

AGRICULTURE

The National Agriculture Magazine

TODAY



AGRICULTURE YEAR BOOK 2015



Dear Readers,

It is again that time of the year, while keeping with our tradition; we present to you the latest edition of the Agriculture Today Year Book. The eighth edition of the year book is the result of the unfaltering support, constant encouragement and faith reposed on us by our loyal readers. Our readers have been the reason for the unopposed presence of the magazine, Agriculture Today, in the Indian scene for more than a decade. The magazine, over the years, has become the platform to discuss and debate topics of agricultural relevance.

Agriculture Today Year Book of 2015 features articles penned by the some of the most eminent personalities in Indian agriculture. These articles represent different facets of Indian agriculture, introduce many new concepts and initiatives and also have identified several areas of concern in Indian farming. The year book 2015, has tried to strike a right balance with combination of data, analysis and information.

I would like to thank all the eminent writers for their valuable contributions for the Year Book 2015. Their timely and appropriate contributions were influential in making this year book a reality. I trust that the Year Book will serve as a useful guide and reference to all those related to the agriculture sector, including government officials, policy makers, scientists, agribusiness companies, NGOs, institutions, agri researchers, professionals, planners, students etc. We have lent our best of efforts to create this year book. Nonetheless, there is further scope for improvement which we promise to refine in the next edition of 2016. I request all our esteemed readers to impart their valuable support by sending in comments and suggestions.

I take this opportunity to express our gratitude to Prof. MS Swaminathan, Chairman and all the members of the organizing committee of the Agriculture Leadership Summit 2015 for their valuable guidance. I am also thankful to my colleagues specifically Ms. Anjana Nair, Pinaki Ranjan Dey and Abdul Rehman for their untiring efforts in compiling and editing the Agriculture Year Book 2015.



Dr. MJ Khan

CONTENTS

AGRICULTURE YEAR BOOK 2015

Chief Editor's Corner	1	5. Towards Achieving Self Sufficiency in Pulses	98
Agriculture- International Scenario		– Dr. Aditya Pratap and Dr. N.P. Singh	
1. Global Agricultural Production	8	6. Sectoral strengths, issues and coping up strategies of coconut, arecanut and cocoa in India	104
2. Agriculture Made in Austria: Sustainability and Quality as a Recipe for Success	14	– Dr. V. Krishnakumar, Dr.S.Jayasekhar and Dr.P. Chowdappa	
– Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management			
3. Dutch Partnership with Indian Agriculture	18	Animal Husbandry, Dairy and Fisheries	
– Mr. Alphonsus Stoelinga		1. Overview	112
4. Brazil in Bio-economy	20	2. Indian Livestock: An Asset under Smallholder Production System	116
– Maurício Antônio Lopes		– Dr. R S Gandhi	
5. New Zealand's journey to becoming a world-class, global food producer	22	Agriculture and Indian Economy	
– HE Grahame Morton		1. Overview	124
Food Security - Issues and Strategies		2. NIFTEM's Model of Rural Development	128
1. Achieving the Zero Hunger Target	28	– Dr. Ajit Kumar	
– Prof. M S Swaminathan		3. Strengthening Family Farms - Policy Changes	134
2. Microbial Technologies for Sustainable Agriculture Development and Food Security	34	– Prof. S.K. Patil	
– Dr. K. RAMASAMY		4. Five Events that Transformed Rural India	140
3. Quality Seeds : Harbinger for Second Green Revolution in India	40	– Pawan Malik	
– Dr. S. Rajendra Prasad and Dr. Dinesh K. Agarwal		5. Rural development through Agricultural co-operatives	146
Climate Change and Sustainable Agriculture		– Sudhanshu JANGIR and Vikram Yogi	
1. Climate Change and Agriculture	48	6. Futuristic Frontline Extension for Transforming Indian Agriculture	150
2. Organic Farming	54	– Dr. K. Singh, Dr. P Adhiguru and Dr. R R Burman	
3. ICT-Based Pest Management for Sustainable Agriculture	58	7. Status of Soil Health in India and its Management	156
– Dr. N. Singh Scientist, Dr. A. Birah, Sr. Scientist and Dr. C. Chattopadhyay		– Ashok K Patra and Sanjay Srivastava	
4. Food Intervention Programmes And Policies For Food Security In India	64	8. Extension for Agriculture and Farmers' Welfare	160
– Anjani Kumar and P K Joshi		– Rita Sharma	
5. Horticulture for Food and Nutritional Sustenance and Livelihood Security	68	Rural Credit	
– S.K. Malhotra		1. Overview	164
6. Diversification – The Need for Agricultural Sustainability in Punjab	74	2. ANDHRA BANK - Triumphant on Strategies	170
– Dr. B.S. Dhillon		– Sri D Durga Prasad	
Crops in Focus		Industry	
1. Overview	80	1. Agri Inputs and Agri Industry - Overview	174
2. Horticulture Crop Production in India	85	2. Micro Irrigation - Overview	178
3. Managing Risk in Wheat Production Against Weather Anomalies	90	3. Automation in Plant Nurseries for progressive Horticulture and Floriculture	182
– Dr. Sendhil R, Dr. Karnam Venkatesh and Dr. Indu Sharma		– Amit Shukla	
4. Indian Cumin Cultivation – Prospects and Challenges	94	4. Accelerated Transfer of Agriculture Technology – Some Dhanuka's Initiatives	184
– R K Solanki, Y K Sharma, P N Dubey and Dr. Balraj Singh, Director		– R. G. Agarwal	
		Latest and Major Agriculture R&D Breakthroughs in The World	189
		Status of Commercial GM Crops- World and India	193
		Different Strokes	198



- A broad spectrum fungicide having preventive, curative and eradivative control of the diseases

- Exhibits high Systemic nature due to the balanced Hydrosolubility and Liposolubiltiy features of the molecule



A pride innovation from **Isagro**, Italy



Five million small farmers join us in celebrating this proud moment!



FORTUNE

The world's leading business magazine has released the first ever –

Change the World

A listing of 51 companies that have addressed the world's biggest social & environmental problems

Jain Irrigation Systems, the only Company from India, is ranked No.7

“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, yield 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, August 30, 2015, 5:35 PM EDT

An inspiring and humbling moment in our cherished 52 year journey.

Doing Well By Doing Good

Our mantra since inception



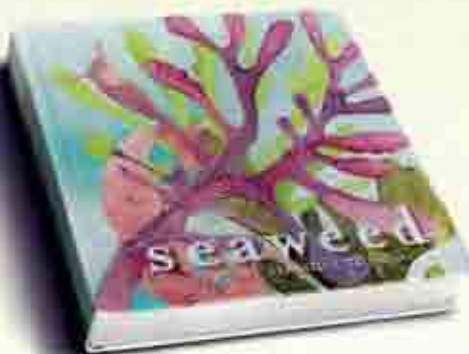


Ensuring Farmer Delight is Our Mission

Every time we put a smile on the farmer's face, we are inspired to do more.



