizers and plant protection chemicals before adopting this new Zero Budget Natural Farming method. They found the old method to be very cost intensive and by their own estimates the cost of cultivation of one acre of paddy was Rs.5000/- to Rs. 6000/- and that of sugarcane Rs.15000/- to Rs. 20000/-.

Similarly the cost of cultivation of one acre of banana was Rs. 25,000/- to 30,000/-. This often compelled them to raise loan from conventional and institutional sources. However, the returns were not commensurate with the investments made for raising crops. The produce from field crops generally met the requirements of the family and the marketable surplus was not sufficient to repay the loan. Market forces were also sometimes detrimental to the interests of the

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farmers resulting in low price realization. It was evident from interaction with the selected farmers that they practiced a form of subsistence farming.

In this bleak scenario all the farmers selected for study attended orientation

Courses were conducted by Subhash Palekarji or his trained promoters at different places of Karnataka. They were convinced that Zero budget natural farming is farmer friendly, ecofriendly and above all extremely cost effective. These reasons were cogent enough for them to give this method a fair trial and hence switched over to this new method. The experience of the practicing farmers and field observations over a period of time lends credence to the following conclusions:

a) The system of zero budget natural farming is eminently suited to the farmers particularly small and marginal farmers because of its simplicity, adoptability and drastic cut in cost of cultivation of crops. The appeal to the farming community lies in the fact that maintaining optimum levels of production and keeping the cost of cultivation to the bare minimum will substantially enlarge the profit margin.

All the sample farmers acknowledged it as farmer friendly and financially viable. However during the initial period of transition to new system, the results will not be encouraging because of the lingering effects of chemical farming. The results will become evident only after adequate mulching and restoration of biological activity in the soil.

b) Treatment with Beejamrutha and Jeevamrutha has given extremely encouraging results for successful cultivation of crops. Beejamrutha does provide adequate protection to crops from insects and diseases during the initial stages of germination and establishment. Mortality in case of treated crop is reported to be almost negligible.

The experience of the farmers bears ample testimony to the fact that Jeevamrutha promotes rapid and enormous biological activity in the soil. However, it should be coupled with adequate mulching so that the soil is transformed into humans rich reservoir of nutrients. It is also observed that providing Jeevamrutha once in a fortnight is better than providing it once in a month. It has been the experience of farmers that dispensing with the use of fertilizers has not

adversely affected crop yields. The use of homemade pesticides has also been found to be effective in managing the crop pests without economic injury to crops.

c) Experience with this method of farming corroborates the fact that adequate mulching promotes humus formation, suppresses weeds and greatly reduces the water requirement of the crops. Live mulching particularly with leguminous crops has been found to be not only a subsidiary source of income but also a safeguard against depletion of nutrients by crops.

d) Mixed cropping particularly with short duration legumes, vegetables and even medicinal plants has certainly expanded the income source of farmers. Vegetables rich in vitamins and minerals are generally marketed after adequately providing for some consumption and this certainly augurs well for overcoming malnutrition which is widespread in rural areas. Sri. Bannur Krishnappa obtained an additional income of more than Rs. 15,000/- by planting Ashwagandha and Coleus in one acre as intercrop with sugarcane.

e) All the farmers selected for study have expressed satisfaction that switching over to the new method from chemical agriculture has paid them good dividends. Savings on cost of seeds, fertilizers and plant protection chemicals has been substantial. Almost all the farmers have stopped borrowing crop loan. They are also not depending on hired labour as the family labour is sufficient to carry out all the farming operations. The yields have been optimal with possibly no decline in future, because of continuous incorporation of organic residues and replenishment of soil fertility. The new system of farming has freed the farmers from the debt trap and it has instilled in them a renewed sense of confidence to make farming an economically viable venture. This is a noteworthy feature in the dark horizon of many farmers committing suicide across the country.

Prospective Study

An appraisal of the 'Zero Budget Natural Farming' so far clearly points to its eminent feasibility for different agro climatic conditions, for different crops and different category of farmers. It has found favor with the farming community because it perfectly blends with their life style which is dependent on land, vegetation and livestock.

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A report of Sugarcane M1 crop in 50 Guntas:

Date of seeding: 12-08-2005. Crop reaped on: 10-11-2006, Farmer: Ramappa, Mandya

Expenses in Rs.	Income in Rs.
Monocod and Dicod seeds for sowing: 500	Monocod, dicod vegetables: 65000
Sugar cane seeds: 1100	Sugarcane yield: 64050
Colie and others: 15400	70 ton@915
Total: 17000	Total: 129050

Comparative study made per acre yield on Chemical and Zero Budget Natural Farming:

Sr.no.	Crop	Chemical	ZBNF	Reference
1	Shaktiman Jowar	16Q	41.6Q	S.N. Patil:9480535959
2	Jowar	6Q expense1500	5Q Expense 500	Inter crops added
3	Red Gram	7Q Expense 3000	12 Q Expense 200	Blait attack is controlled naturally
4	Bengal gram	8Q Expense 3000	6Q Expense 200	JN Nade Gowda 9845257593
5	Sugarcane	55T Expense 8000	80T Expense 1500	
6	Paddy		+ 100Kg	Using Jeevamruth
7	Raagi millet		+ 120 Kg	Sustainable crop
8	Chilli		+ 200Kg	Report by Govt. of Karnataka 2009
9	Mysore Mallige Paddy	Paddy 23Q Rice 50-58Kgs	Paddy 23Q Rice 70-75 Kgs	No infections in natural farming
10	Raagi	4Q Samiya 600-700g/Kg	5Q Samiya 800-900g/Kg	Rain fed draught crop Samiya Quality high
11	Arcanut	6-7Q Bag wt 80Kg	9Q Bag Wt. 85Kg	Reduced Tender seed dropping.
12	Coconut	1000 coconuts 130Kg.	1000 coconuts 165Kg.	Infection free
13	Tomato			Storage without refrigeration
14	Beans, Muli			40 hours fresh
15	Bendi			1 year long crop
16	1 year long crop			Shining crop Nagesh 9448432809

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Sr.no.	Crop	Chemical	ZBNF	Reference
17	Musambi orange	3T	4T	Best quality fruits Palaksha Reddy 9019620006/8951539848
18	Arcanut	16Q	22Q	Sathyanarayana Sagara 9483492012
19	Mango	8Q	40Q	TR Tippleswami
20	Chikkoo			9449643608
21	Banana	40Q	48Q	BM Vishweshwariah 9844025866
22	Lime	400Q	600Q	10days storage Mallikarjun Kumbala 9972209501
23	Coffee, Elachi	2.5Q, 3Q	4Q, 4Q	BR Chidambariah 9342259434
24	Turmeric	30Q	32Q	Throughout year Jaykumar B Patil 9663284619
25	Silk Malbary	100 eggs> 50-60KG Pupas	100eggs> 70-80KG Pupas	18 hours freshness Infection free silk worms Lakshmana 9980089219
26	Jasmin	Daily 34Kg	Daily 56Kg	Dr.Prasanna 9448165506

Farmers naturally argue on the yield we get and the earning they made per acre from the crop. Farmers need to also look into other aspects that add value to their crops and the farm land. The quality of the crop that is free from all kinds of chemical and organic poisons is the main consideration. Secondly the size, taste, natural color and the fragrance of the yield very much matter in naturally farmed fruits. We have seen 6 feet tall Banana bunches in Nagpur Manoj Jonjwal's Zero Budget Natural Farming. We have videos taken of the Zero Budget Natural Farming course held by Sri Subhash Palekarji with local Telugu translation for the benefit of the farmers. Printed small books in Telugu to help farmers to start implementing the Zero Budget Natural Farming immediately. So far around 1 lakh farmers in A.P and Telangana have shifted to Zero Budget Natural Farming.

Government of Kerala is actively promoting Zero Budget Natural Farming inviting Sri Palekar to keep conducting his workshops regularly for the farmers. Andhra Pradesh Government has organized a State level 8 days full-fledged workshop to 6000 farmers in January 2016. {The author of this article conducts 1 day (6 hours) Zero Budget Natural Farming workshops in

Telugu, Kannada, Hindi and English languages. He also conducts online Zero Budget Natural Farming courses to those interested invoking interest to Software Engineers and other professionals staying abroad. 100 such well educated people staying out of India have returned to their home towns adopting Zero Budget Natural Farming enjoying healthy food and wealthy life.

Farming is no more the last resort but the best choice of the highly intelligent people. Zero Budget Natural Farming is the brilliant people's wisest life style.

Workshops are intended to be held at the WTC Global Economic Summit 2015 at Mumbai by the author. For more details contact: M.R. Ravisankar 09392444251 and email: mahaacharya@gmail.com

Ref:

1. Kannada Book "Shunya Bandavalada Naisargika Krushi" by Shankaranna Doddannavara
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3. https://en.wikipedia.org/wiki/Zero_Budget_Farming

4. www.palekarzerobudgetspiritalfarming.org/

5. <https://youtu.be/Xwv5K7LH6IO>

6. <https://youtu.be/7TQWHhXeIS8>

Maha Acharya Ravisankarji is a reputed Yoga Master who has been guiding people into living natural and nature friendly life for the past 3 decades. He has a million followers throughout the world. His research into teaching infants by parents has helped many couple to have healthy brilliant babies.

He is the President of the Rishi Samskruti Vidya Kendra Meditators Horticulture and Rural Development Society ® in Vinukonda in A.P. promoting Zero Budget Natural Farming in nooks and corners of the States of A.P. and Telangana.

He is also the President of Neighborhood Community Network establishing self-governed communities. This movement has earned UN recognition with the best children's movement award.

He is an advocate by qualification and still pursuing his education doing LL.M. having two children doing their graduation. His quest for truth and natural living has taken him to his small hometown, Penukonda where he is doing his experiments with Zero Budget Natural Farming and training farmers there.

He is an advisor to many corporates adopting Zero Budget Natural Farming and also a consultant for those who try to switch over to Zero Budget Natural Farming. His training to youth from rural areas is providing them opportunities to serve establishing Zero Budget Natural Farming in many estates.

His various workshops in English, Hindi, Telugu and Kannada languages has been inspiring millions to adopt natural life style enjoying health and prosperity together.

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Only Skin Deep - The Future of Human Civilisation

Through time immemorial, wars have been fought over it and mankind has sung paeans eulogizing its many virtues. Yet today we either take it for granted or ignore it – as though it were nothing but dirt. This is our invaluable and almost irreplaceable resource, our top soil. At many places just a few inches thick, veritably the skin of Mother Earth. This miracle of nature holds the key to our very survival and we need to understand how we can preserve and nurture it for future generations.

Mother Nature needs a hundred years to make 1 millimeter of top soil, so to create just 10 inches would have taken her all of 25000 years. As we recklessly exploit this resource and allow it to blow away in the wind, spare a thought and see what we are likely to fritter away.

Mankind derives 99.7% of the calories needed for survival from land and just 0.3% from the world's oceans and this is not likely to change remarkably

in the near future. These precious calories come from a handful of crops like rice, wheat, corn, soybean, potatoes, pulses and oilseeds. These critically important crops need soil to be in peak productive condition for meeting the demands of a growing population; otherwise this could impact our progress and stress our social order and services including health to breaking point.

Availability of Land and its Deterioration

In its research report published as recently as February 2015, the WORLDWATCH INSTITUTE has stated:

Increases in food production, per hectare of land, have not kept pace with increases in population, and the planet has virtually no more arable land or fresh water to spare. As a result, per-capita cropland has fallen by more than half since 1960, and per-capita production of grains, the basic food, has been falling worldwide for 20 years.

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The world population was 3 billion in 1960 and total cultivated area in the world was 1.4 billion hectares. The land supply has increased a fraction to 1.5 billion hectares in 2010, but the global population has increased to 7 billion within the same period. This means that per capita availability has fallen from 0.45 hectares in 1960 to 0.21 hectares in 2010.

According to the United Nations, world population will swell to 9 billion people by 2050 assuming our growth rate declines from 2.5 to 2 per cent per year. This estimate is questionable if we consider the bulge of population in the age group of 17 -35 in developing countries. Even so, the per capita availability of land will decline to 0.17 hectares. This fragmentation of holdings can seriously affect the ability of small and marginal farmers to feed themselves and their families so producing a marketable surplus will be a remote possibility. Moreover, our input intensive agricultural production strategy and rising cost of inputs can potentially disenfranchise countless millions of our rural populace from the economic mainstream.

Our land supply is not likely to increase, on the contrary, The International Food Policy Research Institute estimates our current practices are causing vast swathes to either go out of production. Every year 19.5 million hectares of farmland are converted to non agricultural use to meet demands from industry, infrastructure and real estate. In addition, about 10 million hectares is degraded annually by erosion, salinity, alkalinity and other causes directly attributable to human intervention. In other words, the cultivable land will actually decline by about 1.7% per year. This will place a tremendous strain on our ability to feed our people in the long run as we run out of arable land to grow crops.

Growth of food production has apparently kept pace with demand thus far, this is illusory because the distribution of wealth has been inequitable and a sizeable population goes to bed hungry each night. Out of our 7 billion people, it is estimated by the FAO that as many as 3 billion (nearly 43% of our population) are chronically malnourished. This corresponds closely with the figures reported by a 2007 study of the UNICEF which showed that the proportion of our population subsisting on less than \$2/day which works out to 2.2 billion people, of whom as many as 1.2 billion earned less than \$ 1.25/day. Even in

parts of Asia, the average daily calorific intake of the population is only marginally higher than Sub Saharan Africa and this does not take into account protein consumption, which is almost out of reach.

Deleterious Effects of Soil Erosion

According to David Pimentel and Michael Burgess from Cornell University, our current practices are causing us to lose valuable and almost irreplaceable top soil 10 -30 times faster than the rate at which nature can replenish it. They estimate that this causes a loss of productivity of \$37.6 billion in the US alone, every year. The need to replace the lost nutrients with chemical fertilisers costs US farmers to spend \$ 20 billion annually. Losses due to soil erosion are higher in developing countries which could be losing as much as 40 tons of soil per hectare annually. Contrast this with forested areas that lose only up to 0.05 tons per hectare annually.

Erosion causes loss of valuable soil organic matter that binds most of the N, P and K. Fertile soils carry 100 tons of organic matter per hectare making up 4% of total soil weight. This binds up to 95% of the N and 25 -50% of the P. Lower soil profiles exposed after erosion contain almost no organic matter and little nutrients. Each ton of eroded top soil carries with it 1-6 kgs of N, 1-3 kgs of P and 2 -30 kgs of K. Replacement of these nutrients is not just costly for the farmer, they can affect human health and the environment.

Loss of soil organic matter and the resultant excessive reliance on chemical inputs has a severe impact on soil ecology and bio diversity. Reduced soil bio diversity directly corresponds with reduced resistance to drought. Loss of organic matter impacts other species like earthworms that maintain the integrity of the ecosystem. It is reported that a reduction in organic matter from 1.4% to 0.9% lowered grain yields by 50%. This means that degraded soils consequently support lower plant biomass creating a downward spiral that ultimately affects us as well.

Soil erosion contributes to climate change as organic matter carried by soil is oxidized more rapidly to carbon dioxide. The increasing levels of this gas in our atmosphere which is directly attributable to human activities are the highest observed in the last 800,000 years. The levels of silting of water bodies is a direct consequence of soil erosion and this can cause reduced storage

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capacities that could prove devastating during a drought. Increased presence of soil particles in the air we breathe can lead to increased incidence of diseases like TB and anthrax.

Fluorosis of ground water and leaching of nitrates leading to methemoglobinemia or blue baby syndrome are well documented results of excessive fertiliser use. Large scale eutrophication of water bodies in the developed world leading to a loss of marine life and toxic algal blooms have been observed with increasing frequency. This has been vividly documented in large areas of the Atlantic bordering Florida which are likely to become dead zones the size of France, if this is not corrected.

Loss of soil structure is a natural consequence of our intensive practices. Sub soil compaction caused by agricultural machinery, crust formation and reduced moisture holding capacity are other undesirable effects. All these raise the costs of production (due to the need for resowing) and irrigation requirements besides causing loss of productivity and profits.

The use of chemical fertilisers directly contributes to climate change through the release of nitrous oxides. The impact on the atmosphere of the release of 1 kg of nitrous oxide is equal to 300 kgs of carbon dioxide. It takes over 120 years for such gases to be removed from the atmosphere, so the cumulative impact this can have on climate change can be imagined. Over 80% of the release of nitrous oxides in the atmosphere is directly attributable to agriculture and allied activities especially the application of chemical fertilisers.

What can we do

Usually, the answer we have come to expect, which is to go green, brings with it the expectations of declining production which would run contrary to the goal of feeding a rising population. The nutrient demand of high yielding crops could not possibly be met by natural means, can they? What about the effect of pests and disease? Surely we would need more fertilisers and pesticides? An eco friendly approach cannot possibly produce quick results, right? WRONG!!

Introducing the step system

A new, holistic system that tries to integrate the best of both worlds by introducing cutting edge

products and ideas to help restore soil ecology and optimize the use of chemical inputs – fertilisers and pesticides. This method, pioneered by Sequoia Bio Sciences, operating out of Pune, India is now being increasingly used on large swathes of prime farmland in North India with significant increases in yields of most crops.

The first basic principle of the STEP System is that the health of our top soil has a direct bearing on the health of our crop and has a direct bearing on productivity. Also soil structure, organic matter content and soil bio diversity hold the key to the long term sustainability of agricultural practices. The second principle is that Mother Nature can restore the soil ecological balance if given a helping hand and the results should begin to show up fairly quickly.

The third principle is that farmers will only adopt any new technology if it is proven to be cost effective when compared with current practices. This system brings a slew of natural products including potent plant extracts, concentrated formulations of naturally occurring soil microbes and endo mycorrhiza and other environmentally friendly ideas which promise to change the face of agriculture. A system which by restoring soil structure and ecology, helps improve productivity and reduce the incidence of soil borne pathogens. A system which is cost effective and promises to put the smile back on the faces of countless farmers all over the world.

The STEP System is extensively field tested over several years and is in use on over 100,000 acres of farmland. This is now being validated in premier US research facilities after which it will be released for the benefit of growers all over the world.

This system promises to help growers overcome serious problems caused by viruses, bacteria and fungi which are proving difficult to control using conventional chemicals.

By using the STEP System, farmers can eventually rationalize the use of chemical fertilisers as their soils regain productivity and even reduce the quantity and cost of seeds.

The beneficial microbes used in the STEP System improve agglomeration of soil particles; thereby soil structure and moisture holding capacity is improved, which in turn increases root development substantially. This improves drought

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tolerance and reduces risks to the farmer. In North India it was observed in April 2015 that the wheat crop that benefited from STEP Treatment was able to withstand unseasonal wind and rain much better than conventionally raised crops and produced much higher yields despite the adverse agroclimatic situation.

Significant increases in yields and quality are observed by farmers who have used the STEP System in India. These successes stretch from HLB affected citrus groves and disease affected chillies and capsicum fields to potatoes affected by virus and even wheat, rice, cotton and vegetables. Paddy farmers from Punjab who have used the STEP System are reporting yields (in October 2015) of 7.5 tons to over 10 tons per hectare against an average yield of 4 tons per hectare in the state.

Among the most remarkable observations is the near complete restoration of citrus groves severely affected by HLB within a year to unprecedented levels of productivity. When these groves are observed today, it is difficult to imagine that these were slated for uprooting and destruction a short time ago. Some farmers have increased their income between 3.5 to 16 times over one to two years. A quiet revolution is taking place in North India as farmers begin to take this up in one village after another, restoring the profitability from a crop that seemed destined for destruction by this disease which was hitherto considered incurable.

Some of the products incorporated in the STEP System have already been permitted for use in the US by the United States Department of Agriculture (USDA), the Centre for Disease Control (CDC) and the California Department for Pesticides Regulations (CDPR) as these products are basically used as soil amendments. These products have been field tested by US growers on many crops across the country with good results.

This could well be THE alternate approach and the answer to the conundrum of matching the demands and aspirations of a growing and more prosperous population to shrinking availability of land. A method that deserves a chance to be tested, experienced and used for the benefit of the entire world.

For this is a method that can bring countless millions of small farmers in the developing world

out of the depths of poverty and help them become a vital part of the global mainstream. More importantly, this is a system of farming which is in step with nature and therefore more sustainable.

Useful links and references

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<http://www.sequoiabio.com>

Mr. Uday Bhavanishankar Philar
Founder CEO
Sequoia Biosciences Pvt Ltd, Pune

Agriculture Productivity in India

Agriculture in India has taken great strides after Independence. We had a green revolution whereby we witnessed substantial improvement in productivity and after that the productivity levels have stagnated.

The share of agriculture, which was at one point in time constituted more than 50% of the GDP was down to less than 14%. The contribution of Agriculture to GDP will reduce in the coming years considering the fact that Services sector will grow at 10% p.a and Industry is also likely to catch up with the recent initiatives by government.

Compared to the above growth rates and the goals for future growth, we are aiming a growth rate of only 4% pa. in agriculture which is much below the growth targets for Industry and Services and also below the potential of agriculture growth.

Despite India emerging as one of the players in Agriculture in the global arena, the productivity of crops compared to the world best is half in some products and one third in few other products. There is also a significant variation in productivity of crops between states.

The following trends were observed in Agriculture production and productivity, which makes us consider various options for improvement in productivity in agriculture.

Average growth rate of Agriculture and allied sector in India Between 2005-06 to 2013-14 was the highest for MP followed by Puducherry and Jharkhand with a growth rate of 9.56%, 9.04% and 8.59%.

	2009-10	2010-11	2011-12	2012-13	2013-14(P)
MP	8.92	0.24	18.17	18.63	23.28
Puducherry	-16.55	25.62	-14.36	11.23	11.23
Jharkhand	-6.21	4.46	26.23	6.15	8.30

Average growth rate of Agriculture and allied sector in India Between 2005-06 to 2013-14 was the lowest for Chandigarh followed by Kerala and Goa with a growth rate of -3.87%, -0.52% and 0.15%.

	2009-10	2010-11	2011-12	2012-13	2013-14(P)
Chandigarh	-13.10	-6.94	-15.72	-8.76	-0.59
Kerala	-1.57	-6.37	-0.06	4.39	-
Goa	0.80	1.66	1.45	-4.53	-

There is a wide variation in Agriculture growth in various states and in state like Chandigarh, it was showing a constant decline.

Percentage share of Agriculture in India GDP (%) at constant (2004-05) Prices was as follows:

	1950-51	1990-91	2000-01	2004-05	2010-11	2011-12	2012-13
Share in GDP	41.8	24.9	24.0	16.0	12.4	12.3	11.8

Percentage Growth of GDP at constant (2004-05) prices for agriculture sector was as follows:

	1951-52	1990-91	2000-01	2004-05	2010-11	2011-12	2012-13
Growth %	1.6	4.3	-0.6	0.1	9.5	5.3	0.9

India's position in world agriculture in 2012:

India with a share of 2.4% of world's agricultural area ranks seventh after Australia. Russia is at top position. India's position in Wheat and paddy production is second after China whereas it ranks third in rapeseed production after Canada and China.

India is at second place after China in groundnut production. India's contribution in world Paddy production is at 21.38% compared to China's 27.90%. Yield of India is 3720.82 KG/ha while China has 6774.72 Kg/ha in paddy.

India's contribution in world wheat production is 14.13%, compared to China's 18.02%. Yield of India for wheat is 3177.49 kg/ha while China has 4986.74 kg/ha.

India ranks fourth in Maize production with a yield

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of 2555.68 kg/ha. While USA ranks first with a yield of 7743.90 kg/ha.

The reasons for Poor agriculture productivity are :

1. Large number of small farms with low productivity and high cost.
2. Poor farmer training / Low skilled farmers.
3. Poor Farm management practices.
4. Unremunerative prices to farmers.
5. Less importance given to agriculture compared to Industry and services.
6. APMC act.
7. Low technology adoption.
8. Poor water management.
9. Resistance to using genetically modified crops.
10. Poor post harvest infrastructure resulting in wastage.

There is a big scope for increasing the productivity of agriculture in India at farm level , post harvest and at the distribution stages. The following action plans could be taken up for achieving a higher level of productivity.

1. Growth target for agriculture. We have to set a stretch target of 6% growth for the entire country till we achieve the best productivity in the world in each crop. The targets at the national level should be broken down into targets for each state and district. Once the targets are set, detailed action plan in terms of what is to be done in each district should be outlined with clear milestones for each District Agriculture Officer.
2. The focus should be on crops and states where agriculture productivity is low and there is a need to set a positive growth target for each state and crop.
3. In Central and State budgets, there should be separate allocation in the annual budget for productivity improvement initiatives.
4. Best practice sharing. Within India itself, some of the states are well advanced in agriculture and they have better productivity and farm management practices compared to other states. The best practices should be documented , including the case studies of successful farming and these should be shared with all the District Agriculture officers. We can also learn from the best practices from other parts of the world.

5. Since the average size of the land holding is showing a declining trend, the economies of scale for farming is also showing an unfavourable trend and concepts like producer co-operatives modeled on the basis of Amul Experiment could be adopted across India. The concept of cooperative farming to achieve economies of scale could be adopted across the states. To start with, each milk co-operative in the state can also start a co-operative for farming ,where members who are engaged in farming can form part of this co-operative. By achieving economies of scale, the cost of production of crops would come down.

6. Skill Development mission has been created for many of the manufacturing industries. On the similar lines, a skills development mission for farming to impart the best training to farmers could be considered by the government.

7. The penetration of mobile has become all pervasive today and this medium could be used very effectively to communicate to farmers on the Market price of their produce which will help them to realize a better price. This process has to be facilitated by modifying the APMC act , enabling farmers to sell their produce to any buyer. When farmer realizes, better price, the need for input and output subsidy also will go down, which will help to reduce the subsidies incurred by the government . This will improve the balance sheet of both the state and Central governments.

8. Technology adoption. Since most of the farmers are marginal farmers, they are not able to adopt the latest technologies of farming. Once a cooperative model evolves, it would be easy to adopt better technologies for farm management.

9. Irrigation management. At each district level, they have to identify scope for building water resources, implementing participatory irrigation management and adoption of micro irrigation systems.

10. India has 13 mn ha of cultivable waste land. Action plans could be identified to expand the farming into these areas, this will help in increasing the production of crops.

11. Post harvest, lot of wastage is reported in India, which reduces the realization on sale of products. Now there are efforts to improve the post harvest supply chain including creation of cold chain across the country. A countrywide,

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state wise and district wise strategies to be developed for post harvest management of crops. The savings from post harvest management could be used for improving the productivity of farms.

12. The food processing industry in India is still in the take off stage and there is a big scope for improving the productivity through setting up food processing units linked to farms. Here private sector can play a major role.

13. Private sector also can play a major role in aggregation of farmers through contract farming as well as direct procurement of produce for retailing.

14. Government has to reallocate a part of the subsidy budget for farm productivity and bring in Systems, procedures and policies to improve the productivity . it has to play a catalytic role by giving equal emphasis on Agriculture and its

growth and use agriculture as one of the pillars of high GDP growth.

15. Already there are schemes for Agricultural credit and insurance and all these schemes could be reviewed to encourage and support higher level of agricultural productivity in the system.

By involving all the stakeholders and communicating to them the role , they can play in improving the agriculture productivity and facilitating the regulatory and policy measures, India should be able to achieve an annual growth of 6% in Agriculture, till it reaches optimum productivity levels. Through join efforts of all the stake holders, India will be able to achieve desired productivity.

R. Kannan
Hinduja Group

Enabling Quality Food for All

On the eve of inauguration of mega Agricultural exhibition i.e. KRISHI VASANT at Nagpur our Honorable President Shri Pranab Mukherjee delivered the inaugural speech. During his speech, he said that there are 2 major items that are responsible for draining out our valuable foreign exchange. These items are 2 F's. 1) Fertilizers & 2) Fuel. He also said that there were 3 F's which were draining away our foreign exchange while he was Finance Minister. The F's are 1) Food 2) Fertilizer& 3) Fuel. But the farmers of India have played a major role to stop the import of food thereby saving a major share of foreign exchange.

Problems: - 1) Our soils are being spoiled and fertility level is going down. 2) The water of the well we used for drinking about 10 years before has become unfit for drinking. 3) Air is polluted. 4) Food is not good for health as it should be. Therefore the diseases related to stomach are on rise day by day.

Reason:- These problems are because of unjust use of chemical fertilizers, pesticides and industrialization.

Solution:- If we make use of cow dung along with

farm waste & organic waste from the city and villages, crores & crores tones of good quality organic manure can be produced with very small capital within short span of time and that will not only save valuable foreign exchange but also improve the health of our nation by way of reduction of pollution of the soil, food & water by the fertilizers and give us healthy and nutrition's food, water and air.

We have forgotten some of the unequal, unparallel treasure of knowledge given to us by our Rishis - who were also social scientists.

I hereby want to mention a few points that can make us economically and physically strong and intelligent. If we carefully study the cow in right spirit of economic and science. Here, I want to concentrate only on the cows and buffaloes that are at present considered economically not viable.

1. Maintenance of cows that do not give milk is supposed to be non-economical but this is a misconception or we have been misguided.

2. A cow/bullock that is sold for Rs. 4000 - Rs. 5000 can yield manure as well as gomutra to the tune that if properly managed can give you a

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net profit of Rs. 1500 Per Month. I: e. Rs 18,000 per animal per year.

IS THERE ANY BUSINESS / INDUSTRY IN THE WORLD THAT GIVES YOU INCOME OF RS. 1500 PER MONTH BY INVESTING RS. 4500 ONLY ONE TIME and THERE IS NO LIMIT FOR ITS MULTIPLICATION.

3. Very good quality organic compost can be prepared from the cow dung, farm waste, dried leaves and any organic matter which will not only reduce the pollution but will produce the products that will again add to the greenery that further reduces pollution.

4. A lot of pharmaceutical, domestic & agro useful products can be prepared from cow dung & urine. E.g. Vermiwash, Amrutpani, Soap, Ayurvedic Medicines for health of crops, human beings, etc.

5. Things which are required for Vermi compost, if not used will otherwise pollute the environment. Environment will be polluted if things like dried leaves, garbage, useless parts of green vegetables, etc. are not used for making manure.

6. Vermi compost / organic manure not only eliminates the environmental pollution but also enhances the germination of seeds, plant growth, and crop yield which indirectly adds to the greenery and decrease the use of chemical fertilizers and reduce pollution.

7. Billions of rupees can be saved which are used for import and subsidy of chemical fertilizers. I am writing the things which are known by a common man. A lot of research has been done in this sector and a lot more is going on. If for these things the Environment lovers, Nation lovers comes together for discussion then definitely our INDIA will become SUJALAM, SUFALAM and HEALTHY.

8. Gobar Gas can be prepared from Cow dung and garbage which can be used for

- I. Cooking Food.
- II. Running Engines
- III. Many other uses.

9. The cow dung is used in the making of organic manure that stimulates the growth of flora and fauna that makes the soil more productive.

10. Plants, trees not only purify the environment, but also give oxygen and convert the

contaminated air to food, fruits, timber, wood, etc.

11. Increase in the use of organic manure and cow urine will promote not only organic farming but also generate more & more oxygen to make the atmosphere healthy.

12. While rearing the cow cost of maintenance is fully loaded on the milk. If it is divided in manure, urine and milk, dairy business shall be more and more profitable.

Old aged Parents are also disliked in the Economical age and if a cow is giving an economical support then think, understand and do the necessary action.

Economic Revolutionary Facts

1) According to the Google the number of cows in India on 2-4-2015 was 281 million that comes to 28.10 crore round off for calculation 28 crore.

2) Deshi cow gives 4 kg dung daily if sent for grazing and more if it is stall fed. A cow sent for grazing yields 4/5 Lits. Of Gomutra every day whereas the stall fed cow may yield more.

From the approx. 4 kg of cow dung plus 10 kg farm and or house and or village waste we can get 12 kgs of good quality organic manure within 40-45 days. This results in $12 \times 30 = 360$ kg. Good quality organic manure per cow per month. To the cow dung a kg or two may also be added as the earth is also food for earthworms. But for our purpose we take 12 kg of manure per day per cow i.e. per year $12 \times 30 \times 12 = 4320$ kg say 4000 kg = 4 tons per year.

3) Deshi cow yields 4 Lits. Of Gomutra and it can be preserved for one year under normal condition and can be used for spraying on crops. The rate of gomutra of deshi cow may be calculated @ Rs. 7/Lit. The yield of Gomutra will be $3 \text{ Lit} \times 30 \text{ days} = 90 \text{ Lit per month} = 90 \times 12 = 1080$ Lits. Per year.

4) Monthly expenses for a unit of 20 non milking deshi cows, that are sent for grazing is, Rs. 6000/- for the month for one labour + One part time labour for cleaning is Rs. 3000/- per month + Rs. 3000/- Misc. Expenses + Rs. 10,000/- on fodder per month + Rs. 2000/- on Shelter per month comes to = Rs. 24,000/- per month.

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Rs. 6,000/- Labour
 +Rs. 6,000/- Over heads
 (Part time Labour + Misc.)
 Rs. 10,000/- Fodder
 Rs. 2,000/- Shelter

Rs. 24,000/- Per month

5) Monthly income from a unit of 20 Cows comes to

This income does not include the income from milk plus the increase in the number of cattle, milk, vermiwash, etc.

Manure (1) 20 cows x 12kg/day x 30 days 20x12x30 day = 240x30	=	7200 kg.Org.Manure
(2) Cost of 7200 kg manure @ Rs. 5/- kg.	=	Rs. 36,000/-
(3) Cost of Urine Rs. 7/- per lit. 20 cows x 3 Lit. X 30 days 1800 Lit x @ 7/- per Ltr.	=	Rs. 12,600/-
(4) Sale of Earthworm 10 Kg @ Rs. 500/ Kg	=	Rs. 5000/-
(5) Total from Manure & Urine 36000 + 12600+5000	=	Rs. 53,600/- Per M.
(6) Less expenses	(-)	Rs. 24,000/- Per month
NET PROFIT		Rs. 29,600/- Per month
Say Rs.		Rs. 30,000/-
(7) Income per cow/month 30000 ÷ 20		Rs. 1500/- Per Month per Cow

If you prepare products like AmrutPani Dhoop, (Kamdheni Ark), Ghanjeewamrut, Mosquito Coil, Medicines, Soap, Panchgavya and various products developed by Govigyan Anusandhan Kendra Deolapar there will be no limit and people are there who are earning more than Rs. 10,000/- per month.

(a) Our import of chemical fertilizers is about 3 lakh crore per year and the result is (1) We have contaminated our Soil (2) we have contaminated the water from well as well as rivers making it unfit for direct drinking. Is not the use of fertilizers over years responsible for this?

The solution is

1) Increase the production of organic manure substantially and reduce the import of fertilizer drastically. 2) Awareness of the importance of organic manure.

The dry cows are available on

- (1) Open market
- (2) From the farmers
- (3) From various Gorakshans. Some Gorakshan offer free.

There are number of schemes for cows/cattle by the State Govt. as well as Central Govt. You can avail the facilities and benefits from the same.

With the introduction of ban on cow slaughter the responsibility of all Indians has increased because if the cows are not properly maintained it will again become a subject of mockery. So before it becomes a subject of mockery we should understand the economic importance, the miraculous importance of cow but we should be fast **Action should initiate here and now.** Otherwise you may get involved in some of your personal problems and forget about this.

Our area that could be brought under cultivation during 2013-14 was app. 112.9 million hectares which for practical purpose taken as 11.29 crore hectors 11.29 x 2.5 (Approx. 30 crore acres).

If one cow can yield 4000 kg good quality organic manure per year from the cow dung of 28 crore cows + Organic farm waste we can prepare 4 tonnes/year resulting in 28 crore x 4 = 112 crore tonnes of the quality organic manure i.e. every hectares can get 10 tonnes of organic manure/year which is sufficient dose.

Will you use Vanaspati Ghee in place of deshi ghee it Deshi Ghee is available in plenty?

With the application of 10 tonnes of the best quality organic manure per hectares per year. We will –

- (1) Improve health of our soil which has become sick with the use of chemical fertilizers.
- (2) Our water especially well water will not be polluted with nitrates and other chemicals that percolate through soil to make water unfit for drinking. If there are no pollutants in soil, the quality of water shall be improved.

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(3) Crores & crores of rural youth shall get direct as well as indirect employment checking the exudes to cities.

(4) If the maintenance of cow becomes profitable, the yield of milk shall increase many-fold because the dry cows also give milk in due course of time and produce better quality female calf that will give higher quantity of milk.

(5) Organic waste from farms, city, home, Institutions is the major cause of pollution. This waste can be converted into good quality organic manure resulting in “the things which are responsible to pollution and creating favourable atmosphere for mosquitoes and other insect shall be converted into the products; because of which if added to plants will yield greenery that controls pollution. Spreading of greenery shall not only provide clean air but good quality poison free grains, vegetables, fruits which are good for health”.

With reduction in Imports drastically and export of Organic food substantially our balance of trade will be favourable which is at present negative converting our nation in to economically powerful country. This situation will lead to lesser demand for dollar and the cost of Rupee shall be improved. With the improvement in quality of food, air water and more & more use of cow milk we shall not only be healthy physically but also be a better knowledge power of the world.

Organic food will improve the disease resistance power of our family and friends. Organic food will help to have more white cells in human body. White cells improve disease resistance.

Unemployment:

Better understanding of cows and the proper and better utilization of our natural resources will generate employment for every hand who wants to work and led healthy life.

We have the largest number of the most educated and intelligent youth of the world. They should think and find still better and innovative uses of the products and develop technologies for better use of cow urine, dung, milk and many more useful products & technologies.

What is development?

Is spoiling of soil, water food & health a development?

Why do young people leave their native place in search of jobs? Is this development?

Is the increase in the number of patients of Heart diseases? Cancer, kidney, lever patients a development?

Solution:

Better understanding of the cow will solve the above problems. How these problems can be solved in already mentioned in this article.

(1) Understanding the cow will lead to substantial production of Organic manure resulting in (1) Improvement in the health of the soil (2) Yielding better quality Food, Fruit & vegetables because of the use of organic manure and no use of chemicals (3) Better quality food, water and air will lead to the better health of our people, soil, cattle which is interdependent.

(2) Our young educated youth shall get employment in their village by production of organic manure, cow urine, milk, healthy food, grain, vegetables, fruits etc. So they get-employment in their village.

(3) Is giving unfair price to the farmers for his crop a development?

Words are useless without ACTION,

There is a lot of scope in this field. Wake-up! This one thing is for the cow/buffaloes that do not give milk. Think of the cow, buffalo, goat giving milk, bull working in the farm, cow dung, gomutra, natural waste like dried leaves, flowers from temple, garbage, neem, karanj, etc. can be used & 1) Agriculture production of the country can be increased to a great extent. 2) Pollution can decrease many fold. 3) Use of Natural food, vegetables helps us to stay healthy and can also increase the export and can lower the prices. 4) If import is reduced drastically and export increased, value of Rupee shall appreciate. 5) If the cost of maintenance of a cow is recovered from urine and organic manure, the cost loaded on milk shall be reduced and animal husbandry shall be profitable.

It is time for action!

Let us come forward and volunteer for the service of the cow. Let us devote with our body and soul. Whatever way we feel, we should save the cow, for our children, for humanity. The cow is not only the symbol of the divine gift of earth but its also

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beneficial for health and prosperity for all. Come, let's share it!

Come on and join hands to give scientific thoughts and we will together spread the importance of Indian cow and the gain from the cow. We invite your suggestion because there is

unlimited scope in the field of breeding, processing of milk, ghee, etc.

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Agricultural Development and its Implications for Food Security and Farmer Welfare: Lesson Learned from Indonesia

Introduction

Indonesian current population reached up to 255.46 million in 2015, and is predicted to rise to around 285 million by 2030. Population growth cannot be avoided and will influence the higher need of food demand. Therefore, domestic agricultural production for food security and farmer welfare are economically and politically important in Indonesia. Agriculture in Indonesia acted as a buffer sector, being able to absorb the workforce laid off in other sectors. It contributes 14.4% of GDP and absorbed approximately 38.07 million new workers in 2013.

Indonesia has also improved food security significantly since the early 2000. However, those achievements have not been able to solve more fundamental problems at both consumers and producers level, especially at the farmers level. Recent food price volatility has shown that the fundamental of food economy are still vulnerable. In addition, efforts to increase farmers' productivity and welfare will be certainly difficult. Therefore, food security and farmers' welfare are the keywords in agricultural development.

The government has done much to build agricultural sector. However, its fact is still lacking and needs to be improved again. Therefore, as a pivotal component of Nine Priority Agenda (Nawa Cita) for Indonesia 2015-2019 agriculture has been a priority sector to achieve rice-self-sufficiency and to improve farmers' welfare. The Government of Indonesia (GOI) has identified rice, corn and soybean as priority crops for self-sufficiency within the next three years, with rice self-sufficiency as the top objective.

This paper describes policy direction and its implications for food security and farmers' welfare. Applying this, the paper focuses on performance of agricultural development, which will be started by having a good grip of some issues and challenges in facing food security.

Issues and Challenges

The challenges that Indonesian agriculture is facing over the coming decades are complex. Main issues and challenges of agricultural development in the future include:

1. Global climate change that will reduce the capacity of agricultural production at national and global level so that it becomes a threat to food security, energy security and water security;
2. Increasing scarcity of availability and competition for land and water use will lead to difficulties in extending the land and water for agriculture which will further encourage the emergence of land and water grabbing on global order;
3. Population growth and urbanization will increase the demand for food, water and energy so that the pressure in the realization of food security, water and energy more weight;
4. Innovation of science and technology is increasingly complex and exclusive ownership so that the independence of science and technology become a prerequisite for realizing agricultural food security and farmer welfare;
5. Industry and trade facilities and global agricultural produce increasingly dominated by a few multinational companies thus threatening the existence of small-scale agricultural enterprises are still dominant in Indonesia;

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6. Increased demand for assurance and quality attributes of the product complexity has led to the development of the value chain (global) transparent and traceable (traceable) as an imperative requirement of market access for farmers (small); and

7. Demands of government decentralization, community participation and governance reforms the government can impede agricultural development if not managed properly.

Besides utilizing the internal strength such as abundant natural and human resources, the ability to make external challenges into opportunities is the key to the success of agricultural development in Indonesia in the future. These opportunities include:

1. The use of human resource of such a large and still growing, particularly the demographic dividend, as the basis of competitive advantage Indonesian agriculture, including the implementation of the processes driving production (human resources) and value chain development (social capital typical of Indonesia);

2. The use of the comparative advantages of Indonesia as a tropical country and maritime, which naturally is the region with the highest effectiveness and productivity in harvesting and transformation of solar energy into biomass feedstock bioindustry, became the basis of a competitive advantage in the bioeconomy;

3. Utilization of an increase in demand for food, feed, bioenergy and bioproduct environmentally friendly by developing bioindustry that produce these products are complementary;

4. Utilization of the new tendency rewards for environmental services and amenities services as an opportunity to develop agro-ecological agriculture;

5. Utilization global advancement of science and technology for the development of agriculture and bioindustry innovation through the development of site-specific system of innovation with a capital base of research institutes and universities that are widespread throughout Indonesia;

6. The use wisely the potential of land and water resources that are still available is quite large in Indonesia, especially in the outer islands; and

7. Exploiting the momentum of the decentralization of government, public participation and governance reform for the development of the political system of

agriculture-driven and oriented to small farmers.

The Policy to Achieve Food Security and Farmer Welfare

The concept of food security is multidimensional, encompassing food availability, affordability, adequacy, safety and quality. In this context, farmers, the majority of the population, serve an important role in national life as the backbone of food security. Increased production and farmers' income will determine the sustainability of food security. This is clearly stated in the policy direction and strategy is summarized in Table below.

Table. Policy strategy and agricultural development program plans 2015-2019

Item	Remark
Public policies	(1) Improving rice self sufficiency and increasing corn, soybean, sugar, meat, chili, and shallot productions; (2) Developing competitive, export, and import substitution products as well as bioindustry raw materials; (3) Strengthening the institutional seed/seedling, farmer, technology, extension, quarantine, and food security systems; (4) Developing the agricultural cluster area; (5) Focusing on strategic commodities; (6) Developing facilities, infrastructures, and rural agro-industry as the basis of sustainable bioindustry development; and (7) Implementing good governance and bureaucratic reform.
Technical and operational policies	(1) Climate change adaptation and mitigation, post-natural disaster management, and plant protection; (2) Agricultural multi-product re-orientation; (3) Subsidy and agricultural credit financing application and management; (4) Thematic program management supporting agricultural development; and (5) Biodiversity utilization and management.

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Item	Remark
Policy strategies	(1) Increasing the availability and land use; (2) Improving agricultural facilities and infrastructures; (3) Developing and expanding seed/seedling logistics; (4) Strengthening institutional farmers; (5) Developing and strengthening the agricultural financing; (6) Developing and strengthening bioindustry and bioenergy; (7) Strengthening the agricultural product market networks; (8) Strengthening the capacity building of agricultural human resource; (9) Improving support to innovation, technology, and quarantine; (10) Providing information services; (11) Administering the regulation; (12) Using the information and communication technologies; (13) Organizing the plan; (14) Structuring and strengthening the organization; and (15) Managing the control system.
Development programs	(1) Increase production, productivity, and quality of food crops; (2) Increase production, productivity, and quality of environmentally friendly horticulture; (3) Increased production and productivity of sustainable estate crops; (4) Accomplish food-based animal and smallholder livestock agribusiness; (5) Improved value-added, competitiveness, quality, marketing product, and agricultural investment; (6) Provide agricultural facility and infrastructure developments; (7) Generate sustainable agricultural-based bioindustry technology and innovation; (8) Improve agricultural extension, education, and training; (9) Increase diversification and community food security; (10) Improve quality of agricultural quarantine and biosecurity supervision; (11) Monitor and improve agricultural government apparatus accountability; and (12) Support management and implementation of other related technical tasks.

Source: Strategic Plan of Indonesian Ministry of Agriculture of 2015-2019

Agricultural Development Performance

The “Kabinet Kerja” of the President Joko Widodo, during October 2014 - September 2015 has resulted a good performance in the agricultural sector for food security and farmer welfare, namely:

1. Food production

Since October 2014, the focus of government to achieve food security by developing strategic

food are: rice, corn, soy, chilli, onion, beef and sugarcane. Data Forecast (ARAM-II) BPS indicates paddy production in 2015 amounted to 74.99 million tonnes of paddy, up 4.15 million tons (5.85%) in 2014. Production of maize is 19.83 million tons of dry seed, up 0.82 million tons (4.34%) and soybeans 982.97 thousand tons of dry beans, up 27.97 thousand tons of dry beans (2.93%).

Increased production of paddy rice is the highest during the last ten years. This production increase comes from increased productivity of 52.9 ku/ha, up 1.54 ku/ha (3.0 %) and harvested area of 380.87 thousand hectares (2.76 %). Having realized increased production of 74.99 million tons of paddy, it has reduced a round of 7.3% of paddy to other uses and losses, thus earning 69.52 million tons of paddy that is ready to be processed into rice. Furthermore, using the conversion of grain rice to 62.74%, obtained rice production 43.61 million tons, up 2.41 million tonnes (5.8%) in 2014. By using a standard consumption of 124.89 kg per capita per year and total Indonesia population in 2015 is about 255.46 million, so rice balance sheet showed a surplus of 10.25 million tons of net to meet the needs of the household from 31.90 million tons, the use of non food 1.45 million tons or the total requirement 33.35 million tons.

High corn production happens because the productivity of 51.39 ku/ha, an increase of 1.85 ku/ha (3.6%) and, harvested area increased by 22.61 thousand ha (0.59%), compared to 2014. Corn balance sheet showed a surplus of 930 thousand tons of net to meet the needs of the animal feed industry from 8.25 million tons, the local animal feed 6.34 million tons, 3.92 million tons of food industry, household 0.39 million tons, seeds and others.

Soybean production increased from contributing to the productivity of 14.92 ku/ha, up 0.22 ku/ha (1.42%) and harvested area increased by 9.16 thousand ha (1.49%) compared to 2014. The production increased by 2.93% higher than the average of the last five years. In line with the increase in population and the needs of industry, the 2015 soybean production has not been able to

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meet domestic needs (deficit of 1.55 million tons), so it remains to be imported from abroad.

Sugarcane production in 2015 is estimated to be 2.72 million tons, an increase of 3.65% compared to previous year's 2.63 million tons. While the need for sugar for direct consumption, domestic industry and the specific needs of 2.82 million tons of sugar, which means balance deficit of 100 thousand tons.

Production of beef carcass cattle/buffaloes in 2015 is estimated 409 thousand tons increased by 5.23% compared to 2014. This production has not been able to meet the needs of 454 thousand tons of meat consumption, so the balance was a deficit of beef 45 thousand tons.

Vegetables production fluctuates, for red chilli estimated 2.01 million tons, or increase by 7.41% compared to 2014, while consumption of chilli 1.96 million tonnes, which means a surplus balance of 52.2 thousand tons of chilli. With this condition imported chilli can be controlled. Furthermore, shallot production 1.26 million tons, up 2.51%. While domestic consumption needs 947 thousand tons, which means the availability of a surplus of 313 thousand tons so the part of its surplus was exported abroad (1,500 tons).

2. Farmer's exchange rate

Farmer's exchange rate (NTP) is one indicator of the ability to see purchasing power of farmers in rural areas. It also shows the exchange of agricultural products with other goods and services. If the exchange rate higher, the consumption and farmer's purchasing powers is also higher. An improvement in farmers' income occurred based on the farmer's exchange rate; from 101.24 percent in September 2013 to 101.86 percent in March 2014. In October 2015, NTP reached 102.46 percent or increased 0.13 percent over the previous month (102.33 percent). BPS records also some increases of NTP in agricultural subsectors during September-October 2015, such as paddy 122.82 to 124.28 percent (increase of 1.99%), food crops from 125.763 to 127.21 percent, up to 1.99%, horticulture (101.80 to 101.96

percent), smallholder tree crops (96.26 to 96.39 percent).

3. Regulations on Imports

Indonesian regulations only permit The Indonesian National Logistics Agency (BULOG) to import rice. Control policies on imports and encourage exports in 2015 have shown results. In 2014 there were imports of rice of medium quality. Since January 2015 there are no imported rice has been made therefore saving USD 374 million of foreign exchange. Maize production in 2015 rose 8.72% followed by an increase in corn exports, and it has gain USD 102 million in foreign exchange and on the other side-imported corn has been controlled, thus saving USD 483 million in foreign exchange.

Control on imported commodities such as chilli, shallot and white sugar and export of mung bean from Gresik and Shallot from Bima, and hatching



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eggs has been increasing Indonesian foreign exchange. By controlling the imported products and increasing food export from January to August 2015, the country can save up to USD 4.03 billion or about IDR 52 trillion (exchange rate USD 1 = IDR 13,000). In addition, these policies have a positive impact on domestic price stability and contribute nearly IDR 215 trillion, consisting a gain surplus of IDR 74 trillion for farmers and IDR 141 trillion for traders.

4. Agricultural modernization

Agriculture Modernization through mechanization is an effective solution to replace traditional farming and to overcome the labor scarcity. Agriculture Mechanization has long been done, but with limited quantities. In 2014 can provide only less than 10,000 unit agricultural



machineries. In 2015 the government of Indonesia has conducted a large-scale of agriculture mechanization include: Rice Transplanter, Combine Harvester, Dryer, Power Thresher, Corn Sheller and Rice Milling Unit (RMU), tractors and water pumps. The government of Indonesia in 2015 has distributed 26,100 unit of tractors and 2,790 unit of combine harvester for all farmer group associations in the country. The use of that mechanization saves the cost of production mechanization $\pm$ 30% and 10% decrease crop losses.

Strategic Plan for Agricultural Development

Indonesia's commitment in agricultural development is focused on the achievement of food security and the increase of farmers' welfare. The strategy to be achieved in the period of 2015-

2019 are as follow: (1) land optimisation of one-million-hectare paddy fields; (2) Infrastructure rehabilitation for 3-million-hectare irrigation; (3) fertility restoration of agricultural land; (4) land conversion management; (5) development of post-harvest facilities and agricultural commodity barn; (6) food import management; (7) development of one million of Seed-Sovereign Village Program; (8) development of one thousand of Food Organic Piloting Village Program; (9) Increase in Land Access for smallholder from 0,3 hectares to 2 hectares every household; and (10) development of bank of agriculture and small and medium enterprises.

Closing

Food Security and farmers' welfare are the keywords in agricultural development. Increased production and farmers' income are an important role in increasing farmers' welfare. We are all aware that it is not an easy task to achieve the above targets, however, based on the agricultural development performance in 2015, we are optimistic that we will get the targets achieved if all stakeholders can work together to overcome various major obstructing problems and constraints and provide encouragement that is believed to be a key to the success of agricultural development in Indonesia in the future.

Ministry of Agriculture of the Republic of Indonesia

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Enhancing Farmers' Access to Sustainable Intensification Technologies in India: CSISA's Approach to Scaling Zero-Tillage Wheat in Bihar

Overview of CSISA

In recent years, gains in cereal productivity in South Asia have slowed markedly and, simultaneously, issues of resource degradation, declining labor availability, and climate variability pose steep challenges for achieving sustainably intensified cereal-based systems that meet the dual goals of improving food security and rural livelihoods. To address these challenges, the Cereal Systems Initiative for South Asia (CSISA; <http://csisa.org>) was established in 2009 to pursue an interlinked set of research and innovation system interventions to catalyze durable change at scale in South Asia's cereal systems through accelerated adoption of sustainable intensification (SI) technologies.

Operating in rural innovation hubs in Bangladesh, India, and Nepal, CSISA involves partnerships with the public, civil society and private sectors to pursue the following goals: (1) Promote resource-conserving practices, technologies and services that increase cereal yields with less water, labor and input costs; (2) develop and disseminate high yielding, stress-tolerant cereal varieties to withstand the impacts of climatic change in South Asia; (3) impart new knowledge on crop management practices, livestock feeding and aquaculture management from future-oriented research; (4) improve access to market information and enterprise development; (5) strengthen policy analysis to remove constraints to the adoption of new technologies; and (6) build strategic partnerships and capacity to help sustain and enhance the scale of benefits of improved cereal growth.

CSISA is jointly implemented by the International Maize and Wheat Improvement Center (CIMMYT), the International Rice Research Institute (IRRI), the International Food Policy Research Institute (IFPRI), the International Livestock Research Institute (ILRI), and WorldFish, in close partnership with public and private sector organizations across South Asia. CSISA is funded by the United States Agency for International Development (USAID) and the Bill & Melinda Gates

Foundation. CSISA has been approved to continue its work until 2020.

Problem background

Enhancing the productivity of the rice-wheat cropping systems in the Indo-Gangetic Plains (IGP) is of primary importance for ensuring food security for more than 20% of the global population (Erenstein et al. 2008; Chauhan et al. 2012). The Eastern Indian state of Bihar is a net importer of wheat with 868,000 MT purchased against a base production of just over 5 million MT in 2010-11 (Paulsen et al. 2012). With an average of 2.14 MT ha⁻¹ over the five-year period 2008/09 - 2012/13 (MoA 2013), Bihar has the lowest wheat yields in the IGP. Coupled with the highest population growth rate in India (MoHA 2013) and increasing per-capita wheat consumption (Paulsen et al. 2012), the gap between consumption and production is poised to widen in this densely populated state of 104 million people (MoA 2013) without concerted efforts to enhance agricultural productivity. Furthermore, the regions that currently supply wheat to Bihar, such as the Northwestern state of Punjab where wheat yields averaged 4.59 MT ha⁻¹ over the same five-year period (MoA 2013), have comparatively little scope for further boosting yields (Aggarwal et al. 2004).