Biostadt is a young, dynamic organization in the business of serving the farming community with innovative Agricultural solutions by pioneering Biotechnology research products, Crop protection Chemicals, High Quality Seeds & Aquaculture inputs.



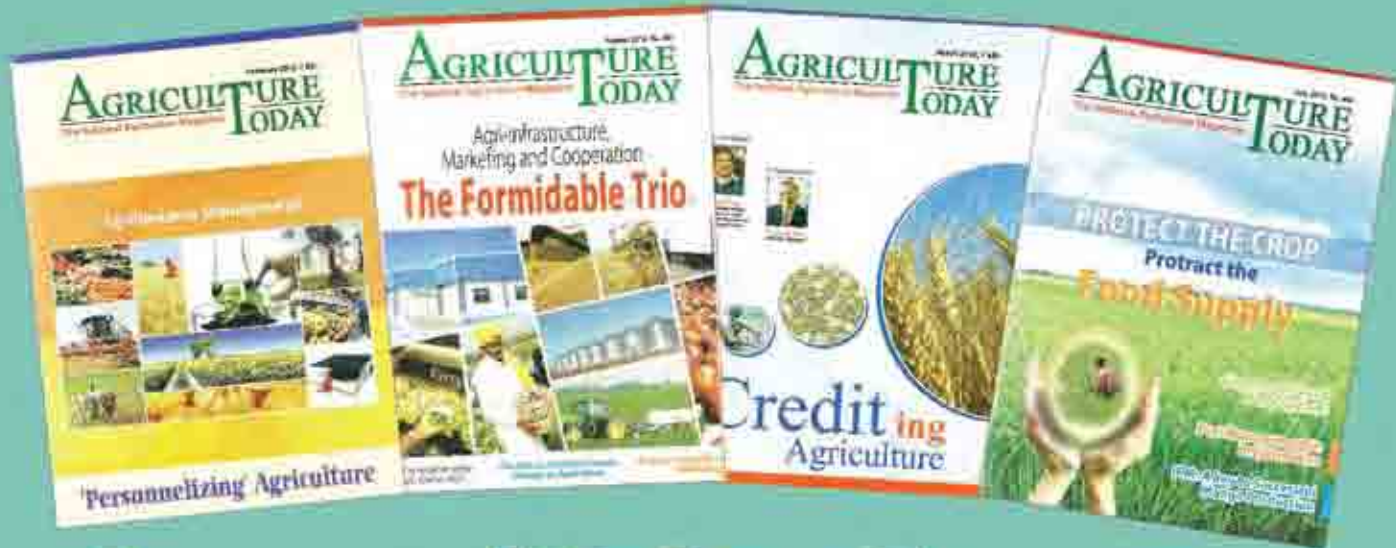
Biostadt introduces coffee-table book on seaweed science.



Biostadt Induced Lactofermentation Technology
A miracle of Agricultural science to prosper
in a smart world.

BIOSTADT
www.biostadt.com

BIOSTADT INDIA LIMITED, 602-A, Poonam Chambers, Dr. A. B. Road, Worli, Mumbai - 400 018.
An ISO 9001:2008 Certified Company An ISO 14001:2004 Standard Company



Incredible Stories

Subscribe today

I would like to subscribe to **Agriculture Today**

Term	Institutions & Library	Individuals	Students
<input type="checkbox"/> One Year	₹800	₹500	₹300
<input type="checkbox"/> Three Years	₹2000	₹1200	₹700
<input type="checkbox"/> Life Membership		₹6000	

I will Pay with

Demand Draft

Cheque

Cash

No.

Bank Draw

Dated

DD should be drawn in favour of Agriculture Today

Name: Ms/Mr:

Organization Name:

City: office:

Ph: (Resi.): Fax:

Mobile No: E-mail:

Terms & Conditions: Rates and offer is valid in India only please allow one weeks time for the delivery of magazine by post. For the subscription related queries please contact: 306 Rohit House Tolstoy Marg, New Delhi- 110001, Ph: 91-11-23353406, 91-11-23731129, E-mail: subscription@agriculturetoday.in,

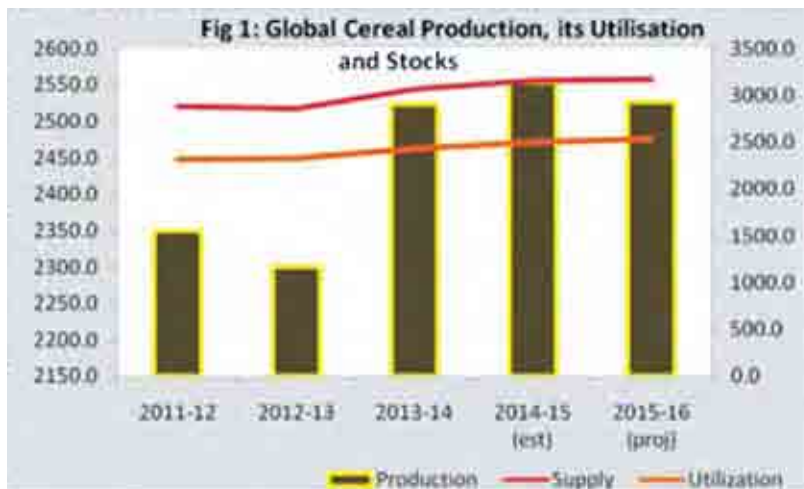
www.agriculturetoday.in

AGRICULTURE TODAY

**AGRICULTURE -
INTERNATIONAL
SCENARIO**

Global Agricultural Production

According to latest report from the Food and Agriculture Organisation, released on 9th July, 2015, the forecast for global cereal production in 2015-16 is 2526.5 million tonnes. This is a marginal 1% lower than the level of estimated cereal production in 2014-15. As shown in Fig 1, from 2011-12 to 2015-16 (forecast figures), the global cereal production has increased by 7.5%, from 2349.6 million tonnes in 2011-12 to 2526.5 million tonnes in 2014-15. During the same period, total utilisation of cereals increased by 9.5%, from 2313.9 million tonnes in 2011-12 to 2534.2. The total supply of cereals globally in 2011-12 and the projected figures of 2015 increased by almost 10%, from 2887.3 million tonnes in 2011-12 to projected 3171.5 million tonnes in 2015-16. The total estimated production of global cereals in 2014-15 increased significantly because of exceptionally high levels achieved by the EU and the Russian Federation. The projected increase in utilisation of cereals from 2014-15 to 2015-16 is based on the expected increased use of maize as feed, especially in Brazil, China and United States.