Exacerbating this scenario, there are strong imperatives in Northwestern India to reduce water resource utilization in agriculture to arrest the dramatic declines in groundwater levels that are undermining the sustainability and environmental footprint of production (Humphreys et al. 2010). In recognition of the pervasive yield gaps that characterize the Eastern IGP along with a wealth of under-developed water resources (Aggarwal et al. 2004; DoA 2008), Indian policy makers have turned their attention to meeting both state-level and national foods needs through intensification in the East through programs such as 'Bringing the Green Revolution to Eastern India' (BGREI; <http://bgrei-rkvy.nic.in>). Nevertheless, a variety of factors contribute to the currently low yields in the East, and identifying technical entry points and

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strengthened support systems for innovation that will contribute to agricultural intensification in a manner that is environmentally sustainable, socio-economically tenable, and – just as importantly – broadly scalable among smallholders presents a formidable challenge.

Zero-tillage – one of CSISA's cornerstone technologies

Across the IGP, the combination of zero tillage (ZT) and residue retention ('conservation agriculture') has been found to have considerable agronomic and economic benefits, while improving the environmental footprint of agriculture by reducing energy costs and improving soil and water quality (Mehla et al. 2000; Erenstein and Laxmi 2008; Chauhan et al. 2012; Gathala et al. 2013). ZT is mostly used in wheat in the winter (rabi) season; agronomic factors leading to productivity advantages are related to (i) time-savings in crop establishment, allowing earlier sowing and, hence, reducing risks of terminal heat stress during the grain-filling phase; (ii) reduced population of weeds (iii) better nutrient management; and (iv) water savings. The prevailing ZT practice uses a ZT drill attached to a four-wheel tractor to sow wheat directly into unplowed fields with a single pass. ZT wheat is one of the cornerstone technologies supported by CSISA.

To assess the performance of the technology in farmers' fields, data were collected in a random sample of 1,000 farm households comprising ZT users and non-users spread across 40 randomly selected villages in six districts of Bihar. Based on the survey, a yield increase of 498 kg ha⁻¹ (19%) was estimated for ZT wheat as compared to conventional-tillage wheat, and a total economic gain from yield increase and cost savings of INR ¹ 7,334 ha⁻¹, constituting a 6% increase in total annual income for the average wheat farming household (Keil et al. 2015). If, for illustrative purposes, one assumed full ZT wheat adoption in Bihar with its current wheat production of approximately 5 million MT (Paulsen et al. 2012), a 19% yield increase would translate into a production increase of 950,000 MT, exceeding total wheat imports into Bihar, which were 868,000 MT in 2010/11 (ibid.). These results suggest that broad-scale adoption of ZT technology could play a major role in making Bihar self-sufficient in wheat.

CSISA's approach to enhancing farmers' access to zero-tillage technology

Tractor ownership in Bihar is confined to relatively wealthy farmers, constituting less than 10% of farm households. Since tractor and drill ownership is no tenable goal for most capital-constrained small and medium-sized farmers, their access to the economically beneficial and resource conserving ZT technology hinges on securing affordable access to custom hire of ZT services. To increase the number of ZT beneficiaries in Bihar and other parts of the densely populated Eastern IGP, an expansion of the network of ZT service providers (SPs) is therefore required. Fostering the use of ZT through private-sector SPs has been one of CSISA's core activities since 2009.

These SPs serve as 'Change Agents' by informing fellow farmers about ZT and its benefits and offering respective services, which enhance farm productivity and income on the side of the clients and, at the same time, can constitute an attractive income source for the SPs. CSISA's activities include awareness raising campaigns (regarding the benefits of ZT and other SI technologies, as well as mechanized services provision as a novel business opportunity), identifying potential SPs, facilitating their interaction with the Department of Agriculture (DoA) to enable business development aligned with DoA priority setting, facilitating the purchase of ZT drills, and providing training and backstopping on the proper use of the machines and best agronomic practices in general.

In 2010, the first full year of CSISA, a total of 17 ZT SPs were documented in Bihar and Eastern Uttar Pradesh (EUP). In 2013-14 alone, the project supported the emergence of 421 additional ZT SPs. By the rabi season 2014/15, 1,624 active ZT SPs were documented by CSISA. Across Bihar and EUP, over 50,000 hectares of ZT wheat were sown by CSISA-supported service providers in 2014-15, reflecting an area increase of 42% over 2012-13. A census survey conducted among ZT SPs in Bihar in 2013 indicates that, while the average number of farmers serviced remained quite stable at around 20 per SP, the average area serviced per SP increased substantially from 32.1 acres in 2010 to 81.3 acres in 2011 and 124.0 acres in 2012.

Generally, ZT SPs differ substantially with respect to their business ambitions; the area serviced by individual SPs ranges from a few acres to more

¹ Indian Rupees. 1 USD = 66.5 INR (Sept. 2013).

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than 400 acres per rabi season. The average gross margin of ZT service provision amounts to 209 INR per acre. A profitability analysis that accounts for fixed costs related to the depreciation of the equipment used reveals substantial economies of scale. When comparing different groups of ZT SPs based on the acreage serviced, the top quartile (servicing > 100 acres and focusing especially on relatively large client farmers) earned a net profit of 85,400 INR from service provision in the 2012/13 rabi season, whereas it amounted to only 4,400 INR among the third quartile (servicing >50 to 100 acres); net profit was virtually zero among the two lower quartiles servicing less than 50 acres. It has to be acknowledged that smaller-scale SPs may not view service provision as a major business opportunity, but may merely want to offset part of the investment costs incurred for using ZT on their own farm; for these SPs a positive gross margin may be a sufficient condition for catering to a few clients. Social obligations and the prestige associated with the provision of innovative services in one's own village may be other motives for small-scale ZT service provision. Under the current 50% subsidy policy for ZT drills, at least 44 acres need to be serviced per rabi season to make ZT service provision in wheat a profitable business. In a zero-subsidy scenario, the break-even area would double to 88 acres. Hence, supporting the emergence of relatively large-scale ZT SPs is one of the primary objectives of CSISA, since (1) they will provide more farmers access to the ZT technology and (2), due to economies of scale, they are more likely to continue the business, even under less favorable policies. Socioeconomic research under CSISA has shown that it is the 'small among the large' tractor owning farm households and those with a relatively low own-farm productivity who are most likely to provide ZT services at a sizeable scale. This is plausible as comparatively low returns from agriculture reduce the opportunity costs of engaging in service provision, thus making it a relatively more attractive additional income source.

Conclusions and recommendations

To expand the network of ZT SPs and, hence, the number of farmers benefiting from the technology, CSISA will continue to conduct awareness raising and technical training activities with respect to ZT service provision, which will be targeted at the scarce tractor owners in general. However, fostering the emergence of relatively

large-scale ZT SPs will also require more comprehensive business development training interventions; these will be targeted at the 'small among the large' farmers since these are the most likely to expand their businesses to a sizeable scale. Furthermore, business models will be developed that include demand aggregation and service coordination to reduce transaction costs of service provision and, hence, facilitate the growth of service provision businesses and socially inclusive access to such services also by small farmers.

In the remaining five years of CSISA, the project will emphasize the streamlining of the scaling process with national partners to ensure long-term sustainability beyond the project's life. Furthermore, efforts will be made to foster a support network for spares and repairs for ZT drills and other machinery aimed at sustainable intensification of agriculture in the Eastern IGP.

CSISA's work provides strong evidence that ZT for wheat provides tangible and significant yield and economic benefits to adopters across a range of production ecologies and socio-economic settings in the Indian State of Bihar, while reducing environmental externalities commonly associated with extensive tillage. ZT technology could play a major role in making Bihar self-sufficient in wheat. Hence, BGREI and other development initiatives in the region should continue to provide an enabling environment for the accelerated spread of ZT as an important element of sustainable wheat intensification in Eastern India.

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Agri-Clinics: Micro-level Intervention for Sustainable Agriculture

Introduction

For the food of all and sustainable development we need to develop a true human being with knowledge keeping in view that the evils of caste, creed, and religion which has plagued the entire society. We have to teach the real karma, dharma and religion also along with sustainable knowledge.

1. Moral, social, cultural upliftment of the human beings can cure and eradicate many diseases.

2. Primary and youth education, family and

surrounding environment decides the faith and way of living of a human being and the progress of a nation.

3. Nature (Prakriti) and human beings are eternally same and are interdependent.

To begin with Programme planning and project, its success is in the essence that with what dedication you are using your intelligence and experience.

We need to go back to the basics; awareness, understanding and meditations. It is time mankind matures into being truly human. The maximum

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survival of the fittest is no longer valid and is not capable of meeting the evolving pluralistic, democratic aspirations of mankind today. We have no choice but to grow into realising what Jonas Salk said "Survival of the wisest".

Our duty at present is to go from village to village and make the people understand that mere sitting about idly won't do anymore. Make them understand their real condition and say, "Oye brothers and sisters, all arise, awake how much more longer would you remain asleep"..... also we have to teach and instruct them, in simple words about the necessities of life and in education, trade, commerce, agriculture etc. We should also educate the real culture and religion and the way to live and let others to live.

Every improvement in India requires first of all an upheaval in religion. The purpose of every religion is to eliminate the ego sense so that we can love the whole of humanity as we love our own family. Therefore, this clash, dissension and chaos in the name of religion are nothing but madness.

CHRIST said "Love thy neighbor as thyself". In the Hindu scripture it is said "See God in all beings and love them". Mohammed preached universal brotherhood. He said "You are all children of one parent and therefore must live with each other like brothers and sisters". These great teachers/saints taught us the same truth, but forgetting that, we have formed many distinctions and barriers amongst ourselves and have started hating each other. There is discord instead of unity and hate instead of love.

Therefore, the time has come to develop and deploy an army of technically qualified extension workers with human mindset. Therefore, let us work for that knowledge which will bring the feeling of sameness towards all mankind which will lead us to a real progress and prosperity.

Agri-Clinics & Agri-Business

We have conducted our Agri-Clinics & Agri-Business Training Programme (ACABC) with missionary zeal and have tried to develop trained entrepreneur/extension workers who can transfer the sustainable technology and knowledge with human mindset.

We have around 6000 Blocks in the country and a vast potential of unemployed Agriculture

Graduates and skilled, dedicated and systematic application of their potentiality and services can address all the issues including the present scenario of global warming and climate change, and its impacts on Agriculture.

In the present farmer, farming and agriculture scenario, if we are able to provide all the infrastructure facilities and inputs from soil, water, quality testing to quality produce and value addition, post harvest Management technologies, and application of marketing network through farmer-centered, participatory approach and application of information technology, we can bring evergreen revolution in all the fields of intensive agriculture from micro-level in the years to come.

In the past three decades. One third of the planet's natural wealth has been consumed. As India tries to accelerate its economic growth. It becomes even more important to understand how this growth will impact the human and physical environment. Sustainable development can be achieved only when economic growth benefits the poor and underprivileged who live on the fringes of society. A majority of these poor are in rural India. Sustainable development also similarly requires continuous replenishment and enrichment of environmental capital, which is getting alarmingly eroded today.

Today, the whole world is trying to address the critical issue of sustainability. All organs of society therefore need to work together in mutual partnership in a collective endeavor to achieve economic growth along with social development and environmental enrichment. Development of technologically expert agricultural extension system with a mandate and mission is the need of the hour. The corporate sector has special responsibility to contribute this larger mission while achieving its business objectives. The Indian corporate sector, while generating economic surplus, needs to sharpen its focus on replenishing natural capital and on eliminating poverty, participation and linking of private extension system and its services with corporate sector and financial institution will generate all the infra-structural facilities and inputs from soil water and input quality testing lab to quality produce, post harvest management technologies and marketing network through farmer centered, participatory sustainable development approach and application of information technology.

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To feed India's burgeoning population and effectively ensure long-term food and nutritional security, new policy initiatives are a must. India is challenged by declining per capita availability of arable land, low productivity levels, heavy production losses due to biotic (insects, pests, weeds etc) and abiotic (salinity drought, flood etc) causes, heavy crop losses during storage, absence of profitable & ensured marketing infra-structural system and facilities from micro-level and transportation and declining availability of water as an agricultural input. The way out of this dilemma is technology and development of systematic infra-structural facilities.

Business houses and corporate sector (coming in a big way in the field of agriculture) are and will be in need of quality produce with quantity and their requirement (which will increase and multiply in many-many folds) is presently compensated by many middle men whom they also pay commission and the negative points is that these middle men are not technically qualified and there is always a hidden risk of quality produces. An added advantage with technically expert Agripreneurs to them are that they will be able to plan their future marketing strategies with quality and quantity in domestic as well as in international markets.

Most of the agri-business suffered from the non-availability of quality raw material at acceptable price. Indian agriculture is characterized by the preponderance of small and medium sized land holdings, which are not cost effective to serve the industries requirements. This scheme can fill this gap of scarcity and can become the market hub and the tool of development to balanced nature and remarkable example of private-public partnership from micro level, which will ultimately open many gates of social, economic and cultural activities in the country.

After quality training and entrepreneurial skill development, Agri-Clinics & Agri- Business Centers are established at Nyay-Panchayat level. Keeping in view that all the services required to farmers for sustainable development of Agriculture by adopting ecologically friendly measures from soil test to post -harvest management including value addition are available at their door-step.

Projects are established in phases:

1st Phase with the dealership of inputs-seeds, fertilizers, pesticides (bio-control agents)

SERVICES:

a. Awareness towards latest emerging technologies and field practices through contacts, meetings/kishan gosthies etc.

b. Extension and supervisory services as per need of the soil, irrigation facilities and climate.

c. Awareness towards the impacts of climatic changes, Soil health care, Water harvesting, conservation and management, Integrated nutrient and pest management, Energy conservation and management, Post harvest technology and management, Integrated Crop/livestock systems with value addition, Need of the information management and network systems.

d. To provide appropriate quantity and quality inputs as per need of the soil, irrigation facilities etc.

e. To provide extension supervision and monitoring services throughout the crop/plant period.

2nd Phase: After the success of 1st phase they will go for the 2nd Phase with value addition, animal husbandry and other allied agri-industrial (including storage, cool chain etc.) Because continuous quality extension and consultancy services with quality inputs as per need of the crops and animal husbandry with production technology and management of the 1st Phase will establish the credit of ACABC in their area of operation and thus the failure for 2nd Phase project becomes negligible.

Continuous capacity building, reorientation and retraining towards weaknesses, monitoring and supervision is additionally provided to ACABC to achieve result oriented viability by the organization, but not up to our satisfactory limits of its requirements as these areas lack optimum funding.

Hand holding facilities:-

We have permanent monitoring, supervision cell.

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Experts have also been engaged on contract basis to facilitate agri-preneurs queries if there are any. Continuous monitoring, supervision, capacity building, reorientation and retaining towards weaknesses are additionally provided to ACABC to achieve result oriented viability by the organization.

Agri-Clinics and Agri- Business entrepreneurs associations have been formed in the year 2004. Six Monthly meetings of the trained agri-preneurs at the institute and Kisan Goshtis etc. at Agri-Clinics centers are continuous activities, for evaluation and awareness.

Now, we have started forming Agri-Clinic and Agri-Business sub-association committee at district level. Meetings are scheduled on first day of every month at Vikas Bhawan/Lead bank Office/Krishi Vigyan Kendra. Participants are LDM and Bank representatives; DAO-Krishi Vigyan Kendra and DDM of NABARD.

We have established 2500+ ACABC Centers covering every district in U.P. till date. Two months training is a continuous process. Every month around 25 new ACABC Centers are established. Organization's financial resources are limited and are not able to fully add the visions of sustainability.

Aim:

- 1- To create awareness and provide existing and latest technological development practices of sustainable agriculture practices and management through contact, meetings and visual aids etc.
- 2- To avoid middlemen and distress sale: - Development of ACABC center as a place of storage and market hub for the farmers produce and value addition etc.
- 3- To provide production strategies, consultancy and management technology based on the geographical and climatic conditions of the regions as per need of domestic and world market.
- 4- To develop ACABC as a place for dissemination of knowledge and social values.
- 5- As a place of credit facilities to farmers as per their need involving commercial and private banks. (ACABC should monitor and supervise the actual need of credit, use and recovery.

6- ACABC is an ideal place for Market Information Services.

We are of the considered view as per our experiences that the ACABC can become a model tool of sustainable development of agriculture and its market, and they must be provided supporting facilities and assistance in the interest of nation because no growth can be sustainable if it does not benefits the poor and underprivileged and also if it disrupts and destroys the basic ecosystem for the sale of short term gains.

But success not lies in the training and production of trained entrepreneurs, because it is the proper, smooth and systematic performance and establishment of ACABC which matters and to achieve greater success rate, many gaps and arms are still to be addressed to achieve the logical end in the interest of the country, which are as under according to our experiences.

Financial Assistance and Support: After all the quality training and efforts, the honest support and cooperation of the financial institution from top to micro level is more important for the success of any scheme in national interest. The attitude of financial institutions/commercial banks is not encouraging and the Bank Branch Manager knowingly creates many hindrances

Information Technology in Agricultural marketing:

Boosting agriculture and its allied activities with quality produce and value addition and it's national and international networking for the benefits of the farmers at micro-level institutional/organizational infrastructure should be developed/established to provide latest technological developments, advance weather information, need and requirements of the Agricultural commodities of domestic and global markets having different geographical situations. These institutional infrastructures should be developed or established at regional level based on the soil and climatic conditions of the region.

Internet facilities and linking of Agri-Clinics with such institutional arrangements and with AGMARKNET will help the Agri-Clinics and Agri-Business centers to plan and implement the Agricultural production strategies of the area by providing consultancy, inputs, production and post-harvest management technologies to

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farmers as per need of the domestic and world market based on agro-climatic conditions.

ACABC will nullify the role of middle men and will ensure that the quality produce, processed and value added products are profitably marketed (domestically and internationally) and if needed, scientifically stored and pledged for financing and marketing credit to avoid distress sale or to fetch good market price to provide small farmers the economic strength to retain the produce with themselves till the market prices are favorable.

Future Trading:

Needs for the prosperity of rural India:

- a. To eliminate the role of middle men and rural money-lender (Mahajan)-As explained above ACABC can act as a service provider for the viability of the credit made available by the commercial or private banks for the production, storage and marketing.
- b. Direct participation of farmers from micro-level in the Purchase and Sale of the commodities at every stage of the market.
- c. Participation and linking of ACABC and its services with domestic market, export houses and financial institution will generate all the infrastructure facilities including marketing network through farmers centered, participatory approach and application of information technology.

Therefore, all organs of society need to work together in mutual partnership in a collective endeavor to achieve economic growth along with social development and environmental enrichment. The Corporate sector has special responsibility to contribute to this larger mission as a humble service of the nature while achieving its business objectives. The Indian corporate sector while generating economic surplus needs to sharpen its focus on replenishing natural capital and on eliminating poverty.

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Post-harvest Management

Fruits – What Taste Good Should First Test Good!

In recent years, with growing technology, awareness with respect to food adulteration has largely amplified. The consumers now demand fruits which has reached a satisfactory state of ripeness and which exhibits the true organoleptic characteristics of the produce and of the variety concerned. Fruits being food that nourishes mankind of all age's intensifies its importance of being pure and safe.

Are those beautifully packed and fresh looking exotic fruits displayed on the stands in posh markets really healthy? Are those juicy looking red apples really naturally red or added colour enhances the looks?

In this fast moving business world many question like these arise in the minds of a common man. To understand if they are really healthy or not, fruits undergo a series of Qualitative and Quantitative analysis.

What taste good should first test good!

Before the sample is analysed, it undergoes a sequence of events also called as Chain of Custody

Chain of Custody

This fundamentally comprises of Sampling, Sampling Record, Packaging and Transportation of sample to the Lab.

In any scenario, to achieve a desirable final outcome, the first step being "right" is very important. So also is the case with analytical techniques, where sampling is the most crucial stage. Sampling being the backbone of every analytical technique, once the sampling is done in the right way, the following steps automatically fall in place.

A. Sampling

General guidelines for sampling fruit are submitting separate samples to the laboratory if you are dealing with: different fruits; different cultivars or varieties; areas of crop which have had different chemical treatments, or which have been sprayed on different days; produce sourced from different growers for repacking or processing need to be followed. As well as samples of perishable fresh produce, should be kept cool BUT

NOT FROZEN. Individual fruits and vegetables should not be cut or divided. Sampling of Fruits is done in two ways:

- Taking a sample of produce in the field.
- Taking a sample of harvested produce collected in packing store houses.

a) Taking a sample of produce in the field

Representative samples of the crop must be taken by a recognised procedure. Each plant or fruit should have an equal chance of being chosen. Even when using the best possible sampling techniques there will be variability between different samples.



- Sample the parts of the crop that normally constitute the marketable produce.
- Avoid taking diseased or under-sized crop parts or produce at a stage when it would not normally be harvested.
- Take samples in such a way as to be reasonably representative of typical harvesting practice.
- Take care not to remove surface residues during handling, packing or preparation.
- Sample and bag the required weight of samples in the field and do not sub-sample.
- Keep records of the samples taken and the method used.

The sampling procedure to be followed and the minimum amount to be sampled are given in Tables 1, 2 and 3

Circle each tree or bush and select fruit from all segments of the tree or plant, high and low, exposed and protected by foliage. For small fruits grown in a row, select fruit from both sides, but not within 1 metre of the end of the row.

Post-harvest Management



- Select the quantity of the fruit according to its density on the tree or plant, i.e. take more from the heavily laden parts.
- Take both large and small fruits where appropriate, but not so small or damaged that they cannot be sold.

Table 1: Sampling of fruits

Commodity	Quantity, method of collection
Citrus fruits e.g. orange, lemon, mandarin, pomelo, grapefruit	A total of 12 fruits from several places on 4 individual trees. If this produces a sample weight of less than 2 kg, more fruit should be taken to yield a 2 kg sample
Pome fruits e.g. apples, pears	
Large stone fruit e.g. apricots, peaches, plums	
Miscellaneous fruit e.g. avocados, guavas, litchi, mangoes, papayas, pomegranates, kiwifruit	
Small stone fruit e.g. cherries	A total of 1 kg from several places on 4 trees
Grapes	A total of 12 bunches, or parts of 12 bunches, from separate vines to give at least 1 kg
Currants, raspberries and other small berries	A total of 0.5 kg from 12 separate areas or bushes
Strawberries, Gooseberries	A total of 1 kg from 12 separate areas or bushes
Miscellaneous small fruits e.g. olives, dates, figs	A total of 1 kg from several places on 4 trees
Pineapples	A total of 12 fruits
Bananas	A total of 24 fruits. Take two fingers each from top, middle and lowest hand of four harvestable bunches
Tree nuts e.g. walnuts, chestnuts, almonds	A total of 1 kg
Coconut	A total of 12 nuts

<http://www.depi.vic.gov.au/agriculture-and-food/farm-management/chemical-use/publications/sampling-soil-vegetables-fruit-and-grain-for-residue-testing>

b) Taking a sample of harvested produce collected in packing store houses

All fruits sent for analysis are not necessary sampled directly at the farm. At times fruits are harvested at the farm and collected in packing store houses where they are sampled and sent for analysis. Each laboratory sample should be made up of several individual sub-samples. As far as possible, sub-samples should be taken randomly throughout the lot and should be of a similar size. For example: sub-samples would consist of a single fruit for larger items; a single bunch or bundle for grapes, etc. a single punnet or a small scoop of produce for small items (berries etc.). If produce has been packaged, sub-samples should be taken from more than one box in the lot.

The minimum number of sub-samples to be taken is given in Table 2. The minimum quantity that should be sent to the laboratory is given in Table 3. Ensure that the requirements in both Table 2 and Table 3 are met.

Table 2: Subsampling

Weight of lot (kg)	Minimum number of sub-samples
Less than 50	3
50 - 500	5
More than 500	10

<http://www.depi.vic.gov.au/agriculture-and-food/farm-management/chemical-use/publications/sampling-soil-vegetables-fruit-and-grain-for-residue-testing>

Table 3: Sample quantity required

Commodity	Examples	Minimum quantity required
Small or light products, unit weight up to about 25 g	Berries, peas, asparagus (if not bunched), olives	1 kg
Medium sized products, unit weight usually between 25 and 250 g	Apples, pears, citrus	1 kg (at least 10 units)
Large sized products, unit weight over 250g	Melons, grapes (bunches)	2 kg (at least 5 units)

<http://www.depi.vic.gov.au/agriculture-and-food/farm-management/chemical-use/publications/sampling-soil-vegetables-fruit-and-grain-for-residue-testing>

Examples

- 2 pallets of apples are to be sampled. They consist of identically marked boxes and are clearly all of the same variety. This is one lot. The total estimated weight of the lot is >500 kg. The minimum number of sub-samples required is 12. This is also the minimum number of units

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required for the laboratory sample. One apple should be taken from each of 12 separate boxes randomly over the two pallets. If 12 apples do not weigh more than 1 kg, take sufficient extra sub-samples to bring the final sample weight up to 1 kg.

- 8 pallets of grapes are to be sampled. 4 pallets consist of sultana grapes and 4 of purple grapes. These are two distinct lots. It is decided to only take samples from the purple grapes. The total estimated weight of the 4 pallets is >500 kg, so at least 10 samples must be taken. One bunch of grapes is taken from each of 10 randomly placed boxes throughout the 4 pallets. These combined give a weight greater than 2 kg, which is more than the minimum quantity required, so no more sub-samples need to be taken.

If replicate samples were required, they could be obtained by either repeating the above procedures for each replicate or by taking two sub-samples from each randomly selected box or placing them into separate sample bags.

B. Sampling record

The sampling officer must record the nature and origin of the lot; the owner, supplier or carrier of it; the date and place of sampling; and any other relevant information. Any departure from the recommended method of sampling must be recorded. A signed copy of the record must accompany each replicate laboratory sample and a copy should be retained by the sampling officer. A copy of the sampling record should be given to the owner of the lot, or a representative of the owner, whether or not they are to be provided with a laboratory sample.

C. Packaging and transmission of the laboratory sample

The laboratory sample must be placed in a clean, inert container which provides secure protection from contamination, damage and leakage. The container should be sealed, securely labelled and the sampling record must be attached, with no possibility of labels becoming separated from the sample or damaged by moisture. Where a bar code is utilised, it is recommended that alphanumeric information is also provided. The sample must be delivered to the laboratory as soon as practicable.

Spoilage in transit must be avoided, e.g. fresh samples should be kept cool and frozen samples must remain frozen and sent to the laboratory as soon as possible, taking any necessary precautions against leakage or spoilage.

• Method of packing:

(I) Fruits shall be packed in such a way as to protect the produce properly.

(ii) The materials used inside the package must be new, clean and of such a quality as to avoid causing any external or internal damage to the produce.

(iii) The use of materials particularly of paper or stamps bearing trade specifications is permitted provided the printing or labelling has been done with non-toxic ink or glue.



(iv) Fruits and Vegetables shall be packed in each container in compliance with the recommended international code of practice for Packaging and Transport of Tropical Fresh Fruit and Vegetables (*CAC/RCP 44-1995) of practice for export and as per the Instructions issued by the Agricultural Marketing adviser from time to time for domestic market.

(v) The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the Fruits and Vegetables. Packages must be free of harmful foreign matter and obnoxious smell.

(vi) Contents of each package or lot must be uniform and contain only Fruits and Vegetables of same origin, variety and grade designation.

(vii) The visible part of the contents of the package (if present) must be representative of the entire content.

(viii) Contents of package may have different fruits and vegetables of different grades as per buyer's requirements with proper labelling.

• Method of Marking and Labelling:

(I) The grade designation mark shall be securely affixed to or printed on each package in a manner

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approved by the Agricultural Marketing Adviser or an officer authorised by him in this behalf.

(ii) The following particulars shall be clearly and indelibly marked on each package, namely:

- (a) Name of the commodity;
- (b) Variety;
- (c) Grade designation;
- (d) Size code (if prescribed);
- (e) Lot/batch/code number;
- (f) Country of origin;
- (g) Net weight/No. of units;
- (h) Name and address of the packer/exporter;
- (i) Best before date (where applicable);
- (j) Storage condition, if any;
- (k) Date of packing;

(l) Such other particulars as may be specified by the Agricultural Marketing Adviser.

(iii) The ink used for marking on packages shall be of such quality which may not contaminate the product.

(iv) The authorised packer may, after obtaining the prior approval of the Agricultural Marketing Adviser, mark his private trade mark or trade brand on the graded packages provided that the same do not indicate quality other than that indicated by the grade designation mark affixed to the graded packages in accordance with these rules.

• Fruits may be graded and marked as per buyer's requirements for exports provided the minimum requirements specified in the relevant schedule are met.

Grading of fruits according to AGMARK

	Extra class	Class I	Class II
Table Grapes	- Superior quality. - Typical of variety in shape, development and colouring and have no defects. - Berries must be firm, firmly attached to the stalk, evenly spaced, bloom virtually intact.	- Good quality. - Typical of variety in shape, development and colouring. - Berries must be firm, firmly attached to the stalk, bloom intact, be less evenly spaced - Good keeping quality of the package. - a slight defect in shape, - a slight defect in colouring	- Slight defects in shape, development and colouring provided these do not impair the essential characteristics of the variety. - The berries must be sufficiently firm and sufficiently attached. - Less evenly spaced along the stalk - Good keeping quality of the package. - light sun scorch affecting the skin only - slight bruising - Slight skin defects.
Litchi	- Superior quality. - Typical shape, development and colour of the variety - Free of defects, with the exception of very slight superficial defects - Good Keeping Quality & Presentation in package form.	- Good quality. - Characteristic of the variety and/or commercial type. - The following slight defects however may be allowed provided these do not affect the general appearance of the produce, the quality and presentation in the package.⁹ - slight defects in shape and colouring - slight skin defects Provided these do not exceed a total area of 0.25 sq.cm.	- Satisfy the minimum requirements specified in general characteristics. - The following defects may be allowed, provided, the Litchis retain their essential characteristics as regards the quality, the keeping quality and presentation. - defects in shape, - defects in colouring, - skin blemishes provided these do not exceed a total area of 0.5 sq. cm.

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	Extra class	Class I	Class II
Mangoes	- Superior quality. - Characteristic of the variety - Free of defects, with the exception of very slight superficial defects - Good Keeping Quality & Presentation in package form.	- Good quality. - Characteristic of the variety. - Slight defects, provided these do not affect the general appearance -, the quality, the keeping quality and presentation. - slight defects in shape; - slight skin defects due to rubbing or sunburn, - suberized stains - healed bruises not exceeding 2,3,4,5 sq. cm.	- Satisfy the minimum requirements. - Following defects allowed, provided they retain the quality, keeping quality and presentation. - slight defects in shape; - slight skin defects due to rubbing or sunburn, - suberized stains - healed bruises not exceeding 2,3,4,5 sq. cm.
Pomegranates	- Superior quality. - Typical shape, development and colour of the variety - Free of defects, with the exception of very slight superficial defects - Good Keeping Quality & Presentation in package form.	- Good quality. - Characteristic of the variety. - Slight defects, provided these do not affect the general appearance -, the quality, the keeping quality and presentation. - slight defects in shape & colour - Slight skin defects (i.e. scratches, scars, scraps and blemishes) provided these do not exceed 5% of the total surface area.	- Satisfy the minimum requirements. - Following defects allowed, provided they retain the quality, keeping quality and presentation. - defects in shape & colour - Skin defects (scratches, scars, scrapes and blemishes) provided these do not exceed 10% of total surface area.
Pineapples	- uperior quality. - Characteristic of the variety - Free of defects, with the exception of very slight superficial defects - Good Keeping Quality & Presentation in package form. - The crown - simple and straight with no sprouts and shall be between 50 and 150% of the length of the fruit with trimmed or untrimmed* crowns.	- Good quality. - Characteristic of the variety. - Slight defects, provided these do not affect the general appearance -, the quality, the keeping quality and presentation. - slight defects in shape & colour including sunspots - slight skin defects (i.e. scratches, scars, scraps and blemishes) not exceeding 4% of the total surface area. • The defects must not affect the pulp of the fruit. • The crown, - simple and straight and slightly curved with no sprouts, and shall be between 50 and 150% of the length of the fruit for pineapples with trimmed or untrimmed crowns.	- Satisfy the minimum requirements. - Following defects allowed, provided they retain the quality, keeping quality and presentation - defects in shape & colouring; including sunspots, - skin defects (scratches, scars, bruises and blemishes) not exceeding 8% of the total surface area. • The defects must not affect the pulp of the fruit. • The crown, if present, shall be simple or double and straight or slightly curved, with no sprouts.
Guavas	- Superior Quality, - Characteristic of the variety - Free of defects - Good Keeping Quality & Presentation in package form	- Good quality. - Characteristic of the variety. - Slight defects, provided these do not affect the general appearance -, the quality, the keeping quality and presentation. - slight defects in shape and colour; - slight skin defects due to rubbing and other superficial defects such as sunburns, blemishes and scars not exceeding 5% of the total surface area, • The defects should not affect the pulp of the fruit.	- Satisfy the minimum requirements. - Following defects allowed, provided they retain the quality, keeping quality and presentation - defects in shape and colour; - skin defects due to rubbing ,sunburns, blemishes and scars not exceeding 10% of the total surface area. - The defects should not affect the pulp of the fruit.

<http://agmarknet.nic.in/fveggmrules04.htm>

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Analysis and Testing

The quantitative analysis of fruits and their products may broadly be divided into physical analysis and ultimate analysis. The former gives useful information, particularly from the Grading and adulteration point of view, while the later

refers to the determination of a chemical or biological contamination. For domestic trade, Fruits shall comply with the residue levels of heavy metals, pesticides, Aflatoxins and other food safety parameters as specified in Prevention of Food Adulteration Rules, 1955.

Analysis of Fresh fruits according to FSSAI are as follows:-

Sr. no.	Parameters	limit as per FSS Regulations	Method of analysis
A	Physical Analysis		
1	Rotting	Absent	Visual Examination
2	Rodent Contamination	Absent	DGHS manual
3	Added colouring Matter	Absent	DGHS manual
4	Added Wax coating	Absent	DGHS manual
5	Mould	Nil	Visual Examination
B	Ultimate Analysis		
i	Preservatives (3.1.4)		
1	Sulphur dioxide	600 ppm	AOAC method
ii	Metal Contaminants (2.1.1)		
1	Lead	2.5 ppm	ICP/AAS
2	Copper	30.0 ppm	
3	Arsenic	1.1 ppm	
4	Tin	250 ppm	
5	Zinc	50.0 ppm	
6	Cadmium	1.5 ppm	
7	Mercury	1.0 ppm	
iii	Crop Contaminants (2.2.1)		
1	Aflatoxin	30 µg/kg	HPLC/LCMS
iv	Naturally Occurring Toxic Substances (2.2.1)		
1	Agaric acid	100 ppm	GC/ HPLC
2	Hydrocyanic acid	5 ppm	AOAC (Titrimetric method)
3	Hypericine	1 ppm	GC/ HPLC
4	Saffrole	10 ppm	GC/ HPLC
v	Pesticide residues (2.3.1)		
	Other fruits		
1	Trichlorfon	0.1 ppm	LCMS / GCMS
2	Carbendazim	5.00 ppm	
3	Monocrotophos	1.0 ppm	
4	Phorate	0.05 ppm	
5	Endosulfan	2.0 ppm	
6	Chlorpyrifos	0.5 ppm	
7	Ethion	2.0 ppm	
8	Paraquat Dichloride	0.05 ppm	
9	Carbofuran	0.1 ppm	
10	Phosalone	5.0 ppm	
11	2,4D	2.0 ppm	
12	Benomyl	5.00 ppm	
13	Aldrin, dieldrin	0.1 ppm	
14	Chlordane	0.1 ppm	
15	DDT	3.5 ppm	
16	Dichlorvos	0.1 ppm	
17	Dicofol	5.0 ppm	
18	Dimethoate	2.0 ppm	LCMS / GCMS
19	Fenitrothion	0.5 ppm	
20	Inorganic Bromide	30.0 ppm	
21	Alpha, Beta, Gamma, Delta HCH	1.00 ppm	
22	Malathion	4.0 ppm	
23	Parathion	0.5 ppm	
24	Parathion Methyl	0.2 ppm	
25	Phosphamidon residues	0.2 ppm	
26	Pyrethrins	1.0 ppm	

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Sr. no.	Parameters	limit as per FSS Regulations	Method of analysis
27	Cholobenzilate	1.0 ppm	
28	Formothion	1.0 ppm	
29	Thiometon	0.5 ppm	
30	Captan	15.00 ppm	
31	Copper Oxychloride	20.00 ppm	
32	Ethylene bis-dithiocarbamates	3.00 ppm	
	Pears		
1	Phosalone	2.0 ppm	
	Cherries		
1	Ethylene bis-dithiocarbamates	1.00 ppm	
	Pomegranate		
1	Propineb	- 0.5 ppm	
	Peaches		
1	Ethion	1.0ppm	
	Apple		
1	Thiophenatemethyl	5.00 ppm	
2	Fenarimol	5.0 ppm	
3	Hexaconazole	0.1 ppm	
4	Diodine	5.00 ppm	
5	Dithianon	0.1 ppm	
6	Difenoconazole	0.01 ppm	
	Grapes		
1	Tridemorph	0.5 ppm	
2	Dimethomorph	0.05 ppm	
3	Propineb	0.5 ppm	
4	Cymoxil	0.1 ppm	
5	Tridimefon	2.0 ppm	
6	Fosetyl – A1	10 ppm	
7	Penconazole	0.2 ppm	
8	Myclobutanil	1.0ppm	
9	Diuron	1.00 ppm	
10	Iprodione	10.0 ppm	
11	Chlormequatchloride	1.00 ppm	
12	Tridemorph	0.5 ppm	
	Citrus fruits		
1	Phosalone	1.0 ppm	
2	Diuron	1.00 ppm	
3	Monocrotophos	0.2 ppm	
4	Formothion	0.2 ppm	
	Papaya		
1	Thiophenatemethyl	7.00 ppm	
	Pine apple		
1	Ethephon	2.00 ppm	LCMS / GCMS
2	Alfa Nephthyl Acetic Acid	0.50ppm	
	Mango		
1	Benomyl	2.00 ppm	
2	Carbendazim	2.00 ppm	
3	Ethephon	2.00 ppm	
4	Tridemorph	0.05 ppm	
	Banana		
1	Benomyl	1.00 ppm	
2	Diuron	0.10 ppm	
3	Carbendazim	1.00 ppm	

http://fssai.gov.in/Portals/0/Pdf/Final_Lab_Parameters%2821-08-2012%29.pdf

Conclusion:

Like the famous English saying “Never judge a book by its cover” same is the case with the fruits we see. Not necessary that every red apple or Juicy watermelon we see, be safe and pure. Hence what taste good should always first test good.

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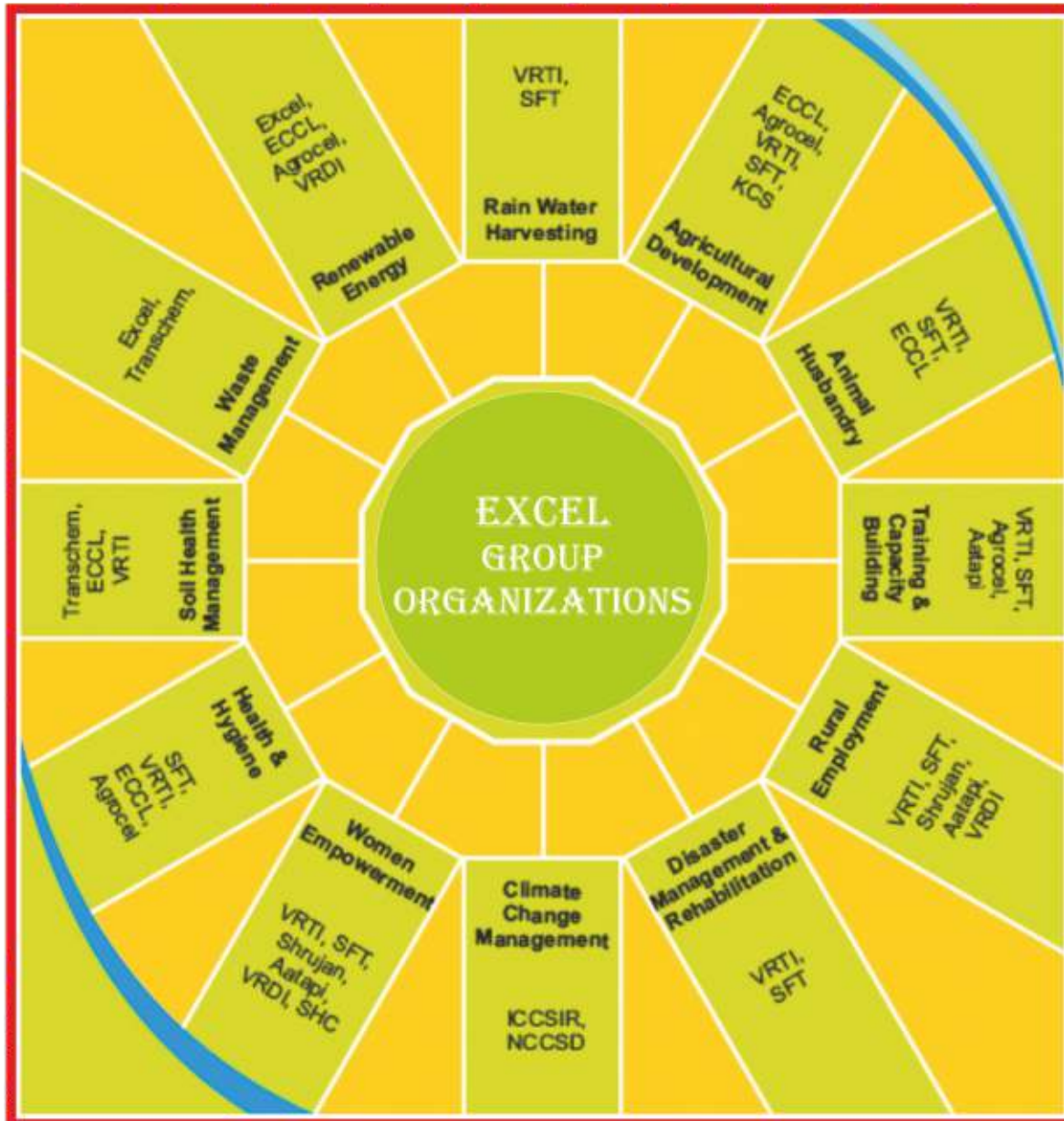
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Post Harvest Management: An Approach to Support Economic Development of Rural Women in India

Women are strong contributors to a country's economy, and constitute a large proportion of the agricultural work force globally. According to FAO estimate, if women farmers have the same access as men to agricultural resources, this could increase agricultural production in developing countries by 20-30 per cent, and potentially reduce the number of hungry people in the world by 100 to 150 million.

The rural women face disparities in freedom, income and resources and the apparent gender inequality is pervasive, persisting across many dimensions, manifesting itself in the household, social institutions and economy. According to a study by Mankekar (1990)

74 per cent of the entire female working force is engaged in agricultural operations out of which 28 per cent are cultivators and 46 per cent are involved in agricultural operations like transplantation of saplings, winnowing, storage of grain etc. all being handled almost exclusively by women.

India is the second largest producer of fruits and vegetables in the world¹. They not only provide nutritional security, but also generate a high income to growers. In spite of this fact, post harvest losses in fruits and vegetables are about 25-40% depending upon the kind of produce and its pre and post-harvest management. These losses mostly occur in the field, in packing houses, in storage, during transportation and in the wholesale and retail markets due to poor infrastructure, meagre pre and post harvest management as well as marketing of the produce. Better production practices, careful harvesting and suitable as proper packaging, storage and transport can contribute to good quality produce. Fruits and vegetables are inherently more liable to deteriorate since even after harvest, they are biologically active and carry out transpiration, respiration, ripening and other biochemical activities, which vitally impact the quality of the produce.

Post Harvest Losses and Food and Nutritional Security are the foremost priority areas for Scientists, Technologists and Administrators as

the global population is crossing over 7 billion mark. Knowing its importance both in the national and global context, Amity University Uttar Pradesh is laying special emphasis on Horticultural Research and Management and has established Amity International Centre for Post Harvest Technology & Cold Chain Management (AICPHT&CCM). Eminent agricultural and food scientists have joined the mission.

AICPHT&CCM is involved in providing training and promoting research activities in the field of Horticulture targeting reduction in post harvest losses in fruits and vegetables by adopting good practices in harvesting, sorting, grading and packaging, proper storage and transportation to help profitable marketing of fresh produce. Training is also provided in converting agricultural produce into value added products through the application of different forms of processing and utilization of waste generated during handling and processing. All trainings are aimed at helping small holder women farmers and SMEs. Some of the efforts made by the Centre in this direction are being cited in the article

Under the Project entitled "Rural Bio-Resource Innovation-Application to Uplift the Socio-Economic Status of Farmers and Entrepreneurs from Uttar Pradesh" funded by Department of Biotechnology, Government of India, AICPHT&CCM has established three Common Facility Centres (CFCs) in Uttar Pradesh at Gayatri Suman Farm & Nursery, Bulandshahr; Krishi Vigyan Kendra(KVK), Ghaziabad and KVK, Gautam Budh Nagar and one in the North-eastern State, Manipur (KVK, Sylvan). Farmers and entrepreneurs are provided hands-on training and demonstration of 5-day duration each at the CFCs, in post harvest management of fruits and vegetables which help them to reduce post harvest losses and generate higher income. Participants learn the skills of pulp extraction of fruits, preparation of tomato puree, juices, squashes and nectars along with their bottling and corking, and making them ready for marketing. Training is also provided on waste utilization of plant parts to obtain nutritional value added products.

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A couple of case studies are given below emphasising rural women entrepreneurship encouraged by the hands-on training.

Case Study -1 : Success Story of Rural Women in Uttar Pradesh

A majority of the village population in Uttar Pradesh earns its livelihood from the sale of fresh fruits and vegetables. This is hardly adequate to ensure a stable income for small and marginal farmers given the vagaries of monsoon and pressures of intermediaries. The utilization of fruits and vegetables both in the form of fresh produce (highly perishable) and processed products (durable) would help increase their source of income and thereby, improve their economic status. Success of post harvest management depends on an integrated approach so that nothing goes waste and there is 100% utilization of the horticulture produce.

- A woman (Mrs. Tyagi) learned under the training how to blanch peas, packing, storing and marketing. She used to grow peas. Till year 2011, the excess peas grown were either sold at a very low price or fed to the animals. After taking the training, in the year 2012, the peas were blanched and stored for 9 months which fetched a good income for her. In the year 2013, in the training she came up with another five more women to learn more about simple processing technologies. She was happy expressing the amount of income gained by her using simple technologies. The level of confidence she gained among her family members was an added pleasure.

Case Study 2 : Success Story of an Entrepreneur in Manipur

The North-eastern region due to its peculiar agro-climatic conditions has considerable potential for horticultural production. Banana, pineapple, passion fruit, plums and oranges are the most important crops among fruits. These fruits cover about 60% of the cultivated area and account for 66% of the production of fruit crops. The horticulture markets in almost all the north-eastern states are largely unorganized despite of having a wide range of horticultural crops, the desired growth in this sector had not happened. The lack of infrastructure, procurement & marketing practices, processing & packaging facilities were the major constraint in marketing of the produces.

- In the year 2014 our training programme was extended to North-East under the DBT project. Ms. Hexiong, an upcoming entrepreneur drew immense benefit from our training. She learned about processing of different fruits especially passion fruits, figs and plums which are available in abundance in the local area at Manipur. She started processing and marketing the products like sweet mango pickle, fruit squashes etc., which added to her income. Further, she also expressed the desire to learn more about processed products and their nutritional value, to enable her to market the items successfully. Now she has her own small business in which she has employed 3-4 persons.

Our focus for economic development of rural people:

- Emphasis on creating rural employment for mitigation of poverty
- Efforts to improve agricultural production efficiencies and optimum utilization of the produce
- Develop technologies to convert the discarded food as garbage into some form of edible food, or at least, animal feed
- Development of research and innovation to meet the marketing challenges
- Harmonization of extension message to encourage operational synergy of programmes by extension providers to make the farmers commercially oriented in their thinking
- Constant review and update of appropriate extension packages
- Creating awareness among extension providers for quality horticultural produce and Good Agricultural Practices and Good Manufacturing Practices

Conclusion:

The emergence of women entrepreneurs and their contribution to the national economy is quite visible in India. Women's entrepreneurship has been recognized during the last decade as an important untapped source of economic growth. Entrepreneurship development among rural women will help to enhance their personal capabilities and increase decision making status in the family and society as a whole. They can also be engaged in starting individual or collective income generation programmes with the help of self-help groups. This will not only generate

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income for them but also improve the decision-making capabilities that lead to overall empowerment.

¹*National Horticulture Board Database -2011, Ministry of Agriculture, Government of India, www.nhb.gov.in*

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Opportunities & Challenges for Emerging Food Processing Sector in India

The food processing industry is one of the largest industries in India. It is ranked fifth in terms of production, consumption, export and expected growth. Moreover, India is the world's second largest producer of food next to China and has the potential of being the biggest in agro and allied sector. Fuelled by what can be termed as a perfect ingredient for any industry, large disposable incomes, the food sector has been witnessing a marked change in consumption patterns, especially in terms of processed food.

Increasing incomes are always accompanied by a change in the food basket. The proportionate expenditure on cereals, pulses, edible oil, sugar, salt and spices declines as households climb the expenditure classes in urban India while the positive happens in the case of milk and milk products, meat, egg and fish, fruits and beverages.

For instance, the proportionate expenditure on staples (cereals, grams, pulses) declined from 45 percent to 42 percent in rural India while the figure settled at 32 per cent of the total expenditure on food in urban India. A large part of this shift in consumption is driven by the processed food market, which accounts for 32 percent of the total food market. It counts for US\$ 30 billion, in a total estimated market of US\$ 92 billion.

The Confederation of Indian Industry (CII) has estimated that the foods processing sectors has the potential of attracting around US\$ 40 billion of investment in 10 years and generate employment of 10 million person-days. The Government of India has formulated and implemented several Plan Schemes to provide financial assistance for

setting up and modernizing food processing units, creation of infrastructure, support for research and development and human resource development in addition to other promotional measures to encourage the growth of the processed food sector.

Food processing is a large sector that covers activities such as agriculture, horticulture, plantation, animal husbandry and fisheries. It also includes other industries that use agriculture inputs for manufacturing of edible products. The Ministry of Food Processing, Government of India indicates the following segments within the Food Processing industry:

- Dairy, fruits & vegetable processing
- Grain processing
- Meat & poultry processing
- Fisheries
- Consumer foods including packaged foods, beverages and packaged drinking water

Though the industry is large in size, it is still at a nascent stage in terms of development of the country's total agriculture food produce, out of which only 2 percent is processed. The industry size has been estimated at US\$ 70 billion by the Ministry of Food Processing, Government of India. The food processing industry contributed 6.3 per cent to India's GDP in 2003 and had a share of 6 percent total industrial production. The industry employs 1.6 million workers directly. The industry is estimated to be growing at 9 to 12 per cent during the period 2002 to 2007.

Value addition of food products is expected to

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increase from the current 8 percent to 35 percent by the end of 2025. Fruit & vegetable processing, which is currently around 2 percent of total production will increase to 25 percent by 2025. The highest share of processed food is in the dairy sector, where 37 percent of the total produce is processed, where only 15 per cent is processed by the organized sector. The food processing industry in the country is on track to ensure profitability in the coming decades. The sector is expected to attract phenomenal investments of about Rs 1,400 billion in the next decade.

Segmentation of different sectors in food processing industry:

Sectors	Products
Diary	Whole Milk Powder, Skimmed milk powder, Condensed milk, Ice cream,
Fruits & Vegetables	Beverages, Juices, Concentrates, Pulps, Slices, Frozen & Dehydrated products, Potato Wafers/Chips etc.
Grains & Cereals	Flour, Bakeries, Starch Glucose, Cornflakes, Malted Foods, Vermicelli, Beer and Malt extracts, Grain based Alcohol
Fisheries	Frozen & Canned products
Meat & Poultry	Frozen and packed - mainly in fresh form, Egg Powder
Consumer Foods	Snack food, Nankeens, Biscuits, Ready to eat food

Primary food processing is a major industry with a highly fragmented structure that includes hundreds of thousands of rice-mills and hullers, flour mills, pulse mills and oilseed mills, several thousands of bakeries, traditional food units and fruits, vegetable and spice processing units in the unorganized sector.

Challenges and Opportunities

The future of the Indian farmer depends on the success of the food industry as India's prosperity is predominantly linked to the growth of incomes in the agrarian sector of the economy. Increasing liberalization of the economy has tried to lift the protection that the food and agriculture sector

once enjoyed in the country. This has exposed the sector both to the opportunities and challenges of the global food economy.

The market forces are compelling the Indian agriculture producers to increase the quality of their farm produce while continuing to maintain their cost competitiveness in order to be able to compete effectively in the global food market. Even in the domestic market, rising per capita incomes and changing demographic profile of the population has ensured the growing demand for processed and convenience foods. Increasing consumer awareness about health and hygiene has shifted the focus of the market to "safe" foods. The Indian food-processing sector is undergoing a veritable revolution - all the way from the fork to farm.

Indian food processing industry has seen significant growth and changes over the past few years, driven by changing trends in markets, consumer segments and regulations. These trends, such as changing demographics, growing population and rapid urbanization are expected to continue in the future and, therefore, will shape the demand for value added products and thus for food processing industry in India. The Government of India's focus towards food processing industry as a priority sector is expected to ensure policies to support investment in this sector and attract more FDI. India, having access to vast pool of natural resources and growing technical knowledge base, has strong comparative advantages over other nations in this industry. The food processing sector in India is clearly an attractive sector for investment and offers significant growth potential to investors.

Challenges faced by the Indian industry:

The most crucial challenge today that the Indian food processing industry is facing is the lack of suitable infrastructure in the shape of cold chain, packaging centres, value added centre, modernized abattoirs etc. Improvement in general infrastructure is also a must requirement for the industry to progress. Some other important initiatives that are needed:

- Promotion of appropriate cross breeds while conserving indigenous breeds of livestock
- Establishment of livestock marketing system
- Promotion of rural backyard poultry in a cooperative marketing setup
- Development of cooperative dairy firms
- Enhancing livestock extension services

Post-harvest Management

- Encouraging private veterinary clinic
- Institutionalising a framework for utilising synergy between restoration and creation of water bodies for water harvesting and fishery
- Provision of an insurance package to avoid distress

Strengths and opportunities that India enjoys:

As per Area, India is the seventh largest country, with extensive administrative structure and independent judiciary, a sound financial & infrastructural network and above all a stable and thriving democracy. Due to its diverse agro-climatic conditions, it has a wide-ranging and large raw material base suitable for food processing industries. Presently a very small percentage of these are processed into value added products.

It is one of the biggest emerging markets, with 1.25 billion population and a 250 million strong middle class. Rapid urban population, increased literacy and rising per capita income, have all caused rapid growth and changes in demand patterns, leading to tremendous new opportunities for exploiting the large latent market. An average Indian spends about 50 percent of house-hold expenditure on

food items, Demand for processed/convenience food is constantly on the rise. India's comparatively cheaper workforce can be effectively utilized to setup large low cost production bases for domestic and export markets.

Liberalized overall policy regime, with specific incentives for high priority food processing sector, provide a very conducive environment for investments and exports in the sector. Very good investment opportunities exist in many areas of food processing industries, the important are being : fruit & vegetable processing, meat, fish & poultry processing, packaged, convenience food & drinks and milk products.

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NIFTEM's Model of Rural Development

Village Adoption Programme (NIFTEM's Unique Outreach Initiative) Linking Farmers & Rural Youth to Nation Building

Village adoption is a unique program conceptualized and being implemented by NIFTEM for its students since 2012, with a view to sensitize and educate them of the problems and practices of the farmers at the grass root level. The aim is to help the Indian Food Processing sector accomplish its objective of all- inclusive growth and facilitate the process of integrating the underprivileged sections of our population with the main stream economy.

The Framework of Village Adoption Programme:

- Under this programme, B. Tech (Food Technology & Management) and M. Tech students are divided into groups of 10 to 12 students at the time of joining NIFTEM.
- Each group is lead by a Faculty member

(Mentor) and adopts a village anywhere in India and nurses it during the entire programme of study.

- The Groups go and stay in the village twice a year: 10 to 12 days each time in every semester. It is a symbiotic process leading to exchange of Knowledge.
- While villagers gain scientific and technical knowledge through students who promote future possibilities of food processing among them, students obtain firsthand experience of Indian rural scenario and understand traditional processing technologies adopted by the villagers.
- Students gain general awareness of the village life and facilitate the process of integrating the underprivileged sections of our population with the main stream.

Post-harvest Management

- Students learn to contribute towards “Nation Building”.

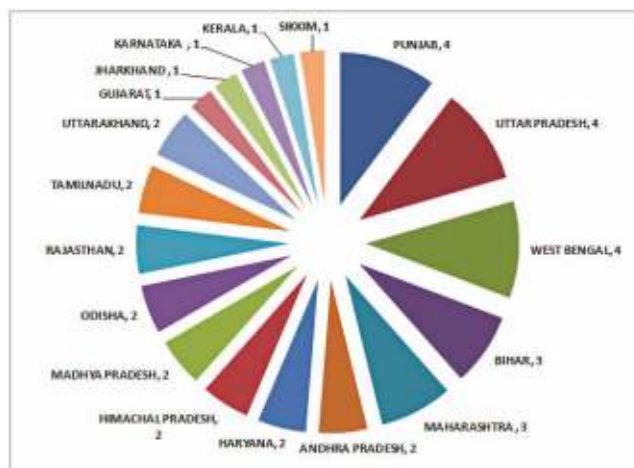
Steps in the Village Adoption Process

- The students shall have to identify a village and establish a work plan at the beginning of the first semester and work during the semester for 10-12 days at the village site
- The students will work in a group under the guidance of a mentor faculty and will develop realistic village development plan for 4 years including identification of local resources and avenues for promoting entrepreneurship in food processing sector.
- Sensitize and train the farmers and local youth about Food Processing and its advantages- Encourage farmers & local youth to become Entrepreneurs, establish micro and small Food Processing Enterprises, form Producer's Company and establish Food Processing Units.
- Provide access and training programs to farmers
- Prepare a catalogue of traditional food production practices/ food preservation/ traditional recipes of food, etc.
- Imparting trainings on basic processing and value addition techniques for enhancement of shelf life, etc.
- Promote Good Agricultural Practices (GAP).
- Conduct an extensive survey of the village & record demographics and prepare a data base.
- Organize resources - By providing vital linkages, micro credits, Govt. Policies.
- Prepare and present a report at the end of each semester.
- In addition, Professors and Senior Officers of NIFTEM visit the groups as observers when the groups are in the village to guide them and closely evaluate their progress.

Work done in Village adoption programme

Owing to the success of first session of village adoption programme (29.10.2012-03.11.2012), NIFTEM undertook the regular subsequent visits under its innovative programme till date. So far Eight visits has been accomplished viz., second (11-16th March 2013), third (30th June-09th July, 2013), fourth, (19-27th October, 2013), fifth (23-29th December, 2013, sixth (02-11th March, 2014), seventh (17-26 September 2015) and eighth (15-24 March 2015). **During the Eighth village adoption programme, 36 teams of NIFTEM visited 39 villages in 18 States of the Country.** The details

of the locations are presented in Table at **Annexure I.**



The salient achievements have been compiled as follows:

- Food Processing promotional Initiatives
- Entrepreneurship Development
- Preparation of project reports
- Product Development processes
- Developing Market Linkages
- Cataloguing of traditional knowledge
- Make in India initiatives through VAP
- Infrastructure Development
- Social Issues addressed
- Sawachh Bharat Abhiyan through VAP
- Initiatives on promotion of Renewable energy utilization

A. Food Processing promotional Initiatives

About 500 programmes including Trainings and Expert Lectures, Awareness Camps organized on food processing and value addition, postharvest management, product development, entrepreneurship development etc



Demonstration on preparation of Mushroom Juice in a Kalupatti village, Dindigul, Tamilnadu

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Lecture on Food Processing opportunities in Seoni, Madhya Pradesh



Demonstration of Bakery product preparation during a training session in the village in Madhya Pradesh



Interactive session of villagers with KVK representatives on Food processing opportunities in Kure, Bhusawal Maharashtra

B. Entrepreneurship Development (Identification of Entrepreneurs)

Phase 1

- More than 125 entrepreneurs are potential ones who are associated with different teams and in processes of finalizing their ventures in agro food processing and few have already initiated the work.

Phase II

- VAP teams also identified about **50 prospective entrepreneurs in their respective village and adjoining areas who will be further**

given training to establish ventures in agro-food processing (Total about 1546). They will be imparted 1 week training programme and of those selected ones will be taken up for 1 month EDP programme in regional centers followed by 3 months of industrial training programme. **During VAP 8, about 250 such entrepreneurs were trained in selected pilot locations by imparting 1 week training programme.**



Fruit squash production and bottling demonstration in Uttar Shibakara village, West Bengal



Demonstration of Tomato cocktail preparation in mobile processing van arranged by Team NIFTEM, Kalupatti, Tamilnadu



Members of team NIFTEM working closely with rural youth to support entrepreneurial venture of opening & running a canteen in village School (production-selling-estimated investment), Bagroda, Bhopal

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Members of team NIFTEM working closely with rural women in the village on Papad Making Initiative, Jhalarpatan, Rajasthan



Demonstration on making and packing of Mango products like Aam panna and pickle by Team NIFTEM in village Pulicunnoo, Kerala

C. Preparation of project reports

NIFTEM VAP Teams are continuously working very closely on different micro and medium level projects with selected potential entrepreneurs to guide and share the relevant information. The teams have shared with them customized project reports for initiating and supporting their ventures in domain of agro food processing and value addition.

D. Product development processes

Students along with their mentor have taken about **150 Product Development Training Programmes** at village level in different villages and practically demonstrated **preparations of jams, jellies, pickles, fruit based beverages like mango panna, products like banana chips, dried banana flakes, bakery products like biscuits, cakes, fried snacks like bread pakora, bread rolls etc and also share** one to two page leaflets indicating the process flow charts and estimated expenses



Products made at village level after creation of Women SHG by Team NIFTEM and promoted under brand name of "Sankalp", Village Lahra, Hathrus, UP

E. Developing Market Linkages

Team VAP in Different locations worked with various self help groups and supported to form backward and forward linkages for their product and process developments and promoting their products in the market. This organized effort lead to **revival of about 115 exiting self help groups and creation of about 28 New Self help groups.**

F. Cataloguing of traditional knowledge

• Preparation of booklets on traditional food recipes

o Almost all the existing groups have completed the process of cataloguing the traditional recipes of their respective locations and has documented in form of small booklet. **There are about 500 such recipes which are unique and with scientific intervention can be**



Training program on Banana flower pickle making by Members of Team NIFTEM in Alanganallur, Tamilnadu

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standardized for mass production and sold in domestic as well as export market.

- **Preparation of booklets on traditional food preservation practices**

- o Various groups have compiled information on traditionally existing Food Preservation Practice and documented them in form of booklets. **About 200 such methods have been documented by various teams.**

G. Make in India initiative through VAP

- o As the efforts were directed to collect the traditional recipes as part of local heritage which could be further standardized and made popular for National and International market, NIFTEM is in process of finalizing few best recipes to initiate the research project on scientific interventions, quality management, protocol development and standardization for commercial production.

- o Apart from this various handouts, video shows, pamphlets, rallies were also carried out in villages to raise awareness among youth and prospective entrepreneurs.

H. Infrastructure Development

VAP teams has networked with district administration and worked diligently for **creation of tangible infrastructure like development of roads linking to main roads, access to potable water, repair of drains, creation of sanitation facilities by creating awareness about government schemes and subsidies on creating pukka toilets in houses, development of school building, plantation drives, addressing meal quality issues in mid day meals schemes of Anganwadi, etc. Amazingly the efforts yielded construction of more than 220 pukka toilets in the associated villages, about 27 vermi-composting units and about 38 initiatives were going on for renovation of roads, drains, school building, anganwadi infrastructure, installation of clean drinking water sources.**



Efforts of Team NIFTEM under VAP leading to construction of Pukka Road in village Kalavacharla, Rajahmundry/East Godavari, Andhra Pradesh

I. Social Issues addressed

Above 450 dedicated programmes addressing social issues on Girl child education, Female Foeticide, Child labour, Health care, Sanitation and Hygiene have been organized in adopted villages.



Nukkad Natak organized by members of Team NIFTEM on raising awareness about avenues in food processing and importance of hygiene and sanitation in village in Uttar Pradesh

In a very unique initiative Team NIFTEM under its village adoption programme undertook an initiative to share and increase the knowledge of rural community targeting youth, women and children by opening of NIFTEM Gyan Kendra (Village library), either in common accessible panchayat office location or at village school. So far as about 24 such libraries have been created and since their inception Team NIFTEM has enriched the library resources by collecting and contributing about 569+ books which includes books on management, subject textbooks, current affairs, general knowledge, preparation for competitive books, homemaking, food processing, agriculture management, good agricultural practices, etc.

J. Swachh Bharat Abhiyan

In recently completed VAP 8, Swachh Bharat Abhiyan was taken up very rigorously and about 35 dedicated programmes were organized to raise awareness about this programme leading to cleanliness drive in school, in respective village and nearby locations. Teams also created Core teams in Village schools to sustain the campaign.

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Swachh Bharat Abhiyan undertaken at a Village Karkambadi, Chittor, AP



Swachh Bharat Abhiyan initiative in Chotti Ladha, Bihar

K. Initiatives on promotion of Renewable energy utilization

VAP teams laid due emphasis in promotion of renewable sources of energy like Solar lighting, solar cells and contacted energy department of each state to send representative in the village and educate farmers about using the solar lights. Sarpanchs and Panchayats were made aware about subsidies available for them to take solar lightening project for the village.

Success has been achieved in **installing Solar Panels for heating water and solar lamps in houses as well as Solar Street lights. The effort yielded about 100 dedicated lectures on promotion on renewable energy about 99 awareness campaigns installation of about 110 solar street lights/ solar lamps in different locations under VAP. Few biogas plants (25 in numbers) were also established in different locations.**



1. During 1st Visit

2. Solar lights installation during 2nd Visit

Awareness raising efforts of Team NIFTEM on renewable sources of energy leading to installation of Solar Lights in the Village Jhalarpatan, Junakheda, Rajasthan



Interaction in Karkambadi village with representatives of MP Uoorja Vikas Nigam, Bhopal.

3. In Ramch Patel home installed a Solar Panel for his house.

Interaction with representatives of MP Uoorja Vikas Nigam for promotion of renewable sources of energy leading to installation of Solar panels in the Village Bagroda, Bhopal, MP



Installation of Solar lights in Hariharpur, Bihar

The consolidated activities under VAP are presented in tabular form in Annexure II

Future Programmes

- Now, we are in the process of planning the launching of a programme for skilling the entrepreneurs by starting five days training programme in the village location itself followed by a follow up advanced training of four weeks on entrepreneurship development to the selected entrepreneurs so as to take them to the logical end of establishing micro enterprise. This programme would be followed by a **six months “Hand Holding Phase”** so that the trained entrepreneur is assisted in all the activities viz. preparing DPR, taking loan from the bank, procurement of

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equipments and machinery, marketing tie ups, etc.

- Our efforts will be directed towards establishing Primary Processing cum Pre-Cooling centre in the village, which could become the hub for hands-on training of farmers and rural youth in food processing and also provide limited CA

storage to the farmers for their perishable fruits and vegetables, etc. Attempts are being made to develop a Hybrid Energy System (Solar+ Biomass+ Grid Electricity) to run these primary processing centre.

Selected Village Locations under NIFTEM's Village adoption programme (State-wise presence as on March 2015)

S.No.	Name of the Village	Block and Sub District/ District	STATE
1.	Kalavacharla	Rajahmundry/East Godavari	ANDHRA PRADESH
2.	Karakambadi	Renigunta/ Chittoor	ANDHRA PRADESH
3.	Harihapur	Hajipur, Vaishali	BIHAR
4.	Chhoti Ladha	Keoti/Darbhanga	BIHAR
5.	Khairimal	Chakia/ East Champaran	BIHAR
6.	Koyli	Vadodara	GUJARAT
7.	Gangwa	Hisar	HARYANA
8.	Rawalwaas Kala	Hisar	HARYANA
9.	Nauni	Solan	HIMACHAL PRADESH
10.	Tunna	Mandi	HIMACHAL PRADESH
11.	Hocher	Kanke / Ranchi	JHARKHAND
12.	Mangur and Yalgud	Belgaum and Kolhapur	KARNATAKA and MAHARASHTRA
13.	Pulincunnu	Veliyanad/ Alappuzha	KERALA
14.	Bagroda	Phanda/ Bhopal	MADHYA PRADESH
15.	Simariya	Seoni	MADHYA PRADESH
16.	Kure	Bhusaval/Jalgaon	MAHARASHTRA
17.	Pimpri Gawli	Ahamednagar	MAHARASHTRA
18.	Lathor	Kaprakhole/ Balangir	ODISHA
19.	Dhansimulia	Balasore	ODISHA
20.	Vairowal	Tarn Taran	PUNJAB
21.	Mansakalan	Bathinda	PUNJAB
22.	Behniwal	Sardulgarh	PUNJAB
23.	Tarmala	Lambi / Muktsar	PUNJAB
24.	Aloda	Sikar	RAJASTHAN
25.	Junakheda	Jhalarapatan/ Jhalawar	RAJASTHAN
26.	Samlik Marchak (Nandok)	East Sikkim	SIKKIM
27.	Alanganallur	Alanganallur/Madurai	TAMILNADU
28.	Kallupattai	Rajakapattai/Dindigul	TAMILNADU
29.	Parseda/Amauli	Fatehpur	UTTAR PRADESH
30.	Naglamohan	Mathura	UTTAR PRADESH
31.	Arjunpur	Bakshi Ka Talab/ Lucknow	UTTAR PRADESH
32.	Bichpuri	Bichpuri/ Agra	UTTAR PRADESH
33.	Dhanpau and Lakhwad	Dehradun	UTTARAKHAND
34.	Dakshin Kalrayar Kuthi	Cooch Behar/ Cooch Behar2	WEST BENGAL
	Dakshin Arjunda and	Gram Panchayat -Chaitanyapur-	
35.	Chalkradhabon	1/ Block Panskura-1, Midnapore (E)	WEST BENGAL
36.	Kamlapur (Nimpith)	South 24 Parganas district	WEST BENGAL

Salient Achievements in VAP (consolidated in Numbers)

Sr No	Activity	In Numbers
1.	Food Processing promotional Initiatives	
	<i>Number of lectures arranged on:</i>	
	• Promoting Postharvest management & Food Processing / Value addition	208
	• Promotion of renewable energy	112
	• Entrepreneurship development	134
	• Sanitation and hygiene	159
	• Girl child education/ education	126
	• Female feoticide	35
	• Alcoholism	51
	• Other GAP, Government schemes, Banking and finances, Subsidies, Dairy and poultry farming, Organic farming, Alcoholism, Social issues, etc	87
	TOTAL	912
2.	Number of training programmes on product /process development organized/conducted in village (Jam/pickle/ chutney/ beverage/biscuit/cake/ paneer/ Khoa/toffee etc.)	
	• Duration 1 day	118
	• Duration 2 days	29
	• Duration 5days	9
	TOTAL	156
3.	Number of entrepreneurs/potential identified in Phase I Team NIFTEM is working very closely with these entrepreneurs since VAP I in the respective villages and guiding then through various states of their venture establishment and promotion in core area of postharvest management, organic farming and agro-food processing.	125
4.	Potential Entrepreneurs selected for training in Phase-II VAP teams also identified about 50 prospective entrepreneurs in their village and adjoining areas who will be further given training to establish ventures in agro-food processing	1546
5.	Detail project reports on ventures in food processing sector prepared and shared with budding entrepreneurs in the village	138
6.	Market surveys conducted	113
7.	Opening of NIFTEM Gyan Kendra (Village library)	24
8.	Approximate Number of Books contributed to Gyan Kendra (since initiated)	569

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9.	Awareness campaigns	
	• Jan chetna yatra	91
	• On postharvest management	153
	• On promotion of renewable energy	99
	• Sanitation and hygiene	129
	• Social issues	128
	TOTAL	600
10.	Number of medical camps organized	45
11.	Pamphlets created	
	• On food processing/Postharvest management Value addition/GAP (English/Hindi)	115
	• On food processing/Postharvest management/Value addition (in regional language)	101
	• On Social issues (alcoholism/smoking/etc)	103
12.	Video shows	
	• PHM/GAP/Food Processing	228
	• Sanitation and hygiene	114
	• Renewable energy	65
	TOTAL	407
13.	Number of Visits for farmers to industry and institutions	72
14.	Collection and documentation of traditional recipes	494
15.	Collection and documentation of Traditional methods of storage (in numbers)	217
16.	Documentary prepared during village adoption programmes (on various topics like Govt. Schemes, opportunities on food processing, sanitation hygiene, before and after comparisons, etc.)	35
17.	Plantation drive	65
18.	Nukkad Natak/Skit	39
19.	Total Number of the members in the Core groups created by respective VAP teams in their village	468
20.	Visible Impact	
	• Number of success stories identified	73
	• Venture/s initiated by identified entrepreneur, if any	78
	• Formation of New SHG	28
	• Reviving/guiding existing SHG	116
	• Number of solar lamps/ solar street lights installed in different villages	113
	• Number of Toilets construction in different villages	222
	• Construction of roads/pathway/drains/ renovation of school buildings and angan wadi infrastructure/ installation of clean drinking sources etc	38
	• Installation of biogas unit	25
	• Construction of vermin-composting unit	27

National Institute of Food Technology Entrepreneurship & Management

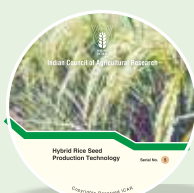
PUBLICATIONS OF ICAR



Inventory of Indigenous Technical Knowledge (ITK) in Agriculture (CDs)



Video Films on ICAR Technologies



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Post-harvest Management for Improving Food Security

Introduction

Food security apparently means the supply of food, and individuals' access to it. The final report of the 1996 World Food Summit enumerates that food security "exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". Famine and hunger are both rooted in food insecurity. Chronic food insecurity translates into a high degree of vulnerability to famine and hunger; ensuring food security presupposes elimination of that vulnerability. The FAO has also identified the four pillars of food security as availability, access, utilization, and stability. One report of FAO indicates that almost 870 million people were chronically undernourished in the years 2010-2012, which is 12.5% of the global population. In India, 30 million people have been added to the ranks of the hungry since the mid-1990s and 46% of children are underweight. Many countries have been experiencing food shortages and distribution problems. These result in persistent and often widespread hunger amongst significant numbers of people. Under the constraint of growing population and nearly constant net sown area, the need for increasing food production has to be met through increasing productivity and more intensive cropping in order to attain food security. However, in developing countries, while agriculture needs to double by 2050 to feed the growing population, 30% of the harvested crops are still wasted because of improper post-harvest conditions. In this context, reducing production and post-production losses, or preserving what has been produced, has also become inevitable.

Food security and nutrition security

Along with food insecurity, undernutrition and malnutrition are common problems in developing countries. Severe malnutrition in early childhood also often leads to defects in cognitive development, which is a very serious concern. The persistent high underweight rates in preschool children have been a matter of serious concern for

policy makers and programme implementers. Mere self sufficiency in food grain production cannot result in steep reduction in under-nutrition rates or micronutrient deficiencies because population needs adequate quantities of balanced diet to remain well nourished and healthy. Therefore, there is a need to focus on comprehensive interventions in improving food and nutrition security. Thus the Tenth plan of India envisaged that there would be a paradigm shift from household food security and freedom from hunger to nutrition security for the family and the individual.

Strategies to improve food security

Agriculture, including animal husbandry and fisheries, is the predominant provider of food, feed and fibre. Though India has now become a leader in food production in the world and has abundant availability of a wide variety of crops, fruits and vegetables, livestock and seafood, still the present population and population growth rate are matters of concern for food security. The population of the country is growing at a steady pace and the number of people below poverty line is very significant. Even globally, the growth in food production has been greater than population growth and hence food security has become a fundamental concern all over the world.

Increasing the production and productivity of different crops and growing more nutrition rich crops are the immediate necessities. This will help farmers to grow more food, and provide market conditions that offer higher farm incomes. With more money, farmers are more likely to diversify production and grow higher-value crops, benefiting not only themselves but the economy as a whole. Some factors that can be considered to achieve food security include increasing the crop area, better crop management practices, improving the availability of good quality water for farming and better management of water, reclamation of degraded land, which is often a result of intensive farming, and proper management of plant diseases. The climate change effect needs to be considered along with

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the above. When there is a need to increase the crop area, a huge area of farm land is being converted for urban use. It is very important to manage the rainwater and soil moisture more effectively, and to use supplemental and small-scale irrigation, which can help the greatest number of poor people. It is required to bring new freshwater sources through better local management of rainfall and runoff. Diseases affecting livestock or crops can have devastating effects on food availability especially if there are no contingency plan in place. With increase in agricultural output as a result of green revolution, the energy input to produce a crop has also increased at a greater rate and the ratio of crops produced to energy input has decreased over time. Proper marketing of the produce is also important.

The challenge is complex; nevertheless increasing the production and effective distribution are two major steps in achieving food security for all. But there is another option to make more food available, which is through proper post harvest management and value addition.

Post harvest management and value addition

To sustainably achieve the goal of food security, food availability needs to be increased through reductions in post-harvest losses at farm, retail and consumer levels. Better post-harvest management could really improve the food quality and safety, food and nutrition security of smallholder families and their livelihoods. Post-harvest management comprises the various technologies and practices undergone by the farmer, farmers' groups or cooperatives and/or agribusiness companies, from the field to the plate, to handle the crop production immediately following harvest, up to its final destination, such as storing, transport, cleaning, sorting, processing and packing.

Post harvest loss reduction

The post harvest system comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food. The term "post-harvest loss" refers to measurable quantitative and qualitative food loss in the post-harvest system

and reducing the post harvest loss along with making more effective uses of today's crops is critical in facing the challenge of feeding the increasing world population. The losses can be due to many factors. Biological causes of deterioration include respiration rate, ethylene production, rate of compositional changes (associated with colour, texture, flavor, and nutritive value), mechanical injuries, water stress, sprouting and rooting, physiological disorders and pathological breakdown. The rate of biological deterioration is determined by the several external environmental factors like temperature, relative humidity, air velocity, and atmospheric composition (concentration of oxygen, carbon dioxide and ethylene). Poor handling, unsuitable containers, improper packaging and transportation can easily cause bruising, breaking, impact wounding and other forms of injury. The perishable crops, because of their high moisture content, are inherently more susceptible to deterioration, especially, under hot and humid tropical conditions. Inadequate marketing infrastructure is another major bottleneck of existing production system. Many parts of the country do not have dependable, fast and equitable means of transferring the product from field to market.

Horticultural crops are essential for nutritionally balanced diet, being good sources for vitamins, minerals and anti-oxidants, and the loss of horticultural produce are the highest. Factors affecting post-harvest food losses of perishables vary widely from place to place and become more and more complex as systems of marketing become multifaceted. In case of inland fishery sector, harvest and post harvest losses occur mainly due to discards of small fish, improper handling immediately after catch, insufficient icing, inefficient containers used for transportation of fish, delays in transport, physical damage and bio-chemical changes. A good deal of loss occurs in case of live fish transportation. Efficient utilization of fish resources by reducing post-harvest losses has been of prime concern in recent years as global production falls short of growing demand. There are losses of milk at different stages as production, procurement, processing, and transportation of processed or unprocessed milk to the market, milk distribution/sale. Poultry production sector suffers from huge losses due to uncontrolled

Post-harvest Management

production, inadequate processing, lack of cold-chain and disorganized marketing.

A study in India about 10 years back concluded that the losses for selected cereals, constituting 94% of the national cereal production, were in the range of 3.9 % to 6.0 %. The losses were observed to be 4.3% to 6.1 % in case of pulses. The slightly higher losses in pulses were mainly due to high storage loss. Among all the selected pulses, black gram indicated highest losses in harvesting (1.1 %), collection (1.0%) and threshing (1.6%) operations. In case of oilseeds, the losses were in the range of 2.8% to 10.1 % with highest losses incurred in groundnut and mustard. For cereals, pulses and oilseeds, the losses in farm operations constituted about two-thirds of the total losses. Therefore, efficient technologies for these farm operations could lead to the reduction of losses. The losses in inland and marine fisheries were found to be 6.9% and 2.9%, respectively. The losses of marine fish did not include on-board loss. The estimated annual value of the post harvest losses was about Rs.27800 crores.

Thus, there is a need to reduce the post harvest losses by taking appropriate steps. Better storage, value addition and marketing are the keys to reduce the losses. The wholesale markets in our country are in desperate need of improvement in terms of facilities and sanitation, space for loading, unloading, ripening, consumer packaging, temporary storage, etc. Collective marketing through marketing cooperatives, producers groups, and coordinating the marketing program may be encouraged.

Value addition

In general, adding value is the process of changing or transforming a product from its original state to a more valuable state. Market forces have led to greater opportunities for product differentiation and added value to the raw material because of the increased consumer demands regarding health, nutrition and convenience. Value addition to agricultural produce can lead towards food security in which the Food Processing Industries play a significant role. Considering the growth in the production of major agricultural produce, by-products and its value addition through food processing sector can lead to the most effective and economical way of increasing per capita food

availability by reducing the agricultural wastages which in turn move towards food security. India's strong agricultural base, variety of climatic zones and accelerating economic growth holds significant potential for food processing industry that provides a strong link between agriculture and consumers, there-by increasing job opportunities. Shelf-stable value-added products can be produced from lesser-known indigenous tree fruits using simple technologies suitable for small-scale commercial production. Promoting the value addition would reduce postharvest losses, increase utilisation and contribute to reducing widespread food insecurity.

Food Waste Management

Food waste is the deliberate wastage of food fit for human consumption, generated throughout the supply chain. Food wastage is an international phenomenon. Global estimates indicate that one-third of the food produced for human consumption is wasted. It affects, although in different ways, both the developed and developing worlds. It has direct impacts on the environment and contributes to climate change; wastes economic capital and the finite resources used in food production; and, finally, it increases global food insecurity. Food wastage is growing considerably and has the potential to threaten food security and the environment. With advance of time, the agri-food chain is targeting for the production of high quality food across a number of parameters. Many foods (fresh fruit and vegetables) are discarded on the basis of appearance and physical characteristics rather than nutritional quality. Some major commodities create very large amounts of waste co-products i.e. brewers' spent grain, peels of fruits and vegetables, etc. These are usually disposed of locally as animal feed, composted or added to landfill. Probably the most significant impact of food on green house gas emissions is wastage in households and the commercial sector like hospitals and institutions. This is rarely considered in life cycle analysis of foods as it is difficult to monitor and quantify.

Improving the post harvest management

Proper post harvest management can help make more food available for our people. The modern post harvest techniques for the food products

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have not reached the common mass and most of the produce are sold in raw form giving the producer a low return for his investment and labour. At present the negligent attitude of farmers towards post-harvest losses and lack of quality consciousness are responsible for huge post-harvest losses. The low awareness about the technology on minimizing post-harvest losses is a major constraint.

In many parts of the country, the crops are sold at throw-away prices during the glut seasons. The traditional storage practices adopted for the food grains, fruits and vegetables add to the problem. The processing methods and equipments adopted for different food materials are mostly unscientific and lack proper technology. Therefore, whatever goes to the market also fetches a low price. Hence, great scope exists to reduce these losses to make more food available for consumption and to add income to the farmers. In addition to giving higher price to the producer, it will also create scope for establishment of small and cottage industries creating employment opportunities. Looking to the production figures of different food materials in the country and the quantum of losses, cost economical food processing, preservation and value addition have a vital role, which can contribute substantially to more availability of food and most importantly can be a safe step to ensure food security.

The food processing industry at present is able to utilise less than 6% of the total fruits and vegetables. The product profile of the food processing industry has remained static using only a few fruits like mango, pine apple and citrus. The production of new products besides being necessary for the survival and growth of the processing industry, can also meet the demand for new taste for domestic as well as the export market. Besides, the use of latest machines and equipments can simplify most of the operations and increase the throughput of the processing plants. Hence modernisation of the food processing industry and value chain management, as and where required, is essential in order to keep pace with the development as well as to be competitive in the international markets. This involves innovations in equipment, processes and nutritious products of mass appeal.

The following strategies may be adopted for

increased value addition and better post harvest management.

- The grain milling, threshing, storage and other systems should be modernized to minimize the losses at each of these unit operations.
- A multidisciplinary approach has to be adopted to identify critical problems related to post harvest, processing and marketing aspects of food grains, fruits and vegetables and their products. A proper co-ordination among scientists, growers and industrialists at certain common strategies of food materials and their wastes is needed.
- The farmers should be assured of some minimum price for quality raw materials. Similarly supply of good quality raw material to the farmers ensure manufacture of high quality finished products.
- Establishment of procurement centers, which should include the provision of grading, sorting, washing, packing and pre-cooling facilities in centralised locations at production area causes an effective post harvest care and handling.
- Refrigerated or insulated trucks and intermediate cooling storage and central godowns with small capacity cold storage at district level needs to be employed for collection and distribution of the commodities.
- Establishment of cooperative societies for proper marketing, distribution and processing and retail outlets at potential consuming areas and multi-raw material distribution and multi-product processing units are essential to process seasonally available fruits and vegetables.
- Ways need be evolved for effective use of grains, fruits and vegetables and their wastes keeping in view the production, processing industries, variety of product and consumption patterns especially in the changing economic and social scenario of the country.

Research, Development and Extension needs

Considering the scenario generated above, the following emerge as strategies for research, development and extension programmes in the field of post harvest technology.

- Proper low cost technologies for preservation

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and value addition of food grains, fruits and vegetables, small and medium scale industrial processes and machinery should be developed keeping in view the farmers' needs. Popularisation of the above developed processes and machinery should be undertaken by demonstrations, field trials and multi location evaluation.

- Research efforts to reduce qualitative and quantitative losses due to different post harvest disorders such as chilling injury, spongy tissue etc. and to increase shelf life under high ambient temperature conditions, which is the only practical feasible technology for Indian conditions have to be given thrust.
- Area specific models for suitable package of practices to reduce losses during different post harvest operations and value addition have to be developed.
- Development of storage/ packaging techniques for individual commodities are to be carried out by using selective permeable package materials, corrugated fibre box etc. Packaging techniques for natural quality retention should be standardised with due consideration to cost and environment. The feasibility of their adoption with respect to individual commodity should be explored.
- Priority areas for research in nutrition include: nutritive value of food items - for macro, micro and phyto nutrients using newer techniques; analysis of uncommon food stuffs for their nutritive value; extraction of nutrient rich components from by-products.
- Monitoring emerging changes in nutritional status due to changing ecology, agriculture, life style and social policy;
- The farmers' and small processors should be trained for use of preharvest treatments to regulate growth, delay maturity, reduce post harvest diseases and disorders, and to use small cost effective short term storage structures.
- The scientists should undertake research in frontier areas of post harvest technology such as applications of bio-technology, cryogenic processing, system dynamics simulation and modeling, super critical fluid extraction to obtain high value oils, fabricated foods and feeds through extrusion technology, membrane technology, and controlled /modified atmosphere storage etc.
- Suitable machineries in post harvest and

processing aspects such as commercial peelers, slicers etc. need to be developed.

- Transportation methods should be standardised, especially for local/rural transport.
- Emphasis should be made on utilisation of food processing wastes and seed processing as the fruits and vegetable seeds involve high costs and form the base for successful production. Presently some methods are available for the use of food processing wastes, but the available technologies are under utilised. Hence the scope should be widened to meet the need of farmers for on-farm use of wastes.

Conclusion

The forgone description indicates that the post harvest system is a complex and variable system. A thorough knowledge of the existing system is a prerequisite for establishing any programme of saving the food, which will improve availability, affordability and access to food with reduced wastage and appropriate processing. Development of an accurate description of the needs may require knowledge and assistance of many specialists. It can also be linked to income generation, particularly for the rural mass. Practical aspects like the creation of model plants and processing enterprises, capacity building will play an important role at all times. To achieve this, all the scientist, farmers, industries and policy makers need to coordinate their efforts in production, marketing, economic analysis, food processing and transfer of the technology etc to harvest synergistic output. Three-quarters of the world's poor live in rural areas and hunger and malnutrition are more common in rural areas than the urban areas. Further the main source of income in rural areas is agriculture. Thus improvements in agricultural productivity and reduction of losses will directly benefit the rural people.

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Vice Chancellor

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The Package's Role in Enabling Food for All

Introduction

Packaging can be inconspicuous and unobtrusive, something that doesn't really affect us. But packaging can also be difficult to open, awkward to handle and difficult to dispose of. Packaging can be beautiful to look at and even convey emotions that the content alone cannot deliver. And beneath the surface, beneath what our senses perceive when we come into contact with the packaged product, packaging is also an enabler for so much more; shipping, handling, information about the content and simplifying our purchases in a store.

But the journey has only just begun towards a world where everyone has food on the table and can be sure that it has not been contaminated – either intentionally or unintentionally.

About a third of all food produced globally for human consumption is lost or wasted – around 1.3 billion tons per year, according to the Food and Agriculture Organization. This is too often due to lack of good packaging and distribution solutions. Wasting food is not only an ethical and economic issue, but it also depletes the environment of limited natural resources. Despite big advances a lot more needs to be done.

All actors in the food chain have a role to play in preventing and reducing food waste whilst ensuring food safety from farm to fork. Those of us working with packaging have an important and inspiring responsibility. We can be proud of what we have done, but humble about what still remains.

A historic perspective on packaging

Packaging has always played a crucial role in the development of human being, for keeping, preserving and handling food & drinks. Very early in time, food was consumed where it was found. Families and villages were self-sufficient, making and catching what they used. When containers were needed, nature provided gourds, shells, and leaves to use. Later, containers were fashioned from natural materials, such as hollowed logs, woven grasses and animal organs.

With the weaving process, grasses, and later

reeds, were made into baskets to store food surpluses. Some foods could then be saved for future meals and less time was needed for seeking and gathering food.

As ores and compounds were discovered, metals and pottery were developed, leading to other packaging forms. Glass-making began in 7000 B.C. as an offshoot of pottery. Made from base materials (limestone, soda, sand and silica), which were in plentiful supply, all ingredients were simply melted together and molded while hot. Since that early discovery, the mixing process and the ingredients have changed very little, but the molding techniques have progressed dramatically. It was first industrialized in Egypt in 1500 B.C. When the blowpipe was invented by the Phoenicians in 300 B.C., it not only speeded production but allowed for round containers.

The process of tin plating was discovered in Bohemia in 1200 A.D. But no one was willing to use metal for food since it was considered poisonous. The safe preservation of foods in metal containers was finally realized in France in the early 1800s. In 1809, General Napoleon Bonaparte offered 12,000 francs to anyone who could preserve food for his army. Nicholas Appert, a Parisian chef and confectioner, found that food sealed in tin containers and sterilized by boiling could be preserved for long periods. A year later, Peter Durand of Britain received a patent for tinfoil after devising the sealed cylindrical can.

Paper may be the oldest form of what today is referred to as "flexible packaging." Sheets of treated mulberry bark were used by the Chinese to wrap foods as early as the First or Second century B.C. During the next fifteen hundred years, the paper-making technique was refined and transported to the Middle East, then Europe and finally into the United Kingdom in 1310.

But these first papers were somewhat different from those used today. Early paper was made from flax fibers and later old linen rags. It wasn't until 1867 that paper originating from wood pulp was developed. Commercial paper bags were first manufactured in Bristol, England, in 1844. The first commercial cardboard box was produced in England in 1817, more than two hundred years after the Chinese invented cardboard. Paper and

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paperboard packaging increased in popularity well into the 20th century.

Plastic is the youngest in comparison with other packaging materials. Although discovered in the 19th century, most plastics were reserved for military and wartime use. Plastic wasn't commercially used for packaging until the late 1950s and early 1960s, with polyethylene making the fastest progress. With the advent of plastics as a significant player in packaging, paper and its related products tended to fade in use. Lately that trend has halted as designers try to respond to environmental concerns. The polyester (PET) container entered the market 1977, primarily for beverages 1977. Today PET is a widely used material for foods.

Demography and globalization demands more and better packaging

Worldwide, more people now live in urban than rural environments. Food and other goods are therefor made at some distance from where they are consumed – packaging is needed to ensure they survive the journey from production to consumption.

Food and other goods have to be protected and contained on their journey from farm to factory via warehouses and shops until they arrive at consumer's homes.

In addition to containing and protecting goods during distribution and storing, packaging has to perform a wide range of other roles including carrying an increasing amount of information, much of which is required by law, being easy to open and reclose as well as tamper-evident. At the

retailer, **the packaging is the silent salesman**. When purchasing decisions often are taken within seconds, the packaging design plays a vital role in catching our attention. For brand owners, the packaging importance to reach out to consumers and touch their hearts and minds cannot be underestimated.

Packaging for food prevents wastage of the significant resources that go into growing, harvesting and transporting it. In developing countries food wastage can be as high as 50 % before it reaches consumers, due to lack of good packaging and distribution solutions. In developed countries consumers typically waste as much as 30% of the food that they buy. Packaging plays a key role in preventing more waste, but proper packaging solutions can do a lot more to reduce numbers in both ends of the value chain. New types of barrier solutions to oxygen, moisture, microorganisms and light will provide even more effective and sustainable solutions in the near future.

In addition to reducing waste, packaging also provides protection from contamination, which is particularly important for food that is often eaten raw or straight from the pack.

New sensor technologies and printed electronics, based on bio- and nanotechnology, on **packaging are expected to provide solutions to inform consumers** whether the content in the packaging is edible or not. Temperature/time sensors have been commercially available as indicator of product quality for several years. This is a field where a lot more is expected to happen, when it comes to actively help to extend shelf life, monitor freshness, display information on quality and improve safety for the consumer.

With visible or invisible solutions on the surface or built in to the package, **packaging can actively support the fight against fraud**, telling whether a product is authentic or not and reducing risks with fake products that could be harmful for consumers.

When the content is important, the package is important.

The role of packaging in reducing food spoilage

Food may deteriorate or spoil due to a variety of reasons. Losing water (getting drier) or gaining



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water (becoming soggy) from the environment is one of them. When products become moisture, microorganisms may start to grow and the food may then be subject to spoilage or to become potentially unsafe. Packaging may be used to restrict moisture loss.

Undesirable chemical changes can lead to unattractive color changes, loss of vitamins, changes in flavor and aroma. Among the most commonly encountered chemical changes are enzymatic reactions, which may proceed rapidly at room temperature and oxidation of fats and proteins during storage in air. This can cause rancidity, off flavors, loss of vitamins, color changes in meat etc. Enzymatic reactions can be decreased in a heating process. Oxidation can be restricted by packaging with a proper barrier to oxygen and or light, as light is a strong catalyzer of oxidation reactions.

Bacteria and fungi are common causes of food spoilage. The rate at which the spoilage develops can be decreased by a variety of means, such as lowering the temperature of storage, lowering the pH, adding preservatives or using vacuum packing or modified atmosphere packaging so that spoilage microorganisms cannot grow.

While canning and retorting processes can be used to inactivate the most heat-resistant organisms, milder heat processes, such as pasteurization, will inactivate only some bacteria and a proportion will survive. The more there are in the raw materials, the greater the number of bacteria that will survive and shorten shelf-life. The more intense the process is, the longer the shelf-life generally.

Packaging will have a primary role of protecting food after processing but may also be used to extend shelf-life. However if the gaseous environment is changed, e.g. vacuum or modified air packaging, this will favor the growth of certain pathogens and spoilage bacteria, while inhibiting the growth of microorganisms that require oxygen.

The conditions during distribution, storage, retail display and storage by the consumer, i.e. ambient, chilled or frozen has a huge effect on shelf-life. While frozen storage will stop the growth of all but a very few spoilage microorganisms, chilling will only slow growth. High ambient temperature in combination with humid storage conditions and

UV light is a high risk environment and generally requires preservation of some kind, either by preservatives, process, packaging or a combination.

Packaging's contribution to society

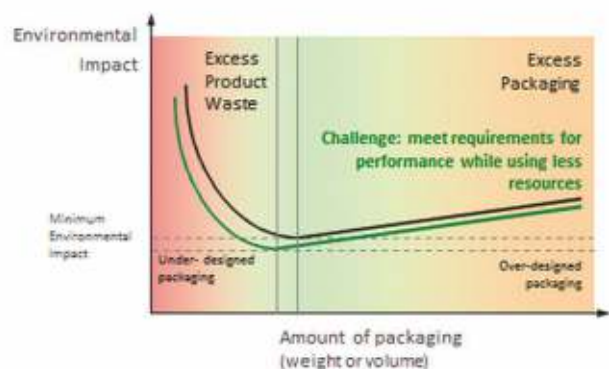
Packaging receives a lot of attention which is out of proportion to its scale in the overall waste stream. Packaging is necessary to protect products in the modern world. Without packaging the society would grind to a halt within days. Consumers would have to grow their own food or shop daily for it. The environmental damage from broken goods and spoiled food would be enormous. Food waste has at least ten times the environmental impact of packaging waste and that's before taking account of the impact of methane from decayed food.

Of the total energy used in the food chain, 50% is used in food production, 10% on transport to the shops and retailing. 10% to make the packaging and the remaining 30% is used by shoppers to drive to the shops and store and cook food.

Many of the facts of what have been achieved and what is being done to reduce the environmental impact of packaging is not commonly known. It is not generally recognized that business have already achieved a great deal and continue to do much to design more effective packaging, minimize environmental impact and increase the amount of used packaging that is recovered and recycled.

There is a general agreement that **the whole package-product system must also be**

A Package Should Save More Than it Costs



Source: The Consumer Goods Forum / The Innventia AB Model

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considered sustainable. If the package system fails to provide adequate protection for the goods it contains it is not really sustainable at all, as in this case both package and product will be wasted.

Product waste has far greater environmental impact than the packaging it comes in. Ten times more resources are used to make products than to make the packaging that protects them. Packaging therefor needs to be designed to keep products as fresh as possible, for as long as needed. To realize a sustainable supply chain and minimize losses of resources it is necessary to take into consideration the overall impact from farm to fork.

Good packaging reduces product waste and facilitates processing and distribution of products.

Proper packaging assures availability of safe, hygienic and undamaged goods for people. Right packaging contributes to a sustainable society and plays an important role in enabling food for all.

Sustainable packaging saves more than it costs.

Per-Stefan Gersbro
Managing Director
Paccedo

Post-harvest Management System for Value Creation of Oranges

Introduction :

Agriculture and Value chain Development should go together to achieve the objective of increased revenue to the farmers and better quality to customers at an affordable price. For more than four decades since Green revolution, the focus was to improve the production and productivity of Agriculture and horticultural produce. Efforts by Government to strengthen Farmer producer organization (FPO) has shown remarkable progress in improving the quality and productivity in last decade. But the progress made is only in one end of the supply chain and does not benefit neither the farmers to get better returns nor the

consumers to get better quality.

Value chain approach is necessary to link the Farmers in emerging markets in order to understand the quality and desired quantity required. Post harvest management Technologies and systems play an essential part of value chain creation in most of the horticulture produce. In India, it has been estimated that about 50,000 Crores of Indian Rupees (8 billion US Dollars) is lost every year due to absence of Post harvest technologies and in-adequate Temperature Controlled Storage and distribution Facility in production and distribution centers.

The statistics of Citrus production in different states are as below:

STATE-WISE PRODUCTION AND PRODUCTIVITY OF ORANGES:

Area in '000 Hectare , production in '000 Metric Ton, productivity = pdy in Metric Ton/Hectare

		2010-2011			2011-2012			2012-2013	
STATE	AREA	PRODUCTION	PDY	AREA	PRODUCTION	PDY	AREA	PRODUCTION	PDY
ASSAM	14.8	170.7	12	15.1	175.7	12	15.85	195.82	12
KARNATAKA	2.2	41.3	19	3	63.6	21	3.2	71.8	32
MAHARASTRA	128	500	3.9	113	443	3.3	133	370	2.8
MADHYA PRADESH	38	684.9	18	44.2	647.5	15	49.52	844	17
RAJASTHAN	15.2	272.5	18	9	179	20	10.5	227.38	22

Source : National Horticulture Handbook

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Scope for Value chain Creation for Oranges:

Orange is the most common Citrus fruits grown in India with good market demand. Citrus Industry is one of the largest in the fruit Industry in the country. The country produces three commercial varieties namely Mandarin , Sweet Orange and acid lime . Oranges are harvested in the states of Maharashtra, Madhya Pradesh, Tamil Nadu, Karnataka , Rajasthan, Punjab , Assam and in Arunachal Pradesh.

The Nagpur Oranges is one of the finest Mandarins produced in the World. The statistics of production and seasonal calendar.

C) Post Harvest Technologies for Oranges:

Citrus De-greening :

De-greening is defined as the process induced after the harvest of citrus fruits in order to accelerate the green colour to the typical colour (yellow or orange colour) of the variety in the peel.

The de-greening process will add value to the product as per demand of the customer and fetch better price .

Understanding De-greening Process and Technology:

It is necessary to understand the de-greening process before starting de-greening the fruits to avoid non desirable physiological changes caused by wrong processing.

There are several factors that influence the process: ethylene, temperature, carbon dioxide - resulting from the fruit respiration, relative humidity, chemical treatments of the fruit on the tree, and possibly most importantly, the condition of the fruit on the tree. If the fruit on the tree has not started to form the red - orange - yellow colors, they will not appear in the de greening room. Fruit must be collected at a correct stage of colour development.

A) Influence of Ethylene:

De-greening of citrus is accomplished through the external input of ethylene that stimulates respiration and speeds up the changes on the peel pigmentation. These changes are consequence of the conversion of the chlorophyll to carotenoids (yellow, red, orange... depending on the variety), is due to degradation of chlorophyll and the

synthesis of new carotenoids.

The ethylene concentration for the process can be between 1 to 5 ppm, with 1 to 2 ppm being the ideal concentration. All added ethylene is negative for the fruit quality, so the minimum possible should be used. Higher concentrations, in addition that they don't speed up the process, can sometimes produce, depending on the temperature, physiological disorders such as: brown stains on the skin, blackening and loss of the calyx, and rapid ageing of the fruit

B) Influence of Temperature:

At higher temperatures the de-greening process will happen faster. But higher temperatures are more aggressive to the fruit, reducing the shelf-life. All varieties of citrus will de-green well at 19°C. Some varieties with stronger skins can withstand being forced at higher temperatures.

C) Influence of Carbon Dioxide

In the de-greening process, changes in the fruit metabolism will increase respiration, resulting in rise of carbon dioxide production.

It is proven that carbon dioxide is an antagonist of ethylene and therefore it acts as an inhibitor in most of the physiological processes favoured by this gas. In consequence, high concentrations of carbon dioxide in the room should lead to a slowdown in the de-greening process.

The optimum concentration for both conservation and de-greening of all varieties of citrus is 2500 ppm CO₂. This concentration should be maintained by ventilating the room with fresh air. Lower concentrations will increase energy use, through higher rates of ventilation. Higher concentrations can give an off-flavour to the fruit, and will slow down the de-greening process.

e) Influence of Relative Humidity

As a result of increase in respiration of de-greening process there is a rise in the emission of water vapour apart from other volatile organic compounds. The fruit will experience dehydration and therefore lose weight and fresh look. These losses are proportional to the vapour pressure difference between its tissues (next to saturation) and the external environment.

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In order to prevent this problem as much as possible, it is necessary to supply water to the room's atmosphere through vaporizer nozzles that should produce such small water drops that would let the relative humidity rise up to 95% without wetting the fruit. This way, with RH close to saturation in the environment, the difference with the vapour pressure on the surface of the fruit's skin will be minimal. The relative humidity can be as high as possible, without wetting the fruit. Between 95 and 100% relativity, a slight temperature drop can cause condensation, so 95% is the normal limit.

B) Present Supply chain from Nasik to Delhi:

The Nagpur Oranges (Rediculata Mandrina) are delivered to major wholesale markets India . The farm price will rise 50% whereas due to the absence of value chain systems the quality will fall 20 to 30% before reaching the whole sale market. The retail price will be vary from 80 Rs to 100 Rs per kg. The farm gate price to consumer price will be 4 to 5 times.

		per kg charge	Rs.per kg charge
Location of procurement	Amravati, Maharastra		
Average procurement price			20
Market fee	Rs 700/ per truck + govt.tax	0.05	0.05
Purchase/agriculture Tax			
surcharge(current, if any)			
market charges(mandi tax etc)		2%	0.4
commission charges(brokerage charges)		5%	1
Octroi current, if any)			
sales tax(current, if any)			
other charges(development cess)		0.50%	0.1
Gunny bags/crates/bins/cardboard box(current, if any)	Rs 215 per plastic crate(containing 18-20 kg apples)or if cardboard boxes used it cost Rs 100/ for 10kg box	1.1	1.1
Local transport(current, if any)			
Transport to Delhi	Rs 5.50/ per kg	5.5	5.5
Warehousing(current, if any)			
Storage		4%	0.8
Quality discount		6%	1.2
Insurance	Rs 2000/ per truck	0.13	0.13
Labour	Rs 000/ per truck	0.4	0.4
Miscellaneous if any	Rs 3000/ per truck	0.2	0.2
Cost on arrival			30.88

Summary :

Creation of value chain involves integration of all stakeholders, Post Harvest Management processes and technology to benefit the farmers and consumers. Understanding the product characteristics, adopting right processes and implementing the appropriate technology will bring the results.

Sivakumar

Director

Agrivaluechain Services Pvt. Ltd

From Supply chain to Value chain :

Creating Value Chain :



Orange Farms: Harvesting with Right tools



De Greening Chambers



Washing and Drying



Sorting and Grading

Agriculture & Food Processing Sectors in Maharashtra

Historically, Maharashtra has been India's most industrialized State and it continues to attract the largest quantum of investments, both domestic and foreign. The gross state domestic product (GSDP) at current prices for 2011-12 contributes about 14.4% of the GDP. The GSDP has been growing at a rapid pace over the last few years. Presently industrial and service sector both together contribute about 87.1% of the State's income. The agriculture & allied activities sector contributes 12.9% to the State's income.

In the State of Maharashtra approximately 65% population is involved in various agricultural activities. Production of rice, jowar, bajra, wheat, tur, mung, urad, gram & various other pulses has been big player in Maharashtra's business. Oil seeds such as groundnut, sunflower, soyabean are the major oil seed crops in the State. Maharashtra leads in the country in terms of horticulture production. Soil, favorable climatic conditions, skilled & unskilled manpower, urbanization & active involvement of farmers have added to the overall dimension of Maharashtra's food processing sector.

The food Processing Industry provides employment to about 2 lakh people. Maharashtra leads in the registered food processing units in India followed by UP and Karnataka. Several FDI proposals have been approved in the food processing sector. 90% of the wine industry in the country is located in Maharashtra. Maharashtra is a bio-diverse state with 9 agro-climatic zones and varying soil types suitable for agriculture development. Maharashtra is one of the best performing State in terms of production & processing of food products and has been always the first choice for investment in food processing sector.

Maharashtra has 8 Agri Export Zones for different products in different regions. These are for Mangoes (one for Alphonso & one for Kesar), Grapes, Pomegranates, Oranges, Bananas, Onion & flowers). MOFPI sponsored food parks have been established in Satara, Paithan, Ahmaednagar and Wardha. The parks are in the developing stage with food processing facilities making use of cereals, pulses and fruit and vegetable production in the State and adjoining areas to carry out a

range of processing activities. It also has storage facilities in the form of cold storage, warehousing etc.

Since Maharashtra is a bio diverse state, certain districts/regions are blessed with abundance of particular variety of food crop(s). For example, districts in Kokan region and certain districts in Vidarbha region receive high rainfall, which is conducive for production of rice. Hence, these areas are major producers of rice. Similarly, for oilseeds and pulses, the soil conditions and rainfall pattern in Vidarbha and Marathwada are favourable.

The state is also a leading exporter of grapes to markets in the European Union and South East Asia. In 2011-12, India exported 108.58 Thousand Tonnes of grapes valued at INR 602.88 Crore, of which, nearly 80% were exported from Maharashtra. The well organized co-operative infrastructure of Grape Growers Association has not only promoted viticulture in the state but also brought the state in focus at the global level. Nashik and Sangli are the major Grape growing districts in the state which cater to the export markets and also house the 'Wine Parks'.

Sr. No	Schemes	Released Grant
1	Technology Upgradation Scheme	2411.82
2	Cold Chain for Non-Hort. Products	1000.00
3	HRD	93.50
4	Promotional Activities	37.80
5	Setting up/ modernization/ expansion of Abattoirs.	-
6	Primary Processing Centers/ Collection centers in Rural Areas	-
7	Modernization of Meat Shops	-
8	Reefer Vehicles	-
9	Old Food Parks	84.26
10	5% administrative Charges	173.50
11	Preparatory Activity	150.00
	Total	3950.76

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MAIDC is a Govt. Undertaking of Maharashtra State, India engaged in manufacture and sale of fertilizers, pesticides, animal feed, agricultural implements and processed food products under the brand name “NOGA”. We have our own fully automated plant with state-of-the-art R&D facilities and a strong marketing network. MAIDC have been appointed as State Nodal Agency for development of Food Processing Sector in the State & also nodal agency for implementation of MOFPI schemes. Currently the Central government has delinked the Schemes. However, State Government is planning to implement the schemes again.

MAIDC through study has identified investment opportunities in Maharashtra specifically in fruits, vegetables, dairy, winery, fishery. Developing value added products & modernization in food processing industry could bring revolution in this sunrise sector along with giving better prices to the farmers of the State. Continuous training & capacity building of workers in food processing industry, improvement in the globally accepted food standards, developing regulatory specifications & brand promotion across globe with the support of investors could improve food processing sector in Maharashtra.

MAIDC

Recent Innovations in Post-production Processing and Value Addition of Food Crops for Sustainable Livelihood¹

With diverse agro climatic zones yielding all kinds fruits, vegetables and other produce to provide food, feed, fiber and fuel, India can become food basket of world. The production and processing systems should assure quality and comply with stringent regulatory requirements to achieve this. This calls for vigorous infusion of engineering and technology inputs in post harvest handling and processing industries.