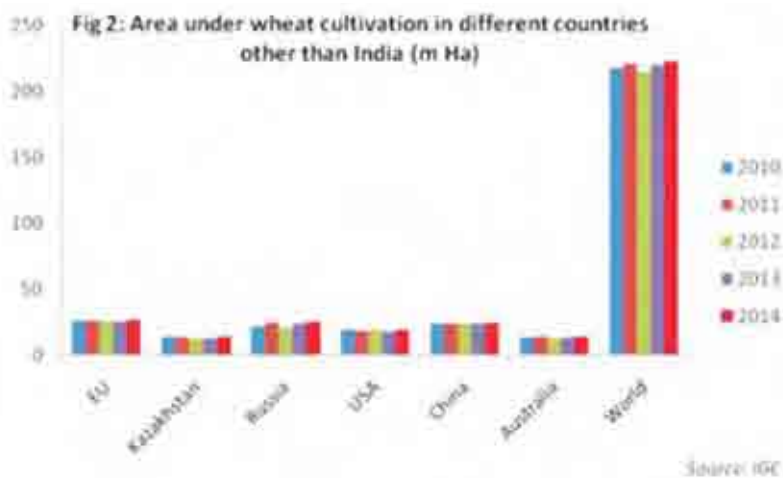
Global Wheat Production

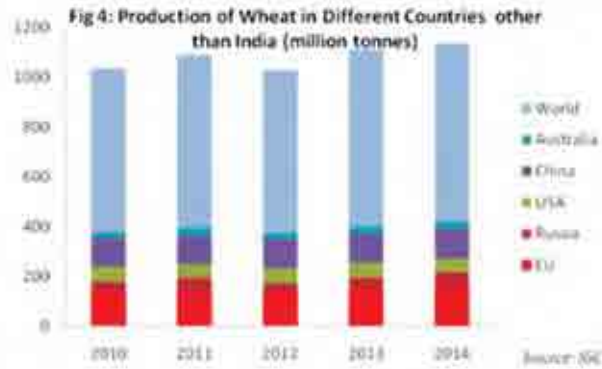
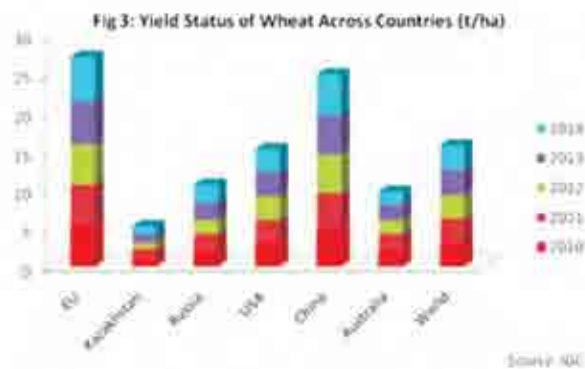
The global area under wheat cultivation from 2010 to 2014 witnessed inter-year fluctuations and on an overall basis, increased marginally by 2.2%, from 217.9 million hectares in 2010 to 222.9 million hectares in 2014. As seen in Fig 2, amongst the major wheat producing countries in the world, the highest increase in area under wheat cultivation was witnessed in Russia. It increased by 13.3% from 21.8 million ha in 2010 to 24.7 million ha in 2014. EU and Australia witnessed a marginal increase in area under wheat cultivation between 2010 and 2014, by 2.3% and 2.2% respectively.



Wheat was cultivated in the EU in 2010 over an area of 25.9 million ha which increased to 26.5 million ha in 2014 while in Australia, it increased from 13.5 million ha in 2010 to 13.8 million ha in 2014. All the other major wheat producing countries in the world experienced marginal decrease in area between 2010 and 2014.

Globally, yield of wheat increased by 6.6% during the period between 2010 and 2014. In 2010, the global average yield of wheat was 3 tonnes per hectare (t/ha) which increased to 3.2 t/ha in 2014. The highest increase in yield during this period was witnessed by Kazakhstan, where the





yield increased by a significant 43%, from 0.7 t/ha in 2010 to 1 t/ha in 2014. Consequently, Kazakhstan has also the lowest yield of wheat amongst all the major wheat growing countries in the world, as seen in Fig 3. Russia and China witnessed an increase in wheat yield by 26.3% and 12.7% respectively between 2010 and 2014. Australia as a country witnessed a significant decline in wheat yield in the recent years. In 2010, the yield of wheat in Australia was 2 t/ha which decreased by 15% to 1.7 t/ha in 2014.



World production of wheat in 2014 was 717.6 million tonnes in 2014. This is an increase of about 10% when compared to the production figures of 2010 at 652.9 million tonnes (Fig 4). Wheat production in Russia increased phenomenally by 44.5% from 41.5 million tonnes in 2010 to 60 million tonnes in 2014. Production in the EU increased by 12.6% from 136.8 million tonnes in 2010 to 143.1 million tonnes in 2014. Wheat production in China in 2014 was 125.3 million tonnes, which is an increase by 8.7% when compared to the production figure of 2010 (115.2 million tonnes). European Union has emerged as the largest producer of wheat globally followed by China and Russia in 2014.

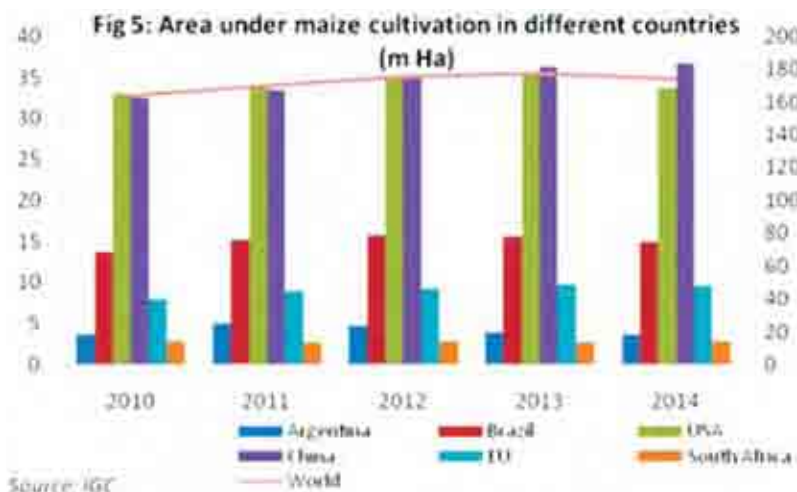
Global Maize Production

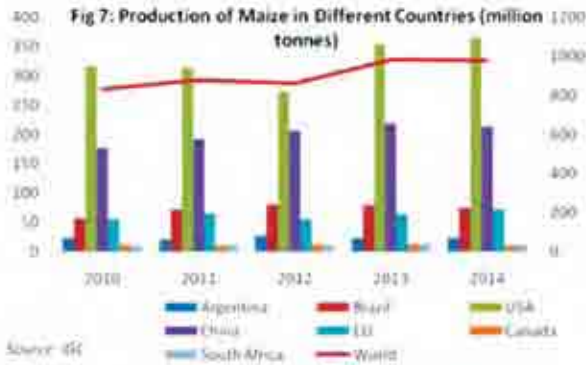
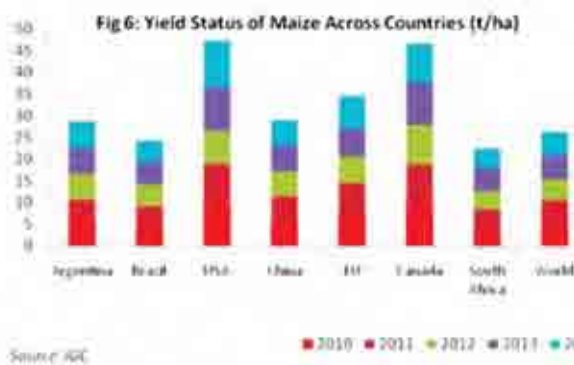
The global area under maize production in 2014 was 173.4 million hectares which is an increase by 6% when

compared to 163.6 million hectares in 2010. However, the area under maize cultivation decreased from 177.1 million hectares in 2013 to what it was in 2014. Maize area in China has increased consistently over the past few years and in 2014 it was 36.7 million hectares, an increase of about 13% when compared to the 32.5 million

hectares in 2010. Area under maize in the EU region witnessed an increase of 20% between 2010 and 2014 (8 million hectare in 2010 and 9.6 million hectares in 2014). In 2014, area under maize cultivation in Brazil and the USA was 15 million ha and 33.7 million ha respectively (Fig 5).

Globally, the average yield of





maize has increased in the recent years. In 2014, the average global yield of maize was 5.6 t/ha. This shows an increase of almost 10% when compared to the global yield data of 2010 of 5.1 t/ha. While Canada and Argentina witnessed decrease in yield during this period, countries like Brazil, USA, EU, China and South Africa witnessed increase in yield during the period spanning from 2010 to 2014. In 2010, the yield of maize in Canada was 9.8 t/ha which marginally decreased by 6% to 9.2 t/ha in 2010. Similarly, yield of maize in Argentina in 2010 was 6.4 t/ha which marginally declined by 3% to 6.2 t/ha in 2014. The highest increase of maize yield was in South Africa, where it increased by 21% from 3.8 t/ha in 2010 to 5.4 t/ha in 2014, registering an increase of 19%. It was followed by the USA where yield increased from 9.6 t/ha in 2010 to 10.8 t/ha in 2014 (increase by 12.5%). Maize yields in China (from 5.5 t/ha in 2010 to 6 t/ha in 2014) and the EU region (7 t/ha in 2010 to 7.6 t/ha in 2014) also witnessed increase during the period (Fig 6).

Except a minor fluctuation in 2012, global production of maize has been increasing consistently from 2010 to 2014. In the year 2014, the total global production of maize was 979.7 million tonnes. This measures an in-

crease of almost 18% when compared to the production data of 830.6 million tonnes in 2010. The largest percentage increase of production was witnessed by Brazil and the EU (30% each). In 2010, the production of maize in Brazil was 57.4 million tonnes which increased to 75 million tonnes in 2014. Production in the EU had increased from 55.8 million tonnes in 2010 to 64 million tonnes in 2014 (Fig 7).

Global Rice Production

Global area under rice cultivation has witnessed a marginal increase between the period ranging from 2010 to 2014. It increased by only 1.5% from 158 million hectares in 2010 to 160.5 million hectares in 2014 (Fig 8). The highest increase was witnessed by Pakistan when the area under rice cultivation increased from 2.3 million hectares in 2010 to 2.7 million hect-

ares in 2014, registering a growth of 17% during the period. The USA and the Sub Saharan African countries registered decrease in net area under rice cultivation between 2010 and 2014. Area under rice cultivation in the USA decreased by 20% (1.5 million tonnes in 2010 and 1.2 million tonnes in 2014). The highest area under rice cultivation in 2014 was in China (30.6 million hectares).

The global yield of rice increased by 7% between the period of 2010 and 2014. In 2010, the global yield of rice was 2.8 tonnes/hectare which increased to 3 tonnes/hectare in 2014. Though the area under rice cultivation has decreased in the USA during the period between 2010 to 2014 as discussed in the preceding section, the yield of rice in the country witnessed the highest increase when compared to other major rice growing countries in

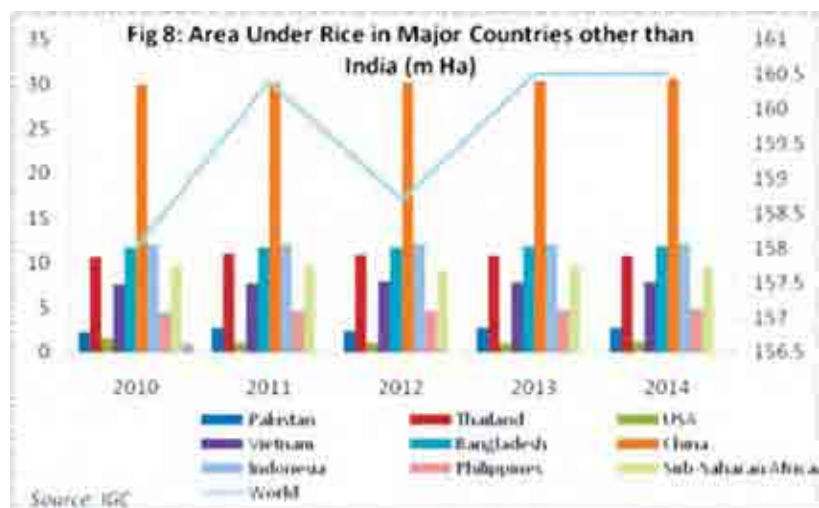
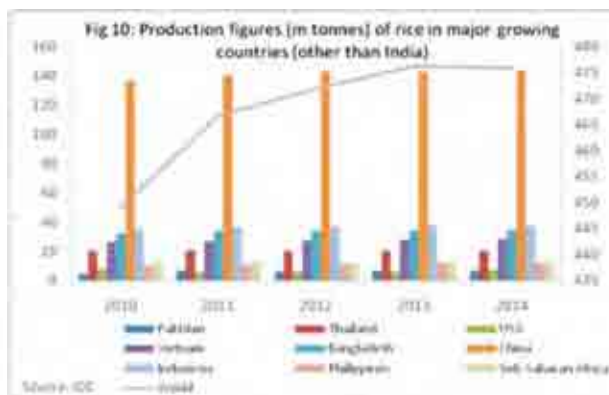
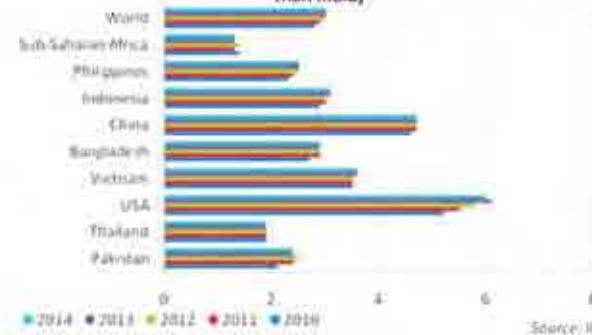