After production, the agricultural crops and commodities have to undergo a series of postharvest operations such as collection, cleaning, sorting/grading, decortication, drying, packaging, transportation, storage and value addition before reaching the consumer. The total postharvest losses range from 6 to 18% (Nanda et al., 2012). The availability of food can thus be increased by reducing these huge losses and preserving the quality of produce to ensure nutritional security. The food processing industry in India is highly fragmented in sectors like grain processing, fruits and vegetables, milk and milk products, meat and poultry, marine products, beer and alcoholic beverages, packaged or convenience food and packaged drinks. Majority of entrepreneurs are small and unorganized. In the present context, technological challenges are becoming more complex than before as demand for raw as well as processed food is increasing and supply sources are dwindling. The science is also

changing rapidly with the emergence of new tools, methods, techniques and approaches that promise technological breakthrough to accomplish the mission. Thus, there is a need to explore alternative ways for enhancement of production, preservation of produce, storage and reduction in the postharvest losses in all agricultural commodities along with assurance of food safety and quality. In this paper scenario of Post production processing and its Future thrusts have been discussed which will not only provide an opportunity to re-think and plan our strategies to prevent post harvest losses and make food available to all but also give opportunities for income and employment generation for sustainable livelihood.

Processing of Food Grains

Main goal of food grains processing is the loss prevention and value addition to the raw food commodities. Raw food materials are cleaned, graded and then conditioned either for storage or processing. Processing is done to make raw commodities edible through primary and secondary processing and ready to eat through tertiary processing. At every stage of processing, value is added to the product, which plays an important role in improving the economic benefits to the farmers. Processing and value addition would also enhance and augment per capita

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food availability from unit arable land; thereby resulting in an overall increase in productivity, employment and income. Postproduction processing is generally commodity specific and with each operation, value is added to the produce. It is estimated that value addition is about 75% for primary processing and 25% for secondary processing.



Processing and Value Addition of Wheat

Wheat is a major crop of India. In the year 1950-51, the country produced 6.5 Million tons of wheat that has increased to 96 million tons in year 2013-14. India has emerged as the second largest producer of this cereal in the world. Wheat consumption in India is mostly in the form of homemade chapattis (unleavened flat bread), using custom milled atta (whole wheat flour). However, branded and packaged wheat atta marketed by large food companies is gaining market share in urban areas due to convenience. Some wheat is also used for various wheat-based processed products like bread, biscuits and other bakery items and their share is rising. Although wheat grain may be used as a whole in different ways in the preparation of food products for humans, yet it is usually pulverized and fractionated during the preparation for further processing. Most of the wheat in India is generally converted to flour, semolina, dalia or grits, etc. Various machines and equipment such as cleaner and grader, pulveriser and grain sifter are developed by R&D institutions can be popularized among small and marginal farmers to adopt them for value addition of wheat.

Processing and Value Addition of Rice

Rice is considered to be staple food diet in most parts of India including the north-east states. Paddy or rice grain consists of husk and brown rice. Brown rice, in turn, contains bran which comprises the outer layer and the edible portion. Rice milling is removal or separation of husk (dehusking) and bran to obtain the edible portion for consumption. The process has to be accomplished with care to prevent excessive

breakage of the kernel and improve recovery of paddy or rice. The main products of rice milling consists about 70% rice, 20% rice husk, 8% rice bran and 2% rice germ. Broken rice, rice bran and husk are usually considered the by-products of the rice milling industry but these are very valuable from economic point of view and may be utilized for various value added products. Parboiling process involves hydrothermal treatment of paddy before milling. The advantage of parboiling process stems from the gelatinization of rice starch and hardening of rice kernel. As a result, breakage losses during milling of rice can be minimized. Number of rice machines like dehusker, polisher and rice separator of different capacity are available which can be adopted even at the rural level



Processing and Value Addition of Maize

Maize processing is essential to convert / fractionate it into various food and industrial products. Traditionally, maize is processed into maize flour in mills for making chapatti or bread. In general, dry milling is used for producing various food products (flaking grits, flour, meal etc) while wet milling is used for production of industrial products (starch, corn oil, animal feeds etc. or germ, fiber, protein and starch). However, in both dry and wet milling methods, the germ is separated from the grain in order to extract and recover the oil. The degermed maize products, obtained by dry / wet milling methods, have longer shelf life than non-degermed maize processed products. ICAR-CIPHET has developed a small capacity maize degermer (50kg/h) for dry degerming of maize, which provides about 60% degermed maize. The cost of this machine is about Rs. 40,000/-. The degermed maize obtained after degerming processing can be utilized for making flour with enhanced shelf life and in grit form it could be successfully considered for making expanded snack food. The maize germ obtained during this process may be utilized for extraction of maize germ oil.

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Processing and Value Addition of Millets

Millets are gaining popularity due to the presence of dietary fibre and phytochemicals in them. Like other cereals, millets also contain significant amount of B-vitamins and minerals such as calcium and iron. Millet protein lacks gluten, hence have a great potential in gluten free food products. These can also find way in quick cooking cereals, or extrude products. These millets are nutritionally superior to rice and wheat. These are rich in protein mineral and vitamins and contain higher proportion of dietary fibre than rice or wheat. In India, the total small millet production was 381.9 thousand tonnes in the year 2009-10. India continues to be the single largest producer of pearl millet and second largest producer of sorghum in the world. The various millet species can be divided into two broad categories: pearl millet and "small" millets. Small millets (except proso millet) have smaller grains than pearl millet. These include, barnyard millet (*Echinochloa colona*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*),



kodo millet (*P. sorobiculatum*), little millet (*P. miliare*) and proso millet (*Panicum miliaceum*). Traditional methods are usually applied to decorticate millet grains partially or completely before further processing and consumption. For human food, the millet grains are customarily milled before being cooked but due to their small grain size, milling is often more complex with millet. Traditional methods are usually applied to decorticate millet grains partially or completely before further processing and consumption. Primary processing of pearl millet grains is required to remove the outer husk. It can be cleaned using cleaner cum grader (Indosaw, Ambala, India), destoned using Destoner (Model 6276, Indosaw and Ambala, India). Dehulling and debranning of pearl millet grains was done using dehuller or pearler (Mathesis Engineers Pvt. Ltd., Hyderabad). ICAR-CIPHET, Ludhiana has also developed pilot scale equipment and machinery, which can be used for processing of small millets. Number of value added products could be developed from coarse cereals and small millets. Barnyard millet flour based muffin is one of the

products, which is gluten free with good amount of nutrition and eating quality. This product is becoming popular very fast because of its gluten free nature.

Pulses Processing and Value Addition

Pulses are the cheapest and rich source of protein, which can be considered lifeline of vast population of India. Apart from being the good source of protein, pulses also contain substantial quantity of minerals, vitamins, crude fiber etc. of seeds. In the area of milling of pulses, CFTRI developed a dhal mill that has the advantage of not being dependent on natural sun shine. It involves subjecting the pulse grain to high temperature (120 degree Celsius) for short time and the dehulling by carborundum rollers resulting in higher dhal recovery. For entrepreneurs including small and marginal farmers in rural areas, dhal mills have been designed at CIAE, Bhopal; PDKV, Akola; IIPR, Kanpur, TNAU, Coimbatore; GBPUA&T, Pantnagar and CFTRI, Mysore. These units in specific regions have gained popularity as these are low investment machines which can be owned and operated with low risk.

Oilseeds Processing and Value Addition

On an average, oilseeds contain 40-45% oil and 20-25% protein, depending on the type of oilseeds. The utilization of oilseeds in India is about 7% as seed, 8% direct food uses and 85% for oil purposes. Nutritionally, the edible oil is the richest source of energy (9 kcal/g) and provides essential fatty acids and transports fat-soluble vitamins in human body. Edible oilseeds in India yield about 17 million tones of cake or meal containing 25-30% protein. Out of this, it is possible to produce about 8 million tons of oilseed meal containing about 40% good quality protein for human consumption. This would yield 3.2 million tones of protein, equivalent to about 13 million tons of additional pulse production.

Groundnut, rapeseed-mustard, soybeans are the three major oilseeds being exploited for oil extraction. Oilseed meals are mostly utilized as animal feed (up to 75%) with about 10-15% being used as organic manure. There is a need for changing this pattern of utilizing the oilseeds meal. Oilseed meal can be made to use for human consumption in the form of full fat or partially defatted/ defatted flour, protein concentrates and protein isolates. Dehulling/ decortication helps in producing edible cake/meal.

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Groundnut is one of the major oilseeds, which fulfils the major portion of oil demand of our country. It is usually processed along with hull for extracting the oil. The resultant cake contains hull, which makes it unfit for human consumption. CIPHET has developed groundnut pod decorticator (capacity 100 kg/h) with >90% decorticating efficiency. Further, CIPHET has developed a groundnut kernel designer (capacity 60 kg/h) with deskinning efficiency of 70-80%. This is quite useful for deskinning of groundnut kernel, which can be utilized for preparing the edible grade meal and good quality ground nut oil. This groundnut meal can be utilized for preparing various value added nutritious products of good economic value. Oil expellers and filter-press of different capacity and size are available in the country which can be installed in villages for expelling of oil. Sunflower seed is considered to be an important oilseed crop because it contains highly nutritious oil in large quantity.

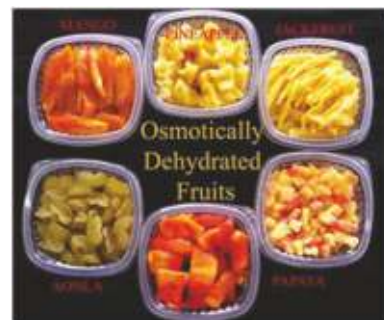
Sunflower kernel has 50% oil content, of which 30% is the essential fatty acid, linoleic acid. The hull comprises 20-30% of the seed, depends on the variety, and contains mostly crude fiber and an insignificant quantity of fat. In India, oil is mainly obtained by mechanical expression from whole sunflower seeds. However, this process suffers from some drawbacks. The hull of the seed causes rapid wear and tear of machinery. The hull reduces food value of the de-oiled meal and also decreases the oil recovery. The dehulling of seeds followed by mechanical expression of oil from the kernel could improve the quality of oil (low wax content and improved color) and de-oiled meal (low fiber and high protein content) as well as reduces the physical damage of oil expression unit due to absence of hull. CIPHET has developed a sunflower dehulling mill (capacity 400-500kg/h). The dehulled sunflower kernel can be processed for oil extraction and edible grade meal, which can be utilized for development of value added products like expanded snack foods, bakery products and also fortified pasta etc.

Sesame seeds contain about 19.0% protein while sesame meal contains 40-45% protein and 6-8% crude fibre with a lysine content of 2.7%. Solvent extracted sesame flour has the highest protein content of 56%. CIPHET has optimized the process parameters for development of protein rich good quality edible grade sesame meal for its further utilization for product development.

Processing and Value Addition of Fruits and Vegetables

India being a home of wide variety of fruits and vegetables holds a unique position in production figures among other countries. The major fruits grown in India are mangos, grapes, apple, apricots, orange, banana fresh, avocados, guava, litchi, papaya, sapota and watermelons. It is estimated that more than 20-22% of the total production of fruits is lost due to spoilage at various post harvest stages. The fresh fruits are mostly harvested by hand or hand tools. Sorting and grading of fruits are done on a very limited scale and that too are based on visual inspection only. Limited pre-cooling facilities are available for highly perishable produce like grapes; strawberries etc. only for export purpose. Processing plays an important role in the conservation and effective utilizations of fruits & vegetables. The processing also helps in generating rural employment; besides, processed fruits and vegetables are a source of earning foreign exchange.

India has favorable climatic conditions and vast potential for growing fruits and vegetables. However, slightly over one percent of the total production of fruits and



vegetables is processed. This is because of a number of problems faced by the industry such as high cost of production, high cost of processing, high cost of packaging and transportation. The prominent processed items are ready to serve beverages, fruit pulps and juices, fruit based ready-to-serve beverages, canned fruits and vegetables, jams, squashes, pickles, chutneys and dehydrated vegetables. More recently, products like frozen fruit pulps dehydrated and freeze dried vegetables. Frozen fruits and vegetables products, fruits juice concentrates and vegetable curry in pouches, canned mushroom and mushroom products have been taken up by the fruits & vegetables processing industries. Many tools and equipment have been developed for harvesting, grading and sorting, handling and storage of fruits and vegetables. Clippers, Safe harvesting, Fruit grader, Fruit Washing Machines, Minimal Processing and dehydration Technology for making fruit bars, candies etc. Ready to serve beverages and other value added products could

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be made at rural level by installing appropriate agro processing units.

Processing and Value Addition of Food Grains for Nutrition Security

Implication of nutritious diet to health and well being is now well understood by the researcher as well as consumers. Dietary adjustment may not only influence present health, but may determine whether or not an individual will develop such diseases as cancer, cardiovascular disease and diabetes much later in life. In India, wheat flour, rice, maize, millets, pulses etc. are the common foods which are processed for making flour and food products and being consumed almost every household in our country. These food ingredients/ processed items may be made functional and nutritionally balanced by the combination of different grains by preparing composite and fortified flour which are the basic ingredients for making chapatti, baked foods, Multigrain protein rich expanded products Fortified rice, fruits juices and candy etc.

Iron fortification of food is considered the most cost-effective, long term and convenient approach to provide additional absorbable iron to populations. Rice represents a perfect food for fortification, because it is a staple food consumed by all population groups (children, elderly, etc.) even by allergic and irrelevantly by their income. Increasing iron concentration in rice grain is expected to enhance iron intake by rice consumers and decrease incidence of iron deficiency anaemia. CIPHET has developed the technology for preparation of iron fortified rice premix using bio-available forms of iron compound and biopolymers coating (Mridula et al.2012). In order to get the desired iron content in the iron fortified rice, the iron fortified rice premix was mixed with unfortified milled rice to a ratio of 1:100. This proportion may vary depending on the availability of the iron content in the premix and requirement in the final product.

In order to make a nutrient dense healthy extruded snack, it is important to wisely select multiple raw materials to attain a balance between protein and carbohydrates. In order to develop nutritionally balanced snack food, pulses such as soybean and chickpea were also incorporated in the extruded product along with maize and sorghum. Extrusion is process by which the starchy and/ or proteinacious materials are plasticized by combination of heat, mechanical shear and pressure. Extruded snacks were prepared from coarse cereals i.e. maize and sorghum along with

legumes viz. bengal gram and soybean etc. These extrudates with flavouring materials can be used as snack foods as well as for preparing the health mix for young children particularly in rural areas suffering with malnutrition. .

Future strategies

Scope of the agro-processing industry encompasses all operations from the stage of harvest till the material reaches the end users in the desired form, packaging, quantity, quality and price. Further, tremendous changes in lifestyle, eating habits and shifting rural habitations are causing an irreversible change that is leading to manifold multiplication of health problems and these health issues have attracted the attention of every segment of the society in the recent past. Efforts should be made to encourage entrepreneurs including farmers to adopt technology and equipments available for processing and value addition of food crops by establishing agro-processing clusters in urban as well as semi urban areas including villages either individually or in group. Further, R&D institutions and Government agencies should evolve following strategies promote food processing among rural entrepreneurs including small and marginal farmers;

- (a) Plan for improvement and extension of agro-processing technology by promoting agro-processing clusters in urban as well as semi urban areas including production catchments in villages.
- (b) Entrepreneurship Development Programme should be organized for entrepreneurs to enhance skills in Food Processing.
- (c) Traditional food products should be converted into affordable health promoting food products through processing interventions.

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Food Processing Industry: Present and Future

1. Introduction

India is the second largest producer of food and holds the potential to be the biggest on the global food and agriculture canvas, according to a Corporate Catalyst India (CCI) survey. The food industry in India comprises food production and food-related processing industries. The food processing industry is one of the largest in India – it is ranked fifth in terms of production, consumption, export and expected growth.

The Agriculture sector is the base for most of the food processing industry and this sector has touched a growth rate of 4.4 per cent in 2012-13. The food grain production at the all-India level is close to 245 Million MT. The Food Processing industry is growing at a 13% growth rate and for the Indian economy the growth of this industry is crucial for the overall growth of the Nation.

2. Food processing overview: Indian Scenario

India annually produces 205 million tons of fruits and vegetables and is the second largest country in farm production in the world but unfortunately the processing percentage is poor - only 4.6 %. In contrast, countries like the USA (65%), China (23%) and Philippines (78%) are far ahead of India in reducing wastage and enhancing the value addition and shelf life of farm products. This is an alarming signal for India as a large volume of the agricultural produce is wasted. About 35% of the fruits and vegetables are wasted annually due to poor storage facilities, amounting to a revenue loss of Rs. 500 billion. Also, 80% of the vegetables rot due to high water content and lack of processing facilities, resulting in a revenue loss of Rs. 125 billion.

The Agriculture sector is vital for any nation and in India it is the principal source of livelihood for more than 58 per cent of the population and I consider the Food Processing sector to be just an extension of the Agriculture sector. The progress of each sector is dependent on the other. In developed countries, because of a developed Food Processing sector, a demand is created in the Agriculture sector. India will follow the same path.

2.1 Indian Food Industry

The Indian food industry is projected to grow from US \$100 billion to US \$300 billion by 2015, according to a report by a leading industry body and Technopak[footnote]. During this period, the share of processed food in terms of value is expected to increase from 43 per cent to 50 per cent of total food production.

The food processing industry is of enormous significance for India's development as it has efficiently and effectively linked the nation's economy, industry and agriculture. The linking of these three pillars has synergized the development process and promoted the growth of the nation to a great extent.

The Food Processing industry is one of the largest industries operating in India and is divided into several segments.

The Food Processing industry operates across various segments that include:

- Fruits and vegetables
- Meat and poultry
- Dairy
- Marine products
- Grains and consumer foods (including packaged food, beverages and packaged drinking water)

The fruits and vegetables processing industry is highly decentralized, and a large number of units are in the cottage, household and small-scale sectors, having small capacities of up to 250 tons per annum. Since 2000, the Food Processing industry has seen a large growth in ready-to-serve beverages, fruit juices and pulps, dehydrated and frozen fruits and vegetable products, pickles, mushrooms and ready-mix vegetables. The small-scale units engaged in these segments of processing are export-oriented. Value addition of food products is expected to increase from 8 per cent to 35 per cent by 2025. Thus, this sector is very important for overall growth of India since this sector takes care of farmers and ensures employment for **skilled and unskilled /educated and non-educated labor**.

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I see a huge potential in post-harvest treatment for fruits and vegetables in the coming days. Due to changes in lifestyle and urbanization, the demand for high-quality fruits and vegetable is increasing. Even the demand for ready-to-use fruits and vegetable is increasing. The scope for cut vegetable is quite high due to the growing demand.

Apart from traditional food processing viz. Mango, Banana, Grapes, Sugarcane, Dairy, etc. this sector needs value addition which will give a good payback to the farmers and will also ensure inclusive growth (**higher returns to all stakeholders**).

India is witnessing a paradigm shift and the following sectors have a huge potential to fuel the growth of food processing in India. These will be the game-changers:

- Nutraceutical industry
- Wine processing
- Pre/Pro biotic Industry
- Packaged water industry
- Ready to eat industry
- Traditional foods processing
- Cut fruit and Vegetable industry
- Post-harvest treatment for fruits
- Export -Brand India
- Food additives
- Food equipment manufacturing

3. Challenges

For overall growth of the food processing industry, along with raw material, there are many other inputs which are required.

The biggest challenge is that the food processing sector is dominated by unorganized players who contribute to 80% of the food processing industry (by volume) unlike other sectors viz. Pharma, Automobile and IT where over 90% of the sector is under organized players. There is a conversion of un-organized to organized sectors but we still need to cross quite a distance.

In India, 85% of the GSDP comes from service and industry sectors and only 15% is from the Agriculture and Food sector, but 55% of the population is dependent on Agriculture/food

sector. If you look at this statistic minutely, 55% sector contributes only 15% in GSDP value and this is mainly due to the lack of processing or value addition. We need to change this scenario and money should go back to the farmers as per their value addition and thus Agriculture/food sector should equally contribute to its size (**1 : 1 ratio**) in GSDP. This is possible if we focus properly like many developed countries who have a higher ratio. This will fulfill our objective of ‘**Sabka Sath, Sabka Vikas**’.

The main challenges in the Food Processing industry are -

- Unavailability of processable quality and quantity of fruits and vegetables and raw material
- Low productivity of Agri products
- Low land holding per farmer
- Poor processing conversion
- Low technology base/low automation
- Labor-intensive operations
- High seasonality : Input availability
- High operating cost due to small scale operations

These challenges can be overcome by proper planning and focus given to this sector.

4. Market Potential

The Food Processing sector is called as Rising-Sun industry due to its inherent potential. In India, today, Food Processing sector has its own advantages like -

- Stable central government – Decision power
- Separate food processing ministry with able leadership and clear focus
- Good urbanization – due to many reason – market is expanding
- Good consumer purchasing power : Middle class segment is increasing
- Good Market potential – Domestic – husband /wife working need processed food
- New Food safety regulations – Nutraceutical industry is part of ‘Food’
- Good in Agri production
- Good infrastructure/investments
- Good in-flow of FDI in the sector

Let’s see how much potential exists in India for the Food Processing market.

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In India we have a population of 120 Crore.

Considering 4 members per family - we have a 30 Crore family base in India.

Let's consider each family spending Rs 2500 on food expenses (which includes milk, oil, grains, vegetables, fruits, etc.). Thus an amount of Rs. 75,000 crore/month is spent by India.

Which means we spend around Rs 9,00,000 Crore per year on Food consumption. This is the food market potential in India and these numbers are on basic needs, not included other high valued items. Over all the demand would grow only.

Now the question is what part of this market is catered to by the organized sector, retail sector or non-organized sector. Are we using our resources fully to cater to this market? Do we have the facility to fulfill this demand? Or are we dependent on import (other countries) ?

5. Some Ideas

5.1 Focus on Market – Build quality brands at low-cost product development.

Today India is a big village. Recently the government has announced removal of the APMC Act and this will certainly fuel the trade from **farmers to consumers**. For export we need to work on supply qualities.

Government and Industry should focus on Market needs and try to meet the demand rather than putting our own production in the Market with low realization.

The focus should be **Market backward rather than production forward**. If the Market needs seedless Guavas or Oranges we should supply the same (I know it's a long process and will take time, but the Government, Agriculture universities and companies should focus on this) rather than supplying normal Guavas and fetching a lesser price. The best example is of Punjabi dhabas – just because of market demand, today we see the success of the dhaba model all across India without any intervention from the government. Similarly, a product like paneer makhani has travelled from Punjab to South India. Idlis have travelled from the south to the north. Dhokla has

travelled from Gujarat to Kolkatta and Rasagulla has travelled from West Bengal to all over India. But we need standardization of the processes and some help in developing products and brands.

There are some success stories like Grapes (seeded to seedless) and Banana (normal to tissue culture) which have changed the complete economics of the trade. We should follow the same route for other fruits and vegetable. In short the Mantra is '**Meet the Market demand**'.

5.2 Focus on Traditional Food processing and Technology

India has a great food map which is spread all across India. Every state has its own food culture and we need to cultivate and nurture this culture to maintain our long heritage. Why not invest R&D efforts to make the traditional food sector more modern with high science? Academia should be given priorities on traditional food R&D and some good innovative techniques should cater to the market. There are many market problems which can be solved by R&D efforts. There are over 300 Food Technology colleges and over 50 Food/Agri universities. They should fuel innovation in the area of Traditional food and bring some economical solutions so that the common man / housewife will get the benefit of such innovation

Some example where small ideas can bring a big impact -

- Roti-making technology : Roti in pre-packed condition with high quality /long shelf life/low prize and hygiene
- Idli / Dosa batter which can stay for 7 days at room temperature
- Dehydration technology at very low cost - This will make 'Ready to serve' products at low cost
- Freezing/Cold storage technology at low cost - This will change the face of farming
- Focus on food equipment design and R&D - Today we have to import most of the equipment. Even for Samosa making we import the technology from abroad.
- Use of traditional packaging materials to balance the environment impact -

5.3 Skill development through Food Technology colleges and Universities

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As mentioned earlier, we have over 300 Food technology / Food science colleges all across India. Can we use these colleges as skill development centers? Some basic curriculum can be made by the ministry and we can design training models which will be executed depending on the area and subject. The target audience would be women and unemployed youth. These colleges can be registered with the ministry directly and depending on the training, money would be reimbursed to the center.

5.4 Focus on agriculture universities to develop high yielding varieties and processable varieties

Today, India is No. 1 in production in many agricultural commodities still our average yield per acre is the lowest in the world. There are many reasons for this and one of the reasons is inappropriate varieties.

There should be a focus on high-yielding varieties and though it is a long term project, it should start with a definite objective and it can be made successful through the PPP model.

5.5 Use of Self-help group infrastructure to meet the local demand

Today, our main objective is to increase the processing percentages and it can be achieved by setting up low-cost processing centers all across India through use of the vast infrastructure of Self-help groups. Even if we pack grain/fruits/vegetables in these centers in a kind of 'Amma model' of Tamilnadu, it can be a huge success. In countries like South Korea, the entire electronic industry has been spread across self-help groups. Big industries outsource the routine/low technology jobs to different households and literally every house becomes part of the industry. If it can happen for high-tech sectors like electronics, why not for Food processing? Lijjat / Amul model is based on the same principle. We should tap the opportunities of big retailers and let them work with self-help groups on win-win terms.

5.6 Standardization of curriculum of all food technology colleges

Today we have various food technology courses under different names viz. Food tech / Food

science / Food nutrition / Food Engineering / Food Bio, etc. Just as in the case of Pharma / Medical / Engineering there is a single standard syllabus, can we create it for Food Technology? The syllabus should focus on industry needs and entrepreneurship development. We could even have various NIFTEM branches in different states. We can bring in IT support and not only the syllabus but activities on research can be tracked with the help of modern IT tools. Research should be focused again on Market demand / Industry demand / Government requirement rather than other reasons. There should not be repetition of research by various universities and a universal research data bank should be available for common reference. We need to include the concept of food safety / Codex in the syllabus.

5.7 Special focus on Nutraceutical industry to reduce the burden on the Healthcare industry

It is said that 'Anna he Purna Brahma'. Today food can be the best of healthcare remedies and we can let medicine be the 'sick care' industry. Preventive healthcare is a big industry and Food could be the best solution through Nutra-ceutical and Ayu-ceutical solutions. Food processing ministry can encourage this sector to bring in some low-cost nutraceutical solutions to take care of some basic healthcare problems like in the areas of Heart / Sugar / Eye care / Kidney care, etc. There are enough bio-active agents which are known in these areas. We should recognize the nutraceutical industry as a special industry under food processing and this will reduce the burden of the healthcare budget. India has a 5000 years old tradition of Ayurvedic ingredients / botanicals which can be tapped for better use but what we need is low-cost models with effective results.

5.8 Special focus on Post-harvest technology with practical solutions

Post-harvest is a typical topic on the radar of the ministry for the last 10 years, but what we need again is low-cost technologies and easy practical solutions. E.g. today Calcium Carbide is banned for Mangoes, but we should have technology as simple as calcium carbide to offer to farmers or traders so they also can use the same for fruit ripening. The same is true for cold storage and de-greening chambers. We need a local model of success and it could be a non-electricity

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dependent model. Recently, someone has innovated a '**Matka Fridge**' to help farmers in Punjab keep their produce for 4-5 days in this structure without addition of extra cost. We need focus on such low-cost post-harvest solutions so farmers can use it effectively.

5.9 Link food processing with tourism industry to attract foreign visitors.

Every state has some special food products. Today Kerala has developed 'Ayurveda spa' and it is successful all across India and has attracted good tourism. Can we develop similar ideas for food? We can link food tourism with the help of Food and Nutrition colleges and again the focus here would be on quality and safety and **authenticity**.

5.10 Brand India - Quality

We need to make the food processing sector very attractive and of excellent quality to develop brand India. Today, the Ministry of food processing is basically focusing on fruit and vegetable processing sectors only. We need to cover all the aspects of food under the umbrella of food processing ministry and need to make a strong 'Brand India' for the international market. Already Apeda has successfully done it for mangoes / grapes. We can do it for processed food. We also need to make careers in Food Processing more attractive & lucrative and there should be a good talent pool coming into this sector.

5.11 Encourage Big food industry to invest in India

There are various challenges for food processing industry and many companies which are already in the sector helping Indian economy to generate employment and tax collection. We need to give special treatment to these industries and some relaxation in tax and subsidies. Government should encourage investment in food processing sector and some schemes should be launch to attract new investment. Big companies (Multinational/domestic) should get confidence and get freedom to work in existing regulatory framework. Many states have started single window system to tackle the industry issues and same can be done at central level.

6. Conclusion

Today, the Indian food industry is a natural choice for foreign direct investment. Special sectors like Nutraceuticals / Post-harvest sector / Traditional food / Convenience food can bring good value addition to farmers, processors and consumers. This is best for overall growth of the economy. I have given some suggestions which could fuel the growth of the Indian food industry in a holistic way. I have not touched upon other aspects like taxation / land reforms / subsidies which are anyway part of existing agendas. I am confident that with a focused approach we can achieve 20% growth year on year in the food processing industry in the coming 5 years and by 2018 India will reach a number of 25% processing with GSDP contribution of 40 % from Agri/Food sector. This will definitely bring our slogan true - "*Bahujan sukhaya, bahujan hitai*".

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Developments in the Food and Agro Sector in Pune – Maharashtra Region

Depleting resources on earth, climate changes, growing populations, deforestation, urbanization and movements from rural to modern city life, lack of basic agriculture knowledge, lack of basic facilities at village level and hence younger generation's unfulfilled needs and desires – and ease of life of white collared executives: beat these challenges if we want to see availability of food and health for our future generations, as well as what we shall want when we are reborn!

We need to go back to the Gandhian Philosophy, and live it. Realization by all is necessary. Learning before its late is necessary. Hope the right prevails.

The Pune and surrounding regions of Maharashtra have been strongly transforming into Agri and Food production hubs of the world. Backed by much Research, Experimentation, hard work, and well-directed efforts by the Government, Universities, Private Sector, Business Managers, Banks and many more inputs, today Maharashtra stands out on many fronts in Agriculture.

NAFARI is one of the prominent Incubation Centres in Food Sector through its new Product, Process, and Service developments. The institute is professionally managed by a Governing Council. It also has been operating as a Meso-organization, and implementing Small Industries Development bank of India's Project- Business Development Services capability development for Fruit and Vegetable processing Cluster in Pune region, for technical, human resource development and consultancy services.

NAFARI, established in 2002, is an autonomous not for profit sharing organization, registered under Section 25 of the Companies Act 1956. The Institute has an ISO/IEC 17025 and NABL Accredited laboratory. The laboratory has been authorized under FSSAI. Recently, **NAFARI has been Recognized by the Department of Scientific and Industrial Research, Government of India, as In-house Research and Development Unit.** The laboratory is equipped with state of the art facilities for chemical and microbiological Analysis of Food, Feed and Water.



Particularly, Pune district is a thriving hub of food processing units in the state of Maharashtra. In proximity of Pune are the urbanized markets such as Mumbai, Nasik, Nagpur, other cities of Maharashtra. The markets of the adjoining states of Goa, Gujarat, Madhya Pradesh, Andhra Pradesh and Karnataka are also significantly contributing to the demand from this region. Lately, the rural consumers are also growing as is visible from the reports on FMCG market reviews. Pune itself has burgeoning local demand within the city as it is now the leading industrial and educational centre of the country.

Furthermore, export markets of the Middle-East,

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the EU, UK and US etc. have been consistently growing for both semi-finished and retail-able products. Good infrastructure development, national highways, international airport and connectivity to port are enabling an enthusiastic enterprising food processing and food service industry.

More focused Research, Development, Innovation, Pilots, Experimentation, Development of Modern Food Sale Hubs, Food Processing Parks, Supply Chain Infrastructure and hand-holding will ensure this region satisfies substantial food needs of the future.

NAFARI

The Role of EOS in Food Security

Introduction about EOS:

- EOS is the competent and official body responsible for standardization activities, quality and industrial metrology aiming at increasing the competitiveness of the Egyptian products in the international and regional markets along with consumer's and environment protection.
- In the framework of EOS's role for continuous development, EOS has established specialized unit in the field of Halal with specified mechanism to achieve the targets of this unit and it was necessary to establish a national governmental body holding the responsibility of supporting industry of Halal in Egypt represented in EOS. The minister of Industry & Foreign Trade has issued decree no. 561 for 2012 stating that EOS is the sole body that is responsible for licensing production companies to affix Halal mark on commodities and products in the light of Egyptian standards issued in this connection

- The presidential decree no. 29/1957 stipulated the establishment of EOS under the name of "Egyptian Organization for Standardization", and in the same year EOS became an ISO member.
- Moreover, quality control center has been established and joined to EOS according to the presidential decree no. 392/1979. Hence, EOS name was changed to be "Egyptian Organization for Standardization and Quality Control". Lately, EOS name has been changed to be "Egyptian Organization for Standards and Quality" according to the presidential decree no. 83/2005

Food Security in Egypt:

- Food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.
- Food security and agriculture are critical

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dimensions of addressing challenges in Egypt, including poverty alleviation and population health. High population rates, increasing per capita income and urbanization are fuelling the rising demand for food, especially cereals. Egypt has developed a "national economic plan" under the direct supervision of the prime minister through the involvement of the ministries and interested parties concerned as well as the private sector, based on the strategic plan for the health sector 2007- 2017 through the involvement of the Advisory Council on Food Security in the formulation and implementation of the plan so that it is modifying the orientation of the Council than only on agriculture to the rest of the dimensions of the issue of food security.

- The following elements helping in the maintenance of food security:

1- Providing support to ensure that relevant institutions deliver evidence-based policies and joint sustainable elements on food security in a coordinated manner.

2- Ensuring analysis of key national surveys and surveillance systems, developing early warning systems and contingency planning.

3- Ensuring that the Government's food subsidiary system and food-based safety nets deliver good quality food packages efficiently to vulnerable and poor families as well as targeted high-risk populations.

4- Enabling vulnerable people, especially women and children, to consume adequate, healthy and nutritious food.

5- Achieving efficient supply chains in food production, including adoption of good agricultural practices, reduction of post-harvest losses, and development of local markets and food distribution systems.

So, food standards are considered the backbone which the above mentioned elements depend on them.

- **EOS participate in the food safety & security system through the following**

1. Developing Egyptian Standards

a. EOS is concerned with developing Egyptian standards through specialized technical committees in the field of food production.

b. The structure of these technical committees involved all the food sector stakeholders as follows:

- * Control authorities.
- * Industry representatives .
- * Consumer protection authorities.
- * Academic institutes & universities.

That is to ensure neutrality and achieving consensus on developing standards.

c. EOS has issued approximately (4000 standards) in food sector through 30 specialized technical committees

2. Hosting International mirror committees & National committees

a. Hosting International mirror committee "Egyptian CODEX Alimentarius Commission"

The Main tasks and responsibilities :

- Studying the problems that are related to national industry and setting the ways for solving these problems .
- Setting and issuing guidelines and recommendations to ensure food safety according to International Codex guidelines and code of Hygienic practices.

b.Participation in High National committees

EOS has a membership in two high national committees under the umbrella of the Egyptian ministry of health as follows :

1- The higher committee for food safety

2- The higher committee for water quality

These committees discuss all national issues related to food and water in respect of safety and health of the consumer.

3. Ministerial Decrees (Endorsing Egyptian Standards as obligatory requirements)

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a. The Egyptian standards developed by EOS, that have an impact on health & safety, are endorsed as obligatory requirements for national industry, as example:

- Ministerial Decree no. 50 /2008 for “obligating the industrial establishments that are producing bottled natural water to apply Hazard Analysis and Critical Control Point (HACCP) system described in Egyptian Standard no. 3778 issued in this concern”.
- Ministerial Decree no. 757 /2008 for obligating the industrial establishments that are producing food and beverages to implement any of the following system:
 - * ISO 22000 system
 - * Hazard Analysis and Critical Control Point (HACCP)

b. Ministerial Decrees no. 130/2005 and 515 /2005 for obligating the Egyptian producers and importers in food sector to fulfill the Egyptian

standards essential requirements (all criteria related to safety, health, environment and fraud like microbiological criteria, heavy metals limits, MRLs for pesticides etc) as well as declaration through labeling.

4. Registration of the industrial companies applying management standard (ISO 22000).
5. Granting license for quality mark and conformity certificate for the Egyptian products in various fields.
6. Supporting the initiative for establishing food safety authority.
7. Undertaking the responsibility of the enquiry point relevant to Technical Barriers to Trade Agreement (TBT).
8. Carrying out the activities of the national COPOLCO Committee.

Egyptian Organization for Standardization and Quality Control (EOS).

Coconut Sector in India: Evolving Towards Excellence in Agribusiness

Contemplating context

Agro-processing is now regarded as the sunrise sector of the Indian economy in view of its large potential for growth and likely socio-economic impact specifically on employment and income generation. Some estimates suggest that in developed countries, up to 14 per cent of the total work force is engaged in agro-processing sector directly or indirectly. However, in India, only about three per cent of the work force finds employment in this sector revealing its underdeveloped state and vast untapped potential for employment. As a matter of fact, India is the second largest producer of food, next only to China. Around 26% of GDP in India comes from food and agriculture. Food processing sector ranks fifth in terms of its contribution to GDP. There is tremendous untapped potential which is presently languishing

in darkness. It is an indubitable fact that India has incredible opportunities in the field of food processing because of various factors. Nevertheless, agribusiness has its challenges for rural development in terms of resource utilization, rural livelihood and rural ecology. Issues regarding appropriate technology, labour productivity, cooperation, credit, marketing and extension services are crucial even in the new regime of reforms.

There exists a huge scope for coconut based agribusiness¹ in India with reference to processing and value-added products. The crop provides employment opportunities to more than 10 million people in the country. Technologies are available for individual processing for the production of snowball tender nut, neera (kalparasa), coconut chips, copra, vinegar, desiccated coconut (DC)

¹ The processing and related activities centered on the crop generate employment opportunities for over three million people in India. In addition, the crop contributes Rs.92000 million annually to the Gross Domestic Product (GDP) of the country. The coconut sector also contributes to foreign exchange earnings to the tune of Rs.21385 million through the export of coconut and coir products.

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coconut shell charcoal, packed tender nut water, coconut cream and milk powder. Fairly high level of capital is required for the establishment and operation of these enterprises.

Despite the importance of coconut with respect to its economic, nutritive and health contributions, coconut sector in India is not considered as remunerative as other agro-sectors. The failure to move up the global value chain and thereby resisting the market pressure on domestic prices in an open economy environment is one of the major causes of the crisis faced by coconut industry in India. In this scenario, we need to develop a sturdy and vibrant coconut industry which does not depend on copra/oil. In order to turn this vision into reality, we need to come up with breakthrough coconut products with Unique Selling Proposition (USP) and therefore, it would be a worthwhile attempt to promote the entrepreneurship in the coconut sector.

Coconut Sector: Global Concerns

There are umpteen reasons for preparedness in the international spectrum of coconut and its value added products. Some of the pertinent aspects are- 1) the declining share of coconut oil in the world's oils and fats market 2) a proposed levy on vegetable oil imports to the European Community and a campaign against coconut oil in the US 3) more stringent aflatoxin regulations imposed in the international copra market and 4) erosion of the European desiccated coconut market. The EU has a set of regulations that can impact on most aspects of the coconut industry. They relate to health, food safety and other regulations such as those related to packaging, waste recycling and labour laws. In this regard, entrepreneurs who wish to enter this market should give cognisance to the regulations governing market entry.

It is pertinent to note that the failure to respond to changing patterns in the world trade in coconut products may have adverse effects on employment and revenue of the Asian Pacific Coconut Community (APCC) countries which are mainly depending on coconut as a major livelihood option. Therefore, it is important to define the factors that drive international coconut product markets; assess the factors that determine demand in the major consumer nations of the world; and identify threats to the industry's viability posed by US and European Community

trade restrictions, competition from other oils, and mycotoxin contamination and other food safety issues. The international markets for coconut value-added products (mainly European Union and USA) are of late, becoming increasingly quality conscious and the food safety standards in these countries are becoming more stringent than it was earlier. The Good Agricultural Practices (GAP) and Hazard Analysis & Critical Control Points (HACCP) have become mandatory under the Sanitary and Phytosanita Agreement of the WTO. Moreover, private standards are also proliferating in recent times for organic products. It is noteworthy that the border rejections of consignments are becoming rampant in the recent times owing to an array of issues related to food safety standards and the imperfect documentation of the test results. India has experienced these kinds of consignment rejections in the case of marine products exports and the government could adequately revamp the entire supply chain of the seafood export sector according to the safety standards of the export destinations. Such an experience equipped India on measures of precaution and mitigation of food safety related issues of any agricultural products. Moreover, Indian export sector has become vibrant with very high growth rate since Coconut Development Board (CDB) has upgraded to the status of Export Promotion Council (EPC).

Coconut Based Agribusiness: A Bright Future

Large-scale integrated production of value-added coconut products is a challenging business opportunity. Coconut based agro-processing complex is a suggested long term investment with an initial expenditure of Rs 2 Crores for setting up processing units integrating copra, coconut oil, fibre, compost, shell powder, vinegar, desiccated powder and coconut chips for processing 25,000 nuts per day. The realized gross returns of various integrated coconut processing models over edible oil industry alone vary from 19.05 per cent to 98.4 per cent. Such an integrated approach ensures better price stability for coconut and its products and stabilizes the gross farm income for coconut farmers. However, those who are willing to start these units on a large scale, needs to understand the basics of international demand for diversified coconut products and the expected quality parameters at the international level.

In India, about 4,000 tonnes of desiccated coconut is manufactured annually and consumed

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mainly by confectionery and biscuit industry. Taking into consideration the present day food consumption patterns and growth in confectionary industry in the country (10-12%) the demand for desiccated coconut is likely to increase in coming years. On the other hand, the domestic demand for activated carbon is estimated at 44,930 tonnes/annum and the likely growth rate is 10% per annum. The coconut shell charcoal is the main raw material required for the manufacture of activated carbon. World demand for activated carbon is expected to grow at five per cent per year, and in this regard, the annual demand of coconut shell based carbon alone is 1,25,000 tonnes. Studies highlight that the demand for coconut shell carbon in water purification will grow because of proposed stricter limits on the levels of Arsenic and Methyl tertiary butyl ether (MTBE). Thus, there is no dearth of opportunities in the value added coconut sector, which is challenging and demands excellent entrepreneurship.

Commercialisation of Business Ideas

Virgin coconut oil (VCO) is growing in popularity as functional food oil and the public awareness is increasing. Coconut chips are prepared by osmotic dehydration of coconut slices and then drying. Coconut chips are crispy and can be packaged and marketed in laminated aluminium pouches, which will have shelf life of 6 months. Snow Ball Tender Coconut is the kernel taken out from 7 to 8 month old tender coconut by keeping the water inside intact. It can be served in an ice cream cup. Kalparasa (Neera) is a natural and non alcoholic beverage, high in nutritional value and an instant thirst quencher. The more value added products from Neera are palm syrup, palm wine, palm jaggery, palm honey, palm sugar, palm candy and palm vinegar. ICAR-CPCRI has developed a technology for collecting Kalparasa (Neera) by a refined technology and the sap thus collected can be preserved up to 45 days under cold condition (in refrigerator) without adding any preservatives and additives with the bottling technology. The Institute aims at introducing Kalparasa as a natural health drink for commercial sales.

From the potential technologies listed above, development of marketing ideas and percolating it through the agribusiness channels needs skill development. Knowledge regarding the potential technology and transforming it into business plans and market plans requires further concerted

action, and in these lines back-up from the developmental departments, commodity boards and chambers of commerce and industry are inevitable. Networking the producer – distributor – sales units to cater to the demand of the market needs market research also.

An important aspect with respect to the coconut products marketing is certainly regarding the positioning of the product line. For instance, the initial feedback implies that coconut chips relatively lack the characteristic of irresistible indulgence. This coupled with extremely low brand awareness indicates a need for attitudinal shift for coconut chips from the consumer front in order to make this product line a big success. It would be appropriate to plan the coconut chips production based on the frequency of the product movement, and rather than attempting to push large quantity through few shops, it is worthwhile to push small quantity through large number of shops. In the case of rural units producing VCO and Chutney Powder, an assured steady neighborhood market was observed and the products have ample potential for the urban markets as well. And at the same time, at coconut producer company levels, with assured supply chain, we need to take care of the economies of scale by increasing the quantity produced.

In order to transform the business ideas into activities and business development, it is necessary to conduct capacity building trainings for the selected entrepreneurs on target-oriented aspects. Imparting training to potential coconut processing entrepreneurs would result in development of competitive enterprises.

Hurdles in the sectoral prosperity

Evolving trade agreements: The significance of analyzing coconut sector in India in the light of recent policy issues, especially the ASEAN-India Free Trade Agreement (AIFTA) emerges in the context of commodity crisis. The likely impact of AIFTA could not be undermined for three reasons. Firstly, the present context should be seen as a continuation of evolving trade liberalization regime and the effects of such a regime on the plantation crops sector. Secondly, although coconut and coconut oil is put under the negative list, the tariff reduction in palm oil², which is a close substitute of coconut oil, would turn up detrimental in the near future. Thirdly, the agreement is evolving one and the tariff rates

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fixed are ceiling rates (the maximum level to which tariff can be fixed), thus providing adequate flexibility to fix the tariff rates to lower levels. Although coconut and coconut oil are in exclusion list of AIFTA, there is a general commitment under AIFTA to review the exclusion list every year with a view to improve the market access. Obviously, there will be pressure to reduce the number of tariff lines kept in the exclusion list. Therefore, there always exists a threat in the case of coconut, seeing that, the existing price difference may facilitate the cheap imports in the case coconut is removed from the exclusion list.

Issues of domestic trade policies: A major distortion in the domestic edible oil market is being created by the government policy of giving subsidy on imported palm oil and soyabean oil for PDS consumers. This heavy subsidy on palm oil erodes the demand for coconut oil and leads to falling prices of coconut oil and thereby copra. Besides, the import duties on edible oils have moved basically in counter-cyclical nature to the level of edible oil prices in global markets. This is a rational policy choice which is required to stabilize edible oil prices in the domestic market. But the tariffication followed of late in the edible oil sector has turned up to be detrimental to the coconut sector.

Changing consumption pattern of coconut and coconut products: Of the total production of coconuts in the country, about 50 per cent is used as mature nuts, 35 per cent is used for copra and 15 per cent is consumed in the tender form for drinking purposes. Ninety two per cent of the mature raw nuts are consumed for domestic purpose and a meager eight per cent is absorbed by the industry for converting into value added products like desiccated coconut, coconut milk/cream/powder and other products. In order to upgrade into a commercially vibrant sector, there is an urgent need to restructure the existing consumption pattern through providing more emphasis on value added coconut products. A general decline in household level consumption of coconut for culinary purpose has been observed invariably among major states as well as at the all-India level. These changes in the consumption pattern will definitely have a policy level implication as far as the demand of coconut is concerned.

Volatile prices: The coconut market in India is always unstable and uncertain due to frequent fluctuations in prices. Usually fluctuation in price occurs due to change in market conditions aroused in response to seasonal and annual variation in production apart from competition from other edible oils particularly palm oil. Coconut prices in India have been historically integrated with the coconut oil prices. In general, the farmer prefers to sell fresh coconut when the price of coconut is attractive, as he receives a remunerative sum in his hand immediately and he can get rid of processing and transportation charges. Contrary to this, if the copra and oil prices are lucrative, farmer prefers to do at least primary level processing which would augment farm level copra production.

Skewed product dependency: The nutraceutical and therapeutic values of coconut are being internationally recognized and large number of value added products is being traded world over. However, the domestic market is chiefly confined to coconut oil alone, and its price is highly volatile and depends on other vegetable oils. Further, the situation is also facing threat of import of large quantities of coconut products to India from other countries and will lead to further fall in domestic price of coconut and also adversely affect the economic viability of many coconut processing units in the country.

Cognitive perceptions: Product positioning is an important aspect to be taken care of with regard to increasing the demand for high value coconut products. The coconut and coconut products still positioned as a product detrimental to heart health. Such a positioning has certainly had an adverse effect on the aggregate demand for the coconuts.

Innovation System of coconut sector: The innovation system for coconuts in India is unique wherein several governmental agencies/institutes undertake the research and development for the commodity, with evidently lacking collaborative efforts. It is worthwhile to note that there is no direct link between activities of different stakeholders in the coconut sector, and the coordination across research agencies and concerted effort of developmental agencies are the missing links in the coconut sector of India.

² The introduction of palm oil varieties as Special Products deserves special mention here. The coconut economy of the country is impacted on account of very low applied rates of import duties on palm oil (7.5 % for refined oil and 2.5% for the raw variety) and its subsidized provision through the public distribution system.

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This has apparently reflected in the technology channelization and technology adoption in many ways.

Leverage points and plausible way forward

General ambience: A paradigm shift in placing the coconut from an oil seed crop to food crop is utmost important and, this can be made possible by diversifying and popularizing the value added products from coconut among the consumers. Enhancing farm level income through productivity improvement and other production measures, product diversification and subsequent demand creations for the new products are the need of the time. The ambience of coconut sector in the domestic arena is positive wherein the horizontal node of the value chain aspect is strengthened by the formation of coconut producer's society at the grass root level to producer's company at the highest level. Thereby providing an excellent auxiliary support for the ambitious export orientation programmes related to the international coconut market. The strategic positioning of developmental and research support (CDB, KAU CPCRI, NAFED) is another very important factor which may be proved as an element providing competitive edge.

Establishing high-tech coconut market: We need to establish an international market for coconut products in India wherein a high profile infallible system of export supply chain can be developed, monitored and evaluated. Coconut Development Board has a diverse range of product management skills with excellent export orientation, and prior experience in coconut-sector policymaking. The board can be facilitated by the apex research institute for coconuts in the country, ICAR-CPCRI by the already formed strategic research and development synergy. Since India is a vibrant and high potential domestic coconut market (far ahead in comparison with all other APCC countries), by establishing a high-tech international market here, will certainly have positive change towards attitude on consumption of coconut products. This will slowly increase the per capita consumption, and in long run, by developing a strong domestic market in India, we can mitigate the price risks of economic crisis/ low demand in Europe/USA.

Evolving specialized products: There is a surging demand for the organic products especially in the

US and EU. Since coconut can be easily converted into organic cultivation, we need to explore the possibility of organic certification and labeling of the coconut products. We can develop an organic coconut supply chain to be oriented to the niche outward markets in the world. Coconut products can be certified as organic, GMO-free, natural, healthy and environment-friendly. To improve market access of coconut products, the conduct of market promotional campaigns through participation in high-impact trade exhibitions, technical seminars on health and nutritional aspects of coconut products need to be intensified.

Highlighting sectoral interest: Regional trade agreements are becoming inevitable in the growth path of trade liberalization and globalization. The most important aspect in the evolving trade agreements regime is to appropriately reflect the sectoral interests/issues in the national agenda, so that the sectoral apprehensions are well represented in the regional/ free trade agreements. In order to materialize this, in-depth sectoral studies in collaborative mode on various facets of coconut economy in India has to be conducted and well chalked out sectoral policy documents should be brought out.

Coconut trade agreements: For better trade relations among the APCC countries, it is imperative to form a regional coconut trade agreement among the APCC countries. The modalities of such a commodity specific trade agreement should be worked out with utmost care wherein we should end up in a win-win situation. In this respect we need to thoroughly analyze the existing the tariff structure of each APCC countries, and an unbiased tariff reduction schedule should be proposed. It is also important to consider the existing tariff structures of close substitutes/competing products of each countries and there by arriving at a consensus.

Revamping domestic policy: The import duty for palm oil has to be dynamically adjusted to its international prices as palm oil prices acts as an anchor to all edible oil prices. A bearish trend in palm oil prices exerts downward pressure on prices of all edible oils with an adverse effect on domestic production and further rise in palm oil imports. Therefore, there is an urgent need to re-calibrate the import duty structure. The policy of low duty import and further subsidization of palm oil price through PDS at the cost of domestically

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produced coconut oil implies a serious fallacy of policy and needs to be corrected urgently.

Changing cognitive distortions: It is a proven fact that with the base of the Medium Chain Triglycerides, coconut has got a positive health image in culinary and nutraceutical sectors. Further concerted efforts to break the cognitive belief on adverse health effects of coconut and its products need to be revamped with authentic medical certification.

Providing business incubation: To catalyze the agribusiness in the coconut sector, Business Incubation services should be established to support the entrepreneurial companies through an array of logistic provisions in terms of resources and services. It is imperative to provide infrastructural, technological, establishment-wise backstopping and financial guidance and support for transformation of institutional and sectoral innovations into commercial products.

Strengthening market intelligence: An effective price signaling with expert market intelligence system is of paramount importance to mitigate the frequent price fluctuations in coconut and its major products. In this connection, a collaborative effort to chalk out a supply chain frame wherein the coconut oil lobby syndicates are brought under the control of Coconut Development Board/NAFED should be an urgent initiative.

Restructuring the innovation system: The current sectoral innovation system of coconuts in India has huge strengths on the research front, but unilateral increase in productivity is not the sole solution for the sectoral crisis. The lack of price stability, inadequate price support mechanism and marketing facilitation are the other factors detrimental to the functioning of coconut value chain. The lack of effective group coherence and professional approach (among different stakeholders) are still remaining as problematic facets.

Summing Up

The Indian coconut sector has inherent strength of varied agro-climatic conditions, huge domestic demand, highest productivity, robust research and development, and ToT systems. However, so far the sector has not effectively utilized the possible linkage between them for increasing the production and marketing efficiencies. The remedy for achieving competitiveness lies in

aggressive product diversification to reduce the dependence on copra and oil as the price determinants. The Institutes should take a lead role to re-engineer and revitalize the coconut sector in the country by providing adequate emphasis on product diversification and creation of neo-market platform to promote coconut as a high nutrient value product with Good Management Practices (GMP), Good Agricultural Practices (GAP) and Hazard Analysis and Critical Control Points (HACCP). Facilitation of co-creative, innovative, vibrant social enterprises is warranted to pass on the value creation in the coconut sector to farmers in an appropriate manner to reduce the social disparity. With the growing realization of lesser profitability in small farm holdings, producers/farmers should be encouraged to get together and form into small cooperatives or crop based organizations to develop and utilize community facilities for farm operations, post harvest processing and marketing to economize on production as well as marketing costs. Further, research orientation will lead to an increase in the number of economically viable coconut farms of different sizes and increase in the number of processing enterprises. For the vision of developing a sturdy and vibrant coconut industry which does not depend on copra/oil/ to come true, we need to come up with more breakthrough coconut products with Unique Selling Proposition (USP) which is strong enough to capture the niche export market segment. As the technologies are adopted only when profitable, policy interventions in market and regulation of trade tariffs to the benefit of the industry to compete with global players are the way forward. To encourage investments in the coconut sector, the government, as matter of policy, must consider coconut as a priority crop in its national agricultural development agenda. The government and private financial sector through the banking system should provide support through reasonable credit schemes for coconut processing business ventures. Support for the agribusiness innovation is inevitable for effectively turning ideas to products in the market place. Development of new products from an innovation requires a multi-subject knowledge and well equipped research facilities.