Fig 9: Yield (t/ha) of major rice growing countries (other than India)



the world. In 2010, the yield of rice in the USA was 5.2 tonnes/hectare which increased by 15.3% to 6 tonnes/hectare in 2014. USA has also emerged as the country with highest yield in all the years from 2010 to 2014. Bangladesh and Vietnam recorded a steady yield of 2.9 tonnes/hectare and 2.5 tonnes/hectare during most of the years between 2010 and 2014 (Fig 9).

While the area under global rice production increased by just 1.5% in the period between 2010 and 2014, the total global production of rice witnessed an increase of almost 6% during the same period (Fig 10). In 2010, the global rice production was 449.1 million tonnes. This increased to 475.8 million tonnes in 2014. Most of this increase in production was driven by countries like Pakistan, Bangladesh and Philippines. Pakistan

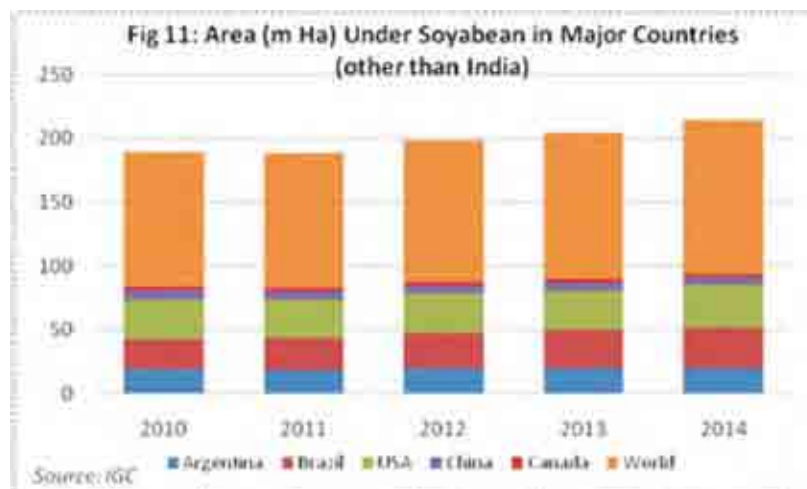
recorded the highest percentage increase in rice production globally, increasing by 35.4% from 4.8 million tonnes in 2010 to 6.5 million tonnes in 2014. Philippines was the second largest country in terms of percentage increase in yield (10.5 million tonnes

in 2010 to 12 million tonnes in 2014 with 14.2% net increase) while Bangladesh was the third largest country in terms of percentage yield increase (31.7 million tonnes in 2010 to 34.6 million tonnes in 2014 with 9.1% net increase). China has been the highest rice producing country globally during all the years between 2010 and 2014, and in 2014, the total rice production in China was 143.5 million tonnes.

Global Soyabean Production

Area under global soyabean cultivation has been increasing consistently in the past years. In 2010, the total area under soyabean across the world was 105.1 million hectares which increased to 120.9 million hectares in 2014, registering an increase by 15% during this period. The increase in area under soyabean was mostly driven

Fig 11: Area (m Ha) Under Soyabean in Major Countries (other than India)



by countries like Canada and Brazil. In 2010, the area under soyabean in Canada and Brazil were respectively 1.5 million hectares and 24.2 million hectares which increased to 2.2 and 31.5 million hectares respectively in 2014, registering an increase of 46.6% and 30.1% respectively during the period. Globally, the USA over the years is the largest in terms of area under soyabean and in 2014, the country had 33.8 million hectares of area under the cultivation of this crop (Fig 11).

The average global yield of soyabean is more or less consistent at 2.5 t/ha during the period from 2010 to 2014, except for the minor fluctuations in 2011 and 2012 (Fig 12). The specific country data of the major soyabean growing countries of the world also reveals a similar trend with countries like China and Brazil (from 2012 to 2014) maintaining an yield level of 1.8 t/ha and 2.9 t/ha respectively. The highest increase in yield was experienced by the USA when it increased by 10.3% from 2.9 t/ha in 2010 to 3.2 t/ha in 2014. Yield figures compared between 2010 and 2014 for Brazil and Canada indicates a decrease of 6.4% and 6.8% respectively. In 2010, the yield of soyabean in Brazil was 3.1 t/ha which decreased to 2.9 t/ha in 2014 and in Canada, the yield decreased from 2.9 t/ha (2010) to 2.7 t/ha (2014).

While the global yield of soyabean

remained relatively constant at 2.5 t/ha, the total soyabean production globally posted an increase of 15% between the period ranging from 2010 to 2014, mostly owing to growth in area under the crop globally. The total global yield of soyabean in 2014 was calculated at 307.4 million tonnes, increasing from 266.5 million tonnes in 2010. Though the yield in Canada and Brazil decreased during 2010 and 2014, owing to the substantial increase in area under soyabean cultivation, these countries increased their net production figures from 4.3 million tonnes and 75.3 million tonnes respectively in 2010 to 6 million tonnes and 91 million tonnes respectively in 2014. This marked an increase of 39.5% and 20.8% respectively for Canada and Brazil during the said period.