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Policy & Regulation

Dietary Habits Need Policy Focus

Dr. Bhavani Shankar, Professor of International Food, Agriculture and Health, SOAS, University of London is an applied economist who is currently analysing economic drivers on food nutrition; evaluating nutrition policy and the role of agriculture in enabling better nutrition and health, both in developing and developed countries. Through this interview, he has shared his views on the impact of government policies on food consumption, nutrition, dietary intake, health and overnutrition.

What are your observations on the government policies of developed and developing countries towards food consumption? How do these policies impact dietary habits of the people?

Governments around the world influence dietary habits of consumers through their policy actions, but quite often this is done unintentionally, with the government actually aiming to achieve some other objective, not necessarily dietary change. Agricultural policy is a good example of this. Governments around the world, including developing nations, intervene heavily in the agriculture sector to achieve objectives relating to improving agricultural productivity, farmer incomes, poverty eradication, etc. These often involve huge investments, and have the potential to strongly influence diets indirectly. For example, the agricultural research investments of India have traditionally been strongly geared towards cereal staples, i.e., rice and wheat, and this has played a key role in feeding the population over the decades. Influencing dietary quality has never been an explicit objective of these investments, but in practice, by promoting rice and wheat production, they have played a role in making diets more rice or wheat-intensive. Now the research community is starting to ask whether such policy can be made more 'nutrition sensitive' – ie can we embed certain nutrition goals into these policies without losing sight of their primary objectives? So for example researchers and policy advocates are now asking if more focus and investment is now needed on pulses or nutritive grains like millets (bajra) – these may be nutritionally valuable, but have been neglected in terms of policy.

Of course, there are also a large number of consumer policies that are more directly diet and nutrition focussed, particularly in developed countries. This is an exciting time to be studying this area, with countries starting to experiment with a new generation of policies like nutrition-based 'fat' taxes or subsidies. For example, the tax on sugary drinks in Mexico is an ongoing policy

experiment that the public health and food communities are watching with great interest.

There was a sharp rise in the prices of food commodities across the globe in 2008. What were their nutrition implications in developing countries?

There is a large amount of variation across countries in the extent to which international price changes transmit into local food price changes. This depends upon the country's trade dependence and local policy actions, amongst other things. However, in countries in which local food prices did rise significantly, poorer consumers typically responded by switching from more expensive sources of energy to less expensive sources. Energy or calorie intake is the most basic requirement – energy deficiency translates to hunger. Naturally then, poor consumers faced with rising food prices, attempt to stave off hunger by shifting to cheaper source of calories. But this typically means that more expensive sources of calories, like fruit, vegetables, animal source foods – foods that are important for providing critical vitamins and minerals – are sacrificed and poor consumers increase intakes of cereal and other staples. Thus the key nutrition implication of rapidly rising food prices is typically a reduction in the quality of diets.

In India, there is stiff opposition to the introduction of genetically modified breeds in food crops because of its alleged impact on health. Can we have your perspectives on this.

I think GM has an important role to play in food security in many countries around the world. There is almost no credible evidence on negative health effects from consuming GM. There is however a lot of scaremongering. If you look at the evidence base, there is about as much, or less, convincing evidence on GM foods and health as there is for mobile phones and health. But you don't see an effort to ban mobiles – there are 900

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million mobile phones in India! To an extent this is understandable: food is fundamental and we have an emotional connection with it, and it is hard to be completely objective about it. But GM has some tremendous applications to offer, ranging from insect resistance (leading to lowered chemical use in crops) to nutrition provision. I believe it is a matter of time before GM applications are widespread in food crops in India and elsewhere. Of course, there are genuinely important concerns to be taken into account in harnessing the technology, like the power that could be wielded by large biotech companies that produce GM varieties. But I believe it is possible, with some strategic thinking and policy support, to overcome those problems and make GM an important part of the food security portfolio.

While most of the attention on nutrition in India tends to be focused on hunger and undernutrition, there is also a growing problem of overnutrition. What are your thoughts on this, and what government policies are appropriate to tackle this?

Yes, there is a widespread misperception that overnutrition and diet-related chronic diseases like diabetes and heart disease are ‘rich country’ problems. The prevalence of these diseases has been soaring over the decades in India and also many other rapidly growing developing countries. There is a significant association of the rise of these problems with changing lifestyles – dietary imbalances and reduced physical activity –

particularly in big cities, but also increasingly observed in small town and rural areas. Our food systems and dietary habits have changed substantially over time; we now consume a significantly higher proportion of processed and prepared foods that are high in fats, salt and sugar.

In India, a key priority has to be to deal first with the widespread prevalence of trans fats arising from the use of partially hydrogenated vegetable oils in our foods. Dalda or vanaspati is a key source in India. Trans fats are everywhere in our foods since they help extend shelf life and improve the texture of processed foods. But trans fat is a killer – the evidence on this is very robust. The Food Safety and Standards Authority of India has proposed legislation requiring labelling of trans fat content in foods, which is a welcome move. But more needs to be done – we need effective, long-running awareness campaigns and nutrition education in schools. Sooner, rather than later, we need to move towards effective norms that limit trans fat content in foods.

Thought also needs to be given to a policy strategy to limit sugar intakes, particularly via sweetened beverages. The sugary drinks tax experiment in Mexico may well hold some important lessons for India.

Mushroom – A Highly Potential Yet Untapped and Unorganised Food Sector



Introduction:

The theme of the summit “Enabling Food for All” elaborates the basic yet a necessary requirement for people living across the globe. For a developing country like India looking at composite growth, digitalization and empowerment of youth, it is a challenge to meet these basic requirements for everyone. This summit has rightly focused at the basic needs to enable the path of determination and development for everyone. The first step towards achieving our goal can be “Enabling food for all”

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but the focus has to be “Enabling Quality Food for All”. And this is where Mushroom can play an important role in improving the Food Quality and add proper nutrition to the food. Mushroom can not only add the nutrition to the meal but also become an agricultural product which can lead to financial security and economic sustainability of our rural population.

Mushroom – A Wonder Crop

Mushroom, as most of us are aware, is a class of fungi and is rich in Protein, essential amino acids, Vitamins etc. Some of the edible mushrooms in India are Oyster Mushroom, Milky White Mushroom, Button Mushroom, Shiitake Mushroom, King Oyster Mushroom, and Paddy Straw Mushroom. Most of these edible varieties are easy to cultivate commercially and with little investment and has been largely practiced in India by farmers. The basic substrate for its cultivation is agro waste and is cheaply available. Reports suggest that close to 87 % of Indians are Malnourished. And this is one crop which has the high potential to at least address the issue of malnutrition, if not solve it to its core. India has been practicing mushroom cultivation over centuries and recent research and focus has further reinvented a better technique for its cultivation.

Mushroom – A tool for economic sustainability

Keeping in mind, the huge generation of Agro waste and domestic waste in our country, Mushroom cultivation can be highly popularized and we can take this menace of waste disposal as an advantage and utilize it for a better and healthier crop production. “Waste to Wealth” is a topic which the complete world is talking about and India can take a lead towards realizing the revolution. We have seen Green Revolution, White Revolution in our country and have garnered huge success in terms of delivering the potential. It's high time; we talk of another revolution, Mushroom Revolution and work hard and harder towards making it another success story for years to come. The rural population needs to be technically advised on using the agro waste and cultivating mushroom in their houses like any other backyard fruits or vegetables. This can give

their family a healthy meal and a healthier lifestyle in terms of monetary gain after selling the produce. Similarly, urban population needs to be advised and trained to utilize their food / domestic waste and cultivate mushroom just like their terrace gardening/home gardening as a hobby. The cultivated mushroom can be prepared into various delicacies and provide the necessary nutrition to the family. With this, we can even reduce or lessen the garbage problems faced in many cities and towns across India. We also serve



the vision of “Swachh Bharat”. All the degradable waste material can be utilized within every household and contribute towards a healthier nation building.

Mushroom – A component for Value Added Food Products.

In recent times, the focus has been not only to improvise on the cultivation technology but at the same times our researchers and growers have started focusing on another sector to promote and supplement mushroom fortified food products. Some of the common food products prepared from mushroom include pickle, cookies, chips, papad, ketchup, chyawanprash, soups, fortified sambhar & rasam powder and so on. The list is getting bigger with lots of variants and new products being added every year. The complete ideas behind such projects are to provide mushroom in some or the other form in daily meals to every household, thus increasing the visibility and acceptability of mushroom among all class & sector. This in turn has become a tool for further business development and production of

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mushroom in both large and small scale in the country.

Mushroom – An example

Mushrooms are miniature pharmaceutical factories, and of the thousands of mushroom species in nature, our ancestors and modern scientists have identified several dozen that have a unique combination of talents that improve our health (**Paul Stamets**).

Let us take a simple example to implement the Mushroom Program in a village. We can provide the basic training and infrastructure to cultivate mushroom in every house in that village. Let every house cultivate one Kg on a daily basis. 100 gm can be given back to the family for their daily meals, another 100 gm can be contributed to local school for their Mid Day Meal program and the rest can be sold to the nearest city/town. Since, the cultivation does not involve external labour or raw materials, the cost of cultivation can be barely minimum. For a village with 50 houses, we can procure 40 Kg mushroom for sale. A part of the money earned can be given back to the individual households. This practice can not only provide them with basic nutrition in their meal but also add to their regular income. If the program can be initiated extensively, this can end the plight of farmers in our villages and certainly work towards reducing the suicidal incidents due to lack of financial support. Our government mechanism and non government organizations can join hands and create the platform for those 70 % population who feed the country but themselves sleep with half stomach. And we have several examples in our own country where an initiative has turned out to be revolution over a decade.

In small towns and cities, Mohalla samiti can come forward and take up the initiative of Garbage - compost - mushroom, thus solving the huge problem faced across the country of garbage dumping. We can then have a Clean India... A Green India and a Healthy India. Less garbage means less spread of diseases, less medical cost, better medical facilities, improved income for everyone. This will be a Win-Win situation for everyone, whether it is common people or government agencies.

A Conclusive remark

Though this might seem to be an ideal project or a philosophy on black & white, but knowing the potential and resources within our country, this does not look to be a far-fetched reality. When we stand in this forum to discuss the methodology and route map to realize our dream of “Enabling Food for ALL”, we can certainly not ignore the potential of mushroom as a tool towards realising our goal. Among all possible mechanisms to see a healthier India, mushrooms will have its own story carved in gold.

We need to focus on enabling food for all but at the same time, we need to provide the resources to procure the food, i.e., financial stability. Mushroom, being a product from waste, not dependant on soil or climatic conditions, a food supplement etc., gives us every reason to consider the untapped and unorganized industry for a brighter days ahead.

For thousands of years, Eastern cultures have revered mushrooms health benefits. Mushrooms have long been celebrated as a source of powerful nutrients. Often grouped with vegetables, mushrooms provide many of the nutritional attributes of produce, as well as attribute more commonly found in meat, beans or grains. Mushrooms are low in calories, fat-free, cholesterol-free, gluten-free, and very low in sodium, yet they provide important nutrients, including selenium, potassium (8%), riboflavin, niacin, vitamin D and more. Nutrition researchers, communicators, and government and industry organizations now need to come forward and work in sync for a better living, for a healthy living. With a hope and belief that the summit will conclusively work towards realizing the goal of “Enabling Food for All”, I wish them and everyone good luck.

Thank You
“Happy Mushrooming.....!!!”

Sushant Shekhar

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India's Agrarian Crisis Demands A Holistic Approach

The Father of India's Green Revolution, Professor M. S. Swaminathan, Founder, M S Swaminathan Research Foundation is well known world over for increasing agricultural yields in India since the 1960s. In an exclusive interview, he speaks on agricultural sustainability, farmers' distress, soil management, food security, women's role in agriculture, among others, which play a critical in improving the current scenario of India's Agriculture.

Your name has gone down in history as the Father of the Green Revolution in India. Could you elaborate on how your Foundation has been able to use Eco-technology to bring about agricultural sustainability?

Ecotechnology involves blending of traditional wisdom and ecological prudence with frontier science such as biotechnology, information technology, renewable energy technology, space technology etc. At the field level, the 'Biovillage' concept is a tool for converting ideas into action. By mainstreaming ecology with technology development, we can integrate environmental sustainability with economic viability.

In your view, how should farmers' distress be best addressed? Separately, will India's farmers benefit if the country becomes a member of the World Farmers' Organisations?

The latest reports of the National Crimes Record Bureau (NCRB) as well as of several non-government organisations on farmers' suicides contain distressing news. The suicide rates are high in Maharashtra, Telangana, Andhra Pradesh, Karnataka and Madhya Pradesh. Some analysts relate high suicide rates to the cultivation of cotton due to problems arising from high cost of inputs and risks involved in marketing. The National Commission on Farmers had made several recommendations to alleviate agrarian distress in the suicide prone areas. In my view, we should develop and implement immediately an Agenda for a Farmer Suicide Free India. Such an action plan should include the following:

- Establish an **Agrarian Distress Consultancy Centre** at every Krishi Vigyan Kendra in farmer suicide prone areas. The Centre should have at least one male and a female advisor, well versed in the art and science of advising those who feel hopeless and go to the extreme step.
- Strengthen the coping mechanism of cotton farmers who take to expensive newer



technologies by persuading seed companies to give farmers insurance cover, against unforeseen damage caused by unfavourable weather.

- Strengthen the agriculture insurance mechanism and promote insurance literacy.
- Empower women farmers to have access to 'Kisan Credit Cards' even if they do not have title to land.
- Promote farming systems involving pulses, millets and oil seeds which are high value, requiring low water.

Above all, in the various relief packages announced by governments, high priority should go towards care and education of women and children in households, where the male farmer has taken his life. Agriculture is a life giving profession and we should not be silent onlookers to the shameful situation, where farmers have to take their own lives.

Farmers of this country are not well organised and hence their voice is seldom heard. I tried to make the National Commission on Farmers, the voice of the farmers.

What are some of the practical solutions to address malnutrition in India? How can we ensure growth in production of nutritional crops like pulses, fruits and vegetables?

To eliminate hunger, we should pay concurrent attention to overcoming **undernutrition** caused by

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inadequate purchasing power, **protein hunger** due to insufficient intake of pulses and other protein rich foods and **hidden hunger** caused by micronutrient deficiencies. In addition, we should pay attention to clean drinking water and sanitation, in order to ensure absorption of food in the body.

For example, we are short of pulses like pigeon pea, chickpea, moong, urad, lentil, etc. and the price of pulses has gone up by over 60% during the last year. As a consequence, protein hunger is tending to increase. The year 2016 is declared the 'International Year of Pulses' by the United Nations. Most of the pulses are native to India. They are grown without irrigation and under low soil fertility conditions. This is why the average yield of most pulse crops are about 500 kg/h. Crops like arhar (pigeon pea) which are grown in Australia from seeds obtained from India, yield over 4 tonnes per hectare. The import of pulses is increasing and now exceeds 3.6 million tonnes.

Pulse crops require more phosphorous in the soil. Therefore, the Soil Health Cards given to those cultivating pulses should be designed to address the specific nutritional needs of these crops. The soil health monitoring and advisory service, which I have been recommending, could be equipped to render specific advice, to pulse crop cultivators on the nutrients needed, based on soil testing. In other words there has to be cropping or farming-system based Soil Health Cards which could help the farmer to enhance the productivity of the conserved cropping and farming system. From now onwards, we should provide soil health cards for enhanced pulse production. We can then accelerate progress in bridging the demand and supply gap in the case of pulses and make the 'International Pulses Year' purposeful.

From 'green revolution' to 'evergreen revolution', what are the best practices to make the gradual transition with special reference to climate change?

The transition from 'green revolution' to 'evergreen revolution' can be achieved by adopting ecotechnologies like integrated pest management, integrated nutrient supply, scientific water management and improved post-harvest technology. The best practices for such a transition are described in detail in my book 'From



Green to Evergreen Revolution: Indian Agriculture: Performance and Challenges'.

This year is the 'International Year of Soils'. What are the pressing issues in soil health management in India?

2015 is declared as the 'International Year of Soil'. We should pay special attention to the following:

- Declare areas characterised by fertile soils capable of sustaining two to three good crops a year as a **Special Agricultural Zone (SAZ)**. SAZ identification and declaration may be made by state governments in consultation with farm men and women. Special facilities may be provided to farmers to maintain SAZ as the custodian of national food security.
- Establish in each of our 130 agro-ecological zones, a Soil Health Monitoring and Amelioration Centre. Such centres should not only help farmers with soil health cards but also extend assistance to rectify soil defects like salinity, alkalinity, water logging etc.
- Pay special attention to soil organic matter since this is essential for improving the hydraulic conductivity (physics), chemistry and microbiology of the soil.
- Popularise local level of soil health assessment systems such as the presence of earthworms and nitrogen fixing and phosphorus solubilising microorganisms.
- Train a cadre of local level Soil Health Managers (both men and women) to help in both soil health monitoring and amelioration.

Agriculture has not been a central focus of India's Union Budgets. What are your recommendations on the agriculture sector for the next Union Budget?

Agriculture and rural development are in need of much greater investment. There is a mismatch

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between production technology and post-harvest technology. We should end this mismatch by making greater investment in post-harvest storage, processing and marketing. The next Union Budget should also provide more funds for agricultural research, education and extension. The return from investment in public good research is very high and hence greater allocation will lead to greater benefits for the country.

How will the new Land Acquisition Bill impact farmers in particular and agriculture in general?

There is considerable debate on this topic among Parliament Members and Farmers' Organisations. We should try to develop regulations which will represent a win-win situation both for farmers, farming and national development goals. For this purpose, three prerequisites are essential. They are, safeguarding our food security system, strengthening the livelihood security of farm families and acquisition for a public purpose and not for private profit.

What according to you is the adverse impact of genetic engineering on the nutritional value of the crop?

As far as I know, there has been no adverse impact of genetic engineering on the nutrition value of the crop. Most of the crops grown in the United States are genetically modified. Some scientists are working on biofortification like enhanced vitamin A content through Genetically Modified Organisms (GMOs). However, we do not have yet a regulatory mechanism which inspires the confidence of the public, political leaders, professionals and the media. We need a parliament approved Biosafety Regulatory Authority.

What are the impediments to India's food security? How can women contribute to it?

Women are already playing a very important role in agriculture, which by and large remains unrecognised and unrewarded. I therefore introduced Private Members' Bill titled Women Farmers' Entitlements Bill for adoption by Rajya Sabha. Unfortunately, this could not be taken up before the end of my tenure in the Rajya Sabha.

How should the government make agriculture sector an attractive career option for the youth?

Attracting and retaining youth in farming is the major challenge. For this purpose, we should make agriculture both intellectually satisfying and economically rewarding. The economics of farming is conditioned by input – output prices and import-export policies. Therefore, we need synergy between technology and public policy. The National Commission on Farmers has made detailed recommendations on how to attract and retain youth in farming. Involvement of educated youth will help to promote the technological upgradation of agriculture.

Our Prime Minister recently launched the 'Skill India' Movement on the occasion of World Youth Skills Day (July 15, 2015). In this connection, I would like to share some experience in imparting new skills which can strengthen the quality of life as well as livelihood of rural and tribal families. Our programme follows the principle laid out by Mahatma Gandhi that we should combine brain and brawn or intellect and labour, while developing skill programmes for rural communities. Unfortunately, this principle is often forgotten in government programmes like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). For example MGNREGA will confer immense benefits both to the individual and to the nation, if skills are imparted in the areas such as child care, maintenance of crèches, rain water harvesting, water shed management, drip irrigation, greenhouse cultivation, biodiversity conservation and converting biodiversity hotspots into happy spots through conservation, sustainable use and equitable sharing of benefits.

MS Swaminathan Research Foundation (MSSRF) designed the Biovillage model in 1992 of human centred development in the Union Territory of Puducherry. This programme aims to impart new skills to both, those who possess land or livestock, as well as those who are classified as landless labour, especially for women. Special attention was given to women, since they are usually the most hard worked and least paid. Thus, assetless women will grow mushrooms in a small space in their hut which has now become a substantial income generating activity. If one goes to a village and ask men and women what they are doing, the

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answers will be somewhat under the following lines:

“I am a plant doctor; I am an academican of the National Virtual Academy; I am a climate risk manager; I am a community hunger fighter; I am a biodiversity conserver; I am a soil health manager etc.”

Thus, the men and women who acquire new skills are very proud of their capability in areas relevant to both rural life and employment. A majority of

our people are young and hence imparting skills to economically underprivileged young women and men should receive priority under the ‘Skill India’ Programme. If ‘Skill India’ is properly developed, it will not only enhance income, but also the self-esteem of rural families. We will be able to retain youth in farming only if they find farm occupations intellectually stimulating and economically rewarding. Thus, ‘Skill India’ can confer multiple benefits.

Enabling Food Security with Safe Food Only

“Food Security Act “which has been passed by the Indian Parliament in 2013 is confused by some people as “Food Safety and Standards Act, 2006” also. Whereas “ Food Safety and Standards Act, 2006 ” is meant to regulate and monitor the manufacturing, processing, distribution, sale of import of food so as to ensure safe and wholesome food, “ Food Security Act, 2013 ” is meant to ensure availability of food grains to the Indians as per following norms:

Beneficiaries of the Public Distribution System (PDS) are entitled to get 5 kgs per person per month of cereals at the following prices:

- 1) Rice at Rs 3 per kg
- 2) Wheat at Rs 2 per kg
- 3) Coarse Grains at Re 1 per kg

In a country of 1250 million, it is a very difficult task to ensure Rice / Wheat / Coarse Grains of 5 kgs per person per month through Public Distribution System. While ensuring quantity, quality of food grains are to be maintained as per Food Safety and Standards Act, 2006.

Food Safety and Standards Act, 2006 is applicable to domestic and imported food products. However, export is not within the purview of FSS Act, 2006. Hence the food grains supplied under Food Security Act, 2013 must comply with the standards specified in the Food Safety and Standards Regulations, 2011 (Food Products Standards and Food Additives) in 2.4.6.



As per the regulations, food grains meant for human consumption shall be whole or broken kernels of Cereals. They shall be free from Argemone, Mexicana and Kesari in any form. They shall be free from added coloring matter. The Food grains shall not contain any insecticide residues other than those specified in Regulations 2.3.1 of Food Safety and Standards (Contaminants, Toxins and Residues) Regulations, 2011. The amount of insecticide residue in the food grains shall not exceed the limits specified in Regulation 2.3.1 of the said Table Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011.

The food grains meant for grinding / processing shall be clean, free from all impurities including foreign matter (extraneous matter).

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The standards for Rice shall be as follows:

Rice shall be the mature kernels or pieces of kernels of *Oryza sativa* Linn. obtained from paddy as raw or perboiled. It shall be dry, sweet, clean, wholesome and free from unwholesome poisonous substance. It shall also conform to the following standards:

(I) Moisture - Not more than 16 percent by weight (obtained by heating the pulverized grains at 130 - 133 degree Celsius for two hours)

(ii) Foreign matter - Not more than 1 percent by weight (Extraneous (of which not more than 0.25 percent by weight shall be mineral matter) and not more than 0.10 percent by weight of animal origin)

(iii) Damaged grains - Not more than 5 percent by weight.

(iv) Weeveilled grains - Not more than 10 percent by count.

(v) Uric Acid - Not more than 100 mg per kg.

(vi) Aflatoxin - Not more than 30 micrograms per kilogram, provided that the total of foreign Matter and damaged grains shall not exceed 6 percent by weight.

The standards for wheat shall be as follows:

Wheat shall be the dried mature grains of *Triticum aestivum* Linn or *Triticum vulgare* vill, *Triticum durum* desf, *Triticum sphaerococcum* perc, *Triticum dicoccum* schubl, *Triticum compactum* Host. It



shall be sweet, clean and wholesome.

It shall also conform to the following standards :

(I) Moisture - Not more than 14 percent by weight (obtained by heating the pulverized grains at 130 - 133 degree Celsius for two hours.)

(ii) Foreign matter- Not more than 1 percent by weight (Extraneous (of which not more than 0.25 percent by weight shall be mineral matter) and not more than 0.10 percent by weight shall be impurities of animal origin)

(iii) Other edible grains- Not more than 6 percent by weight.

(iv) Damaged grains - Not more than 6 percent by weight including kernel bunt affected grains and ergot affected grains. The limit of kernel bunt affected grains and ergot affected grains shall not exceed 3 percent and 0.05 percent respectively.

(v) Weevilled grains. - Not more than 10 percent by count.

(vi) Uric acid - Not more than 100 mg per kg.

(vii) Aflatoxin - Not more than 30 micrograms per kilogram

(viii) Deoxynivalenol (DON) - Not more than 1000 micrograms per kilogram. Provided that the total of foreign matter, other edible grains and damaged grains shall not exceed 12 percent by weight.

Therefore, while supplying 5 kilograms per person per month, Rice / Wheat / Coarse Grains @ Rs 3/ , Rs 2/ and Re 1/ respectively through public distribution system, quality of the grains must conform to the Food Safety and Standards Regulations, 2011 (Food Products standards and Food Additives) . Regular testing of the supply must be done at Food Safety and Standards Authority of India notified NABL accredited laboratory to ensure that the supply made are safe for the consumer.

Since the food grains supplied through public distribution system are to be stored in warehouse and transported to the retailer before distribution, proper care must be taken in every step starting

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from procurement of food grains , storage of food grains and transportation of food grains.

In Food Safety and Standards Regulations (Licensing and Registration of Food Business), 2011, Schedule IV , Part II, Hygienic and Sanitary Practices to be followed by all food business operators applying for license have been described in details. The establishment in which food is being handled, stored and distributed by the food business operators and the persons handling them should conform to the sanitary and hygienic requirement failing which license will be cancelled.

It consists of several steps like location and surroundings, Layout and design, equipment and containers , facilities like water supply for cleaning utensils / equipment and washing of raw material, personnel facilities and toilet, air quality and ventilation, lighting , procurement of raw materials, storage of raw materials, food distribution / service, management and supervision , food testing facilities , audit , documentation and records , cleaning and maintenance, pest control systems , personal hygiene and training.

Details of all these steps have been described in Schedule IV , Part II of Food Safety and Standards Regulations (Licensing and Registration of Food Business) , 2011, which must be followed strictly to ensure safe and wholesome food under National Food Security Act , 2013.

Hence National Food Security Act, 2013 cannot be implemented properly if the food grains supplied



does not conform to the Food Safety and Standards Regulations, 2011. There must be close coordination between these two agencies to ensure quality and quantity of the food grains. Enhanced productivity of food grains, proper checking of food grains during procurement, storage of procured food grains without contamination, transportation under proper hygienic and sanitary conditions of food grains are all important steps because food grains may be contaminated at any stage from procurement to storage to transportation to distribution. Safe food grains can only make safe meal to the Indian.

National Food Security Act, 2013 will not only ensure food to every Indian but it will also drastically reduce wastage of food grains due to prolong storage in the warehouse, during transportation and during distribution. Strengthening of infrastructure is very much essential at every stage. It is a huge social responsibility taken by the Government of India.

Pradip Chakraborty

Former Director

Food Safety and Standards Authority of India

India's Long Standing Partnership with the World Food Programme

Working towards achieving Zero Hunger in our lifetime

End hunger, achieve food security and improved nutrition, and promote sustainable agriculture – Sustainable Development Goal (SDG) 2 sets before the world community a huge challenge. SDG 2 calls for a concerted and comprehensive response to ensure access to food by all people, ending all forms of malnutrition and ensuring sustainable food production systems.

The year 2015 presents a unique opportunity for the United Nations World Food Programme (WFP) to build on its work and move towards the targets set by the SDGs. As the world's largest humanitarian agency fighting hunger worldwide, WFP reaches more than 80 million people with food assistance in 75 countries each year. In India, WFP's engagement goes back to 1963.

WFP's early engagement in the country aimed at promoting economic and social development and responding to emergency food needs. WFP has delivered assistance in India through nearly a hundred different development and emergency projects.

For its first 20 years in India, WFP focused on using food aid as a means to improve food security and nutrition and to promote economic and social development. WFP actively contributed to the National Dairy Development Board's Operation Flood for over 10 years, starting in 1969. This project was one of the largest undertaken by WFP in India and used dried-skimmed milk and butter oil to improve the availability of dairy products in major urban centres. WFP also began addressing the specific nutritional needs of India's vulnerable populations in the mid-1970s. From the mid-1980s, WFP contributed to the construction of the Indira Gandhi Canal, which brings water to the desert areas of northwest Rajasthan. At the community level, WFP distributed food assistance to encourage participation in numerous operations supporting rural development. In recent times, evolving with the socio-economic changes in the country, WFP moved from providing direct food aid to providing technical assistance and capacity building services to the Government of India.

According to the recently released Rapid Survey on Children (RSoC) conducted by the Ministry of Women and Child Development, with technical support from UNICEF, nearly 29.4 percent of children (aged less than three years) are underweight, 15 percent are wasted and 38.7 percent are stunted.

In its current avatar, WFP's role in India couldn't be more relevant. Focusing on enabling the country's food-based social safety nets to function more efficiently and effectively in providing food to those who need it the most, WFP is working closely with the Government. In particular, WFP is working to transform the existing Targeted Public Distribution System (TPDS). TPDS - India's largest food-based social safety net, reaches out to over 800 million beneficiaries. WFP is working on an end-to-end computerization of the system, which will ensure greater efficiency, transparency and accountability. This includes the digitization of the beneficiary database, computerization of supply chain management and a grievance redressal mechanism and transparency portal.

Contributing to the Government's other large-scale food-based social security net - the Mid-Day Meal (MDM) programme, WFP is working to enhance the nutritional value of the programme. WFP is providing iron fortified rice through school meals to almost 100,000 children in Gajapati district in Odisha. The fortified rice provides a significant proportion of the recommended dietary intake of iron for children aged 6-14 years in Odisha. The initiative has shown positive results - with a significant decline in anaemia reported amongst children in the region in the last two years.

The National Food Security Act (NFSA), passed in 2013, gives an important direction to WFP's future engagement in India. Leveraging on its global expertise, as well as capitalizing on India's strong knowledge base and technical know-how, WFP is scaling up its TPDS initiatives in the country, and advocating for the institutionalization of food security analysis within the government system, to guide states in their policy and programming.

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Working towards achieving the Zero Hunger vision in India, WFP's engagement continues to evolve to address the food security and nutrition needs of the world's second most populous country.

WFP is part of the United Nations system and is voluntarily funded. Born in 1961, WFP pursues a vision of the world in which every man, woman and

child has access at all times to the food needed for an active and healthy life. We work towards that vision with our sister UN agencies in Rome -- the Food and Agriculture Organization (FAO) and the International Fund for Agricultural Development (IFAD) -- as well as other government, UN and NGO partners.

Current Situation and Strategies for Availability of Onion Throughout the Year in India

1. Introduction

India being endowed with varying agro-climatic conditions provides opportunity for growing large number of horticulture crops including vegetables. Onion is an important vegetable and spice crop grown in almost all the parts of India since, thousands of years. It originates from the region comprising North West India, Afghanistan, Tazik and Uzbek. Western Asia and the area around the Mediterranean seas are the secondary centers of development. It is used as salad and cooked in various ways in curries, fried, boiled, baked, used in soup making and pickles. The medicinal properties of onion as anti- microbial and antibiotic are well recognized. Though common onion is not rich in food value, these have got considerable quantity of cellulose and sugar. Common onion ranks medium in the supply of proteins, calorie value and vitamin B & C. Small onions are, however more nutritive than big onions. The onions are regarded as highly export oriented crop amongst vegetables and earning valuable foreign exchange for the country. Though the country is producing sufficient quantity of onions, but the availability of produced quantity is not regular and sufficient to meet the demands for both domestic requirement and exports. Thus a perspective is presented to regulate the production of onions round the year in the country.

2. Global Perspective of onion

A global review of area and production of major vegetables shows that onion ranks fourth in area and production of vegetables in the world among

nine major vegetables namely onion, potato, cauliflower, green peas, cabbage, tomatoes, okra, green beans, cucumber and gherkins. In India among these nine vegetables, onion ranks second in area and third in production. About 857.95 lakh tones of onions produced from about 44.44 lakh hectares area in the world. India ranks second in area and production, the first being China amongst the onion producing countries in the world. The highest productivity of onion in the world is of Korea Rep (64.58 MT/ha) followed by USA (54.47 MT/ha), Spain (53.69 MT/ha) and Netherland (45.85 MT/ha). India being a second major onion producing country in the world has a productivity of 15.41 MT/ha only. (FAO 2013)

Maharashtra is the leading state in India producing 58.64 lakh MT onions from 4.68 lakh hectare area. The other major states producing onions are Madhya Pradesh, Karnataka, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana, Tamilnadu, Odisha, Telangana and Uttar Pradesh and in India per hectare yield is highest in Gujarat (25.4 MT/ha) followed by Madhya Pradesh (24.09 MT/ha), Bihar (24.01 MT/ha), J & K (22.94 MT/ha), Haryana (22.29 MT/ha) and Punjab (22.27 MT/ha). Productivity of onion shows variable trend as the crop is susceptible to various weather variations. Yield obtained in India with those obtained in developed countries show that there is a wide gap between the optimum yields of the onion crop. The details of area, production and productivity of onion in different countries of the world during the year 2013 are given in Table -1 and state-wise area, production and productivity of onion in India during the year 2013-14 are given in Table-2.

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3. State-wise annual requirement of onion in India

The total annual requirement of the country based on population and onion consumption is given in Table-4. The data indicates that out of total estimated requirement of 182.26 lakh MT, the country is producing 194.02 lakh MT of onion annually. The consumption data is based on the study conducted by National Horticultural Research and Development Foundation (NHRDF) during the period 2012-13 in 12 states, which includes 6975 samples of rural families and 5330 samples of urban families. The result shows that 45.63 g / person/ day consume onion and 87.58% population consume onion. Sometimes prices increase due to disturbance in harvesting schedule and more losses in storages, the gap if any needs to be bridged based on defining strategies in medium and long terms to make sure availability of onion round the year in the country.

4. State-wise status of onion production in India

Two to three crops of onions are now taken in various parts of the country. Fresh onion starts coming from July onwards in the markets from Kurnool in the State of Andhra Pradesh, Tirpur in Tamilnadu and continues upto April-May in other parts and in Andhra Pradesh and Tamilnadu States, from July to October and also in March-April. In Karnataka State, also there are two crops as that of Andhra Pradesh. In Maharashtra State, fresh onion starts coming in market in September-October (Satara) and continues from October to April-May in Nasik, Ahmednagar and some parts of Pune district. Gujarat State produces three crops i.e. rainy season (November-January) in Bhavnagar district, winter (February-March) and summer (April) in Rajkot, Junagarh and Jamnagar districts. Rainy season onion production, which was not common in northern pocket, is however, now being taken up in some pockets of Rajasthan (Alwar, Dausa, Bharatpur and Ajmer), Haryana (Rewari, Mewat and Gurgaon districts) and Punjab (Patiala) states thereby making Maharashtra onion surplus for export. In Northern, Eastern and Central parts of India, rabi onion is commonly cultivated which is available in April-May (Table-3). Multiplier onion (shallot) is grown in Tamilnadu and Odisha states. The quality of multiplier (shallot) onion produced in Odisha is better. Small pickling onion is produced in Andhra Pradesh near Mydukur in Cuddapah district during rainy season and in Karnataka near Chickballapur and Bangalore in all the three seasons exclusively for

export. The quality of Karnataka small onion is better in view of mild climate which prevails almost round the year there.

Round the year availability of onion is depicted in Table 3. The Table-3 clearly indicates that early rainy season onion is cultivated only in southern and eastern states i. e. Tamilnadu, Karnataka and Andhra Pradesh and Maharashtra and harvesting takes place from July to September. Later on fresh onion harvesting started almost in all the subsequent months in one or other states of the country. As per the availability and requirement, (Table - 4), the states Andhra Pradesh, Bihar, Odisha, Rajasthan, Tamilnadu, Uttar Pradesh are facing annual deficit of onion. Karnataka is having annual surplus of 11.44 lakh MT to cater the need of adjoining states and others. The requirement of these states are, sometimes, met from the onions produced and stored in Maharashtra, when Karnataka is not having too much surplus. Similar is the situation for other states also where deficit in lean periods is met out either from Maharashtra, Gujarat, Madhya Pradesh or other adjoining states, but due to climatic vagaries and other abnormal situations, round the year availability is hampered resulting into rise in prices, quantity restrictions and ban on export, and sometimes import of onions are also done to fulfill the requirements.

India has sufficient R & D backup in terms of development of improved varieties, standardization of pre and post harvest technology and seed production technology. The technologies developed by National Horticultural Research and Development Foundation (NHRDF), Horticultural Institutes of Indian Council of Agricultural Research (ICAR) and various State Agricultural Universities are being disseminated to the farmers by NHRDF and State Dept. of Horticulture / Agriculture, but to achieve the goal of self sufficiency, several genuine constraints have been identified and the gap is required to be bridged for ensuring onion availability round the year.

5. Constraints

No doubt production and productivity have increased substantially over the past 20 years; it still has quite low productivity when compared to the countries like Netherlands, United States of America, China & Korea Republic. The constraints which have been identified for low production and productivity are enumerated as under:

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- Non – availability of high yielding storable varieties for all the three seasons.
- Lack of strategy for expansion of area in rainy, winter and summer seasons in non-traditional pockets.
- Non-availability of quality seed of improved varieties in adequate quantities.
- Onion varieties developed are not uniform in colour, shape & size. Bolting and doubles are observed in almost all varieties. The marketable recovery thus is low.
- Non-availability of high yielding & storable F1 hybrids.
- All varieties are susceptible to diseases and insect pests.
- Sub-optimal standards of cultivation adopted by farmers.
- Lack of high TSS white onion varieties suitable for dehydration and high TSS bigger bulb sized yellow varieties for export.
- Inadequate storage facilities, transportation and marketing support.
- No regular Government policy on export.

6. Strategies to ensure availability of onion round the year

In order to make onions available round the year for consumption, export, planting material for seeds and also for dehydration, the following medium term and long term strategies are to be adopted:

6.1. Medium Term Measures

6.1.1. Augmenting quality seed production programme

Onion seed production is normally being taken up in Gujarat, Maharashtra, Karnataka, Madhya Pradesh and to some extent in Orissa, Rajasthan, Tamilnadu and West Bengal. Though no authentic data on demand of seeds are available, the total requirement of onion seed based on area under onion comes to about 8200 tonnes. Out of this only 8-10% seed is produced by organized sectors like National Horticultural Research and Development Foundation, National Seeds Corp., Maharashtra State Seeds Corp., Indian Council of Agricultural Research and State Agricultural Universities. Rest 90% seed is produced either by private seed companies (35%) or by the farmers themselves (55%). Thus there is need to strengthen the production of quality seed. The

quality seed production of improved varieties will replace the local seed material thereby production and productivity will also increase.

The Government of India has taken up good initiatives through its National Horticulture Mission (NHM) programmes where assistance is being provided to the state Government and also National Horticultural Research and Development Foundation for encouragement to the farmers for quality seed production. The assistance is also being provided for creating infrastructural facilities and seed storage to seed producing agencies including NHRDF to maintain the quality of seed. Now, it is necessary for state governments to ask / involve state seed corporations to come forward and produce quality seed of onion at least to meet the requirement of their states.

6.1.2 Rainy season onion production through bulblets

Since rainy season onion is cultivated during monsoon, it has been observed that nursery is damaged during heavy rainfall or due to unfavorable climatic conditions. The technology of production of rainy season onion through sets (bulblets) has already been standardized and developed by NHRDF. NHRDF distributing seeds of rainy season onion varieties Agrifound Dark Red for production of sets in states of Gujarat, Rajasthan, Haryana and Punjab and onion growers engaged in bulblet production. The productions of bulblets needs to be strengthened in above states as well as in other potential states like Bihar and Uttar Pradesh also so as to increase early production of onion during rainy season.

6.1.3 Area Expansion under rainy season onion

The area under Rainy season onion crop in the country is about 20% of the total area cultivated. This needs to be increased in non traditional rainy season onion producing states so as to ensure the availability and reduce the pressure of supply from major rainy season onion producing states like Maharashtra and Gujarat. The NHRDF on its own and with financial assistance from National Horticulture Board and also under its National Horticulture Mission programmes of Government of India has taken up the programme on area expansion of rainy season onion by protected growing of seedlings in Northern and Eastern India covering states of Haryana, Rajasthan and Bihar and good coverage under rainy season

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onion noted. The project was also taken for production of bulblets in northern and eastern India where demonstration and trainings were arranged. The involvement of more agencies required so that significant impact noted.

6.1.4 Adoption of plant protection measures during epidemics

Quite often due to unfavourable weather conditions, diseases like purple blotch, stemphylium blight, colletotrichum blight and thrips, insect pests are attacking the standing onion crop and a major damage in production and quality is experienced. These diseases and insect pests are to be controlled by a campaign on mass plant protection, so as to restrict the pathogens/pests for entering into the unsprayed field. The education and training on diseases and insect pests management are to be imparted to the farmers and Agriculture Department Officers for tackling such situations on large scale.

6.2. Long term measures

6.2.1. Development of high yielding variety of F1 hybrids

The varieties presently developed and popular amongst farmers are though giving optimum yield but the productivity level is certainly low as compared with the high yielding varieties popular in other countries. Thus there is need to develop such varieties which are high yielding and either tolerant or resistant to diseases and pests. Onion being cross pollinated crop, it always has wide scope for selection as natural variability is created constantly. Besides, to increase the yield, F1 hybrids are needed. The thrust area of development of F1 hybrids in short day types has remained still an important area of research. Despite identification of CMS lines alongwith maintainer by the Institutes of Indian Council of Agricultural Research, no commercial hybrids have reached to the farmers successfully. The efforts are being made by NHRDF also for screening of the germplasm having tolerance to purple blotch and stemphylium blight. Several new collections are due to release. More efforts are required to be made by public sector Institutes for development of F1 hybrids in short day conditions.

6.2.2. Establishment of monitoring cell for reviewing production, availability and prices of onion

The monitoring groups at State level and District level are required to be formed to review the crop condition, area expansion as well as storage. Based on the recommendations of this group, State Govt. will formulate the programme for increasing onion production and storage capacity in most of the onion growing areas. The financial assistance for creating storage facilities is also required. Present storage capacity is estimated to be around 25.00 lakh MT in India compared to 12.0 lakh MT in 1999-2000. Further the programmes are required to be continued in order to increase storage capacity every year with target of 30 lakh MT by the year 2010-2011, when total onion production is expected to the tune of 150 Lakh MT. The National Horticultural Research and Development Foundation (NHRDF) has also provided technical guidance for creation of storage facilities and maintaining buffer stocks to regulate the supplies to the states of Karnataka, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh, Odisha etc. For creation of more onion storage facilities, the subsidies should be provided by major onion producing states to the growers so that the buffer stock would be maintained.

6.2.3 Quality seed production and distribution in adequate quantities

As discussed earlier, the total requirement of quality seed of onion is over 8200 tonnes. Out of this National Horticultural Research and Development Foundation, National Seeds Corp., Maharashtra State Seeds Corp. and such other agencies are meeting requirement about 8-10% only. Rest quantity of seed is supplied by private seed companies and is being produced and distributed by the farmers themselves, where there is no quality control about isolation and rouging off types and so on. Further, seeds of newly developed identified varieties having better yield and quality are not being produced. There is, therefore, urgent need for National Horticultural Research and Development Foundation, National Seeds Corp. and Maharashtra State Seeds Corp. to discuss and arrange quality seed production of improved varieties in large quantity for meeting the demand of the farmers. Although it is neither possible to produce the entire quantity of seed by different agencies nor it is possible to replace the old varieties at one stroke, slowly and slowly the

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programmes are to be planned for replacement of old varieties in phased manner.

6.2.4 Development of biotic and abiotic stress tolerant varieties

As mentioned under the constraints, presently, there is no variety which has been bred by the Universities or Institutes as resistant to different field or storage diseases and insect pests so also heat tolerant or moisture stress. Since purple blotch, stemphylium blight diseases and thrips insect in the field, basal rot, black mold and bacterial brown rot in storages are the diseases many times causing severe damage to the crop, there is need to develop resistant / tolerant varieties quickly so as to solve the problem of the farmers and make available quality onions in adequate quantities. This work can be taken up by ICAR Institutes, NHRDF and State Agricultural Universities.

6.2.5 Adaptation of biological control measures against pests and diseases

Presently farmers are being advocated to use pesticides for control of diseases and pests where there is problem of pesticide residues beyond the permissible limits. Since it is health hazardous, if there are residues beyond the permissible limit, there is need to develop biological control measures against diseases and pests. It is therefore essential that necessary facilities for developing the biocontrol techniques, may be strengthened and training to farmers be imparted. It may be mentioned here that European and other such markets are very particular about pesticides residues, as such efforts in development of biological control measures against diseases and pests are to be undertaken. The promotion of organic farming will also be one of the important tools to combat the problem.

6.2.6 Development of yellow colour hybrids and OPs for export especially to European and Japanese markets

India is presently exporting onions to mostly Gulf countries, South East Asian countries, Bangladesh and Sri Lanka, where there is not much scope to increase the further export. There is, however, good scope to increase the export by diversifying the market to Europe and Japan. These countries do not prefer our strong pungent onions. Presently very little quantity of yellow onions is

being produced in Jaipur district of Rajasthan state of India but that too for local consumption. There is possibility of producing yellow onions at economical rates which could be harvested from February onwards. It may be produced in Odisha, Maharashtra, Gujarat, Madhya Pradesh and other parts. Europe and Japan require mild pungent yellow onions from February onwards till May. India, therefore, can very well arrange production of yellow onions for supplying to Europe and Japan. Custom farming of yellow onions could be organized exclusively for export by the exporters with the help of NHRDF or other such agencies.

6.2.7 Development of bigger bulblet varieties in multiplier / shallot types

Thailand is the major supplier of multiplier / shallot onion at present. There was a time when India was the major supplier of multiplier / shallot onion to Sri Lanka and other countries. In view of multiplier / shallot onions being vegetatively propagated crop, Sri Lanka and other countries selected their own material and started multiplying themselves instead of depending on India. Thailand being at higher latitude the size of bulblets is bigger. In India so far major attention for development of multiplier / shallot onion has been given in Tamilnadu. Since Odisha also grows multiplier / shallot onion and has better material in view of being at higher latitude, bigger bulblet variety should be developed so as to regain the export of multiplier / shallot onion already lost.

6.2.8 Training of trainers, farmers, traders and exporters

Trainers, farmers, traders and exporters should be trained regularly with the latest innovations in the production and post harvest management so that farmers are able to get good crop and traders and exporters are able to handle the crop with minimum post harvest losses in various post harvest handling operations at their level.

6.2.9 Establishment of adequate curing and storage facilities by farmers, traders and exporters

Presently there are only few traders and onion growers who have got storage facilities and curing sheds that too of conventional types. The losses thus are on very high side after the produce is brought to the market. It is necessary for the

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onion growers to have at least a small 10 tonne capacity temporary curing shed for curing of the bulbs after harvesting in shade and then store in ventilated storage godowns so that whenever prices are low, they are able to withhold the stock and release slowly and slowly without post-harvest losses. Traders and exporters should also have their own curing shed and also storage godowns of improved types having ventilation from bottom to avoid the post harvest losses. This will help in safe handling of the produce and avoid damage from heat and rains. Farmers and other concerned may get help for creation of such facilities from Cooperative banks or NABARD / NHB/NHRDF.

Designs and salient features of improved storage structure developed by NHRDF:

- Construction of structure on raised platform to prevent moisture contact and dampness.
- Use of Mangalore tiled roof or other suitable material to prevent built up of high temperature inside.
- Increased centre height and more slope for better air circulation and preventing humid microclimate inside godown.
- Providing bottom ventilation for free and faster air circulation to avoid formation of hot and humid pockets between the onion layers.
- Avoid direct sunlight on onion bulbs to reduce sunscald, fading of colour and quality

deterioration.

- Restriction on width of each stack to 60-75 cm for hot and humid weather, 75-90 cm for mild and humid weather and 90-120 cm for mild and dry weather conditions.
- Maintenance of stacking height to 100 cm for small and multiplier onion and hot weather and 120 cm for mild weather and for big onion to avoid pressure bruising.
- Providing cubicles instead of continuous stack and sufficient space for ventilation from all sides.
- One cubic meter area of store accommodates about 750 kg onions. Accordingly, construction of godown for required capacity and construction of more units instead of single big structure and in zigzag manner when constructed in more rows.
- Providing two tier if space available is insufficient.
- Periodical disinfections of structures and premises to check rottage. The cost efficiency of structures is based on locally available material and labour.

Designs of onion storage structures for different capacities i.e. 5, 10, 15, 20, 25 and 50 MT have already been developed by NHRDF and design along with estimates for 50 MT capacity is given as under:-

ESTIMATE FOR ONION STORAGE OF CAPACITY 50 M.T.

S.N.	TOTAL QTY.	DESCRIPTION	RATE	UNIT	AMOUNT
1	102	Excavation for foundation	110	Cu.m	1122
2	2.55	P.C.C. 1:4:8 in foundation	2500	Cu.m	6375
3	6.21	R.C.C. 1:2:4 for columns	3200	Cu.m	19872
4	440 kg.	Nominal Reinforcement to columns	52	Kg-	22880
5	3300kg.	Structural Steel Works	60	Kg.	198000
6	160	A/C Sheet Roofing	200	Sq.M.	32000
7	25	A/C Sheet Ridge	120	Rmt	3000
8	2798.4	2"Dia 1/2 Bamboo Strips @2"C/C.	25	Rmt	69960
9				Total:	353209
10			Contingencies @ 5%		17660
11			Total		370869
12			VAT @ 4%		14835
13			Service tax 12.24% on 33% of Total (11)		14980
			G.Total		400684

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Table: 3

Round the year availability of onion in India

Month	Places where Onions are harvested & available	Remarks
January	Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Orissa	Winter
February	Maharashtra, Gujarat, West Bengal, Madhya Pradesh	Winter
March	Maharashtra, Madhya Pradesh, Gujarat, Tamilnadu, Karnataka, Andhra Pradesh, West Bengal, Orissa	Winter
April	Maharashtra, Madhya Pradesh, Gujarat, Tamilnadu, Karnataka, Andhra Pradesh, Rajasthan, West Bengal, Orissa	Summer
May	Maharashtra, Gujarat, Rajasthan, Haryana, Punjab, Uttar Pradesh, Bihar	Summer
June	Haryana, Punjab, Uttar Pradesh, Bihar, Himachal, Uttarakhand	Summer
July	Tamilnadu, Karnataka, Andhra Pradesh	Early Rainy
August	Tamilnadu, Karnataka, Andhra Pradesh	Early Rainy
September	Karnataka, Andhra Pradesh, Tamilnadu and Maharashtra	Early Rainy
October	Maharashtra, Gujarat, Tamilnadu, Karnataka, Andhra Pradesh, Rajasthan and Madhya Pradesh	Rainy
November	Maharashtra, Gujarat, Tamilnadu, Karnataka, Andhra Pradesh, Rajasthan, Haryana, Punjab, Uttar Pradesh, Bihar, Madhya Pradesh	Rainy
December	Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Haryana, Uttar Pradesh, Punjab, Bihar	Rainy

Table: 4

Annual requirement of onion in different states & position of production/availability			
State	Availability (MT)	Requirement (MT)	Surplus/ Deficit (MT)
Andhra Pradesh	1004554	1275102	-270548
Bihar	1304160	1563346	-259186
Gujarat	1851220	909405	941815
Haryana	672170	381829	290341
Karnataka	2065160	920657	1144503
Madhya Pradesh	2826022	1093353	1732669
Maharashtra	5864040	1692389	4171651
Orissa	432050	631747	-199697
Rajasthan	704960	1033464	-328504
Tamilnadu	472690	1086446	-613756
Uttar Pradesh	409956	3005790	-2595834
Rest Other States	1794700	4632546	-2837846
Total	19401682	18226074	1175608

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Indian Agriculture: Challenges and Way Forward

A. Introduction

1. Agriculture is one of the principal source of livelihood for the majority of rural population and the major source of raw material for a large number of industries. The sector contributed 16.2 per cent to Nation's GDP in 2014-15 based on 2011-12 prices. The present population of 1.21 billion expected to stabilize at 1.6 billion by 2050. This implies that per capita availability of land, water and other finite natural resources will continue to decline while the biotic (insect-pests and diseases) and abiotic stresses like flood, drought, heavy rains, cyclones, hailstorm, heat and cold stress are on the rise. Hence, the future scenario of food security may not be bright in spite of the current production of foodgrains exceeding domestic demand. The annual rate of growth of foodgrain productivity fell from 2.17% during 1990s to 2.07% in the subsequent 15 years period

ending with 2014-15. Hence, meeting the future projected demand for foodgrains of 277 million by 2020 tonnes would require concerted efforts to enhance the growth of food productivity. This is more important in view of the adverse weather conditions and natural calamities hitting one or the other part of the country almost every year. Concerted efforts would be required to address the management of production and price risk, judicious use of land and water, investments in agriculture, fair price of farm produce, value addition of farm produce and post-harvest management, strengthening supply chains, improving sources of non-farm income and development of infrastructure and support services in the areas of marketing, irrigation, agricultural extension, credit support and agro-processing and improvement in agri-research & extension, etc.

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2. Even with all public support and R&D investments, the impact of the Green Revolution technology and public policies have largely benefited regions relatively well-endowed in terms of water and rainfed agriculture, which covers about 60 per cent area under plough, remained neglected, though 70-85% of oilseeds, pulses and coarse cereals, 65% of cotton and 45% of rice are grown in rainfed areas. Rainfed region contributes about 44% of total food production in the country. This area also supports 78% of cattle, 64% of sheep and 75% of goats. Even at the best scenario of irrigation development, about 40% of the foodgrain output in 2020 will have to be produced in rainfed areas. The existing large potential-and- realizable yield gap in Eastern States and rainfed farming areas offer considerable scope for increasing food productions even with the existing technology. Productivity and farm income in the irrigated regions have almost reached a plateau. The sustainability of production is facing rising threat due to declining total factor productivity and increasing cost of cultivation. The competing demand for land for urbanization, industrialisation, infrastructure, etc. is likely to cut on land and water in future, thus enhancing productivity per unit land and water and other applied inputs is the only option left. The rainfed areas should be the focus for productivity led future growth in Indian agriculture. Due to diversity of crops grown in rainfed region its R&D requirements are much more than irrigated region. Thus NARS need to make concerted efforts to develop innovative technologies for rainfed agriculture and States need to invest much more in taking improved technologies from labs to field.

B. Need for paradigm shift

3. During Green Revolution and thereafter, the growth in agricultural productivity was achieved largely in favourable environment under assured irrigated cultivation, improved infrastructure associated with assured prices and remunerative marketing opportunities. However, of late, this growth has been realised as environmentally unsustainable. A paradigm shift is required in agricultural planning to make farming profitable and sustainable. The farming should be reoriented from commodity based to area-focussed approach with focus on location-specific technological needs for a given resource endowments and socio-economic situation. The

key initiatives for higher growth in agriculture will include (i) integrated approach in resource allocation on crops, horticulture and livestock depending upon the proportionate contribution of these subsectors in States agri-GSDP; (ii) promoting the knowledge-based agriculture well knitted with the farmers knowledge, expertise and involvement in technological innovations and adoption;(iii) development of farmer-centric institutional framework like FPOs to support production systems and forward linkages; and (iv) policy decisions for strengthening agriculture-industry linkages.