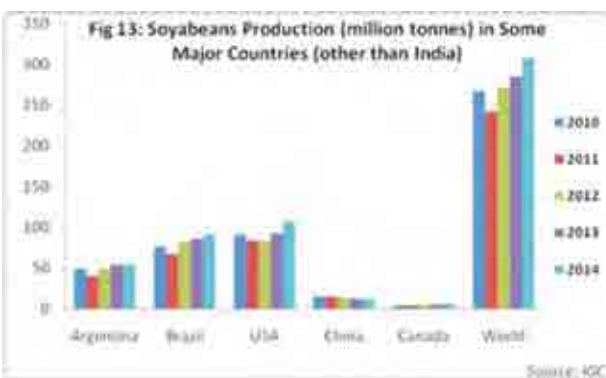
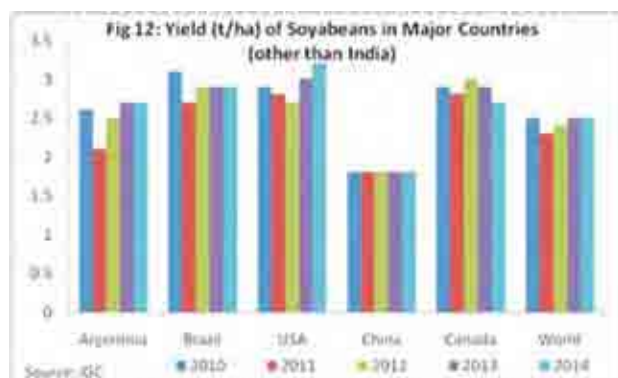
Global Rapeseed Production

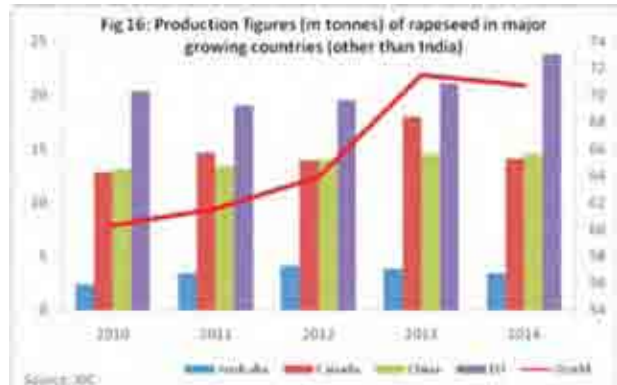
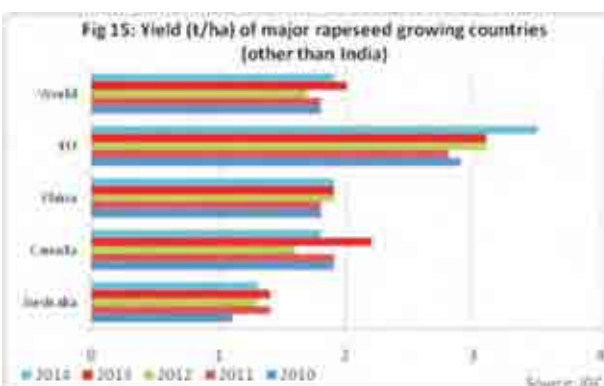
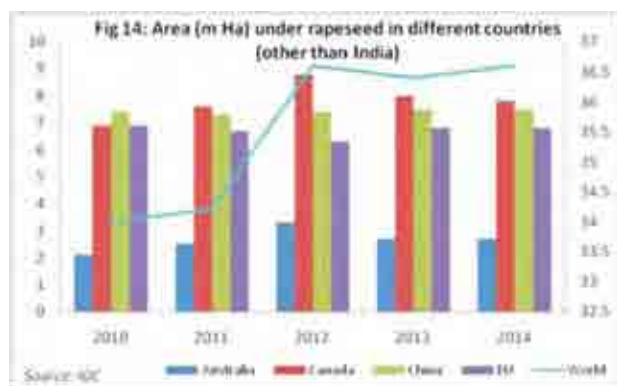
Rapeseed or Canola is an important oilseed crop grown across the world in various countries. The total global area under rapeseed cultivation in 2014 was 36.6 million hectares. This represents an increase of 7.6% when compared to the total area under the crop of 34 million hectares in 2010. Amongst the major rapeseed growing countries, Canada had the highest area under cultivation with 7.8 million hectares in 2014. It is important to note that it reached its peak at 8.8 million hectares in 2012 from 6.9 million hectares in



2010. However, the area declined in the subsequent years till 2014. This could be because of the intention of Canadian farmers to grow more wheat, oats and barley during the years in concern. China was closely following Canada in terms of total area under rapeseed and in 2014, the total area under the crop was 7.5 million hectares. European Union cultivated rapeseed in a total area of 6.8 million hectares in 2014. Australia as a country experienced the largest increase in rapeseed cultivation and between 2010 and 2014, the total area under its cultivation increased by 28.5% from 2.1 million hectares in 2010 to 2.7 million hectares in 2014.

European Union has been experiencing higher rapeseed yield in the recent years and has been considerably higher than the world average yield. In 2014, rapeseed yield in EU





was 3.5 t/ha, almost double the average global yield of 1.9 t/ha. This also marks a significant increase of 20.6% in the yield in EU region, when it increased from 2.9 t/ha in 2010 to 3.5 t/ha in 2014. Yield level in Canada on the other hand has been experiencing significant fluctuations in the recent years between 2010 and 2014 as seen in Fig 15.

Rapeseed production has experienced an overall growth in the recent years between 2010 and 2014. The total world production of canola has increased by 17.2%, increasing from 60.3 million tonnes in 2010 to 70.7 million tonnes in 2014. While all the major canola growing countries have registered positive growth during the same period, Australia has registered the highest growth of 41.6% between 2010 to 2014, increasing from 2.4 million tonnes in 2010 to 3.4 million tonnes in 2014 (Fig 16).

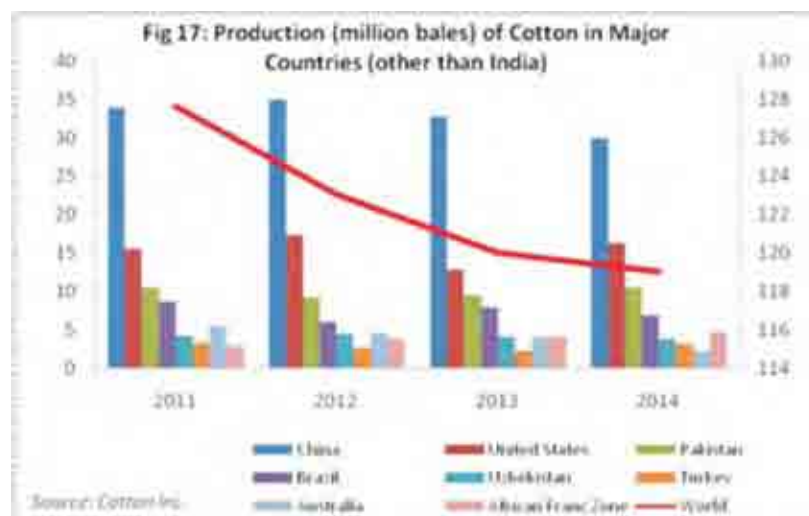
Global Cotton Production

The global cotton production has

been decreasing considerably during the last few years. As seen in Fig 17, the global cotton production has been steadily declining from 127.6 million bales in 2011 to 119 million

bales in 2014 (Fig 17). Most of the major cotton producing countries in the world, including India (not shown in the figure and to be discussed separately in subsequent chapter), China, Brazil, Australia, Turkey etc. have witnessed decline in production of cotton. Production in China decreased by 11.7%, from