3.1 Water Productivity: It is well established that the growth in agricultural productivity and sustainability will only be achieved with the increase in water use efficiency and productivity. To achieve this, in-situ and ex-situ water conservation, efficient use of available water, rain water harvesting, micro-irrigation and integrated watershed management have been increasingly emphasized. This can be achieved through improved land and water management techniques and solutions with active participation of farmers different from input (seeds, water, and fertilizer) intensive farming adopted in the past. The public investment should be scaled up in rainfed areas. The subsidies around irrigation should be linked with sustainability and social equity concerns so as to avoid further depletion of groundwater resources. More concerted efforts should be made to enhance rainwater use efficiency. The average estimated investment in the development of command area during XI Plan was approximately Rs.2 lakh/ha in the irrigated command by the Government which was much less to the quantum of public investment of only Rs. 12,000/ha in rainfed areas of plains and Rs. 15,000/ha in the hilly areas through watershed programme. The estimates suggest that the total investment requirement for unlocking the potential of rainfed agriculture could be Rs. 50,000/ha or more. This underlines that the investment rate in the rainfed areas needs to be enhanced substantially. Investments need to be made in a framework of extensive supportive irrigation with conjunctive use of groundwater and surface water bodies.

3.2 Fertilizer use, soil fertility and fertilizer subsidy: Over the years the soil organic matter has been greatly discounted as the key element for enhancing and maintaining soil health. The declining trend in external application of organic matter has caused low productivity and low

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fertilizer use efficiency. The soil health, by and large, understood and interpreted in terms of soil fertility and plant nutrients deficiencies. The hydrology and biological soil properties were largely ignored. The chemical fertilizer application based on the calibrated soil health cards can go a long way in reducing use of chemical fertilizers thereby reducing the cost of farm inputs. Soil health cards depicting availability of macro and micro nutrients and matching cropping pattern for individual farm holding should be provided. Such information could also be utilized to define the spatial boundary for optimum use of fertilizers and thereby regulating the fertilizer supply under a given cropping pattern and season. The highly distorted use of fertilizers in the States like Punjab and Haryana (ranging from 61:19:1 NPK as against recommended of 4:2:1) is deleterious to soil and environment, and is a heavy drain of the resources as only 25-30% of applied nitrogen is utilized by the crops. On the other hand, several states have very low use of fertilizers which need to be enhanced to increase the productivity. Awareness campaign should be carried out by the States amongst farmers about ill effect of indiscriminate use of urea. An environment needs to be created to evolve efficient and balanced system of subsidy and bringing urea under NBS.

3.3 Seed: Adequate availability of certified seeds is a major challenge for farmers especially in the eastern and north eastern region of the country due to poor seed infrastructure and institutional presence. The situation is getting worsened as the breeder seed production has reduced by 37% in the year 2014-15 as compared to 2011-12. This may cause heavy dent on the productivity growth of majority of the crops. Though the private seed have started making an impact in the seed scenario but still the focus of private seed companies remains on hybrids. The seed replicability is the least and farmers have to purchase the fresh seed every time leading to high profit margin to companies. Consequently, the price of seeds available to the marginal and poor farmers is very high. The fact that the public sector seed production is not commensurate with the requirements of the farmers further adds to their misery. Maintaining a strong local-seed system that is well linked to the agriculture research system is a necessity for productivity enhancement. Many of the diverse crops/ locally adapted seeds do not find a place in the formal seed market chains as they are not profitable.

Rainfed areas are vulnerable to high climatic risks and the seed systems have to respond towards meeting shortages on account of this risk. The wastage of seed due to prolonged dry monsoon spells immediately after sowing is very common. The availability of a second batch of seeds for repeat sowing, if the first sowing fails, needs to be ensured. Fodder seeds are always a scarce resource for which a special plan needs to be developed. The NARS need to evolve good hybrids for high volume crops to keep a check on the prices of hybrid seeds.

3.4 Energizing Agriculture: Use of power inputs to agriculture are now at a low level of 1.3 kw/ha. This needs to be raised to at least 3.9 kw/ha by 2025. Much of this has to come through tractors and self propelled machines. Huge investments are required to ensure availability, efficiency and reach of electric power to the farmers through rural electrification. Non-conventional energy sources like solar power is an important option in areas where conventional electrification has not taken place or its implementation is very expensive. At the same time strong policy decisions need to be taken to increase power use efficiency and avoid overexploitation of scarce groundwater. The rural electrification would be an effective instrument in the Eastern states, for agricultural growth and poverty reduction. The investment on non-conventional energy sources especially photovoltaic, solar power need to be stepped up as an alternative to much expensive conventional electrification. Highly subsidised or fixed tariffs or free electricity supply lead to inefficient use of power and causes indiscriminate exploitation of scarce groundwater with serious implication on its availability and sustainability of agricultural operations. In the relatively water-surplus Eastern states, rural electrification/solar energy can be an important instrument for rapid agricultural growth. However, even here, the farmers have to be sensitised and made aware of conserving scarce resources like energy and water.

3.5 Sustainable Diversification: Overexploitation of groundwater and soil degradation are the major cause of concern for original green revolution areas. An option is to reduce the areas under high water consuming crops like rice in water stressed areas and expand rice area in eastern region where surface and groundwater availability is adequate. However, caution is required in utilizing the groundwater

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even in this region due to problem of heavy metals. Higher investment for storage, marketing and processing infrastructure would be required to avoid any distress to the farmers willing to invest more in alternate crops. Under rainfed agriculture, diversified cropping pattern and its adoption by farmers are necessary to cope with risk and uncertainty of crop failure. Support needs to be extended to input-optimising and cost-minimising options for irrigated as well as rainfed areas. In a high risk situation, low paid out costs in cultivation is a risk minimization strategy. The part of transportation subsidy presently used for operating PDS system in eastern region may be provided to create procurement and marketing infrastructure to avoid any distress to the farmers due to prices falling below MSP. Paid out costs on pesticides, seeds and chemical inputs by the individual farmers can be substantially reduced if focused public investments and interventions are made in creating enabling conditions for farmers to take up sustainable agriculture practices. Pest surveillance, seed banks, biomass regeneration and soil productivity enhancement are some of the needed interventions that will have substantial cost-reduction impact.

3.6 Livestock and Fishery: The livestock management has to be reoriented away from the almost exclusive focus on induction of high yielding breeds. Extensive livestock systems, depending wholly or partly on resources of commons and agriculture residues, needs to be strengthened through improvements in animal healthcare, feed, fodder, drinking water, shelter, institutions etc. Much larger economic value is accrued by livestock sector to disadvantaged farmers and areas. The public support should be enhanced to the extensive livestock systems. Seasonal scarcity and access to fodder, quality drinking water and animal health care services are the major problems in livestock sector. Mortality of animals and small ruminants is significant in the economy of extensive systems. Higher investment for animal health care and nutrition as well as product diversification is required by the States. Pasture and fodder development needs sound technical inputs, robust institutional designs and comprehensive investments to make any meaningful impact. The seasonal surpluses of milk production need to be economically utilized by creating enabling infrastructure for product diversification. Inland fisheries hold a large untapped potential in rainfed areas. Small reservoirs, tanks, water harvesting ponds created

as a part of watershed development or MGNREGS and wetlands have potential for fisheries development. Fisheries productivity needs to be improved with quality seed and feed availability along with mobilization of fisheries cooperatives to achieve Blue Revolution.

3.7 Agricultural Technology & Extension: Generation and dissemination of improved technologies and practices are necessary for realising targeted growth in agri-food output and to address sustainability, efficiency and risk in agriculture. This requires a vibrant system for agricultural research and extension. The weakest link at present is the field extension staff, who are neither in adequate numbers or endowed with competency for transfer of technologies. Therefore, new innovative methods of knowledge management and dissemination have to be put in place. State Agricultural Universities (SAUs) and Krishi Vigyan Kendras (KVK) could play a crucial role as centres of knowledge development, management and transmission to users. However, inadequacy of sufficient funds and infrastructure has rendered these important institutions almost in survival mode. It is high time to revisit functions and mandates of entire NARS with a view to give them more functional autonomy and better governance system. It is essential to bring about better synergy between SAUs and ICAR institutes to avoid duplication of research for which better coordination among the funding agencies is required. Both Centre and States need to work for stepping up the investment in agricultural R&D from present level of 0.6 per cent of agri-GDP to minimum of 1.0 per cent of agri-GDP. The NARS should also work towards reforms to create institutional mechanism for evaluation and accountability of public funding and for mobilising funds from outside sources nationally and globally. States need to focus on bridging the gap between frontline extension and field extension

3.8 Small farmers centric planning: Small and marginal holdings dominates Indian agriculture. They have difficulty in accessing critical inputs for agriculture, especially credit, water, power, quality seeds, fertilizers, pesticides and timely technical assistance. They suffer from weak bargaining power as a result of which the majority tie-ups are between processors/retailers and medium and large farmers. Corporates and other bulk buyers of agricultural commodities also find the transaction costs of dealing with a large number of small

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producers prohibitively high and prefer dealing with bigger farmers and mandi aggregators. Thus Contract farming and formal farmer industry partnerships have not benefited small producers in a meaningful way. Farmer Producer Organizations (FPOs) can emerge as useful mechanisms as they enable a) aggregation of inputs/outputs and optimal deployment of resources to maximize factor productivity; b) access to mainstream capital for improvements in production system assets' c) risk reduction through financial measures, cropping choices; and d) creates opportunity to scale the quality demanding urban consumer and agro-processing industry.

3.9 Agricultural Marketing: The infrastructure for primary marketing is highly skewed across the states. The average area served by regulated market yards ranges from 118 sq km/market in Punjab to 11215 sq km/market in Meghalaya. The markets in agricultural products are regulated under the Agricultural Produce Market Committee (APMC) Act enacted by State Governments. APMC levy multiple fees, of substantial magnitude, that are nontransparent. The levies and other market charges imposed by states vary widely. A major challenge in agriculture marketing is the post-harvest losses faced by the farmers. The recent study of ICAR estimates such losses to the tune of approximately Rs.92000 crore.. These were mainly due to the absence of a well-structured rural market, lacunae in APMC Act, coupled with an inadequate agriculture infrastructure. Reforms in agricultural marketing were initiated to improve competitiveness, reduce the intermediaries in supply chain and enhance the private sector investment in trade and post-harvest marketing infrastructure. However, many of the States are yet to adopt the model Agricultural Produce Marketing Committee (APMC) Act. Recognising the need to benefit of farmers, the creation of a Unified National Agriculture Market has been proposed in the Budget, 2015-16. Karnataka has already initiated the unified market in the State where 51 of the 155 main market yards and 354 sub-yards have been integrated into a single licensing system. Similar initiative need to be taken by the States. Appropriate modification in APMC Act to promote e-trading would be a prerequisite.

3.10 Credit and Finance: The key problem of farmers especially the poorer among them is access to capital at reasonable rate of interest. The

present credit structure and policies tend to view small and marginal farmers as unviable clients to avail credit. The limited outreach of the institutional sector in rural and remote areas especially in the rainfed areas needs to be addressed. Several studies have shown that repayment of debts and concerns of honour are among the main reasons of distress and suicides among the farmers. A number of studies document the positive economic impact of microfinance through self-help groups (SHGs) on indicators such as average value of assets per household, average net income per household, employment and borrowing for income generation activities. The real power lies in the enormous economies of scale generated by the SHG Federations (each of 150-200 SHGs). The SHG Federations can arrange for bulk purchase of inputs (seeds, fertilisers etc) and marketing of outputs (crops, vegetables, milk, etc). They also provide larger loans for housing and health facilities to their members by tying up with large service or loan providers. A variety of insurance services are also made available, including life, health, livestock and weather insurance.

3.11 Crop Insurance: Small and marginal farmers, particularly rainfed farmers face partial or total crop losses due to risks associated with farming. Risks associated with weather fluctuations are beyond their control, especially in view of changes in climate patterns. The traditional coping mechanisms of the farmers for addressing these risks are not adequate and their distribution is highly uneven. Crop insurance has come up as an important tool for risk mitigation for small and marginal farmer households in particular. It is well known that only less than 10 per cent of the farmers in India are covered with currently prevailing crop insurance products. The key weaknesses of current crop insurance products arise from the nature and distribution of risks associated with farming. The risk cover of farmers in rainfed areas through innovative insurance products need to be ensured. Implement weather-based crop insurance using the deficit rainfall approach. Since rainfall is an objective parameter measured independent of the insurer as well as the clients, the moral hazard associated with conventional products does not exist. States need to synchronize the policy initiation date and the sowing date and in calculating compensation based on actual rainfall in each village. The effective delivery of the product depends upon the density of rain gauge

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stations which needs to be increased substantially. States have to invest not only on rain gauge stations but also on precise estimates of yield at reasonably appropriate scale. The soil and water conservation, use of seed varieties with good yield potential, of sustainable agricultural practices and diversification of cropping pattern are complimentary to crop insurance. The crop income insurance may also be piloted and studied thoroughly before large scale replication.

C. Agriculture Industry Linkages

4. The rationalization of policies to realize complementarities of different sectors may enable the farmers to embark on the virtuous cycle of productivity. However, any agri-business model should honour land ownership sentiments of the farmers. There has been a major missing link between agriculture and industry due to poor development of secondary agriculture consisting of post harvest activities, food value chain, forward linkages, supply chain etc. Creation of Supply Chain Infrastructure should be encouraged and incentivised to be established as joint ventures between private sector and FPOs with proper representation of farmer producers in their management. Industry may be encouraged to invest in knowledge institutions which are engaged in agriculture research and facilitate developing appropriate new technologies combining farmers' wisdom and traditional knowledge. Such investment in agriculture research and development by industry may be suitably incentivised by the Government. States need to encourage the private sector to build up scientific and modern storage facilities. The private sector investment to be promoted in developing terminal markets, warehouses, cold chain, etc by declaring them as 'Infrastructure Projects' to enable them avail benefits offered to such projects in the form of concessional credit etc.

D. Land policy reforms

5. The non-agriculture economy is now larger than agricultural economy in rural India. This has caused significant movement in workforce from agriculture to non-agriculture occupations. Both pull and push factors are responsible for workforce in cultivator household migrating to urban areas. The number of absentee farmers is on the rise in many states leaving land fallow. On the other hand, farm size is getting smaller as

landowning families do not want to sell land even when they are not genuinely interested in farming. In consequence, many households own land but do not cultivate it or do not find it profitable to cultivate it and also do not lease it out for fear of losing ownership rights to tenant, on the other hand, a very large number of households engaged in farming on smaller size holdings are looking for opportunities to raise their operational holdings by leasing in land. The net result is that some land is not used optimally and many smaller holdings are suffering from scale disadvantages. However, in absence of proper land leasing policy, a sizeable land remains uncultivated or poorly cultivated for want of investment. Limited but informal contract farming is in vogue in India in crops like tomato, potato, maize, chilli, barely potato, etc. The major constraints are that these contracts are informal and violation of contract does not attract legal penalty. The farmers are often left in the lurch in case of pests attacks and diseases as crops are not covered by insurance. The small farmers tend to get discouraged to participate in contracts due to inadequate scale and access to institutional credit. The share croppers who are not generally recognized by law of most of the States do not enjoy security of tenure to participate in contract farming. The small and marginal farmers need to be organized into groups/associations to enhance their bargaining power to decide the produce and price for contract. This requires reforms in the land policy to achieve economies of scale in agriculture and promote agricultural diversification. Promotion of contract farming and legislation of land leasing may lead to the desired vertical integration leading to rural transformation. The states need to consider reforming the land policy and tenancy laws and modernization of land records followed by registration and titling. The development of waste land and cultural waste land through public private partnership needs to be vigorously pursued.

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The Science Behind Soil Health

Major General the Honourable Michael Jeffery, Australia's National Advocate for Soil Health, has a distinguished military service to his career but is equally passionate about community issues. He is now tasked with the job of restoring degraded land by raising awareness of the critical issues in soil health which is an integral part of sustainable agricultural practices. In an exclusive interview, he speaks about the need for every country to devise a policy on soil to preserve and conserve this precious natural resource. Also, he has strongly advocated mentorship not just to the farmers but also to the youth.

Soil is the basic raw material for agriculture and yet it is the most abused natural resource by farmers through indiscriminate use of agrochemicals. What are the challenges faced by your organisation in effectively communicating the importance of soil health and how can they be overcome?

The challenges facing the future of our soil are not solely the responsibility of farmers but need to be shouldered by the whole community. Understanding the importance of healthy soils for future food, water and energy sustainability is vital and yet difficult to convey to the general population, particularly in the absence of a national policy on how to restore and maintain a healthy landscape. Even expert soil scientists have difficulty in agreeing on what is it that makes a good healthy soil and also, how to measure that health, but consensus is now moving to the levels of soil carbon being a pretty good general indication of soil health.

The overuse of chemicals by many in the agricultural industries and the indiscriminate dumping of toxic chemicals by others have led to some areas of the global landscape sustaining serious if not irreversible damage. However, in most situations, the landscape can be regenerated with a good holistic approach to farming involving appropriate water management, diverse perennial ground covering vegetation and protection of the soil microbial and fungal elements. Conveying this message to farmers is relatively easy, but implementing change to their farming practises is more difficult.

The huge disconnect between the vast majority of the population who are urban dwellers and their rural roots, is of great concern. I have been stressing the need to inform those in cities and towns of the importance of healthy soil and the need to ensure that everyone plays a role in the

regeneration of our landscapes, starting with our soil. Establishing a productive garden in every primary and junior high school, with syllabi to match, would be an effective way to ensure that all children become engaged with the soil, water and the plants which feed and clothe them. Such a program could also help to overcome our serious shortage of agricultural scientists and young farmers.

An effective soil health advocacy can be achieved only with the co-ordinated efforts of all the organisations working in natural resource management (including government, industry and academia). Share with us your experience in co-ordinating the efforts of the relevant institutions and how can it be replicated in a developing country like India.

Advocating for healthy soil will only be truly effective if soil, water and vegetation are acknowledged as vital strategic elements of a nation's prosperity. Pulling together all those involved in landscape management – agricultural, environment, industry, mining, health, education and defence - is a daunting task but one that must be achieved to ensure a national policy approach to landscape management. Providing leadership, building a team involving a collaborative approach with farmers, scientists, academics as well as those representing the bureaucracy and political leaders will enable good policy development linked to a pragmatic approach to 'fixing the paddock'.

How does the emerging challenge of climate change affect soil health and what are the long-term measures you advocate to minimise this impact?

Climate change will dramatically affect the way we live. In fact, there are already demonstrative

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changes to our climate and these are critically affecting farming communities. In Australia we are experiencing more severe floods, wildfires and droughts and the increasing temperatures are affecting both urban and rural areas.

We need to regenerate our landscapes, improve the health of our soil, increase the area of land that is covered by vegetation all year round and minimise the loss of rain water to evaporation. This will then encourage the return of the essential small water cycle whereby the rain falls, it is absorbed by the soil, taken up by the plants through the roots, is transpired from the leaves into the atmosphere and falls again as local precipitation thus completing the cycle.

This regeneration and return to a functioning small water cycle can be also encouraged through the urban environment. City gardens, street trees, apartment blocks with roof top or vertical gardens all contribute to the greening of the landscape and photosynthetic and transpiration processes.

What is the ideal land management policy and land management monitoring mechanism that every country must adopt to preserve the health of soil?

Every country needs to acknowledge the health of their soil as a vital strategic national requirement, with a governing national policy to support it with inputs to that policy from all relevant portfolio areas. Each country's national policy should aim for its soil to be 'fit for purpose' – that is to be fit for all forms of sustainable agriculture, aquaculture, horticulture and so on, as well as being fit for urban dwelling, mining and other industries.

In a country like India, land information is not properly organised and recorded. What is the role of land information in the effective management of soil health and what are the key lessons India must learn from the land information management practices in Australia?

Information which can assist farmers to improve their land, lifestyle and financial outcomes should be easily accessible. In Australia I have worked with an organisation I established called **Soils for Life** to engage 21 leading practise farm case studies representing a variety of farming

landscapes and techniques and all of which have shown a great improvement in economic, environmental and social outcomes. The reports of these studies can be viewed at www.soilsforlife.org.au. In each case, the processes involved in improving the health of the soil, changed management practises and possible alternative farming methods leading to improvements which are presented online for others to share. I hope to see this program roll out to 100 case studies.

While the issue of soil health is associated largely with the agriculture and forestry sector, World Trade Centre Mumbai feels that other sectors like real estate, construction, mining, oil and gas have equal role to play in preserving soil health. Could you share your experience on how to co-ordinate efforts of these sectors in integrated soil health management?

As I mentioned in the answer to number 4, a national soils policy needs to be implemented to ensure each country maintains its soils 'fit for purpose'. If the policy is well thought through, the various industries which use or occupy or mine land, will also need to be cognisant of its importance and have a legal obligation to ensure it is managed in an environmentally sustainable way.

Apart from policing a national policy to protect soil, appointing a National Advocate for Soil Health does have an impact. The Advocate should be someone of standing, with access to senior political members, bureaucrats and leaders of industry, who can speak, educate and promote the importance of soil to the community and private and public sector leaders.

During the last century, agriculture scientists largely focused their research on improving agricultural productivity to meet the food demand of the growing world population. It is high time that the issue of soil health becomes a core agenda for future research on agriculture and forestry. What is your suggestion to agriculture scientist community on orienting research towards soil health?

We need to formally teach and thereby inspire our children to be interested in healthy soil and its key role in planetary well-being. We must ensure there are reasonable numbers of students keen to study this at tertiary level, to provide the numbers of

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agricultural scientists needed who are aware of soil, its composition and its importance for the future of our food, fibre and clean water sustainability. Currently there is great debate on soil carbon, how to measure it, whether it is a good indicator of soil health and how to improve it. Agricultural and soil scientists need to be encouraged to look closely at soil in situ, in different areas with different compositions and use to help answer these questions and work towards an agreed template for healthy soils, which I suspect will relate in some way to improving soil carbon levels.

Is there a possibility to make soil health management a remunerative business proposition so that we can rope in profit-oriented private organisations in the soil health management initiative?

Soil health management could be much more financially viable if we pay farmers fairly for their product and also reward them as primary carers of the agricultural landscape on behalf of the urban population.

Addressing Food Insecurity at a Time of Climate Change

Nancy Creamer is a Distinguished Professor of Sustainable Agriculture and Community Based Food Systems at NC State University, in Raleigh, North Carolina (NC), U.S.A and Director of the Center for Environmental Farming Systems (CEFS). She was a founding member of the International Society of Organic Agriculture Research and also a member of the Scientific Congress of Organic Agriculture Research, established by the Organic Farming Research Foundation. In 2009 she provided leadership for a North Carolina initiative engaging many diverse sectors and partners resulting in a statewide action plan: From Farm to Fork, a Guide to Building North Carolina's Sustainable Local Food Economy, and has spearheaded the development of many of the strategic initiatives identified in the report. Dr. Creamer was a member of the US Department of Agriculture (USDA) Specialty Crops Advisory Committee, and has served as a consultant to the European Commission on funding and evaluation of European-wide organic agriculture research activities. She was appointed by the North Carolina Governor to the legislated NC Sustainable Local Foods Advisory Council in 2010, and was Vice Chair of the Council through 2013. In 2012, CEFS received one of the highest awards that USDA gives: the USDA Secretary's Honor Award for "Assisting Rural Communities in Creating Prosperity so they are Self-Sustaining, Repopulating, and Economically Thriving". Dr. Creamer was recently appointed as a founding

Board member for the Foundation for Food and Agriculture Research which was allocated \$200 million in the 2014 US Farm Bill to support agricultural research.

Established in 1994, The Center for Environmental Farming Systems (www.cefs.ncsu.edu) is a partnership of NC State University, NC Agricultural and Technical State University, and the NC Department of Agriculture and Consumer Services. CEFS' 2000-acre Field Research and Outreach Facility at Cherry Farm in Goldsboro, NC is one of the nation's premier research and demonstration sites for organic and sustainable production systems. Research is based out of six core programs, or "units": the Farming Systems Research Unit, Organic Research Unit, Pasture-Based Dairy Unit, Pasture-Based Beef Unit, Small Farm Unit, and the Alternative Swine Production Unit.

Beyond the farm, CEFS' statewide Food System Initiatives include Supply Chain Development through several outside funded projects, including NC Growing Together and NC Choices; Consumer Engagement through the NC 10% Campaign; Statewide Action Planning through Community Food Strategies; Advocating for Equity in the Food System through Food System Committee on Racial Equity (CORE); and Youth Engagement and Leadership Development through FoodCorps NC (co-hosted with NC-4H, a youth leadership organization), and the Food Youth Initiative.

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These grant-funded projects were supported primarily by the United States Department of Agriculture (USDA), a local health insurance foundation (Blue Cross and Blue Shield of North Carolina Foundation), and the W.K. Kellogg Foundation, a large Food Systems funder in the United States.

Education and Outreach programming includes a Summer Internship Program and Farm Apprenticeship Program, Seasons of Sustainable Agriculture (SOSA) Workshop Series, Amazing Grazing Livestock Educational Initiative, Annual Sustainable Agriculture Lecture, and the Agroecology Education Farm and academic Program.

CEFS has expanded its work over the last 20 years from primarily working on “production systems” to working on community-based sustainable “food systems”, in part, as a way to address growing food insecurity. Climate change will exacerbate food insecurity world-wide (Elbehri, 2015). A sustainable community food system, as defined by the University of California Sustainable Agriculture Research and Education Program (UC SAREP), is “a collaborative network that integrates sustainable food production, processing, distribution, consumption and waste management in order to enhance the environmental, economic and social health of a particular place. Farmers, consumers and communities partner to create a more locally based, self-reliant food economy. One of the most important aspects of sustainable community food system projects is that they increase resident participation to achieve the following goals: A stable base of family farms that use sustainable production practices and emphasizes local inputs; Marketing and processing practices that create more direct links between farmers and consumers; Improved access by all community members to an adequate, affordable, nutritious diet; Food and agriculture-related businesses that create jobs and recirculate financial capital within the community; Improved living and working conditions for farm and food system labor; Creation of food and agriculture policies that promote local or sustainable food production, processing and consumption, and; Adoption of dietary behaviors that reflect concern about individual, environmental and community health”. While food insecurity is generally discussed in a global context, it is also a growing concern in the US. In 2013, 1 out of 7 (14%) American households

(49 million people) experienced food insecurity, meaning they did not have enough food for a healthy, active life for all family members (Coleman-Jensen et al., 2014). Starting in 1990, the United States Department of Agriculture formally established food insecurity, rather than hunger, as its measure of food inadequacy; measures of food insecurity consider both the quantity and quality (in terms of nutritional adequacy and food safety) of available food (Chilton and Rose, 2009). In the state of North Carolina, the prevalence of food insecurity is higher than the US national average, with 17.3% of households in the state being food insecure in 2013 (USDA, 2013). North Carolina is the 11th-worst state in the US in terms of the percentage of food-insecure children (Feeding America, 2012). Food insecurity rates are higher among certain demographic groups, including households with children, Black and Hispanic households, and households in inner cities and rural areas.

Historically, food insecurity has primarily been approached in two ways: either through the provision of direct food assistance or through efforts to increase agricultural productivity. Despite national growth in public and private food assistance and increases in crop and animal productivity, U.S. food insecurity rates have consistently remained between 14% and 15% for the last five years (USDA ERS, 2013). The U.S also paradoxically has higher food insecurity rates than many other developed countries (Nord et al. 2007), while also being one of the most agriculturally productive countries in the world. Clearly solutions in the US must focus on more than just enhanced productivity. This is also true in some other nations that have high food insecurity.

In addition, concurrent with a rise in Food Insecurity in the US, is a rise in food-related illness (for example, obesity and diabetes). A 2012 study estimates that the state of North Carolina spends \$4.6 billion annually on medical care arising from obesity-related illnesses (Trogdon et al, 2012). Obesity trends are associated with an increasingly sedentary lifestyle combined with greater consumption of energy-rich, but nutrient-poor, processed foods that have taken over a larger share of the diet in the U.S. from vegetables, fruits, and whole grains (USDA, ERS, 2012).

Strategically-designed sustainable community-based food systems that increase access and

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affordability to healthy, fresh, and nutritious foods provide the unique opportunity to address both problems simultaneously. We believe that some models that are being developed will be applicable in some global situations as well, where the previous focus on increased productivity through technology and intensification have not been successful alone in addressing food insecurity. In North Carolina and across the US, Individuals and organizations holding a variety of food-related concerns—improving health outcomes, enhancing food access for low-income consumers, involving youth in food systems, preserving farmland, reducing food insecurity, revitalizing rural economies, etc.—are collaborating to foster environments that increase access to locally produced fresh and healthy foods and enhance individual and community health.

One consideration in designing systems where healthy food is more affordable and accessible is being mindful of the impact on farmers. To buffer against climate change impacts, resilient systems require a more diversified and sustainable agriculture within farms (which is the focus of much of our field research at CEFS), but also across landscapes (Legnick, 2015). In the US for example, agriculture is very concentrated in one part of the country or another. For example, a majority of the fruits and vegetables are produced in just two states, California and Florida. Those two states are particularly vulnerable in a changing climate, and in fact, California is now in a severe multi-year drought with continuing water supplies tenuous for agriculture. The state of Florida is vulnerable to hurricanes, rising Atlantic Ocean sea levels, as well as other weather extreme.

If transitioning to Resilient Agriculture Systems means a transition to smaller-scale diversified farms distributed across the landscape, then these farmers will need to be able to earn adequate incomes off of their farms and therefore receive higher prices for their produce than currently is the case. This is at odds with the need for more affordable healthy food to address food insecurity and poor health outcomes. In the US, the loss of farms has reached a crisis level. In fact, according to the last USDA Agriculture census in 2012, the average age of farmers is now 58. Since 1964, the US has lost approximately 1 million farms, and complex food system issues cannot be addressed by fewer and fewer farms.

There is a trade-off between improving access of local and healthy fruits and vegetables and insuring farmers receive adequate compensation to stay in business. While produce isn't necessarily more expensive if it is local and grown by smaller farmers and sold direct (Low et al, 2015; McGuirt et al, 2011), local, fresh produce is more expensive than many of the calorie-dense, nutrient poor foods that are much more readily available. If farmers must continue to bear the full cost of keeping food affordable in the US and improving access to healthy foods, then farms will continue to be lost to consolidation to achieve economies of scale, and a resilient, diversified agriculture will not be achievable.

Food Systems models are needed that go beyond increases in the production of commodity crops, that address alleviating food insecurity and food-related poor health outcomes, but that build resiliency in a changing climate. This warrants creating public- private partnerships that support small and mid-scale farms, but also improves access to healthy foods. More specifically, by integrating highly efficient sustainable production systems with aspects of social entrepreneurship and community-based forms of organizing, CEFS is working to demonstrate how this systems approach can alleviate food insecurity and hunger, while also improving community health, creating jobs, and supporting community economic development and more viable and resilient farms.

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Food and Nutrition Security in India: Opportunities and Challenges

1. Food and nutrition security – the meaning

According to the definition adopted by the Food and Agriculture Organization of the United Nations “Food and nutrition security exists when all people at all times have physical, social and economic access to food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care.” (FAO, 2011a; CFS, 2012).

2. State of Malnutrition in India

With India's per capita net availability of food grains close to 500 gm/ day, the country's food production is sufficiently high to meet the requirements of its population (GOI, 2014a). Partly because of this advantage, India has made significant progress in reducing the absolute number of hungry, as noted in FAO's State of Food

Insecurity Report 2015. Nevertheless, India still accounts for a quarter of the world's hungry. Some 48 % of Indian children under the age of five are stunted, 20 % wasted and 43 % are underweight. As a result, India could achieve neither the hunger targets of the Millennium Development Goals (MDG) nor the World Food Summit (WFS) goals (FAO, IFAD and WFP, 2015). It is noteworthy that neighbours Nepal and Bangladesh have achieved both targets. A 2015 study by the Global Alliance for Improved Nutrition (GAIN) shows rising incidence of malnutrition-related diseases among women in India. It also reports an alarming 74 percent of Indian children under five-years being anaemic.

Disaggregated data on prevalence of malnutrition in under-five children show influences of gender, wealth, parents literacy, social status, and region. Evidence shows that nutritional status of male children is worse than females (GOI, 2014b). The most recent National Family Health Survey-3 also shows higher prevalence of malnutrition in rural

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areas. Similarly, children from disadvantaged groups like ST, SC and backward castes had higher prevalence of nutritional deficiencies and were more likely to be underweight, stunted and wasted. A recent UNICEF (2014) report states that though mild and moderate stunting is similar in both tribal and non-tribal children, severe stunting was nine percentage points higher in tribal children compared to non-tribals (29% vs. 20%).

In India, calorie based nutrition assessments have failed to reflect micronutrient deficiencies which can be present even alongside high or optimal calorie intake for an individual (Deaton et al., 2009; Kennedy et al., 1993). Narayanan (2015) states that India is currently experiencing the triple burden of malnutrition: inadequate calorie intake and under nutrition among a large section of the population; excess intake of dietary energy leading to obesity and other health issues among a section of the population; and pervasive micronutrient deficiency.

3. Income- nutrition anomaly

In India, strangely, rise in incomes have not led to a corresponding increase in calorie intake. While this has puzzled all, the phenomenon is prevalent among both rural and urban areas, and also across wealthy and poor households in varying degrees. This missing correlation between income and nutritional intake suggests that food security would require special attention of policy makers. It can no longer be presumed that nutrition will follow the natural path of economic growth. India is seeing a rapid shift in calorie intake from cereals to other foods, and a change from cheap calorie sources to more expensive ones (Deaton et al., 2009). Recent trends show an increase in calorie intake from sugars and oils, from processed food, resulting in increased health problems.

4. Role of Agriculture in Food and Nutrition Security

Agriculture is central to the discussion on food and nutrition security in India as it employs about half the population; and thereby provides them income to meet their food requirements. Farmers are also entrusted with the task of feeding the burgeoning population of the country. Importantly, achieving agricultural growth is crucial for India since a one percent increase in GDP from the agriculture sector reduces poverty by up to five times as compared to any other sector (FAO, 2012).

Emerging challenges in Indian agriculture

While the agriculture sector in India has performed relatively well over the longer term, some challenges have also emerged. Unsustainable land and water management practices, and the excessive use of major fertilizers NPK (Nitrogen, Phosphorus, Potassium) are a cause for concern. The indiscriminate use of subsidised N fertilizer, urea, particularly has created an imbalance in the soil's nutrient ratio, affecting crop yield and decreasing their nutritional content. This has resulted in increased production costs, through higher requirements of fertilizer input and concomitant higher water requirements. Free electricity incentives by the government to operate water pumps have led to increased ground water depletion. The average size of land in India has reduced to 1.15 hectare per farm holding, and small and marginal farmers now comprise 85 percent of total land holdings (GOI, 2014c). It is, therefore, not surprising that extreme poverty exist more among small producers, landless labourers and rural wage earners.

Increasing feminization of agriculture

Trends show a steady substitution of male work force by females in agriculture due to the migration of men to other employment avenues like construction and transport sector (Roy, 2015). This is expected to have a negative impact on the health and nutrition of women and children due to the diversion of time from childcare. However, feminization of agriculture can be an advantage from the household food and nutrition security point of view if it translates into economic empowerment of rural women by ensuring land rights and better credit systems (FAO, 2011b). Providing equal access to productive resources for women as to men, can increase farms yields by 20 to 30%. This means an increase in total agricultural output in developing countries by 2.5 to 4 percent; in turn reducing the number of hungry people in the world by 12 to 17 % (FAO, 2010).

Responses to challenges emerging in agricultural sector

Apart from improving technology and making the agriculture less labor-intensive, emphasis must be to improve the quality of yield and decreasing waste and loss in production chains. This can be done by improving seed quality, use of bio-

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fertilizers and integrated pest management and increasing the shelf life of food.

The Soil Health Card programme of the government is expected to create greater awareness and understanding in the farming community on specific nutrient needs of the soil and provide advice on the ideal crops to be sown. The challenge lies in implementing this programme in its true spirit.

In view of the pre-dominance of small farmers among malnourished people, it is imperative to make small farms viable through increasing public and private investments, non-farm value addition, improving farm practices, skill development, rural infrastructure and delivery of credit, technology and other inputs, extension and marketing. Shift to subsectors of agriculture, like livestock and aquaculture, where demand is expected to increase in the coming years, are considered ideal for small farm holders. Such a shift will have higher revenue returns, and is the best way forward (World Bank Group, 2014; OECD, 2015).

Similarly, in response to increasing feminization of agriculture, it is essential to design and incorporate agricultural skills training in a decentralized structure. It should allow women to participate in technology development that matches with their requirements and existing skills, and also focus on developing their marketing and financial management skills (Collett & Gale, 2009).

The government's 'Bringing Green Revolution to Eastern India' (BGREI) scheme will also help to shift the focus from north-west India where intensive agriculture has led to over exploitation of natural resources. BGREI has already augmented productivity of water intensive crops in the eastern States of Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, eastern Uttar Pradesh and West Bengal, and has contributed to a sharp increase in production. The scheme promotes integrated agriculture practices, crop diversification and water management strategies. There is increasing realization that conventional agriculture is unsustainable and a threat to food productivity if we carry on implementing it the business-as-usual way. Efforts to increase yield using conventional agriculture has led to a negative trade-off between yield and concentration of essential nutrients (Davis, 2009). A shift to agro-ecological farming will optimize

yields by harmonizing productivity to the physical limits of the agro-ecosystem (Silici, 2014). Similarly, governmental support to sustaining and promoting local and indigenous agro-systems, which have been adversely affected by cropping patterns and use of pesticides, has become an urgent necessity. FAO's flagship publication "Save and grow" (2011c) highlights the importance and benefits of such ecosystem approaches to farming.

In view of the recent NSS survey report showing a decrease in protein intake, a way out can be the diversification of farming by including leguminous crops and millets. Intensifying research on bio-fortification of foods to make them affordable and easily marketable, as was done with iodized common salt, is another way forward.

5. Role of Social protection in ensuring Food and Nutrition Security

Social protection measures of the government in the form of adequate policy and institutional measures are essential for countries to achieve their MDG and WFS targets. Social protection schemes like Brazil's Fome Zero and Bolsa Familia have successfully targeted hunger and extreme poverty. In South Africa, the right to food has been given an explicit constitutional status, and schemes designed to fulfill this mandate has enabled South Africa come close to reaching the MDG target by 2020. It has already reduced prevalence of undernourishment to under 5 percent since 1990 (FAO, IFAD and WFP, 2015).

Social protection measures of India, like the subsidised public food distribution system (PDS) and Minimum Support Price (MSP) have strengthened and supported its food security system. MSP has provided farmers price guarantees for their produce, and also induced better confidence in the adoption of new technologies to increase yield.³

The PDS provides the poor, staple food grains, such as wheat, rice and sugar (and kerosene) through a network of fair price shops (also known as ration shops) established across the country. It has led to enhanced food intake among the poorest, who usually spend the largest portion of their income on food. The PDS also has its down side: it has reduced micronutrient intake among its beneficiaries, mainly by replacing traditional coarse grains with subsidized rice and wheat.

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Likewise, to supplement nutritional intake of children, and pregnant and lactating women India has the Integrated Child Development Scheme (ICDS) and the Midday Meal Scheme (MDM). The ICDS launched in 1975, targets children aged 0-6 years, and pregnant and lactating mothers. While the government has ensured that ICDS centres (anganwadis) are widely present across the country, poor maintenance and leakages in various forms have reduced their effectiveness. Additionally, coverage has been low in some populous states with high poverty and under-nutrition rates (Ramachandran, 2013). The Mid-Day Meal Scheme (MDM), which provides nutritional support to children from class one to eight, has enhanced enrolment, retention and attendance of children. However, there have also been reports of leakages and mismanagement and lack of hygiene.

The most important and perhaps the largest social protection programme in India is the National Food Security Act (NFSA) 2013. It builds upon the Supreme Court's interpretation that the right to food as a fundamental right is inclusive within Article 21— the right to life. The most important implication of this legislation will be to undo the paradox of stocked granaries while the poor face hunger and malnutrition. The NFSA guarantees highly subsidized monthly rations of rice, wheat or millets to 75 percent of rural and 50 percent of urban populations (a total of around 800 million people); universal feeding for pre-school and school children, and pregnant and lactating mothers; and universal maternity entitlements (Mander, 2015). Critics of NFSA point out that apart from high costs, it can fuel increased food grain production at the cost of other non-staple crops.

Public distribution system needs some reforms

As an alternative, shifting to a cash transfer system has been suggested. The arguments in favour have been that, it will cost the exchequer less, give beneficiaries a diversified choice of diet or better quality grains; at the same time creating a ripple effect on the local economy (Narayanan, 2015). Responses to such a proposed shift show that beneficiaries in states where PDS has been successful prefer to continue with the existing system; but in states where PDS entitlements were low due to inefficiency, beneficiaries believed cash transfer would be better. They also suggest that for those who were the poorest, PDS was

essential (Narayanan, 2015). Critics also point out that cash transfers expose beneficiaries to fluctuations of market prices. As a pilot, the direct benefit transfer (DBT) scheme has been recently launched by the government in September this year in Chandigarh and Puducherry.

Use of IT to track food commodity, computerization of Fair Prices Shops (FPS), use of GPS to track delivery to FPS, informing beneficiaries using SMS technology, as in Chhattisgarh, will create greater transparency in the system. The use of biometrics that help to verify beneficiaries, as done in Karnataka, can further check leakages. The States of Bihar and Odisha are also implementing reforms in the PDS system to reduce leakages.

Reviving the ICDS and enhancing its quality through regular training of ICDS workers and expanding its penetration would also go a long way to improve food and nutrition. Promoting community kitchen gardens and kitchens, can be avenues for teaching local women about nutritional value of foods and sanitation. School kitchen gardens can be made a compulsory part of Midday Meal schemes.

6. Sanitation and Nutrition Security

Sanitation is an important component of nutrition security. This is because water supply, sanitation and hygiene, given their direct impact on infectious disease, especially diarrhoea, are important for preventing malnutrition. Nutritional status is compromised by disease. People suffering from diarrhoea, for instance, will not benefit fully from food because frequent stools prevent adequate absorption of nutrients. Moreover, people with under-nutrition are more susceptible to infectious diseases, and they take longer to recover. Open defecation, high prevalence of open sewages, disposal of untreated sewage to rivers and unsafe drinking water supply is aggravating nutritional status in India. The Swachh Bharat Abhiyan, started in October, 2014 to address the problems of sanitation by creating awareness and citizen participation in 4041 statutory towns across the country, envisions a 'Clean India' by 2019.

7. Role Nutrition education can play

Some studies show that nutrition deficiency and undernourishment are not dependent on

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household food security alone but also need to tackle issues such as poor feeding practices among infants and young children (IYCF), which depends on knowledge, attitude and practices of the family (Ramachandran, 2013). Thus, to ensure food and nutrition security it is of prime importance to prioritise awareness on nutrition. Poor perception of highly nutritious coarse grains like millets, linking them with poor social and economic status, has made them undesirable as compared to other traditional staples like rice and wheat. This calls for efforts to make such foods more appealing by creating awareness on their nutritional value.

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Climate Change – Implications on Food and Nutrition Security and Associated Undernutrition within Poor Communities of India

This article highlights how climate change further exacerbates the already huge problem of undernutrition and seeks patronage of various sectors on supporting nutrition programs addressing undernutrition in areas that are highly vulnerable to effects of climate change within India.

More than 40% of the world's severely acutely malnourished¹ children live in India. According to the National Family and Health Survey-3 (NFHS-3), conducted between December 2005 and August 2006, a total of 6.4% of children in India

Undernutrition is defined as the outcome of insufficient food intake and repeated infectious diseases and poor care practices, often due to economic, political and socio-cultural factors. It includes being underweight for one's age, too short for one's age (stunted – chronic undernutrition), dangerously thin for one's height (wasted – acute undernutrition) and deficient in vitamins and minerals (micronutrient malnutrition).

suffer from Severe Acute Malnutrition (SAM) and a total of 19.8% suffer from Global Acute Malnutrition² (GAM), figures that denote a countrywide nutritional emergency. These numbers equate to 24.1 million acutely malnourished children in India, 7.8 million of which are severely acutely malnourished.

Despite India's impressive economic growth in the last decade, acute malnutrition in the country is not decreasing, and is most likely increasing. 25 of India's 29 states had SAM levels of greater than 4% in 2005-06³; no strong regional patterns emerge, but sub-state (district-level) concentrations of malnutrition have been identified. In general, the

groups at highest risk of malnutrition are rural families, girls, scheduled tribes / castes, and the poor.

The recent food and economic crisis has magnified the challenge of undernutrition. With over 200 million people who are food insecure, India is home to the largest number of hungry people in the world⁴. In the ranking of the Global Hunger Index 2008, it covers position 66 out of 88 ranked countries and has an “alarming” food security situation. This crisis further combines with the growing threat and negative impacts of climate change.

As the climate changes, ensuring long-term access to sufficient and nutritious food for all becomes an even greater challenge faced by humanity. Even in the most optimistic global warming scenario, the effects of climate change on undernutrition would be devastating, and would undermine current efforts to reduce hunger and ensure good nutrition. Amongst the many facets of human life that have been disturbed owing to climate change, undernutrition has not received the attention it merits, considering that determinants of undernutrition, which relate to food, health, sanitation, water and care practices, are directly affected by climate change. Despite the obvious critical situation and strong interconnection, food and nutrition security is still markedly absent in climate change negotiations.

The impact of climate change on undernutrition – understanding the pathways

Climate change amplifies the threats for all underlying causes of undernutrition. Climate change effects, some of which are already being experienced (higher temperatures, rising sea levels, variation in precipitations, ecosystems at risk, and more frequent, intense and unpredictable extreme climate events) impact undernutrition through multiple pathways, including food

¹ Children with Severe Acute Malnutrition (SAM) are nine times at risk of dying compared to normal children.

² Global Acute Malnutrition (GAM) is a combination of Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM). / ³ NFHS 3 / ⁴ India State Hunger Index 2008

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The impacts of climate change are already being felt; the projections being alarming

“If nothing is done to combat climate change, an additional 600 million people around the world will suffer from undernutrition in 2080”

UNDP Human Development Report, 2007 – 08. Fighting Climate Change: Human solidarity in a divided world, 2007 p. 90

security, water and sanitation, and care practices. Some of these pathways are further explored below:

Food Security at Risk

Climate change amplifies threats to livelihoods and food security through its direct impact on food availability, access, quality and utilization. The multiplication and the alternation of natural disasters related to climate change (droughts, scarcity and irregular rainfall, floods, pest pressure on crops and livestock, etc.) reduce if not destroy farmers' production resources and pose a major threat on the functioning of agricultural production systems: destruction of crops and fodder, loss of livestock, soil depletion, etc. These yield falls will have a disastrous effect on the income of small producers who are currently practicing small-scale agriculture and family farming. This loss of income, due to the increased frequency of natural hazards, will have major

A study conducted by IFPRI suggests that “climate change is expected to lower grain yields and raise crop prices across the developing world, leading to a 20-percent rise in child malnutrition”. The study also sights that “the total calories available in 2050 will be lower than in 2000, increasing malnutrition rates in South Asia in particular”.

IFPRI, 2009. Climate Change Impact on Agriculture and Costs of Adaptation

economic consequences on the ability of people to meet the basic food needs of their families. In addition, the instability of crops will increase the volatility in the prices of basic food commodities in markets, resulting in detrimental price fluctuations for producers as well as consumers.

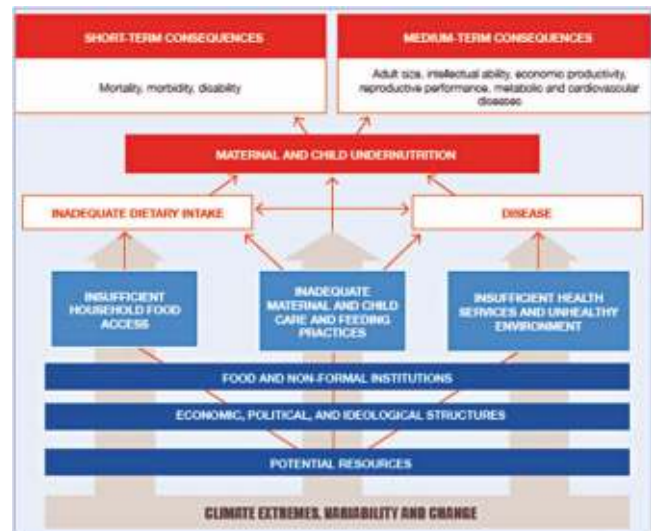


Figure 1: The conceptual framework illustrating the causes of undernutrition and the links with climate change

Water Stress

The quantity and quality of water resources will also be negatively affected. Major variations of temperatures, precipitation patterns and humidity will have a strong effect on vector-borne diseases and will contribute to undernutrition. Competition

Droughts are expected to be more frequent in some areas, especially in north-western India, Jharkhand, Orissa and Chhattisgarh.

With India close to the equator, the sub-continent would see much higher rises in sea levels than higher latitudes. Kolkata and Mumbai, both densely populated cities, are particularly vulnerable to the impacts of sea-level rise, tropical cyclones, and riverine flooding.

World Bank, 2013. India: Climate Change Impacts

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over increasingly scarce resources will increase the risk of conflicts and migration patterns, which in turn will again increase the risk of food insecurity. Water resources are predicted to be strongly impacted by climate change, with wide-ranging consequences for human societies, geopolitics, and ecosystems.

Moreover, the scarcity of these resources will represent an additional workload for girls and women who are most often responsible for household water supply. Beyond simple access to water, climate change is also responsible for increased flooding and droughts in areas that are mostly lacking basic sanitation and hygiene facilities (especially urban areas).

Health and Care Practices Impacted

Climate change also negatively affects nutrition through its impact on health. According to the Lancet series on maternal and child undernutrition of 2008, climate change is the biggest global health threat of the 21st century, and is already contributing to the global burden of disease and premature death. Climate change will also put further strain on the already heavy workload of women, negatively impacting their ability to provide proper care to infants and young children, heightening the risk of undernutrition.

Climate change is expected to have major health impact in India with child stunting projected to increase by 35% by 2050 compared to a scenario without climate change.

Malaria and other vector-borne diseases, along with and diarrheal infections which are a major cause of child mortality, are likely to spread into areas where colder temperatures had previously limited transmission.

Heat waves are likely to result in a very substantial rise in mortality and death, and injuries from extreme weather events are likely to increase.

World Bank, 2013. India: Climate Change Impacts

Food and nutrition insecurity, forced displacements, water resources contamination will weaken the health of the most vulnerable populations. This weakening will promote the prevalence of vector-borne diseases, resulting in a weakening of the population's nutritional status. Beyond these serious impacts on physical health, heat-related stress as well as shock and trauma caused by significant climate events will cause more psychological distress, once again related to the victims' age and gender.

The Poorest and the most Vulnerable are the Worst Affected

The paradoxical situation here is that the people who are the least responsible for climate change

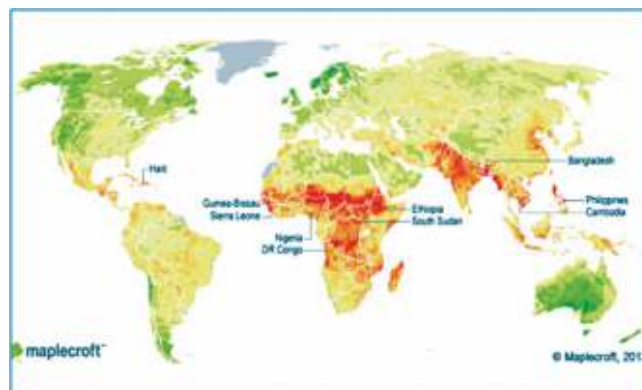


Figure 2: Map of vulnerability to climate change, showing India as a hotspot. Source: Maplecroft, Climate Change Vulnerability Index 2014

are the ones who suffer the most from its consequences. Recent data⁵ showed that the poorest people already suffering from the highest rates of malnutrition will be the most vulnerable to climate change. The populations involved are mainly small producers and women producers who live from subsistence farming, fishing or livestock, sources of livelihood that are very sensitive to climatic hazards. Following a disaster, the poorest often have no choice but to resort to negative coping strategies (reducing food intake, selling productive assets, etc.) which impede their resilience capacities and aggravate their food and nutrition insecurity. Spontaneous and recurrent shocks and stress are at the heart of this vicious circle in which women and children are the main victims. Food-insecure people are highest hit by climate change: they require increased attention.

⁵ Maplecroft, Climate Change Vulnerability Index 2014

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Too little has been done by Donors and Policy Makers to address the problem of undernutrition in a changing climate

There is an urgent need to apply resources to fight against undernutrition and help the most vulnerable build their resilience to the changing environment. However, between 2005 and 2009, investments in nutrition interventions by major donors accounted for only 1% of the need identified in the countries⁶ with highest burden of undernutrition including India. Increased funding for nutrition specific and nutrition sensitive programs is more urgent than ever.

Governments and donors should urgently increase their financial and technical support

toward adaptation in countries like India, as currently financial contributions remain insufficient to meet demands. Immediate additional public funding is required in order to support adaptive strategies of India's poorest to climate change. Better nutritional health can improve the resilience of the population to climate related shocks and stresses. Therefore, government and donors should support nutrition focused adaptation and disaster risk management strategies⁷. And they should target women and children most at risk of undernutrition as a priority.

Fight Hunger Foundation



**Many things we need
can wait.**

A child cannot.

**Now is the time his
bones are formed, his
mind developed.**

**To him we cannot say
tomorrow, his name is
today.**

Gabriela Mistral

Chilean poet, Nobel Prize in literature

⁶ Horton S, Shekar M, McDonald C, Mahal A and Brooks JK (2010) Scaling up Nutrition: what will it cost? World Bank

⁷ ACF 2013, Enhancing Climate Resilience and Food and Nutrition Security

Role of ICTs in Farming Sector

Introduction

The success of Green Revolution in India indicates that with access to technology and support services farmers could contribute to expanding and energizing agriculture. India has rich experience with large number of Information & Communication Technologies (ICT) projects providing a range of services in the villages. They proved that technology could make a difference in rural life. For the five decades prior to 2010s, it was government initiatives beginning with radio followed by TV and internet providing services to farmers. The advent of disruptive technology in the form of internet and mobile phone from the early 1990s transformed the way agricultural knowledge and services are accessed by agricultural professionals and farmers. Large number of private initiatives through a variety of services and applications entered in to the scenario. This changed the context and purpose of the ICTs role in development, livelihood and empowerment.

India has rich experience with large number of ICT projects providing a range of services in the villages. Many ICT projects proved that with information, agriculture can be improved to be more sustainable, economically viable and ecologically balanced. In spite of large number of ICT projects, there is vast untapped potential for its use in agricultural development by reducing the time and space barriers. This article provides a brief overview of ICTs experiences in Indian agriculture.

Technology

The range of ICT projects in the country were conceived and developed by public, private, non-government organisations, co-operatives and individuals. A variety of technologies were/are deployed, tested and modified for providing access. Initial rural ICT projects experimented with telecom and VSAT connectivity spent their prime effort in infrastructure including power

supply. Almost all the projects provided the last mile connection using the telecom infrastructure for the sole reason of its affordability. This situation changed with mobiles gaining popularity.

A key technology factor that changed is about convergence. In simple terms devices such as digital cameras, digital video cameras, computers, mobile telephones and television could be linked to share and exchange information. Such convergence opened up tremendous possibilities for delivering a big basket to the consumer empowering them to choose, use and control voice data and images delivered through a common device.

A number of entrepreneurs are coming up with innovative platforms linking farmers to markets. The smart mobiles could play an important role in low volume traceability applications at farm level, e.g. for scanning or taking a digital photograph of a bar coded label, performing first-level verification and authentication on the spot, and transmitting the label image and basic information about a shipment to an application or receiver further up the chain.

Telecom Policy

New telecom policies on establishing cellular towers in rural areas promoting wireless technologies solved the rural access issue due to its high scalability, low operational cost, and adaptability to voice and data transfer. With entry of private cellular operators in to rural areas coupled with government telecom policies on wireless access, the connectivity is improving and more and more regions are being covered with this technology at affordable cost. The country now has more than a billion wire-less subscribers with about 50 per cent rural tele-density in 2015.

Banking services are key input to farming. More convergence of telecom and agricultural policies in the coming years would help in providing better financial services to farmers.

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Services provided

Most ICT projects offered multiple services needed for the rural people. The services covered can be classified in to three broad categories, viz. knowledge, e-governance and transactional services.

Knowledge services: Dissemination of information on agriculture, weather, market prices, package of practices, employment, news, expert advices, other farmers experiences, education and training.

E-governance: access to local or state or central government services, programmes and records like bill payments, certificates, renewals, registration, examination results, input supply information, procurement etc.

Transactional services: Exchange of information involving payments for sale / purchase of goods and services, insurance, financial services etc.

Most ICT projects provided few common services like market information, farm practices, web browsing, email, training, news, travel booking and information on government programmes and services. All projects contributed in their way to bridging the digital divide and are in service of farmers playing a catalytic role in technology-led development.

A number of ICT projects provided extensive support in agricultural services comprising crop, animal husbandry, fisheries and agro-processing. Projects planned for purpose of providing specific services survived. The projects supported by state and central governments showed firm commitment to maintain them and they survived. The key roles for the public sector in implementing e-agriculture are in preparing and effectively disseminating relevant content on crop cultivation techniques, information on input, disease, soil and fertilizer dosage, etc. On the other hand, private sector has been developing a profit model providing quality commercial services in the reach of the farmers.

The competence of the public entity in generating authentic and reliable information fits well with the private sector's interest in using its expertise to disseminate information on a sustainable basis. Thus, ICTs are witnessing a number of public-private partnerships.

Some mega initiatives like iksl, m-kisan, m-krishi, ikisan, reuters market light, managromor, ishakthi, digital green, choupal, kcc, lifelines, aAqua, etc. are providing a variety of services to more than 100 million farmers. A good number of them operate on pan India basis and some are global too. The common feature most projects provide location specific and time sensitive information direct to farmers. They ensure that the service does not add economic strain on the farmers. Besides, these agencies partner with self-help groups, non-government organisations and other stake holders in rural areas to provide more intensive information services to members, especially to extend the reach to illiterate and weaker sections.

Content

The ICT projects put more focus on addressing connectivity divide, which got resolved by new telecommunication technologies. On the other hand, knowledge divide continues to be a key challenge. Various public institutions have a repository of scientific and technological information on agriculture and it is available on open access to all. The challenge is on integration of information from various sources and making it available as per ones need. ICT applications providing such one-stop service are successful. Recent initiative of Rice Knowledge Management Portal (www.rkmp.co.in) tried to build, validate, and contextualize the huge amount of rice knowledge (running in more than 16,000 pages with 18 platforms). Similar effort is required in other commodities too.

SMS answer facility via mobile phone is a common feature in almost all ICT projects now owing to its reach, simplicity and affordability. Farmers subscribe to the SMS services and information is made available to them as and when the

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information is updated. Weather and market information being most common.

For large number of illiterate and small farmers, who cannot be expected to pull the information, there are systems that push personalized information to them in their local language. Infomediaries have been playing a key role in linking farmers to knowledge and information. The experiences of successful use of ICTs indicate technology push to grass root level are effective and have good social impact too.

Various public institutions have a repository of scientific and technological information on agriculture and it is available on open access to all. There is plenty of basic information on many aspects of farming and farm related issues. An average farmer may not be able to manage such vast information. The challenge is on integration of information from various sources and customizing accordingly. ICT applications providing such one-stop service are successful.

Several successful initiatives are taking into account the local situations and making efforts to solve one or two core problems. The spill-over effect may automatically address several other issues. Some ICT models are now available for effective information transfer leading to job opportunities to rural youth.

Media usage

As per National Sample Survey Organisation, during 2012, around 40 percent of the cultivating households accessed technical help from various agencies/ sources. In the 1990s and up to the year 2000, the most popular communication medium in Indian villages was Television (TV) followed by Radio. While the villagers generally used TV and radio for entertainment purpose, only 40 per cent used it for agricultural purposes. Besides TV and Radio, newspapers were third most important communication medium and the reading percentage more or less corresponded with that of literacy percentage of farmers. Phones were possessed mostly by the large farmers (less than 5 per cent) and they were rarely treated as means for agricultural communication.

The situation changed rapidly with advent of mobiles. The information use surveys of recent years indicate mobiles as the most popular communication medium followed by TV and newspapers. Radio lost its position due to its reach and limitation of content.

Since the farmers are comfortable to TV medium, they preferred the content treatment of the agricultural information similar to the TV broadcast. However, providing agriculture information as multimedia using audio and visuals is challenging and expensive too. However, transmission with 3G and higher technologies is changing the scope of information use.

Impact of ICT Initiatives

Research studies on assessment of information and communication technologies on farming revealed that the farmers not only accessed the information quickly but also enabled them to save cost of cultivation and realizing better market prices to the produce undertaken. The yield gain was up to five per cent and cost of cultivation reduced up to 15 per cent in different crops. However, ICTs helped farmers save travel time and transaction costs by more than 80-90 per cent.

Research studies on assessment of information and communication technologies on farming revealed that the farmers not only accessed the information quickly but also enabled them to save cost of cultivation and realizing better market prices to the produce undertaken. The yield gain was up to five per cent and timeliness of providing information (pest diagnostics, online fertilizer recommendations, etc) led to reduced cost of cultivation up to 15 per cent in different crops. However, ICTs helped farmers save travel time and transaction costs by more than 80-90 per cent.

Mobile phones have increased daily wage earning fishermen's incomes from reduction in price dispersion, reaching new markets to avoid crowding at a market and there by elimination of unsold as waste. In a typical market it could increase per capita GDP by two per cent.

Many ICT experiences reveal that farmers get

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higher returns on the basis of the timely access to market information and also save their time, travel charges and avoid unnecessary administrative hurdles.

A number of ICT projects demonstrated their potential for poverty alleviation, health, education, agriculture, marketing and sustainable development. Opportunities of ICTs in agriculture and rural development are being viewed as an investment rather than expenditure. Empowering the rural people using ICTs is seen as yet one more policy instrument for economic development.

Road Ahead

1. Certain niche product chains (eg: poultry, many horticultural, spices and organic food products) have well established market chains. The business houses use a more advanced central systems supported technologies in the higher levels of the supply chain and many use mobiles at the lower ends connecting to farmers. Such businesses are potential for integrating farmers in their supply chain through ICTs.
2. There is positive regulatory support promoting cellular, mobile and IP based broad band technologies to enhance and speedup penetration of tele-services in rural areas. Such policies, in turn, continue to push the ICT enabled services to farmers in rural areas.
3. The ecosystem is transforming to motivate and inspire youth towards innovation and entrepreneurship. With increasing investments on digital technologies, ICTs can help creating shared value across the value chain suitable to farmers. This would encourage more enterprises plunging in to business models to access them and provide need based value added information to the farmers.
4. Agriculture resources information using GIS models, expert systems, databases on successful technologies have major role in digital literacy and decision making. Such high end applications need more innovative and novel applications to make them simple, accessible and intelligible to farmers.

5. The impact studies are few based on select projects. They are not sufficient to understand the contribution of ICTs in agriculture development. In-depth research needed to provide policy relevant advice on how ICTs can better contribute to food security.

Conclusion

The paper was conceived as a primer to the larger subject on ICTs use in Indian agriculture. It reviews variety of ICT models and innovations, the successes and changes over time in terms of their technology, ownership and service to farmers. Provision of right type of information to right type of people at right time is the need of the hour for making farming more sustainable, economically viable and ecologically balanced. The experiences so far point to potential of ICTs linking farmers to markets besides empowering them to access required information for efficient and effective management of their farms and homes. The ICTs use is evolving at rapid pace. The concerns on human capacity, delivery model and value added information to farmers is going to pave way for more innovative ideas and tools in a market led development environment.

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Transformational Regime for Agricultural Insurance: India Perspective

The twenty first century has come a long way contributing to the upward and downward trends in the world economies either developed or developing ones. In case of emerging markets or developing economies the most prominent issue lies in the fact that there is a concentration of unorganized sector which makes the economy difficult to be aligned or in tune with the developed economies. This issue needs to be emphasized as the emerging markets help in catering to the demand from the developed economies. Moreover it also happens that the developed economies are in search for opportunities in the emerging markets to offload their innovations which have already surpassed their need in the developed world. As far as sophistication is concerned, emerging markets lack technological advancement which relays time delays thus, reducing the economies of scope in general. The developed economies have built in systems responsible for integrating their masses into a single disciplined manner. However, it is observed that there is massive urbanization of the rural households in a developed economy and it lacks the sustainable sustenance virtue. This is in contrast to the old patterned rural economy in an emerging economy like India wherein there is an automatic recycling between consumption and disposal. These healthy systems are being replaced with the developed world mechanisms which are fundamentally far away from such an important virtue. Emerging markets have become mere dump yard accepting infrastructure as it is from their developed counterparts.

The developed economies in fact created emerging markets. An economy was classified as developed or developing on the basis of rating given to the economy so as to park the excess liquidity generated in the developed economy and seek the advantage of arbitrage on basis of this rating. The emerging markets are manifested with issues mainly pertaining to development which has been moreover very un sequential and unruly. This fact is backed by the fact , for eg India wherein there is excess of urbanization leading to dwindling of land for agricultural production which will become one of the major reasons for food shortage leading to imports and thus pressure on the current account. Presently, the

land under agricultural cultivation is 60.3% however, with growing urbanization already a shortage of manpower is being felt. Apart from agriculture as a profession contributing the highest share of employment and GDP in India, it still remains not a very favorite choice of employment in areas where penetration of school education and skill based education is growing.

At the same time, agriculture as an occupation is surmounted with risks mainly environmental in nature. Climate change has aggravated this situation. Agricultural insurance per se plays a very important role in doling out subsidies and hedging the environmental risk in agriculture across the globe. Agriculture's share in GDP is decreasing, but it still remains a significant contribution to the national income. Most of the farms cultivate rain-fed crops and are susceptible to the changes of the Indian monsoon. Crop insurance is of utmost importance for the wellbeing of the agricultural sector. Crop Insurance protects the participating farmer against natural calamity such as hailstorm, floods, drought, and other perils. It is a risk management tool planned to level agricultural risks and deal with the consequences of natural disasters. The Government of India in co-ordination with General Insurance Corporation of India (GIC) had introduced a scheme called the National

Agricultural Insurance Scheme(NAIS). It is found that the NAIS the main crop insurance program in India, has already made quite a mark in the agricultural insurance sector in India and about 18 million farmers out of a total of about 125 million have subscribed to it. Its role being to save the farmer from financial losses in case of catastrophic events.

In the above context a primary research was conducted to understand the efficacy of the agricultural insurance products and the relevant schemes which are mandated to be sold along with the crop loan. Testing was done to check the popularity of this product in form of subscription in absence of crop loan being sought.

It was found from our visits to villages in the surveyed Talukas, that technical assistance to

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understand local calamity and losses faced various challenges. Not only is there an urgent need to connect and manage the local farmer's needs but also, there are a number of important pre-conditions for implementation of crop insurance.

Some of the discovered constraints in working the program are high overhead cost, need for larger investment fund, and questions of sustainability. A major driver can be the significant role the government can play by providing provisions of infrastructure such as information technology, preconceived data and meteorological services. One of the important cost drivers for implementing schemes is technical assistance. There are climate change scenarios that necessitate changes in the program to maintain actuarial soundness of the schemes. It was found that other than the implementation issue there is also insufficient insurance coverage against the broad range of production risks inherent in agriculture activities. Strengthening regulatory compliances and increase in awareness programs will remain the main driver for adoption of crop insurance by the farmers.

The study on data gathering mechanism in crop insurance scheme suggests a considerable scope for improvement in this sector. Companies are looking for ways to reduce administrative cost, cover cost of selling and servicing crop insurance while attaining profitability where premiums would exceed the claims settled. The report highlights the concerns of the cost-delivery of crop insurance. Government and insurance companies face scale-up issues at the farmer level. This remains one among the key challenges for the Government to pursue.

Also survey results show that small area farms dominating the agricultural sector in India are not traversed. So farmers with modest farms are not benefited. The crop insurance schemes were found to benefit larger farms the more efficient ones and even then claims disbursed in those were over 350% of premiums.

General characteristic of the crop insurance is that it is heavily subsidized by the Government but coupled with problems such as delays in payment and very small margins for recognition of claims even in adverse circumstances, hence, farmers would only buy when made compulsory in nature, and there is capacity constraint in agricultural

reinsurance to underwrite systemic risk. Indian NAIS uses yield based crop insurance in which insured yield is based on percentage of the farmer's historical average yield.

Current "one size fits all" insurance option is unable to meet the expectations of all the farmers and small farmers are left in a lurch. A properly-designed risk management system is necessary for protecting farm operators and reinforcing rural development. Products could be designed and priced to enable efficient risk classification in the interest of fairness and protection against adverse selection. Current procedure for determining premium rates and Threshold Yields under NAIS leads to poor risk classification. There is no doubt that there are a number of areas in which the NAIS could be further strengthened. Some suggestions such as – speeding up of indemnity payments, and being more crop specific which is more applicable to small farm holdings – are being made at the end of the report. The World Bank along with the Government of India (GOI) has done considerable work such as developing an actuarially-sound rating methodology and improves the contract design of the area-yield. However, it is still far from attaining timely claims settlement and achieving greater coverage. Operational deficiencies make it difficult for risk classification to be conducted by charging different premiums for the same crop in different insurance units within a state.

An action plan is suggested, including short term steps that need immediate consideration. Poverty assuagement can be significant, where such crop insurance schemes become workable because the cover would benefit smaller farms.

Agricultural Insurance in the Indian Context

Insurance is a formal mechanism used in many countries to deal with production risks. World over it is seen that agricultural insurance schemes are being subsidized on a global scale. The crop yield insurance scheme has been largely impacted due to low coverage and high claims to premium ratio. There are problems with both the design and execution of the schemes. Therefore, for Crop Insurance to be a purposeful policy risk management tool, it would have to reach out satisfactorily to a majority of farmers.

There is a problem of asymmetric information, the situation in which the insured has more knowledge about his or her own risk profile than does the insurer. Asymmetric information causes two

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problems: adverse selection and moral hazard. In case of adverse selection, farmers have better knowledge than do the insurers about the probability of distribution of losses. The farmers thus occupy the privileged situation of knowing whether or not the insurance premium accurately reflects the risk they face. Hence only farmers bearing greater risks will purchase the coverage, generating an imbalance between indemnities paid and premiums collected. Agricultural insurance is often characterized by high administrative costs, due to the risk categorization and monitoring systems that insurers must put in place to prevent asymmetric information issues. Other costs include getting the data needed to prove accurate premium rates and directing claims adjustments. As a percentage of the premium, the smaller the policy, generally, the larger the administrative costs. Spatially correlated risk, moral hazard, adverse selection, and high administrative costs are all important causes why agricultural insurance markets may fail. Cognitive failure among potential insurance purchasers and ambiguity loading on the part of insurance suppliers are other possible causes of agricultural insurance market failure.

Apparently, “*individual farm approach*” would reflect crop losses on realistic basis and hence, most desirable, but, in Indian conditions, enforcing a crop insurance scheme at “individual farm unit level” is beset with problems, Such as:

1. Non availability of past record of land surveys, ownership, tenancy and yields at individual farm level
2. Large number of farm holdings (nearly 116 millions) with small farm holding size (country average of 1.41 hectares)
3. Remoteness of villages and inaccessibility of farm-holdings
4. Large variety of crops, varied agro-climatic conditions and package of practices
5. Simultaneous harvesting of crops all over the country
6. Effort required in collection of small amount of premium from large no. of farmers
7. Prohibitive cost of manpower and infrastructure

Hence, ‘*individual farm based*’ approach is not possible.

In general, farms in Maharashtra are significantly smaller than farms in big developed regions. It is but evident that for conventional crop insurance

products, smaller farms in general imply higher administrative costs as a percentage of total premiums.

Crop insurance is not the universal solution to the risk and uncertainties which are integral to farming. There are many shortcomings in the traditional crop insurance. The important ones are:

1. Moral hazard
2. Adverse selection
3. Multiple agencies and their huge administrative cost which are hidden in the government budgets
4. Lack of reliable methodology for estimating and reporting crop yields
5. Delays in settlement of claims
6. Program only limited to growers (farmers)

The thought of crop insurance came forth in India during the early part of the twentieth century and it is still evolving in terms of scope, value spread and structure.

In general, there is no “one-size-fits-all” policy recommendation for the government in agricultural risk management. Instead of one-size fits all approach, we can look at associating the risks with the type of crops. Measurement of evaluating circle level should change and it should be at village level. More importantly, the government subsidy on insurance schemes has to reach that farmer who requires it the most as the claim is calculated on the basis of crop cutting experiments carried out by agricultural departments of respective states.

The Government is looking at below listed four criteria when considering alternatives for addressing agricultural risk management needs: These are:

1. Fiscal constraint
2. Growth
3. Market oriented risk transfer
4. The social goal to reduce poverty and vulnerability in rural areas

Several vital matters and questions were revealed during interactions with the farmer, analysis of secondary data, and consultations with other relevant stakeholders. Some of the important questions were:

1. Should crop insurance be made voluntary or remain mandatory?
2. What should be the strategy to create awareness and reach of the product?
3. Should crop insurance be part of comprehensive insurance policy?

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There is an urgent need to educate farmers on the insurance schemes. The Government should use all formal and informal networks to diffuse awareness in this area. The State Governments can be made accountable to ensure that farmers take crop insurance schemes through the co-operative sector and get some benefit when burdened by natural calamities.

Agricultural Insurance in the Global Context

In the USA, Canada and other non-EU Countries, there are some insurance instruments developed, such as index insurances, area insurances, whole farm insurance or revenue insurances which are not developed in EU. The EU has mostly classic insurance schemes (mainly single-risk and combined insurance, but also yield insurance) mainly private except in Greece and Cyprus where insurance is public and compulsory. In many countries the market is in the hands of no more than two or three insurance companies.

An overview is given on the main figures of insurance at country level, their evaluation and market conditions. On average, in 2004 approximately 23% of crops value was insured. Premiums amount on average to 1,583 €M and 4% of the insured value, and subsidies to €497 M or 32% of the premiums. Data on country level come from two sources: the information collected in the fact sheets and information provided by the European Committee of Insurers (CEA). Average loss ratios are from 60 to 70%.

Average premiums for hail can vary from 1% for arable crops to 18% for fruits. Deductibles, franchises, bonus-malus and other techniques are usually used to avoid moral hazard and adverse selection.

Reinsurance is mostly done from the international reinsurance market (Swiss Re, Munich Re, Partner Re, etc.) mainly in the modalities of stop-loss and quota-share reinsurance.

Single and combined risk insurances are available in most countries, predominantly with a basic coverage in hail insurance. The particular case of the US and Canada is quite different, because even though there is yield insurance, single risk insurance schemes are not popular. In both countries, there is a basic coverage which corresponds to yield insurance which covers only for losses above the 50% of the average yield (it is

called CAT or catastrophic coverage). It is highly subsidized by the government (almost entirely in the US - where farmers only pay an administrative fee - and 50% in Canada). As the level of coverage increases, the subsidy decreases. But for any level of coverage, the most important risks are included, so it is possible to speak of yield insurance at a wide variety of coverage levels.

General overview of agricultural insurance systems in Europe

The table below shows the distribution of demand for crop and animal insurance. Europe's agricultural activities include more of livestock farming and raising crops. The European weather is at its worst in winters dominated by hail storms, snow fall etc which affects livestock the most hence, insurance activities in this sector are more prevalent.

Table: Demand for crop and animal insurance: insured value

Country (insurance system)	Year available	Crop insured value (€M)	Livestock insured value (€M)	Production value covered (€M) Crops+livestock	% total insured value of total production	% total insured value of total production
Austria**	2000-05	1,736*	367	2,000	18 %*	-
Belgium *	1993-04	-	-	-	-	-
Bulgaria**	2000-05	1110	191.3	253.1	20.4%	5%
Cyprus *	2001-05	1208	8	1208	-	-
Czech Republic**	-	708	1,862	1,770	-	-
Denmark *	2000	0	-	-	-	-
Denmark**	-	-	-	-	-	-
Finland *	1996-05	-	-	-	-	-
France *	1996-04	12,149	-	-	-	-
Germany**	2000-05	11,283	-	-	-	-
Greece (EU)***	-	-	-	-	-	-
Greece private***	2000-04	85	252	307	-	-
Hungary**	-	-	-	-	-	-
Ireland *	-	-	-	-	-	-
Italy** *	2001-05	3,630	-	3,630	20%	12.6%
Latvia *	2000-05	-	-	-	< 1%	< 1%
Lithuania**	2001-05	3	22.6	25.6	-	-
Luxembourg*	2001-05	86	-	-	-	-
Netherlands**	-	-	-	-	-	-
Poland *	-	-	-	-	-	0.0%
Portugal *	1998-03	561	-	561	14%	14%
Romania**	2000	298.8	-	29.8	-	6%
Slovakia**	2000-04	-	-	-	-	-
Slovenia**	2000-05	59.2	64.8	124.7	10%	-
Spain**	2001-05	5,689*	4,096*	9,033	-	-
Sweden**	2000	-	-	-	-	-
UK *	-	198	1,328	-	-	-
United Kingdom**	2000-04	171	-	-	-	-
Ukraine**	2001	21,127	-	-	-	-

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Only crops & Livestock excluded

1. There are no official data about the agricultural insurance market in Bulgaria. For this reason, all data is based on interviews with senior experts from leading insurance companies.

2. Aquaculture is included in Greece and Spain. In the number of animals, poultry insurance is included in Spain.

3. Data from the Netherlands are for hail and glasshouse insurance. Most data are not supplied by the companies for competition reasons.

4. Animal insurance data are not available for Italy because they are not subsidized. The insured values and premiums data include crops and structures.

Source: European Commission: Agriculture and Rural Development

Livestock insurance market penetration

In the Netherlands, the existence of a compulsory fund for livestock producers hinders the development of livestock insurance. For Italy and France, animal or livestock insurance data are not available because this type of insurance is not subsidised. Nevertheless, the demand of livestock insurance for those countries, as well as for the UK, seems to be quite residual.

In Greece, insurance is compulsory for livestock, but it is voluntary for pigs and poultry. Pigs and poultry insurance are also offered by the public entity ELGA. In the case of Spain, the number of animals includes also those of Poultry insurance which has been offered in 2004 and 2005. If we ignore Poultry insurance, the average number of animals insured for the last three years would reduce from 102.850.000 to 3.800.000. Data on the number of animals would become more meaningful by applying equivalence coefficients to different species, so that everything is expressed in “UGB” (Unité-Gros-Bétail = large livestock unit) or LSU (Livestock Standard Unit).

In Greek's private insurance, the 89% of the premiums and the 80% of the indemnities come from aquaculture. The Greek private insurance has so low premium rates because of the low rates of aquaculture insurance. The rates for aquaculture insurance are around 1.6% while the rest of rates

would average 2.5%, very similar to the Austrian premium rates. The low risk of aquaculture also diminishes the proportion of the indemnities on the insured value from 1.9% to 0.7%. Last, the loss ratio if we do not include aquaculture would be 0.60 instead of 0.38.

Analysis of the primary data revealed major findings which were analyzed on the basis of relationship between 4 pair of variables. These are:-

1. Land Ownership and its Relation to Income
2. Loan and Crop Insurance Subscription
3. Insurance bought with Loan with Awareness from Media
4. Insurance bought independently with awareness from Media

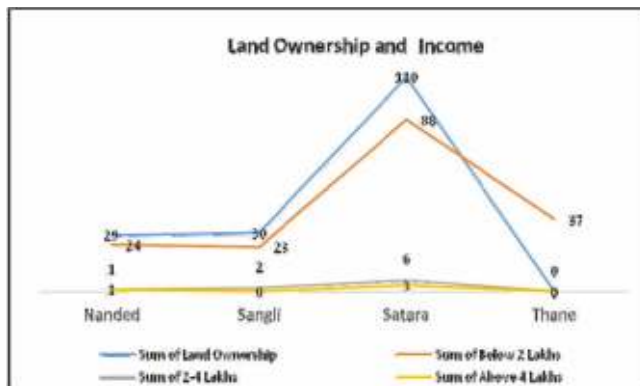
Land Ownership and its Relation to Income

In Maharashtra land is a State subject. As per the provisions of the Agriculture Land Act, 1974 a farmer is entitled to hold 18 acres of irrigated land or 27 acres of land which has no assured perennial supply of water for irrigation, but has assured water supply for one crop. Conversely, a farmer can hold 36 acres of land, which has un-assured water supply or 54 acres of dry crop land. As per the draft on land reforms, the Centre had proposed that the ceiling limit should be reduced from 54 to 15 and from 18 to 10 acres. Land ownership issue is critical as there is continuous decrease in farm sizes and more than 80% of farmers have farm sizes less than 2 hectare in size.

It is found that source of income for most of the sample collected were agricultural income itself. It was also found that land ownership is very vital in contribution to income. There is a very strong relationship between land, people and power. Land being a limited resource its value keeps on increasing due to the demand involved.

The State Government has a critical role to play in land management and in making land available for various purposes. Maharashtra state is making land available for residential development, SEZ development, Industrial colonies, and other commercial usage. Land deals act as a major source of revenue to the government in the form of sale/alienation of land, lease/ground rent and conversion charges.

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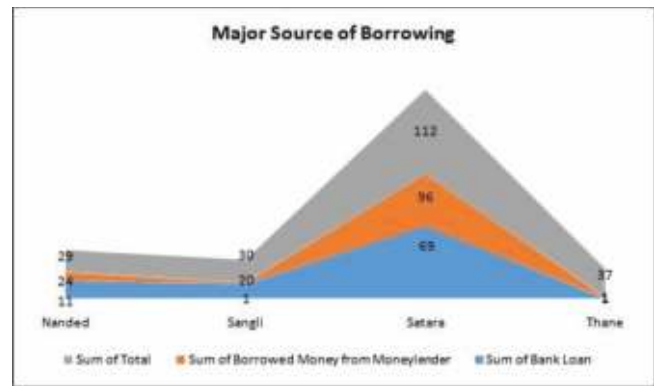


The district wise analyses revealed that majority of the farmers belong to the lower income strata. It was found that most of the farmers had income below Rs 2 lakhs. There were very few in the sample list who had annual income more than Rs 2 lakhs. Agriculture income is exempt under the Indian Income Tax Act. There were very few farmers who had agricultural income more than Rs 2 lakhs which is illustrated from the chart above. There can be a new beginning if Agriculture is regarded as a commercial activity.

Loan and Crop Insurance Subscription

Agriculture finance/credit is said to be the lifeline of farming. Several of the Government, credit policies has ensured the flow of bank credit to finance a range of farm related activities in the form of short-term/long-term credit loans. Farmers require loan for cultivation of crops, meeting short- term credit needs such as seed purchase, diesel oil, electricity, fertilizers, maintenance of farm equipments etc. Every loan taken has an accompanying mortgage such as land or other form of assets. Most of the loans of the farmers in Maharashtra are from cooperative societies. When the credit lines are choked, they rely on informal sources like moneylenders for their financing requirement.

Diagram below shows that out of the total sum borrowed, a considerable chunk of farmers borrowed money from banks and money lenders.



The multiple response analysis of the actions taken by the farmers who were not insured, in case of yield loss, suggested that they borrowed from friends and family (34%), taken a bank loan (28%), sold their livestock (14%), borrow from money lender (11%), sought government relief (10%) and sold of gold (3%) in this order. Borrowing money to square the loss is risky affair. Selling assets is like parting with the accumulated wealth which is equally dangerous. Thus, it could be inferred that crop insurance will assist farmers to minimize the risk/income loss due to natural calamities. Our analysis indicates almost 40 % of the financial borrowing of farmers from moneylenders.

Getting a loan from a bank is an extended process, and banks avoid giving loans to small farmers who have poor capability to repay the loan. This is the main reason the farmers have to turn to moneylenders. Most of the times it is a verbal negotiation with high interest which a farmer has to repay back. In many districts, farmers may offer collateral (such as gold ornaments) for loans. To avoid these hassles measures are suggested by the study group, such as loan rescheduling, waiving of interest in case of distressed farmers who are affected by natural calamities in over rain fed areas. But still substantial results have to be achieved in this area.

In fact idea of a 'Moneylenders Debt Redemption Fund' was floated to help farmers get out of the debt trap of the moneylenders.

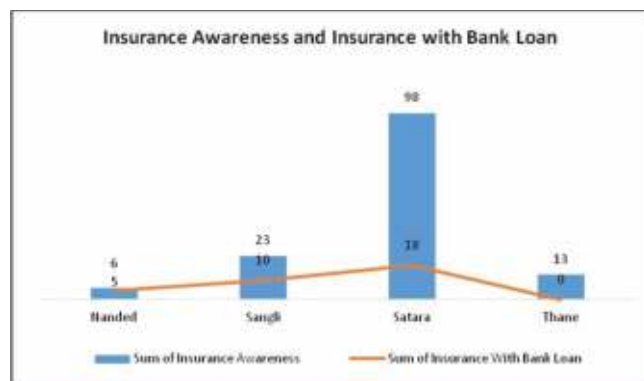
Insurance bought with Loan with Awareness from Media

The Government has set up several schemes such as National Agricultural Insurance Scheme and the

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weather index based crop insurance scheme. However, almost all respondents carry the wrong perception that the banks will pay compensation and that they are the implementing agency. Financial security was the prime reason farmers bought crop insurance.

The chart below indicates the awareness level among the farmers in the surveyed districts. Usually lack of awareness is the main reason for non-availing of such insurance. In many instances, NAIS shows deficit as the premium received is always more than the claims.



We have found low awareness levels in Nanded and Thane districts however it was quite good in Sangli and Satara area. It is more than 75 % in case of both Sangli and Satara regions. This would help in ensuring better penetration of crop insurance in the relevant regions. We have found that there is an urgent need to disseminate information about insurance schemes across the target groups.

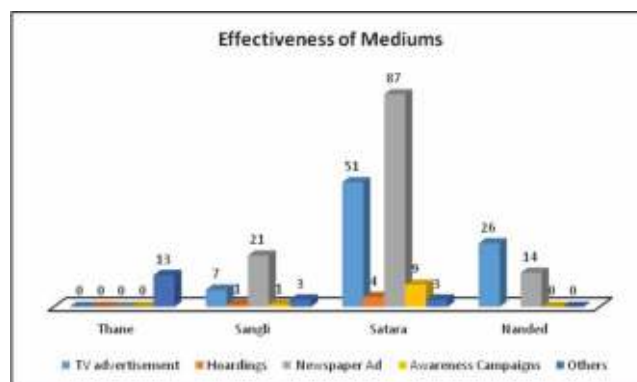
Entire analysis has pointed towards awareness as one of the most important elements which can contribute to better returns from crop insurance as far as the right subscription to the relevant crops is done which is possible only through awareness about the product. Thus, awareness about crop insurance policy and its terms and conditions can make a substantial difference to the life of the farmers. Biggest challenge in enhancing the penetration of crop insurance is to cover the farmers who have not taken any loan from any financial institution as agricultural insurance is prescribed along with the loan.

Insurance bought independently with awareness from Media

The chart below shows the medium of

communications such as TV Advertisements, Hoardings, Newspaper Ads, Awareness Campaigns, Exhibitions, and other used by authorities to educate the farmers. They also use Road Shows, Village Melas, and Film Show in Villages, Radio Programs,

Kisan sabha, and training workshop by insurance companies.



In Thane for instance the medium of communication were bank authorities. As seen in the graph above most effective medium seems to be the newspaper. “Recollect value” on which other campaign such as hoardings or TV is based which do not have worthy effectiveness.

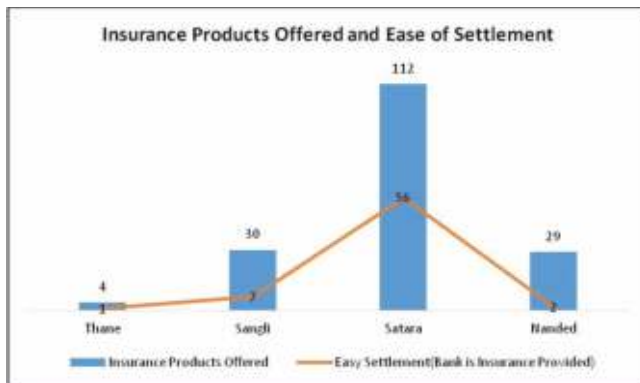
Farmer’s awareness of the product and its functions need to be strengthened in order to make sure it is used efficiently. It is also found that progressive framers are very well aware of crop insurance and opt for it without much doubt.

Easy Settlement of Claims and Buying of Insurance

For the surveyed districts, claims were settled individually for occurrence of local disasters such as hailstorms, landslides, cyclones, droughts, and other catastrophic losses. Below sample shows that ease of claim settlement is almost 50 % in Satara area, however Sangli and Nanded samples were not very satisfied with the entire claim settlement process.

These values are for the crop insurance products sold through banks:

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Claim settlement is one of the burning issues of implementing crop insurance. In many cases it is found that farmers have to work hard to prove the losses. To make a claim the farmer has to keep the document safely, notify the crop insurance officials and produce required evidence when required. The complex institutional mechanism for delivery of crop insurance is reflected in declining efficiency and responsiveness towards the product. This causes serious delay in claim settlement. Delayed flow of funds results in farmer defaulting on the initial crop loan. This cycle acts as a disincentive for farmers to further purchase crop insurance.

We also found that officials had great interest in promoting crop insurance among all the commodity boards and other apex promotion agencies as new agricultural practices need insurance support for their sustainability.

Moral hazard issues complemented with disciplined farmers being rewarded lead to other regular users of farm loans being wrongly motivated to default in the future.

Farmers Expectations from Crop Insurance

Crop insurance supplied by NAIS has several limitations. Respondent farmers suggested improvement in existing scheme and quick settlement of claims which usually takes more than two years in some cases. Due to late settlement of the claim, farmers perceive insurance as a gamble. Some farmers also mentioned that though they were insured in previous years, but discontinued with the insurance as they did not receive a claim payment inspite of natural calamities leading to crop loss. These perceptions can be associated with a lack of awareness on how an insurance product actually works, as the insurance is designed to trigger a

claim payment in case of crop failure, and thus ensuring income stability in the long run.

The following Spider chart indicates the expectations of the farmers from crop insurance:



As shown in the chart above, seasonal changes due to unpredicted climate are not covered. Farmers demanded higher coverage as even the input cost of crop production is not covered in the claim settlement. Higher indemnity level is one of the critical requirements to make the crop insurance more marketable.

One of the reasons for poor product designing can be lack of competition for NAIS. More than 80 % of the insurance beneficiaries mentioned that bank compulsion was the motivation for opting agricultural insurance and no credit is given to the product design itself.

Thus it is concluded that redesign of the subsisting crop insurance schemes (NAIS, WBCIS, etc.) is long overdue and the Government of India (GOI) needs to take prompt steps to revamp the schemes with the help of relevant authorities. There is a dire need for simplification of modalities of indemnity, loss assessment, settlement of compensation and disbursement procedure.

Qualitative analysis

The Qualitative analysis consists of recorded comments and suggestions about the crop and weather based insurance schemes that were subscribed but not covered by the posed questions. As mentioned earlier, there are three parties involved in the process of subscription of the crop insurance by the farmer. The three parties are namely the agricultural department designing the schemes and the insurance companies who are mandated by the government to include the crop

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insurance in their portfolio of various insurance schemes and lastly the banks and the gram vikas yojana offices through which the schemes are distributed.

Data from Primary interviews

All these three along with the farmer were interviewed for their suggestion and their comments which primarily consisted of grievances which were recorded. The same are depicted as follows:-

Comments and suggestions from the farmer:-

Farmers put forth the grievances such as-

1. The claims are not settled in time hence, we do not subscribe to agriculture insurance for subsequent crops

2. The product is not designed as per the crop grown. For instance, cotton is grown in abundance in the adjoining Bhokar area of Kini and farmers have to subscribe to terms and conditions for growing bananas as the insurance sold to them covers banana plantation on a higher scale. This manipulation is happening because the authority required to inspect the claim settlement is the local talathi. Grievance cited by the insurance companies is with regarding the deficiency government infrastructure in implementation of these schemes.

3. Farmer's grievances that the weather stations should be at the village level rather than at circle level.

4. No cushion if crop insurance scheme expires just before a drought it is declared for eg a month, even when the drought prevailed even when the scheme was live, hence , loss to farmer due to the late declaration of drought by the government. The time period of crop insurance schemes is less than half a year.

Comments and suggestions by the *bank officials*:-

1. Lack of government infrastructure while inspecting claims

2. Contradictory circulars from central and state governments on agricultural insurance schemes

3. No dedicated staff for explaining the schemes to the farmer and administering the same

4. The major players in the crop insurance market are of two types government owned AIC and private ones such as HDFC ERGO and ICICI LOMBARD. All the three have mentioned that the crop insurance or the weather based insurance schemes are designed by the agricultural department of the state and not by the insurance companies who actually distribute them.

Comments and suggestions from the *Insurance Companies*:-

1. We are mandated to employ this scheme of crop insurance which does not yield a steady return as the same is heavily subsidized and we are not able to do much as the schemes are designed by the state agricultural department which narrows the scope of the product.

Better independence in designing of the product and better returns to the company for making over and above subscription to the farmer and allotment of funds for its promotion is a necessity. The infrastructure that the government needs to install on whose basis the claims are settled needs better attention and improvement.

2. As per the insurance companies the insurance was supplied mainly along with the loan and there was no separate effort whereas in normal Insurance schemes an agent is involved.

3. It is seen that in Maharashtra the AIC is the major market player implementing the NAIS & HDFC Ergo has a smaller share. It was noted that there was no specific research or development team who designed the schemes and the insurance companies depended heavily on the state department of agriculture for predicting the pre-conditions

Lastly, the state agricultural department:

We have not accessed the same in order to avoid any conflicting bias with regard to the above entities.

Primary interview suggested various factors influence insurance purchase by farmers.

Some of the factors are as mentioned below:

1. Gross cropped area

2. Income from other than sources agriculture

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3. Presence of risk in farming
4. Number of workers in the farm family
5. Premium paid by the farmers
6. Satisfaction with the premium rate and affordability of the agricultural insurance premiums

Probable Risk Identified by the Farmers

Discussion with the farmers helped us identify the risk elements in farming. There are risks such as selective participation also known as “adverse selection” in insurance parlance. There are post-harvest risks experienced by farmers, which are not covered along with the other risks such as, pre-sowing risks which are not covered. There were cases of Ad-hoc settlement of claims. This kind of feedback helped us identify the risk of the farmers.

Conclusions and Recommendations

In the course of this survey, extensive interactions were held with all the stakeholders who are a part of the agricultural insurance sphere; viz. the beneficiaries – farmers, the benefactors – insurance schemes / company officials, the facilitators – district level banks / bank officials and the policymakers & decision makers – the government. Based on those interactions and the secondary data the following conclusive recommendations were made.

Agriculture Insurance Companies

Insurance companies may feel that crop insurance is a financial obligation – there is an impression that it is not a profitable proposition at all. Claims settlement ratio against premium collected is steep.

Risk classification is currently poor, leading to adverse selection and inequity between farmers in near by insurance units. It is observed that there are rarely any insurance schemes other than the ones provided by NAIS and AIC which are availed by the beneficiaries. There lies huge scope for private insurance players to enter this untapped market.

Private Insurers

Private insurers have by and large been reluctant to insure crop and livestock yields. Moral hazard and inadequate risk assessment information make product design difficult. The high frequency and covariate nature of certain risks can bring out insurers to large pay-outs. Consequently, premium rates are often too costly for many farmers to afford without subsidies.

Suggestion to players would be:

1. Post data gathering, actuarially-based premium setting and adjustment to changing weather patterns is also needed.
2. Designed products should be of standard shape for each crop, varying only with limited parameters
3. There should be small insurance unit areas. Reduce the insurance unit area to Gram Panchayat if possible (Modified NAIS has insurance unit at village panchayat level only for major crops)
4. Need to include pre-sowing/ planting risk too
5. Basis of calculation of threshold yield should be checked and fine tuned
6. Increase indemnity level up to 90 % or more if possible
7. Localized calamities need to be covered

Maharashtra Government

There is an urgent need to educate farmers on the insurance schemes. The government should use all formal and informal networks to diffuse awareness in this area. The state governments can be made accountable to ensure that farmers take crop insurance schemes through the co-operative sector and get some benefit when burdened by natural calamities.

Reasons for this are that the government is motored by humanitarian concerns, and their primary aim is to save live and rebuild assets of the rural citizens.

1. Emergency relief might arrive too late.
2. It is hard to provide relief aid to the truly impoverished and needy; large leakages are common.
3. Support for humanitarian relief in the face of catastrophes is not assured, and it often depends on appeals to government after the crisis has already occurred

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We recommend:

1. Provide tools to farmers for evaluating crop insurance products such as premium calculator, pay-out estimator etc.
2. Design a product which will have variable premium subsidies
3. Government administrative and budgetary process for this ex-post funding which otherwise has led to systemic delays in settlement of NAIS claims (up to 9-12 months or more)
4. The experience-based approach suggested for the ratemaking of the modified NAIS (World Bank 2007) can be adapted to set a flat premium rate across a state, and classify risks by varying the products sold across the state. The suggested approach could lead to better risk classification and lower variation in premium rates and products within districts than the existing approaches.
5. More competition should be created to give farmers choice of selection. Private insurers to be advocated to carry out this task.
6. Exemption from Income Tax and Service Tax to build enough Catastrophic Reserve Fund.
7. Furthermore, once disaster assistance has been institutionalized, and people know they can rely on it, people may be encouraged to heighten their future exposure to potential losses, hence an adjustment relating to this must be compiled for eg. Assured compensation for flood damage to homes, can lead to the construction of more households in flood-prone areas.

District Cooperative Banks

Crop insurance is cumbersome to administer and prone to losses. Banks and other financial service providers are often reluctant to lend in rural areas or for agricultural activities because they perceive them to be risky. The rural population is more widely scattered, and the infrastructure may be poor and more pliable to problems.

They are especially concerned about covariate risks (as many borrowers working in the same sector may face a severe shock at the same time and default on their loans), but even independent risks can be difficult to manage (rescheduling loans with small-scale farmers is costly, and eventual repayment is uncertain).

Customers in rural areas require a different range of products than urban clients, and this may require diverse, highly tailored systems, staff capabilities, marketing campaigns, and so on. In addition, the overall capacity of potential staff in rural areas may be more limited. Longer searches and more training would be required in order to staff rural branches. This is seen particularly in the banks who would be dealing with the insurance products.

We recommend following points need to be taken care of by the respective stakeholders in the agricultural insurance sector:

1. Farmer's dependence on informal credit, particularly in rural farming Cooperatives have to be taken care by all possible means
2. Lot of banks help in collecting yield data and there is late submission of this yield data and subsequently there is delay in payment of claims.
3. As far as possible assign a dedicated resource and devise a separate automated mechanism if possible.
4. Provide Funding necessary for certain infrastructure investment such as automated weather stations. More such weather stations if possible at all village level as is the requirement.

Farmers and Cooperatives

If the crop insurance program is to be made a crucial tool in agricultural risk management, the current level of coverage will have to be improved. Cooperatives play significant roles. Within Cooperatives, people pool risks among households; for example, they may share food stocks or rely on kin support networks.

Our view is:

1. Systematic improvement in the accuracy of yield estimates, through process standardization and training, has the potential to reduce basis risk, the risk that insurance claims do not accurately reflect incurred losses.
2. Currently, state governments are responsible for ensuring that crop yield estimates are an accurate reflection of the yields experienced for each crop in each Insurance unit. If this can be done by established co-operatives it would be a radical achievement.
3. Among cooperatives, risk-sharing systems

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would help manage some of the more covariate risks affecting assets and seasonal production and income.

4. These family and cooperatives risk-management methods are astonishingly effective at managing risk, and they have enabled rural societies to last over countless generations, even in many waterless and semi-arid regions subject to terrible drought however, they do have significant limitations.

5. Cooperatives should help with workshops and training given by representatives of Agriculture Insurance Company of India (AIC) and NAIS Study if premium amount should be a variable cost

weather event is hard hence, estimation of possible yield with reference to the actual yield is recommended.

The above discussion centered on agricultural insurance one of the major emerging market issue. This issue has been blanketed by number of other issues in the emerging markets which are in queue to be dealt and disposed off thus removing obstacles from the growth and development of the developing economies. It has been solemnly observed that growth of financial status among the agriculturalists in the US and Europe or the developed world has importantly led to the overall development of the economies now known as developed economies. Emphasis on management

	NATIONAL AGRICULTURAL INSURANCE SCHEME (NAIS)	WEATHER BASED CROP INSURANCE SCHEME (WBCIS)	MODIFIED NATIONAL AGRICULTURAL INSURANCE SCHEME (MNAIS)
Scheme maturity	Established	Potential successor	
Year started	1999	2007	2010
Index	Area yield	Weather	Area yield & weather
Farmers covered in 2010	>22m	>3m	340,000 (Winter season 2010 only)
Government Financing	Ex-post	Upfront premium subsidy	
Open to private Sector	No	Yes	
Average claims +	3.5	1.4	(Expected to be similar to WBCIS)
farmer premiums	(2000-2008)	(2007-2010)	

depending upon the yield obtained by the farmers and the number of hectares on which the insured crop is grown as well as a predetermined price. If this method is adopted, then the farmer would make most of the premium payments in years when he obtains high yields and would pay little in years when the yields are low.

Develop proper programs to move beyond crop insurance towards a novel weather based insurance scheme as an alternative to NAIS. There should be a comprehensive package that includes farmers' huts, tools, and animals besides crops. So the immediate need is introduction of a range of innovative insurance products covering diverse risks. Forecasting crop loss due to an unexpected

of best agricultural practices has been and is an important agenda of these economies. Thus we conclude that agricultural sustainability through agricultural insurance will bring in the necessary balance in agricultural income and lead better management of agricultural practices.

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Agro Economics of UP & Bihar: Need Special “Eye Attention”

Why we are talking about Agro Economics? Because it covers maximum share in FMCG market and this maximum share is 100% extracted from Agriculture. Today world population is about 700 Crores and each person on average basis consumes 4 times solid food and 3 times liquid food means 4900 Crores times food consumption exists and if we multiply this 4900 Crores times with any country currency on daily basis or yearly basis you assume what will be the number. Standalone Agro Economics is an independent economics which needs Focused Independent and Separate Eye. And why we are talking about UP (Uttar Pradesh) Agro Economics on Global Platform? Because of only that UP has its own importance in agro opportunities and potential. Many countries in world are still smaller either in area wise or in population wise. Hence, it is important to discuss on this, which can be replicated to any land-locked or other similar countries.

From ancient world when civilization was developing, they chose the river side and fertile land so that water, transport and food problem could be solved. Fortunately, all things were available that time at UP and it is still available. If in ancient world you hear the most of the developed city name in India, you would find all were at river side and mainly in UP & Bihar, like Ayodhya, Mithila, Patliputra, Magadh, Kaashi etc. The reason is again it is located at very fertile land from wherein the public at large can get their food, water and transport.

Now come to the point that why we are discussing now. The answer is that to understand how Agro Economics of UP can contribute to India as well as to World Economy and to address food distribution issues.

Let us start here. Now do you know what six things required to run any industries? if no, it is below..

Six Power of Agro Economics

Factory: UP & Bihar has Best land in the World

Labor : UP & Bihar has Best Labor in the World example Labor from UP & Bihar went to Gujarat,

Maharashtra, Mauritius, Fiji, Guana Trinidad etc and they build them.

Technology: UP & Bihar has Best 7 Agro Universities

Management: UP & Bihar has Best Brain in the World most of the Technocrats, Bureaucrats from here

Support System: UP & Bihar has natural support system like river, railway and 4 types of weather

Money: This is the problem area in UP & Bihar where attention is required

Now, if any one look at the above will definitely be surprised that if there is all the things which is required then why it is deprived, the answer is simple a Collective Eye has not been put here, who can align and sync the resources up to optimum utilization. Now, I discuss how it can be aligned and optimally utilized.

Six Challenges of Agro Economics

For any agro economics, the first challenge is, if cost of the crop will be high then food prices will be high and middle class of the society will be affected. On the other hand, if price of the crop is low then farmer will be badly affected.

Second challenge is, it is totally depended on nature which is uncertain in his own any changes in weather affects the farmer badly.

Third challenge is, insurance process of crop loss is not as easy and friendly as it is for corporate. Farmer's entire stock is under open sky without any security.

Fourth challenge is, due to family division ultimate land individual farmer is getting down day by day.

Fifth challenge is the young next generation of farmer is now departing themselves from farming.

Sixth challenge is the less reach of market, supply chain, innovation and technology to them.

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How to use Six Power and Resolve the Challenges

Breaking the 6 Challenges

To overcome price risk, the farmer should be directed to the market as far as possible. To the extent farmer will be direct to market. He will get more benefit of market, if prices goes high now a days this benefit is going to the mediators instead of farmers. Using of E-Commerce Portal, Mobile Apps or Online database model will be good idea.

Also, government should review and reclassify the goods and crops between life necessity and non life necessity. Non Life necessity crops should be left to the open market so that farmer can be benefited. For this, if amendment is required in APMC Act, government should do this.

Also, if there is price restriction on some of the crop due to inflation a farmer should opt mix of the crop. Farmer should be taught how to cut the cost of production by using latest technology and innovation in farming and how to use the latest technology and innovation for maximizing the production. These two steps will help them to save from risk of price restrictions. Cash Crop and Mix Crop Promotion will also help in price establishment.

For second and third challenges a review over current insurance practices is required. Now-a-days, process of getting insurance money on crop loss is very lengthy and hectic. A private insurance company and GIC together should make a review and plan so that Crop Survey can be easy and instead of area wise Insurance compensation, it can be given Individual Farming land wise.

Now, the fourth challenge is the diminishing size of land. Government and other institutions should teach them and organize awareness camps wherein they should be demonstrated about the Loss and Benefit of Land Division. They should be educated and motivated about the cooperative farming so that Land Size can be increased for farming. This will help in farming planning as well as will be helpful in reducing the cost.

For fifth challenges it is required to attract youth to the farming and making lucrative carrier in farming. It can only happen by joint effort of Government, Banking, Insurance and Capital Market Institutions. A youth after MBA, Agro engineering or any Agro Degree will be attracted to the farming if they see good numbers in to this.

If any educated guy got more than 20 acre land through cooperative or contract farming and use his expertise, and if bank insurance and government facilitate him for funding and insurance, definitely he can see crores of turnover in this 20 acres. He himself will get Lakhs of profit and associate farmer member will also get Lakhs of profit timely. Knowledge of new innovation and techniques will help youth to cut the cost and maximizing the production. New Insurance Policy will save all of them for any risk. Funding Opportunities alongwith venture funding to be introduced in to this.

For sixth challenge, we have to break the lock of Land and technology. How it can be broken is being described in detail below.

Breaking the Land Lock :

Having lot of opportunity this area is deprived because of the talent and agro varieties is not being reach and known to the National as well as to the Global Market. How we can break this lock is as follows.

Opening Agro Cargo Airport

We have discussed power available at UP and challenges exist; now we move to the solution. As we know, developed states of India as well as world exist now at Port side, earlier in ancient it was river side. Here UP & Bihar and similar countries in the world that are land-locked, faces big problem of supply chain in their Agro Economics. Many of the Agro Produces are in perishable nature, and if it is not transported in proper time all investment will be lost so 1st solution is breaking the Land Lock. For opening a cargo airport no need to make new port, in UP and Bihar. At many places, airport and runway are available. We just need to look into this and make use of them for Agro Cargo Transportation.

Connecting Agro Cargo Airport with Railway Station (Railway Port)

A connection network should be established between all cargo airport and railway station of UP & Bihar. As all we know that UP & Bihar is having very rich rail network even in remote area. Railway has very good amount of Land Bank. If Railway uses their land bank for warehousing and cold storage at different identified points not only farmer railway can earn good amount of money from this. And from this warehouse or cold storage goods can be transported to Agro Cargo Airport.

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Consolidation of data and Promotion of E-Commerce

Now, if you make cargo airport, connecting it to railway station and making storing facility at stations is no use until and unless nation and world does not know what the thing is available and where. Hence, a consolidated database is required of all crops and produces available there so that this can be well connected to the Global Market. Start-up companies in E-Commerce must be promoted so that they can attract and use the Infra facility of Airport and Railway Stations and Highways.

Establishing Agro Park & Food Park

Government as well as private sector should think over the establishment of Agro & food Park here in UP & Bihar as Worlds Best 5 Resources except money is here. Money is movable item which can be flown any where while other five are local items. Brain and Labor force will be more productive if they got job nearby to their family and social harmony and balance will be established which is major factor for any industrial growth. For establishing Agro Park 1st requirement is suppliers which Agro Park will get just on door, second requirement is customer which is well known in the market. There is 700 Crores population and per day 4900 crores time consumption, we need just to hit the eye. Hence market is not a problem, problem is reach to the market which can be possible by railway network, storage network, cargo airport and E-Commerce intervention in to this. Getting fund for Agro Park will be easy FDI & PE can be introduced in to this if Government facilitate.

SPV formation

For establishing Cargo Airport, Railway Port (Warehouse and Cold Storage at Railway Station), Agro Park government and other institutions can form SPV in this regard and get easy funding and investment into this. This will help fasten the process. For Example following type of SPV can be formed.

1. SPV For Government Facilitation/Single Window
2. SPV/PPP for Supply Chain Establishment
3. SPV/PPP for Agro Cargo Airport
4. SPV/PPP for Agro Park
5. SPV/PPP for Transport Facilitation
6. Committee of Experts, Citizen and govt to monitor the Project
7. Cooperative Society for Farming

Tax Holiday Zone

Government should declare tax Holiday Zone for 10 years from all taxes if they are engaged in Agro Park, Agro Airport or Railway Port or any activities which is incidental and ancillary to this. Main Agriculture income is already exempt from tax.

Other Industry Development

Agro Park+ Agro Airport + Railway Port will create more subsidiary industry nearby as well as more business activities nearby. Some of the examples are below

• Food Processing Main & By Product • Dairy Main & By Product • Transport • Packaging • Warehousing	• Supply Chain • Trading • Hotel & Tourism • Education • ITI
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Branding of Local Famous Items will reach at its best price

As you know today time is time of branding. There are many famous items loved by the people living across the world. Some examples are as below.