34 million bales in 2011 to 30 million bales in 2014. One of the reasons that can be attributed to the decline in production of cotton in China could be because the farmers in eastern China reduced area significantly partly due to uncertainties regarding changes to China's support policy. Cotton production in Brazil declined significantly by 19.5% between 2011 and 2014, from 8.7 million bales (2011) to 7 million bales (2014). Cotton production in Australia decreased by more than half (56.6%), from 5.5 million bales in 2011 to 2.3 million bales in 2014. However, some of these significant declines in production of cotton in different countries was offset by significant increase in production in the USA and African Francophone region. ■



Agriculture Made in Austria: Sustainability and Quality as a Recipe for Success

Austrian Federal
Ministry of
Agriculture,
Forestry,
Environment
and Water
Management

Austria's rural areas simultaneously act as spaces for living, economic activity, work, nature, culture and relaxation. They are the key to success in tourism and in commerce, but also in global challenges such as climate change or food security. In 2013, Andrä Rupprechter took up the office of Federal Minister for Agriculture and Forestry, Environment and Water Management (BMLFUW). He committed himself to modern and sustainable area-wide rural agriculture. The goal is to further develop and strengthen rural areas through intelligent, sustainable and balanced growth.

Overcoming Challenges

The unstable situation of the global market and adverse weather conditions currently present difficult challenges to Austrian agriculture.

The tense situation in important markets recently caused a dip in prices for grain, oil and root crops as well as for apples. Due to wet weather conditions, the grape harvest was very low in yield. However, the Common Agricultural Policy of the EU provides the necessary instruments to counteract fluctuations of the market or shortfalls of exports. With the new direct payment system and the Rural Development Program, which is already underway and runs until 2020, a stable framework has been secured.

According to the Agricultural Structure Survey, 166,317 agricultural and silvicultural businesses existed in Austria in 2013. Thus, the

number of businesses decreased by four per cent compared to the last census in 2010. The decline in business is a continuing trend, but has slowed down somewhat. Agricultural and silvicultural businesses cultivated a total of 2,728,558 hectares of agriculturally utilized land in 2013. Of this, 1,297,110 hectares were permanent pastures and 1,364,057 hectares were farmland. Vineyards accounted for 45,320 hectares and orchards for 15,197 hectares. The total area used for forestry amounted to 3,427,510 hectares.

Predominantly Family Businesses

Agricultural and silvicultural businesses are predominantly family businesses. They amount to nearly 92 percent of all businesses. Austria's agricultural sector is generally small-scale and rural in character. Nevertheless, the trend to ever bigger businesses continues: While an average total area of 17.8 hectares was cultivated by a business in 1951, this figure was already at 44.2 hectares in 2013. The development in utilized agricultural area is similar (farmland, kitchen gardens, permanent crops, permanent pastures); here, an increase from 9.4 hectares to 18.8 hectares was recorded.

This trend is also visible in the area of animal husbandry: While in 1995 an agricultural and silvicultural business kept an average of 20 heads of cattle, the herd size has since then continually increased to 29 heads of cattle per business. The porcine sector demonstrates an even more fast-paced development; here, the average stock has almost tripled since 1995, rising from 35 to 103 animals. In sheep and goat farming there has also



been a noteworthy stock increase. The share of organic businesses is higher in Austria than in any other European country. About 22,000 organic farmers cultivate nearly 20 per cent of Austria's utilized agricultural land. Thereby roughly 434,000 hectares are farmed according to the criteria of organic farming.

Rural Development as a Growth Factor

The central instrument of the Austrian agricultural policy is rural development. Via the program for development, 1.1 billion Euro are available for farmers and rural areas per year until 2020; this program is financed by the European Union (560 million Euro), and the federal and state governments. It is embedded in the Europe 2020-strategy, with five core objectives in the areas of employment, research and development, climate change and energy, education, poverty and social exclusion. Thereby it continues the established path of sustainable, ecologically responsible agriculture, but adopts a broader approach than previously. By and large, agriculture and forestry are being made more innovative, more professional and more competitive. The guiding principles are regionality and diversity.

One focal point of the new subsidy program is the investment incentive. With this, businesses are given the ability to increase their competitiveness as well as to raise their eco-efficiency and their resource efficiency. Constructional investments,



technical facilities, special-purpose machines or biomass heating systems are funded. Through this, demand increases; for the most part, the money flows directly into the regional economy, and jobs are created or secured.

Infrastructure, Climate Protection and Social Issues

A functioning broadband infrastructure is indispensable for quality of life and economic success in rural areas. Funding is also available for this, as well as for research and development. Education is an especially important field. The production of sustainable renewable energy is also being promoted more actively than hitherto. Thereby, possibilities for revenue and employment are created. At the same time, this contributes to climate protection.

Measures for small- and medium-sized enterprises (SMEs) as well as social services, for example in the areas of childcare, elderly care, or preventative health care, are a new feature of the program.

The impact of the funding program was examined by the Austrian Institute of Economic Research (Wifo) for the years 2007 until 2013. The regional added value increased by 1.4 billion Euro every year. In the process 31,100 jobs were created, of which 8,600 in agriculture and 22,500 in other fields. Over 147,000 jobs in agriculture and forestry could be secured, especially in disadvantaged areas (source: Grüner Bericht 2013).

Organic Agriculture as a Vanguard

Organic agriculture offers perspectives for forward-looking and sustainable agriculture. The holistic, especially natural approach of organic agriculture also





contributes to the protection of the climate and environment. Austrian organic products are a flagship of Austrian quality abroad.

According to estimates of the organic farmers' movement "Bio Austria", the yearly turnover of organic foods is one billion Euro. 67 percent of the revenue is generated by food retailers, 14 percent in specialized organic food shops. Commercial

kitchens and gastronomy account for five percent, direct marketing for seven percent and seven percent of organic turnover is generated through exports. The most popular organic foods include milk products, eggs, potatoes and grain products (bread, flour, etc.). In the area of meats and sausages, the share of organic products is still relatively low.