• Fresh Flower • Organic Fresh Vegetables • Famous Mango • Malihabadi & Desi Mango of Lucknow Nearby • Banarsi, Langada, Kapuri, Gavarjit/ Jarda & Other Mango • Guava of Allahabad • Amla of Pratapgarh • Magahi Paan of Banaras • Faizabadi Banda & Seeds • Mooli (Radish) of Jaunpur	• Sugar & Sugar Cane Other Products • Banana of Barabanki & Sultanpur • Kala Namak & Other Santed Rice of Maharajganj & Siddharthnagar • Dairy Products • Lichi of Mujaffarnagar • Anandi Rice of Mujaffarnagar • Potato & Their Other Processed Product • Medical Plants • Other Agricultural & Their Processed Product • Sweet Fish of River
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If these items are made available even across the border their lover will loot this. Now the time is ripe to make this available to the relevant market, make customer happy and make farmer happy as well as make government happy. This will be the ultimate goal of Agro Economics.

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A Wake Up Call

Today, we live in a world of over 7 billion or 700 crore people. The world population is expected to reach the figure of 9 billion by 2042. Compare this with the world of 10,000 B.C., or 12000 years ago, just a wink of an eye in geological terms. The human race consisted of no more than 10 million or 1 crore, souls then. They were all hunter gatherers; they hunted animals and gathered wild plants for their subsistence. They drank from streams and water holes and definitely knew how to keep these sources free of pollution and human waste. Water is the basis of life and they knew it. Humans worshipped nature - the nature they were dependant on for their survival. Animism, this ancient form of nature worship, is the oldest religion known to mankind.

The topography of the earth was much as it is today. The human races were distributed in a way that would not change much until 1500 AD - the Mongoloid peoples lived in eastern Asia and in the Americas, the Black races lived south of the Sahara, the aboriginals in Australia and New Guinea and the Caucasoids in Europe, West Asia and North Africa. But the world was changing. The world was changing climatically with the retreat of the ice age, and with global warming. The lush grasslands of North Africa were giving way to the greatest desert on earth - the Sahara.

This article contains generous inputs from information available on the net on the following:

1) WIKIPEDIA

- 2) WATER SUFFICIENCY ON PLANET EARTH FOR ALL
- 3) DRINKING WATER SUFFICIENCY IN 2050
- 4) REVOLUTIONS IN AGRICULTURAL PRACTICES
- 5) ENVIRONMENTAL IMPACTS OF IRRIGATION
- 6) ELECTRICITY GENERATION
- 7) MANUFACTURING IN 100 AD
- 8) THE WORLD IN 10000 BC

And humans were changing too. Their needs were changing with their growing numbers and with the climatic changes all around them. Small bands of hunters gatherers ranged over vast tracts of land. But as the population grew, these people had to improve the productivity of their land. This improvement in productivity came about with the introduction of farming. In the Middle East, cereals such as emmer and barley started to be cultivated. Settlements began to appear around the cultivated areas.

The domestication of wild animals also began. Around 9000 B.C., sheep, goats, pigs and cattle were domesticated and were yielding meat, skins for clothing and milk for additional nutrition. Ploughs appeared and were used to prepare the ground for cultivation. Farming spread to West Asia, Southern Asia, North Africa, Europe and China. By 3500 B.C. most human beings were farmers and would remain so until the 20th century.

This change from the hunter gatherer stage to the

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stage where humans became agriculturists as well as the domestication of wild animals had a great impact on the way water resources were used and managed.

We have seen how man at the hunting gathering stage made use of the natural water resources, without intervening in any way to “manage” or “exploit” or “channelize” them. He needed water mainly for drinking and for washing. With the coming of farming and the settlement of farming areas, man needed to use water differently – for channeling to his farms, for watering his animal stock and for his personal needs. He was “settled” now and water had to be available in all seasons, round the year, at one place. He needed to channel and store water. He needed to protect his farms and his home from floods. Mesopotamia, the “cradle” of civilization and perhaps of agriculture, is a prime example of how human farming communities grew and flourished, became denser than ever before, created large scale irrigation systems and learnt to store water and protect themselves from floods.

Over the next 1000 years these early farming communities grew, acquired sophistication and entered the Bronze Age. Bronze came to be used in weapons and decorations. The demand for bronze led to an expansion of the mining of copper and tin. Long distance trade grew. The demand for water thus underwent a further change. Water, from being the basic of simple needs, became the basic of aided food production and then of manufacture, of trade, of strife even.

Farming came to the Nile valley in 5000 B.C. The lower Nile valley came under a single ruler. Mesopotamia was the only other region to have an urban civilization at this time, under the Sumerians. Life centered on the Nile River and the fertile lands along its banks. Water was harnessed to irrigate fields even in the dry season. Agriculture produced vast surpluses which were used to fund the life styles of the elite, for trade and travel as well as to pay for wars. Tools and artefacts were used not only in agriculture, but in mining, manufacturing, in wars and in social and religious practices as well. The use of water thus got further diversified into non-traditional requirements.

In the Nile delta, the flooding season lasted from

June to September. The people learnt to store the water in tanks and ponds. Farmers irrigated their fields with water from these reservoirs, constructing ditches and canals to transport the water. As the population was growing and social and economic life growing complex, water had to be used in innovative and efficient ways.

If the Egyptian civilization was the gift of the Nile waters, it was the Yellow River, or the Huang-He, along with the Yangtze, that gave birth to the ancient Chinese civilization. The Chinese began farming by 5000 B.C. In the Indus valley farming settlements began around 4000 B.C. By 2600 B.C. towns and cities had been established. In Mohenjo-Daro and Harappa, the houses even had bath rooms and wells. The cities had an elaborate underground drainage system. The decline of this civilization which began in 1800 B.C. is linked to the drying up of the Saraswati River and to a suspected flood that seems to have devastated the area.

The period beginning in about 1000 B.C. saw the rise of the Iron Age. The spread of iron-using technology had a decisive impact on agriculture productivity. The Aryans descended upon India and established their proto-Hindu culture. Around this time, irrigated farming also expanded in North and South America.

Along with the spread of agriculture and agriculture techniques and of stock breeding came the manufacturing techniques in pottery, wood and stone carving, copper and ferrous metallurgy. All these techniques were dependant on a suitable environment, the availability of raw materials, technological skill and above all, water.

The Bronze Age city of Troy which lasted as a city of over 1800 years could not have flourished without water. The city remained under siege for 10 years in around 1300 B.C. One can imagine the important role played by its internal water resources during this time! Water was required not only for keeping alive its residents, but also for its local manufactures, its war “machinery” and its protective moat!

No great settlement of people is possible without water. All the great civilizations of the past were along river valleys – in Mesopotamia along the Tigris and the Euphrates, in Egypt along the Nile, in China along the Huang-He (Yellow) river and in

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India along the Indus river. The Amazon basin of South America saw the rise of agriculture in as early as 6500 B.C. when potatoes, chilies and beans began to be cultivated. The domestication of animals followed. By 2000 B.C. irrigation systems were being developed.

The manufacture of artefacts distinguishes us from all other species. The manufacture of clothing, of pottery, metal objects, stone, bone and wood objects was followed by more complex manufactures such as glass, paper porcelain, ceramics, and then steel, cement, plastics and metallic compounds.

In the year 100 AD, the major empires in the World were the Han, the Kushan, the Parthian and the Roman. Each was dependent on the major rivers that gave rise to it. The world population was still around **20 crore**.

The principle of steam was discovered in around 100 AD in Alexandria but it was not until 1769 that the use of steam power for industry was discovered when James Watt made his great break-through. The first mechanical loom was introduced in 1784 with the help of water and steam power. In 1866 Von Siemens transferred the principle of steam engine to the electricity generator. Mass manufacturing began in 1833 in England with ships' biscuits. Assembly line production began shortly after this. Further "industrial revolutions" took place in the 1960s (with the use of electronic and IT systems that automated production), and at the turn of this Century through the use of cyber-physical systems.

And while these new "revolutions" continue, some ancient as well as old forms of manufacture continue.

What about agricultural practices? How have these evolved?

Revolutions in agricultural practices

We have seen above how agriculture gave rise to sedentary human civilization. The cultivation of plants for food, fiber, bio-fuel, medicine and other products sustains and enhances human life. A remarkable shift in agricultural practices has taken

place in the last century with the development of world markets and in response to new technology. There has been a sharp increase in yields with the use of pesticides and fertilizers and with modern agronomy and plant breeding. This has however caused ecological damage and has had negative effects on human health. Over one third of the world's workers are employed in agriculture and agricultural food production and water management have become global issues fostering debates, disagreements, disputes and worse. Issues crucial to human welfare such as degradation of land and water resources, including aquifers, have arisen. The effects of global warming on agriculture are not even properly understood. In the past century agriculture, especially in the developed world, has been characterized by enhanced productivity and by the use of synthetic fertilizers and pesticides. A range of political issues has arisen such as water pollution, bio fuels, genetically modified organisms, tariffs, farm subsidies and the sharing of river waters. There has also been a backlash, against the negative effects of modern agriculture, in the form of sustainable and organic agriculture movements. In recent years, climate change, population growth, incentives for non-food bio-fuel crops and the overdevelopment of farm land has caused food shortages, and sometimes even riots, in Asia, the Middle East, Africa and Mexico.

The generation of electricity came with its discovery in the early 1800s by the British Scientist Michael Faraday. And electricity has been generated in central stations since 1882. The first power stations were run on water power or on coal. Today, they rely mainly on coal, natural gas, water, petroleum, wind and nuclear energy. Small amounts of electricity are generated from solar energy, tidal power and geothermal sources. Water driven turbines generate approximately 16% of the world's electricity. Thermal power plants are also water dependent and account for 40% of all electricity generated.

Altering the Earth's eco system

The Earth's ecosystem has been, and is being, transformed by man by his constant use of the land to yield goods and services. This is eroding the Earth's bio diversity as well. Constant and increasing use of the land leads to its degradation

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through deforestation, desertification, soil erosion, mineral depletion and chemical degradation.

70% of freshwater sources are being drawn for agriculture, which also makes major demands on water from aquifers. Aquifers in areas as diverse as Northern China, Northern India and Western USA are losing water at an unsustainable rate. This problem has extended itself into Iran, Mexico and Saudi Arabia. Just like agriculture, industry and urban areas are putting pressure on water sources. The availability of clean water is being stretched not just due to the increasing demands on it, but also due to pollution of water sources by agriculture, industry and the household sector (civic requirements).

In addition to increasing demands on water and the pollution of water sources, climate change is also impacting the availability of water. Extreme events, such as droughts and floods are expected to increase. Does the Earth have enough water to continue with current farming practices? Does the Earth have enough water to sustain the rising population that is expected to touch 9 Billion by 2042? And does the Earth have enough water to sustain the rising living standards aspired to by people all over the globe? These are some of the questions addressed below in the context of the three sectors that are the major consumers of water: agriculture, industry (including electricity generation) and household (including drinking and live stock requirements).

The requirement of water by the Agriculture Sector in 2030-2050.

A paper (ESA working Paper No. 12-03, June 2012) prepared by an FAO team in 2012 has argued that at the global level there “should be no major constraints to increasing agricultural produce by the amounts required to satisfy the additional demand generated by population and income growth to 2050”.

However, the paper also argues that there is “no guarantee” that “such increases in agricultural produce will be forthcoming”. If such increases have to come there will have to be necessary investments made and the “right policies will have to be followed providing incentives to farmers,

particularly in countries whose food demand must primarily be satisfied by domestic production”.

An increase in food production can come from a) an increase in the available cultivated land area and b) an increase in food productivity. Land and water are finite natural resources. The scarcity of land and water for food production is compounded by the increasing demands of urbanization, industrialization and bio fuel production.

Will the freshwater sources of our planet be sufficient to satisfy the growing needs of agriculture and non-agriculture users?

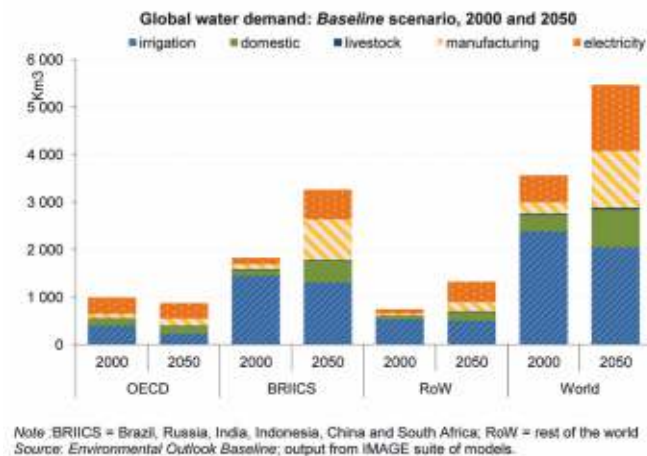
The 2030 Water Resources Group, formed in 2008, consisting of a number of organizations from the private and social sectors had put together a report regarding a strategy to be followed to achieve water resource security. This attempt was the outcome of a mission set out at the Second World Water Forum at The Hague in 2000 : “To make water everybody’s business”, in the words of HRH the Prince of Orange, Chairman of the U.N. Secretary – General’s Advisory Board on Water and Sanitation. The report has come to the conclusion that the ever increasing water demand of our growing population and economy, “combined with the impacts of climate change, are already making water scarcity a reality in many parts of the world”. There has been severe damage to livelihoods, human health and ecosystems. By the end of the next 20 years the demand for water will be 40% higher than today and more than 50% higher in the most rapidly developing countries.

Demand pressures on water include population growth, urban growth, domestic and industrial water usage and a change towards water intensive diets as people become increasingly better off. Climate change plays an important role; agriculture demands more water and so does reservoir replenishment. If the future has to be sustained, we will have to achieve a reversal of current trends in each category. Taking into consideration today’s accelerated pace of human development and the slow pace of handling issues related to water, the crisis is already at our door step.

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I have been looking at estimates made by various organizations of the World's water requirements in 2050 and its availability.

The OECD Environmental Outlook to 2050 has predicted the following scenario



However very exact quantifications are difficult to find. I would however like to quote from the 2010 Global Food and Water Research Crisis Programme Round Table * findings which answered questions such as : a) How will the quantity of water required change between now and 2050? b) What existing and new water sources are likely to be available over the next 40 years? c) What are the implications of water shortfalls? The Round Table concludes that by 2050 there will be a “gap” between the supply and demand for water at the macro level. How large the gap is likely to be is difficult to estimate. Geographically, the gap will be large in some regions, while water surpluses will still continue to exist in some areas. “Nevertheless, water scarcity is already shaping up as the greatest challenge facing many nations”. The water “gap” is estimated to be 3000 Cu km of water a year.

So, where is that water going to come from? It is evident that we, the thinking humans, will have to go through a transformation in the way we think about water and the way we make use of water. The agriculture sector will face the greatest difficulties; it will have to come up with water saving systems and techniques, prevent the leeching of pollutants into water ways and water storages and prevent the inflow of Pollutants. The domestic sector, which is the biggest polluter of

water and water ways, will have to take stringent action on a number of fronts : water use in the urban and the semi urban areas will have to be strictly maintained within prescribed norms. Used water will have to be fully treated before it mingles with streams and water ways or soaks into underground reservoirs. The industrial sector will similarly have to economize on water use and stop the outflow of effluents and harmful chemicals and pollutants.

The education of all stake holders is of the utmost importance, both on the demand side and the supply side. Technological breakthroughs are certainly being achieved, but these can be effective only if social, economic, environmental and governance issues are properly brought to bear on them. While water availability is determined by the climate, there is certainly scope to change people's behavior and the way people respond to the challenge posed by the increasing water demand.

Critical Issues

While accepting as a fact that the future scenario cannot be predicted with any great degree of certainty on account of multiple factors including climate change and technological advancements, I would like to flag the following issues as critical to our handling of water issues:

- 1) A strict adherence to water norms (quotas) for urban use.
- 2) 100% treatment of domestic water released into the environment by urban local bodies, gram panchayats and individual households, so that used water is rendered non-toxic to the environment and to life.
- 3) The proper pricing of water for domestic use. The pricing should take into account not only the cost of supply but the cost of treatment post-use also.
- 4) The volumetric supply of water for all agricultural purposes.
- 5) Again, the proper pricing of water for agriculture.

* This was set up in 2000 under Future Directions International, an independent, not-for-profit research institute based in Perth, Western Australia.

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6) The strict control of the quality of water released after irrigation of crops and plants.

7) The proper pricing of water supplied to industry.

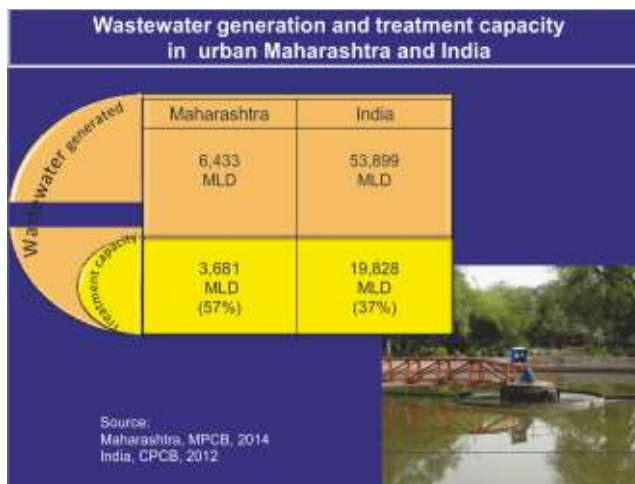
8) 100% treatment of all industrial effluents.

I would like to add here a few remarks on the water scenario in Maharashtra State and the issues requiring the most urgent attention of the stake holders.

The way we treat our waterways, our sources of water and the callous attitude we display towards the sanctity of water will have the most distressing effect on our future generations. Statistics are all very well, and it is one thing to argue that water by volume will probably serve us well until, 2015 if used “efficiently” and “economically”. But the point I would like to stress most of all is that unless the quality of that water is of the required standard, the future of our coming generations does not look too rosy.

A report prepared by the Central Pollution Control Board(CPCB), Ministry of Environment, Forests & Climate Change, Govt. of India, in February 2015, lists the river stretches for restoration of water quality. The CPCB is monitoring 445 rivers in 29 States and 6 Union Territories. They have identified 302 polluted river stretches on 275 rivers and have classified them as Priority Class I to Priority Class IV, Priority I being the worst polluted. It will be seen from this report that Maharashtra has the highest number of cities and towns, that is 161, along polluted river stretches. The Water Quality of rivers in Maharashtra was measured at 156 locations on 49 rivers and out of these 156 locations, 153 locations were non-compliant with Water Quality Criteria with respect to BOD. The polluted rivers includes the Wena, Wainganga, Godavari, Bhima, Krishna, Ulhas, Tapi, Panchganga, Nira, Bhatsa, Indrayani, Kanhan, Koyna, Mula –Mutha, Ghod, Amravati, Darna, Vel, Penganga, Purna, Savitri, Wardha, Venna etc., These rivers have been classified by CPCB in different Priorities based on the level of BOD.

The rivers of Maharashtra State were protected by Govt. in the Environment Dept, under G.R. No. 326



of 15.07.2000. According to the G.R., the flanks of the rivers in all 20 river basins/sub-basins were divided into A1, A2, A3 and A4 categories. The G.R. had specified as to what activities could or could not be carried out in these zones. This was an excellent G.R. targeted at the preservation of river water from being polluted. Unfortunately, this G.R.s has been withdrawn by Govt. on 3.2.2015.

Similarly, a G.R. No.325 of 13.7.2009 had again identified a large number of river stretches and provided for their preservation from pollution and degradation. This G.R. too has been withdrawn under a Circular of 3.2.2015 by Govt.

Given above is a statement of sewage generated in Maharashtra ULBs and sewage treatment facilities set up. The sewage actually treated is much less than the capacity set up.

The facts given above regarding the generation of sewage and its treatment plus generation of effluents and a lack of attention to solid waste management pose serious questions for the future of our water sustainability.

I leave the reader to draw his conclusions and to decide how best each one of us can strive to ensure that at the least the world we leave to our children is no worse than the one we inherited.

Dr. Chitkala Zutshi, IAS
Member (Eco),
MWRRA

Prioritising Nutrition in the Tribal Development Agenda

There are 104 million tribal people in India consisting of nearly 700 distinct ethnic groups, which represent 8.6% of India's population, but account for almost 16% of the poor. The majority of them live in rural areas, many practising traditional agriculture and often dependent on forest produce for their living. The remoteness of their areas of habitation seriously limit their access to government and other mainstream services for health, sanitation, education and livelihoods.

Understanding malnutrition and its impact

India's tribal communities continue to be among the most nutritionally deprived social groups in the country with 54% below five years of age estimated to be stunted¹, a mark of chronic under-nutrition which adversely impacts the development of body and brain² and has profound, irreversible and life-long consequences. Not only is the stunted child less tall, but also more likely to fall ill- and at a heightened risk of death- because of low immunity, unhygienic living conditions as well as poor access to health services, especially in tribal communities. Early and chronic malnutrition is also known to impact brain development adversely which cause the tribal children and youth to fall behind in studies and later at work. The cycle of malnutrition sets in from the time an under- weight, under nourished, and often under-age woman becomes pregnant. Such a mother usually gives birth to under-weight children who start their lives with a disadvantage. Studies now show that those who have suffered from childhood malnutrition are at a greater risk of nutrition related chronic illnesses as well such as diabetes, obesity and hypertension. In brief, the impact of childhood stunting has lifelong implications.

If tribal communities have to become part of the development story of India- and not be left behind- their food and nutrition needs have to be understood and addressed from early childhood, or before.

Factors that make malnutrition a multi-dimensional challenge

There are several universal factors of malnutrition such as limited access to adequate food; early age of marriage; under nourished , young mothers and resultant poor nutrition status right from the womb; inadequate feeding to support rapid growth and development in infancy and early childhood, frequent infections due to unhealthy environments and poor access to essential health services.

Specific to tribal communities, additional factors include laws and policies that limit their access to forest produce; change in feeding habits from millets which are rich in micronutrients and minerals to the rice- wheat diet promoted through the Public Distribution System; lack of adequate livelihoods options for the tribal communities to enhance their family income and live better quality life as well as the lack of awareness about proper nutrition available in their natural habitat. Various factors have pushed tribal groups onto increasingly degraded land, thus making their survival a constant struggle. At the same time, the tribal areas have been starved of the social and physical infrastructure necessary for their participation in the country's growing economy. All of these directly or indirectly also contribute to household poverty which is a key determinant of severe stunting in tribal children.

Much is being done

Emerging economies such as Thailand, Brazil and China have demonstrated that child under-nutrition can be drastically reduced.³ China reduced child under-nutrition by 68% (from 25% to 8%) between 1990 and 2002 and Vietnam, a country poorer than India, has seen a reduction in underweight children from 41% in 1996 to 25% in 2006. It is, therefore, evident that nutrition improvement at a national scale is possible.⁴ However, economic growth does not naturally translate into improved nutrition status, much less among the poor, marginalised and remote populations such as the tribal communities. This

¹ NFHS 3 data / ² Stunting is defined using the mean height-for-age Z (HAZ) score where stunting = HAZ < -2SD and severe stunting = HAZ < -3SD. / ³ http://www.india-seminar.com/2014/661/661_n_c_saxena.htm accessed on 3.06.2015

⁴ http://www.india-seminar.com/2014/661/661_n_c_saxena.htm accessed on 3.06.2015

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aspect is well recognised by the government as well as other stakeholders.

To begin with, it must be noted that even India's constitutional provisions and legislations protect the rights of scheduled tribes to good nutrition. Eg. Articles 11, 21, 39, 46, 47, 243(d), 275(1), 330 to 342 and 366(25) of the Constitution protect the rights of scheduled tribes to good nutrition, directly and through its determinants such as food, land, livelihood, etc. Article 244(1) and 244(2) of Schedule V of the Constitution provides for assistance in nine states which have a preponderance of scheduled tribes and protect their administrative autonomy in tribal majority states. The Panchayats (Extension to Scheduled Areas) Act (PESA), 1996, gives power to tribal communities to protect, manage and control their land, forest and natural resources. However, policy implementation is poor and awareness about their rights is limited among the tribal communities. For example, policies relating to minor forest produce (MFP) are often dictated by a desire to maximize state revenues, and not the welfare of gatherers, who are often tribal women. Many of these edible forest produce have high nutritive value and traditionally were a key source of micronutrient and minerals for the tribals.

Government ensures that budget does not adversely impact nutrition programming for scheduled tribes in the country. The annual budget for every state plan and for 28 central ministries apportion funds to a separate tribal sub-plan (TSP), which is usually proportionate to the scheduled tribe population in the respective states. The Ministry of Tribal Affairs (MoTA) under the Special Central Assistance to TSP and Grant under Article 275(1) of the Constitution also provides top-up funds to states under the TSP. However, most TSP budget items are focused on infrastructure and miss out on softer components, such as basic outreach services. On the other hand, the TSP infrastructure budget also remains untapped whereas they could be effectively used for establishing Primary Health Centres and Nutrition Rehabilitation Centres, or for providing crèches and toilets in remote tribal areas.

Additionally, several states have taken special initiatives to improve nutrition among tribal children. Some ministries have relaxed population norms in tribal pockets for various schemes related to nutrition, health, water,

sanitation, food security and poverty alleviation. Mobile outreach services and free on-call referral transport services cover underserved tribal areas, and monetary and non-monetary incentives are provided to health personnel serving in remote tribal areas. Tribal communities in food insecure, drought prone hot spot zones also benefit from village grain banks. However, remote tribal hamlets with poor road and transport connectivity make outreach and field monitoring challenging, which worsen in situations of civil strife.

Apart from poor utilization of funds, tribals have also suffered because of the poor quality of governance in their areas which is often reflected in the form of shortage of skilled human resource, high staff turnover and absenteeism, which worsens in areas of conflict. Models of good practice have also been evolved by a number of development partners.

Several promising practices have evolved over the years; these include hot cooked meals and nutrition promotion for pregnant tribal women by self-help groups and frontline workers (Andhra Pradesh), tag-tracking underweight tribal children by frontline workers and following them through extra home visits (Chhattisgarh), crèches for children aged 6-36 months (Maharashtra and Chhattisgarh), cash transfer for using primary health services (Maharashtra), partnership with service non-governmental organizations for service delivery in conflict areas (Chhattisgarh), social mobilization (Andhra Pradesh and Odisha) and setting up nutrition rehabilitation centres (Jharkhand).

Community involvement to generate demand and participate in improving access to services is an inherent component of NGO based programmes. However, the number and geographical coverage of NGOs working on nutrition issues in tribal areas are limited.

International Fund for Agricultural Development (IFAD): a partner in response

Support for tribal development has been a notable feature and a core element of IFAD's country programme⁵. Over the past 35 years, IFAD has established a reputation in India as one of the rare International Financing Institutions which prioritises tribal development. IFAD supports projects that help shape agriculture and food systems in ways that improve the nutrition, incomes and productivity of smallholders and the

⁵ IFAD is an international financial institution and a specialized United Nations agency dedicated to enabling poor rural people to improve their food and nutrition security and escape poverty. The Fund provides low-interest loans and grants to developing countries to finance innovative agricultural and rural development projects.

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rural poor. Of course, other sectors have roles to play, but good nutrition begins with food and agriculture. By affecting food systems as a whole, these efforts benefit the entire population. Improving the livelihoods of the rural poor is at the heart of IFAD's work, and maximizing agriculture's contribution to improving nutrition is an essential part of that mission.

The core of IFAD's tribal development initiatives is to empower tribal communities to plan for themselves and take decisions on their priority needs. Successful interventions start with the formation of groups such as self-help groups (SHGs); natural resource management groups that focus on forest and fisheries conservation; and village development committees set up to prepare village development plans and determine the use of community-driven development grants for social and economic infrastructure. IFAD's institutional model of building partnerships between government set-up and local NGOs for high quality last mile delivery has been particularly important in ensuring the effectiveness of these different approaches.

IFAD's work brings the benefits of agriculture to bear on the problem of malnutrition. In addressing malnutrition, agriculture's essential and singular role is to ensure that diverse, nutritious foods, adequate to meet the needs of people of all ages, are available and accessible at all times, either from the market or from farmers' own production. Traditionally, agricultural interventions have focused on increasing food production and raising incomes to reduce malnutrition, hunger and poverty. Although this remains part of a valid approach, it is now recognized that higher levels of ⁶production and income alone have limited impact on improving nutrition. A more comprehensive approach is necessary to optimize agriculture's contribution to good nutrition and make agriculture nutrition sensitive. Such an approach identifies constraints and opportunities to leverage agriculture for better nutrition throughout a 'food system', without detracting from the agricultural sector's conventional goals.

For example, certain targeted actions can promote the availability, accessibility and consumption of nutritious foods for the tribal communities, such as by increasing the nutritional value of the foods themselves. Increases in production and productivity can raise incomes, which can be used to purchase food.

Biofortification and improvements in soil health can raise the nutrient value of crops, as can better storage, preservation and processing. Improved production, processing or marketing efficiency, as well as reduction of waste, can reduce the relative prices or the amount of time it takes to prepare more nutritious foods, making them more attractive as part of the diet. Diversification of production can be achieved through adoption of new crops or new production systems. Agricultural technologies and production systems can increase the diversity and nutritional value of production.

Many such efforts are currently underway across the world. More recently, in the state of Odisha IFAD is in the process of finalising a partnership with the government to improve the overall situation of the Particularly Vulnerable Tribal Groups (PTGs), with an emphasis on improving their nutrition situation through promotion of nutrition sensitive agriculture, among other strategies.

<i>Statewise data</i>	Children 0-59 months, with stunting (%)	Children 0-59 months, who are underweight (%)	Children 6-59 months, who are anaemic (%)	Children 6-23 months fed min. accepted diet (%)
<i>Andhra Pradesh</i>	54.8	47.6	49.2	0
<i>Chhattisgarh</i>	53	53.4	55.1	5.4
<i>Gujarat</i>	60	64	61	4.4
<i>Jharkhand</i>	56.1	65.8	49.6	2.6
<i>M.P.</i>	56.2	71.4	57.7	2.8
<i>Maharashtra</i>	61.6	61	46.9	3
<i>Odisha</i>	58.3	54.9	52.2	4.8
<i>Rajasthan</i>	48.8	47.9	52.8	4.8

The state of tribal children- key nutrition related indicators (NFHS 3 data)

As under-nutrition and malnutrition are the result of a complex web of diverse factors, the response must also be multi-dimensional. To begin with, a three pronged strategy could be considered, namely, helping tribal households to diversify their incomes so that they are better equipped to deal with "hunger" days; providing access to nutritious and adequate food including supplements in the form of hot cooked meals especially to expectant and lactating mothers and infants; and providing nutrition education by making tribal families and youth aware of the nutrition available in their natural habitat. There is untapped scope of mainstreaming nutrition issues

⁶http://www.ifad.org/pub/thematic/nutrition/nutrition_e_web.pdf

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through the livelihood promotion thrift and credit networks, which have huge penetration in the tribal areas. Given that the causes of malnutrition cut across sectors, multisectoral action is essential. Agriculture must partner with other sectors, particularly health, water and sanitation, and education. But there also needs to be convergence; actions in various sectors must take place in a coordinated way so they arrive at the same place at the same time, keeping the tribal household at the centre.

Malnutrition blights lives and undercuts social and economic development. Children who are chronically malnourished in the critical first thousand days beginning at conception can suffer irreversible damage to their physical and mental development. Over their lifetimes, malnourished individuals may end up earning 10 per cent less than well-nourished ones. Good nutrition is thus not just an outcome of economic growth and social development but an essential input as well.

Investing in nutrition through agriculture is more than a social good. It is sound development policy and good economics.⁷

It is well accepted that children the world over have the same growth and development potential. Society, therefore, has a moral obligation to support every child to realize his/her full development potential.

Meera Mishra,
Country Co-ordinator
International Fund for Agricultural Development,
India

⁷ http://www.ifad.org/pub/thematic/nutrition/nutrition_e_web.pdf



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Take a Step Forward with Technology: KisanServ is a Platform like None Before

The days of the Mandi (wholesale market) will be one of the past soon. KisanServ is the step forward that Indian market has been waiting for. It will serve as an answer to all troubles any buyer or supplier has ever had till date in the procurement process. The KisanServ platform is an online replication of the mandi where a buyer and seller can conduct business in the comfort of their home or office. But of course the core feature of this platform lies in its transparency. Apart from connecting a buyer with a seller, the platform provides open channels of communication between the concerned parties. The entire transaction process can be kept clean and tamper proof. This enables suppliers and buyers to sell and procure goods at fair prices and desired quality keeping the middlemen out. The motto of KisanServ is all about making procurement easy!

Food technology has come alive with activity in the last few years. Many platforms have added new features to improve the user experience. KisanServ is definitely a unique addition to this list as it addresses as a solution for the B2B business needs. Anyone in the procurement business today knows that “Well bought produce is already half sold”. The procurement team in a company is crucial. This team keeps the balls rolling and the business a success.

All of the organisations in business today, understand the importance of procurement and they have put in place a number of steps to ensure a good procurement system in their organization. They have in their procurement department a big team in place with different levels and hierarchy, so that they find suitable suppliers. This is also to ensure that they function with better coordination, among themselves and the suppliers. Many companies have put in place a rather high-end software to keep track of their buying. While these initiatives have helped, the organizations and different monitoring activities have been done. There is still lack of transparency in the system and in most situations, it doesn't encourage competition or price advantage.

Human interference becomes a necessity in the buying cycle, to influence the pricing and supplier selection.

Here are a few points that need to be presented, to get a full understanding of KisanServ and why it came to be.

The way the current system works

The existing procurement system is rather heavily dependent on the human touch. People from procurement department identify the suppliers, meet with them and if they like the supplier, enrol them as a registered supplier in the company. This raises more questions instead of presenting answers about the whole selection process. There is obvious chance and a rather high possibility of bias and vested interests setting roots into the supplier selection process. One is left questioning the criteria on which a particular supplier has been selected and whether in reality, a competitive selection process was put in place at all. This also gives rise to cartelization or collusion by suppliers who have been registered.

Take a step back and observe, the one lesson you learn from the market is that competition breeds quality. When the buyer is presented with more options, it is obvious the prices quoted will be more competitive and the goods will be of better quality. A Limited supplier base gives rise to cartelization or collusion. The buyer is clearly placed in a confined position because of the limited options and the supplier knows that the buyer is dependent on them. This gives them edge over the buyer, putting them in a position where they can control the prices to larger extent than they normally could have. So how does the current system encourage competitiveness among its registered suppliers as well as maintain a competitive edge vis-à-vis its business competitors?

Consider this scenario, there are a group of suppliers in the market who are big, influential and

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use various ways (legitimate and illegitimate) to keep the buyers happy and in return the buyers favour them by giving the company's purchase requirement. The buyer's team representative also has the power to justify his decision by making other suppliers' quote non-competitive. On the other hand, there is another group of suppliers who have the ability to supply at a better price and quality but they do not have direct approach to the decision maker or they do not know how to approach the right person. Their voices go unheard as they do not have any intermediary who can take their voice to the right person.

The pain point

Transparency. That is what this entire system is lacking. The lack of the means to track and understand how and why a particular supplier has been chosen is a drawback that the decision-making team faces on a daily basis. The big companies are forced to rely on people. In quite a few cases, this has resulted in abuse of power. Cutbacks to the intermediary has become a norm. Businesses find it hard to analyse if the price they are paying is the price of the market or the price set by an individual. Individuals find it hard to make any head way towards being noticed by the decision makers without a middleman in play. The current situation is beneficial for none other than the middleman and the middleman alone.

Why do we need a procurement platform today?

KisanServ platform enables the suppliers (big or small) to take their voice directly to the decision makers table. No one can influence the pricing and supplier selection, it will be purely on merit i.e. quality, price and performance rating of the supplier. Any supplier can bid on buyer's purchase order, which will be directly recorded in the system. So next time if a buyer selects any wrong supplier or favour any supplier then he/she could be asked to provide the legitimate reasons. It brings efficiency and transparency in the system. There cannot be cartelization of suppliers as a large number of suppliers will be bidding, irrespective of the size, which almost makes it impossible for the suppliers to form a cartel thus ensuring the best price and quality to the buyer. In the words of the founders of KisanServ Mr.

Niranjan Sharma, Mr. Praveen Tiwary, and Mr. Arun Kumar, "KisanServ gives a buyer freedom from the grappling for suppliers at a Mandi every day and the limitation of having only a registered set of suppliers. Once you partner with KisanServ all you need to do is raise an indent and let the live bidding system work its magic. Even the Kisan can benefit from this simply by texting their supplies on a specific number so that a supplier could have access to this information."

KisanServ is the first of a kind platform in the world. Here are some reasons on why it is going to be answer that addresses all the pain points of the system.

Live bidding system

Both buyers and suppliers receive their own-tagged credentials to log on to the platform. When a buyer has a requirement, he simply logs in from his dashboard and raises an indent. An indent is like a procurement form that allows the buyer to fill in the details of his requirements and what quality he is expecting from his products. Once this is confirmed, a buyer can then open the indent to live bidding for a specific period. The buyer also has the freedom to dictate whether he wants his indent to be open to local, national, or global suppliers. As soon as the bid goes live, all the suppliers get a text message alerting them of an open indent. This is how it makes the procurement easy.

The stand out point and its value addition

First and foremost, this platform awards a level of transparency that has never been seen before in the supply chain. One of the main aims behind setting up this platform is to slowly but steadily eliminate the hold that the middlemen have in the procurement process. It is time to take away the control of the pricing from the middlemen and place it in the hand of the markets.

The platform provides the user with a dashboard that allows them to only place new indents but also view indents that have been placed in the past. It keeps records of the quotes that were placed for each indent and highlights the ones that were finally chosen. This can be done from

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anywhere in the country or the world. If the decision maker wants to review, the purchase orders made so far, all that is needed at his end is the login information. The choice made by the procurement team or a representative of the team are left open to questioning if the reasoning behind it is unclear at any point in time. This translates to the removal of the power that the middlemen hold in the system.

Other advantages of the platform

Some of the other advantages that this platform brings with it are price advantage, live bidding, user-friendly interface, quality assurance, and convenience. The platform comes with an easy to understand interface which is super easy to work with. The system guides you through everything you need to do in the process and provides all the analytics according to your purchase pattern.

A platform that will change the way everyone in the industry works

This platform is built for convenience. As long as you have the internet, you can access it from anywhere and satisfy your orders as well as requirements. The most difficult and troublesome part of travel and constant mandi visits is completely removed.

How the live bidding contributes to the price advantage

With the live bidding system, all the relevant suppliers get an update indicating an indent and the timeframe within which they can bid their price. The suppliers can place their bids for the indent within the time frame. The process is a much-needed push for suppliers to work towards being competitive and fair. The other advantage that the platform offers is that none of the suppliers can see another supplier's bid. The aspect of collusion is completely cut out due to this. As a buyer, you now have the freedom to choose what price works the best for you. As a supplier, you now have access to so many more orders - local, national, and global.

How the live bidding contributes to competition

The live bidding system ensures that all the

buyers that are eligible to quote on a live bid are intimated of a bid being open. This means that depending on whether you have opened the bid locally, nationally or globally, you have every supplier in the system presenting quotes (depending on the procurement city) and bringing in the element of competition.

This can be especially beneficial in the case of global tenders that have been raised. In a lot of cases, when it comes to exporting goods out of the country, most suppliers simply do not have the means to reach out to a buyer giving the bigger players in the export market a free run on pricing and delivery. This drops the competition levels so low that the buyer is sometimes left stuck with the limited suppliers and whatever quality they have to offer. The live bidding system opens up this avenue to all the suppliers registered, giving a boost to the competition levels for even export orders.

Quality assurance

The first step towards ensuring quality comes with the tender where the buyer sets the standard of the product they want to procure. If these standards are not met, the buyer has the right to reject the delivery. If both parties are looking for further assistance, KisanServ also has a system (at a nominal cost) in place where a third party ensures that the standards are met.

When you put everything together, KisanServ makes it a rather easy task to improve efficiency and productivity.

In Mr. Niranjan Sharma's view for the future of this platform, he says, "We only want for this to be a place for fair trade. We want every single buyer, supplier, and farmer on the platform to grow and prosper. It is time for the wealth to go to those who have put in the hard work and it is time for the companies to not pay more than the fair price."

Mr. Niranjan Sharma
KisanServ

AgriFood Capital in the Northeast Brabant Region of the Netherlands



Following is a write-up on the agriculture and food sector in the Northeast Brabant region, Netherlands by the World Trade Center Eindhoven.

Sowing innovation Harvesting the future

Developing Northeast Brabant into the AgriFood Capital, an excellent AgriFood region with international appeal national attraction and local collaboration; It's ambitious but realistic. The Northeast Brabant AgriFood contains such high quality and is so complete, it is unique in it's kind. At this moment the cluster is already responsible for €1.9 billion in economic added value and 30% of the region's employment.

Unique AgriFood complex

In the DNA of Northeast Brabant lies a deep connection with AgriFood and thus serves as AgriFood Capital, a strong region and the ideal trail for new food related products, technologies, and concepts. Our strategic location provides us with resources from academic centers in Wageningen, Nijmegen, Eindhoven and Tilburg.

Investing and innovating together

Northeast Brabant has a unique ecosystem of companies, governmental authorities and educational institutions that are involved in the production and processing of healthy food for humans and animals. From breeding to fresh produce and in partnership with other sectors like construction, logistics, engineering and healthcare.

The goals of this collaboration are clear:

- Networking and making connections
- Process and programme management
- Facilitating initiatives with co-financing form the Regional Fund
- Public affairs and communication

Sowing innovation Harvesting the future

Broad Partnership

The collaboration is realized as all attached sectors come together with innovations oriented towards the global issues such as sustainability, nutrition, and the health. We achieve our goals by developing innovative products and services, by adapting education to knowledge needs of our industries and by creating room for innovation and expertise centers.

This way we create enterprising activity together.

Regional force

By turning our shared ambitions into tangible projects and programmes, we maintain our position as a leader in the AgriFood domain and make AgriFood Capital the vital, lively center for AgriFood in the world. We will increase our current advantage by creating a challenging environment for both enterprise, investment and study, as well as nice place to live.



To achieve our ambitions of making a Northeast Brabant in 2020 that excels in AgriFood, we have the following 4 programs lines

1. Excellent labour market

In 2020, Northeast Brabant would be an attractive working environment. We have well-trained and well-educated people with a deep-seated sense of craftsmanship and enterprise. Together, we have created 4,000 new jobs within six years. Working towards solutions together

In our labour market programme 5* Northeast Brabant Works!, Partners in business and education work together in order to achieve a balanced labour market that offers good future prospect. Part of their joint ventures include developing education in process engineering, setting up a mobility portal and developing a HRM network.

Multiplying by sharing

Knowledge gains its value from sharing. For example, in the triple helix organisation Ondernemerslift+, we help innovation start-up enterprise to turn their idea's into businesses. With the 'Leadership of tomorrow' talent programme, we surface discovered talent and help it grow. Northeast Brabant embraces its people, who provide ideas and ambition!

2. Strong enterprise

The entire AgriFood chain has deep roots in Northeast Brabant, from plant breeders and fresh producers to the largest retailers and caterers in The Netherlands. There is a close connection to consumers. Organisations that wish to innovate can rely on the expertise of both their follow enterprises and knowledge institutions through the "AgriFood Innovation Engine".

Cross-border

From identifying opportunities to developing strong new products, we see endless opportunities instead of boundaries. We collaborate with the regions around us to ensure that the southeast of The Netherlands had a great attraction to both large and small (agrifood) companies from home and abroad.

At the same time, we are brokers and advocates for causes like attracting capital, finding businesses locations and/or pinpointing the right knowledge and connections.

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Buffalo Meat Export Sector – An Industry of National Importance

Indian buffalo meat exports industry has completed more than four decades, growing from a small activity of sourcing carcasses from the domestic slaughter facilities and processing in the available cold stores maintained for other purposes, to a world class, modern, integrated facilities for export of larger quantities like that of developed countries. Meat exports were about 35,000 tonnes (Rs. 43 crores) in 1986-87 and reached to more than 1,475 thousand tonnes US\$ 4780 million (Rs. 30 thousand crores) in 2014-15. Buffalo meat exports account for 98 per cent of total meat exports while mutton exports are small due to increasing domestic demand and associated higher prices.

If buffalo production has become successful in the country, it is due to the successful organization of dairy, meat export and leather industries, well supported by farmer oriented, government policies in support of their livelihood, nutrition, food security and economic and social development. A continued effort with appropriate developmental programmes is required for sustaining the buffalo production primarily in the interest of the resource poor farmers.

Livestock health status plays a major role in world meat trade. India has a vast and effective veterinary infrastructure to provide good health coverage to livestock. The country has an

Markets

impressive network of veterinary hospitals and dispensaries functioning in the various States of the country. A well developed academic infrastructure produces qualified and trained man-power. It is supported by Veterinary Biologicals, Diagnostics and Research Laboratories.

Livestock health situation in India is good and improving. Naturally fed livestock; no growth promoters used, no hormones used. Great features of the Indian buffalo meat brand!

Male Buffalo Calf Rearing: This is receiving increasing attention from the Government of India, State Governments and the buffalo meat export sector. All these male calves have the potential to grow to an average live body weight 350 kg as around 2 years of their age. Thus we can see Rs. 30 thousand crore worth of male calves grown for 2 to 2.5 years being available every year. This is a large sum to be shared by the resource poor farmers of the country. This contribution to rural development will be monumental considering buffaloes have special merits in roughage utilization and producing nutritionally superior quality milk. Therefore it does not use otherwise usable agricultural resources.

These developed adult male buffalo calves would finally end up getting dressed at APEDA certified meat export houses and thus help India earn appreciable additional valuable foreign currency to the tune of Rs. 45 thousand crores (on present basis). This would also facilitate selection of better buffalo breeding bulls with a large choice for selection.

It is proposed that male buffalo calf rearing should be promoted on a very large scale so that it not only helps 54% of the Indian population which is involved in agrarian activities but helps small and marginal farmers, who are primarily involved in animal husbandry activities, and they will have an alternate source of income, other than that from doing agriculture labour. Rural women will be deeply involved in this activity as they can easily take care of male buffalo calves at home.

In fact, the buffalo meat export sector is gaining a repute as “An Industry of National Importance”.

The meat export sector, is in fact a model for other sectors, not only the agri sector. The buffalo meat export sector, along with aggressively achieving volume growth, has benefited the economy in other ways. Firstly, it generates huge foreign

exchange and since there is no import the entire foreign exchange is net foreign exchange, which is unlikely to be achieved by any other sector.

The buffalo meat export sector is one of the highest “Employment per capita investment industry” and facilitates huge employment / engagement.

It provides employment and engagement both directly and indirectly e.g. employment generated by the leather sector resulting from buffalo hides supplies. It provides meaningful engagement to small land holders and landless rural population in animal husbandry and dairy. Livestock are an important source of livelihood for small land holders and landless and the buffalo meat export sector’s rapid growth benefits this poorest household the most.

Evidence shows that livestock contributes nearly half of the total income of the small holders. Livestock sector also seems to promote gender and social equity. About 60% of the total workers engaged in the livestock sector are women. The participation of women in other activities including agriculture is low compared to that of animal husbandry. Further majority of workers engaged in livestock sector belongs to socially and economically backward communities. Scheduled tribes (ST), Scheduled Castes (SC) and other Backward Castes (OBCs) together constitute about 70 % of the persons employed in livestock sector.”

Since the accent of the sector is on exports and the infrastructure is state of the art, internationally acclaimed and promotes industrialization in rural / semi rural sector. Present day meat export establishments have all the infrastructure facilities and operation practices in place for achieving the required environment status and are certified with relevant standards for this purpose (ISO 9001:2008 for Quality Management, FSSC 22000:2011 for Food Safety Management Systems, ISO 14001:2004 for Environmental Management and OHSAS 18001:2007 for Occupational Health and Safety).

The foremost contribution of the sector is in creating a market for all its co-products, by-products and waste. This itself makes the sector eco friendly and value adding, since there is very little waste, if at all. Everything has a marketable value: the product, all co-products, by-products and processed waste. Contrary to general belief, abattoir operations are increasingly Green.

Organic nature of waste: Though the wastes generated at meat plants are organic in nature and are decomposed easily without any long term effects, their quick disposal is desired for better environment management and ensuring public image of the plant.

All the modern export plants are a source of modern technology. The technologies and economy of scale of operations and practices followed would serve as practical models for the domestic meat sector. Green lawns and appropriate plants are maintained for a clean environment. The modern meat export plants not only fully follow environment management guidelines but their efficient management of environment is highly appreciated.

Important aspect of value addition comes from intimate market knowledge as to which meat cut / offal / co-product / by-product fetches best value in what market and optimising it. e.g. the 16 meat

cuts from a buffalo and the variety of edible offals have different values in different countries. In many countries / regions many cuts and offals are delicacies and fetch a good price. In other countries these are either not consumed and if consumed they are bought at a low price.

Another aspect of value addition comes from going up the value chain e.g. from frozen meat to chilled meat (by vacuum packing the meat in special barrier films) which is closest to fresh meat in the consumer's perspective.

The scope for sustained development and growth of the meat export sector is there for all to see. All stakeholders need to play their respective role with sincerity following the norms / rules / laws applicable.

TEAM AIMLEA

(All India Meat & Livestock Exporters Association)

Application of Digitalisation and E-commerce in Agro and Food sector

It is emerging as the sun of dawn and will encompass every green field in India like wise as the day progresses ahead. The role of Information technology in Indian agriculture and food processing sector is taking firm rooting through the vast network of computers and mobile phones.

E-commerce has already taken the driving seat in policy making and digital India is no more a dream but a reality. Prime Minister Mr. Narendra Modi has the Vision of Digital India, an umbrella programme that seeks to transform India into a digitally-empowered, knowledge economy with a host of initiatives for a synchronized and coordinated engagement of the government and its agencies. The larger initiative is expected to empower the people and extend services better with the use of information technology and its tools. Government is in the process of setting up an online national agriculture market that will provide more options to farmers for selling their produce. The other objective is to bring speedy internet to entire rural India and thus bringing digital facilities and services and digital education to every corner of the country.

With increasing mobile penetration and Internet access in rural areas, applications of e-commerce in the agriculture sector has increased with an issue-based focus with reference to farmers and indian agricultural products.

A closer review reveals that the focus of Digital India vision is on internet based transparent and effective system by maintaining the records of all the activities digitally. This is the need of the hour and future. Hence this activity has been welcomed from every sector of the population.

IT start-ups are providing useful farming-related and process-oriented information through mobile phones. Thus, trying to bridge the gaps in farm retail supply chain, providing farmers with direct market access, besides weather, water and soil management services. Similarly, various trade portals have started showcasing various agro-products and intend to provide a b2c or b2b platform. Through these exchange, on one side Agro producers – farmers have incomes while on the other side there are products and services which fulfill customer's needs.

The challenge in this ever-growing complex economy is how to connect the needs; with the products and services which fulfill them. Digitalization and E-Commerce in Agro and Food sector has provided an effective tool to bridge this gap. Thus the application of information and communications technology (ICT) in agriculture is becoming more and more important.

The buzz word “IT for Indian farmers by Indians” has already taken its own space on the grass root level. With 100 cr mobiles in India the mobile application based management tools have taken a speeding entry through the IT doorway for the farmers in India and daily new mobile apps are being launched for the benefit of the farmers and food industry with focused agro- food-segments. Thus, the e-commerce in Indian agriculture has become the most sought after segment in the country.

The Indian Agro and Food sector is enormous in terms of size, quantification, linguistic barriers and its rural spread. This challenges the penetration, but with the support of government – IT industry; and the availability of required IT and internet infrastructure has given the required momentum to the Digitalization and E-Commerce in Agro and Food sector.

Use of IT and digital technology is being successfully applied in both the phases of the Agro and Food sector, that include pre harvesting processes like crop cultivation, water management, fertilizer application, fertigation, pest management, harvesting, crop produce handling, And post-harvesting Processes like transport of food products, packaging, food preservation, agro product processing to bring value addition, quality management, food safety, food storage, and processed food marketing and sales. The automation of agriculture is now sustainably implemented on the grass root level similarly the applications of information technology in Agro and Food sector is also taking slow but steady roots in India.

The Indian agricultural scene is dominated by numerous Self Help Groups (SHG) spread across India. These Agro and Food producers from SHGs across India lack marketing skills and funds required for marketing which directly affect their growth. In fact their products are in high demand not only within India but also globally. But the SHGs are unable to reach their prospective market. Similarly, the global market which wants these products are unable to reach to these SHGs

ICT in agriculture

E-Agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-Agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (IT) in the rural domain, with a primary focus on agriculture. E-Agriculture is a relatively new term and Indian government fully expects its scope to change and evolve as the understanding of the area grows.

Indian Agriculture contributes to 18.6 per cent of India's GDP, and approximately 59 per cent Indians derive their livelihood from the agricultural sector. Private sector initiatives like contract farming and agro dot coms have commercialized the Indian agricultural sector.

in absence of effective information tool. Market should be made available timely to these SHGs' products and farmers' produce so that they come out of financial uncertainty and instability. Government efforts towards building roads, ships and airports of international standards cover the infrastructure development which are like Hardware solutions to reach to the market, while as the case study on this subject revealed that www.digin.in, a web portal focuses on the e-commerce requirement to connect SHGs and farmers with the market. A classic example of emerging digital Indian E-commerce.

It's a beginning of the Digitalization and E-Commerce era in the Indian Agro and Food sector, supplemented with the cutting edge of the information technology to give the sustainability its striving for. Indian agro and food sector will witness more and more e-commerce applications and mobile app revolutions in days to come. The e-commerce doorway of growth has just emerged for the agro and food producers in India. But still a long long way to go.....

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Harshavardhan Ranade

Founder Director

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"Jain has built its business by improving the livelihoods of 5 million small farmers in India. Based in the country's western Maharashtra state, Jain began selling micro-irrigation systems in 1986, when it recognized that the technology, commonly used in industrial agriculture, could be adapted for local growers, whose tiny land holdings were traditionally watered by rain or blunt flooding techniques. As Jain's "More crop per drop" slogan promised, yields increased dramatically – 50% to 300%, depending on the plant – as did farmers' incomes. And Jain continues to boost in other ways as well: It has introduced more-viable crop varieties and trained farmers on more productive growing techniques, such as high-density planting for mangoes. The Company also branched into solar water pumps (electricity is often scarce on the farm), financing and food processing – for the likes of Coca Cola and Unilever – so that there is a ready market for these farmers' wares. The Company, the world's second-largest seller of drip irrigation systems, now does business in 116 countries."

– Fortune.com, September 1, 2015

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Notes

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Credible Chhattisgarh विश्वसनीय छत्तीसगढ़



Growth Story of Chhattisgarh

- GSDP of Chhattisgarh is estimated at INR 185.06 Thousand Crore (on current prices) which is about \$ 30.84 Billion for the year 2013-14.
- Chhattisgarh is also amongst the only five states who grew higher than National average growth rate during 11th plan period (2007-12).
- Per Capita GSDP in the State has been increasing and has registered more than three-fold growth between 2004-05 and 2013-14.
- Chhattisgarh has accounted for over 14% of the total investment intents of the Country through IEMs since 2010 which is second highest in the Country.
- MOUs worth more than INR 53,000 crores have been signed by the GoCG in the current FY 2015-16.

Focus Sectors

- Automobile and Auto Components
- Engineering and Spares
- Agri Business
- White goods, electronic and electrical consumer goods
- Information Technology and Information Technology supported service industry
- Apparel and Textile
- Gems and jewellery
- Production of liquid fuel/gas/petroleum product from coal
- Defence Manufacturing
- New and Renewable Energy
- Biotechnology



Contact :

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