Austria occupies the top position

in relative terms of land area cultivated according to organic standards amongst European countries. In terms of absolute figures, Spain is in the lead with 1.4 million hectares of organic land area (2.5 percent of utilized agricultural area). Italy has the largest number of organic businesses (41,000), these making up 8.7 percent of all the Italian agricultural businesses. Organic agriculture is on the rise globally as well. In 2006, 30.4 million hectares were organically cultivated worldwide. In 2012 this number had already increased to 38.5 million. Australia, China, Argentina and the USA utilize particularly vast amounts of land area.

EU-Organic Country No. 1

Austrian policies create a framework which secures the growth of organic agriculture. The organic farming action program of the BMLFUW encompasses provisions for the promotion of organic agriculture. Especially in the areas in which



organic options are less sought after (meats, sausages), the aim is to further enlarge the market share of organic produce.

A larger necessary work effort and additional costs for the feed and housing of animals in combination with lower yields make the production of organic produce expensive. It is important to compensate for these additional costs and lower revenues through funding. This is primarily implemented via the agri-environment program ÖPUL. However, public relations and marketing, consulting and education, and teaching and research play an important role. This is why it is one of the goals of the organic farm action program, to better communicate to the public the environmental performance of organic agriculture (protection of climate, water, and soil, furtherance of biodiversity, etc.). In agricultural schools, more knowledge should be conveyed on the subject of organic agriculture. Through this, Austria should remain the no. 1 organic country of the EU.

Pact for Fairness on a Broad Base

The quality of foodstuff is an important component of Austrian identity. To continue to be able to guarantee high standards in future, the BMLFUW has been putting versatile and sustainable measures in place. Recently, a broad-based pact for fairness between farmers, processors and trade was initiated. In this agreement, guidelines for responsible and successful cooperation along the entire grocery chain should be defined. This strong partnership guarantees that family-based farm businesses can operate profitably even in



times of economic instability.

New Concept for Export Begun

As a reaction to export shortfalls due to the international trade embargo of Russia, Minister for Agriculture and Environment Andrä Rupprechter started an “export offensive” for foodstuff, agricultural products and environmental technology. Exports are a guarantor of growth and jobs for Austria. Particularly in the area of environmental technology there was until recently a high growth rate (plus 11 percent per year from 2007 until 2011). There was also a steady growth in the export of agricultural wares, foodstuff and drinks – up to a record value of 9.5 billion Euro in 2013. The weak global economic situation and political crisis have led to a mitigation of these developments. The areas of agricultural products and foodstuff are particularly affected by the Russian crisis.

With the export initiative the

ministry wants to counteract this. The goal is to position exports more broadly and thus safeguard them against crisis. The BMLFUW is basing its efforts on the cooperation with the Ministries for Economic Affairs, Foreign Affairs and Health as well as with commercial partners. At the start of the initiative, East Asian markets were the main focus. The export initiative also intends for an intensification of efforts in the vicinity of Austria. Germany remains the most important trade partner. Trade with Switzerland, the western Balkans and Turkey is considered to be expandable. The high quality of Austrian products and most notably the high proportion of organic products are the best prerequisites for successes.

With the success of the Rural Development Program until 2020 and the new export initiative an optimal framework could be created to be able to consistently continue the adopted course: sustainability and quality as a recipe for success. ■



H.E. Mr. Alphonsus Stoelinga
Ambassador,
Embassy of the Kingdom
of the Netherlands

Dutch partnership with Indian agriculture

The Indian agricultural sector can be seen as a success story. It has performed remarkably well in terms of output growth, despite irregularities in weather and prices. In terms of agricultural products, India is largely self-sufficient. It is the world's largest producer of milk, potatoes and fruits and a leading producer of vegetables, spices and plantation crops as well as livestock, fisheries and poultry. Yet, India currently finds itself at a crossroad, as reforms are urgently required to achieve greater efficiency and productivity.

The share of agriculture in India's overall economy has declined to less than 15% due to the high growth rates of the country's industrial and services sectors. This indicator, however, does not properly reflect the importance of the agricultural sector, since more than half of India's population depends on income from agriculture. The majority of India's poor are found in rural areas. Furthermore, India's food security largely depends on producing cereal crops, as well as increasing the production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes.

The challenge for the agriculture sector

and policy makers is to produce enough food to feed the population, while at the same time meeting the fast growing consumer demand for a world class variety of food products. They will have to overcome supply barriers and ensure seamless end-to-end linkages to meet an increasing demand. Every year, India sees nearly one-third of its produce go to waste because of deficient cold chain infrastructure and technology. For this reason, India is set on improving skills and infrastructure in the agriculture sector.

India realizes the urgent need for modern technology and know-how to improve the productivity of farmers, in order to face the challenges that lie ahead. By 2028, India is likely to have surpassed China as the world's most populous nation, with a population of around 1.45 billion putting huge pressure on the agriculture sector.

The agricultural sector is also a key pillar of the Dutch economy and a central point of international cooperation. The Netherlands is the world's second largest exporter of agricultural and food products and its productivity five times higher than the European average. Close cooperation between knowledge institutions,





agricultural producers and government is the basis of the success of the Dutch agricultural sector.

During the Dutch economic mission to India in June, our minister for agriculture, Ms. Sharon Dijksma, met with the Indian minister of agriculture Mr. Radha Mohan Singh to discuss ongoing cooperation and opportunities to further strengthen the trade relationship between The Netherlands and India. Both ministers agreed to help each other on various aspects of trade matters, such as improved market access and technical cooperation in the field of agriculture. In the coming years, Dutch agricultural experts will cooperate intensively with their Indian counterparts. To encourage both private and PPP collaboration, the Dutch government has initiated the establishment of agricultural consortiums. In these consortiums, companies represent various areas of agriculture sector, such as horticulture, potato, dairy, cold chain, animal husbandry, food processing and so on. The goal is to integrate Dutch knowledge and expertise locally with available resources in India.

As part of the Indo-Dutch action plan

it was agreed between the Government of India and government of Netherlands to establish a total of 10 Indo-Dutch Centres of Excellence (CoE's) in different states. In the Centres of Excellence, training is imparted and production methods and techniques are demonstrated by companies. Thus, Dutch companies can help in increasing food production in India by improving production methods, enhancing logistics and food safety. The 10 approved CoE's focus on horticulture, dairy, potato and meat chains. Dutch technology and know-how will be adapted to the Indian circumstances. The first centers will be established in Maharashtra, Karnataka, Kerala and Punjab as a pilot project. Gradually, more Centres of Excellence will be opened throughout India.

All in all, we strongly believe that the Indian agriculture sector has an immense growth potential, but a holistic approach is required to increase productivity by improving knowledge, skills and technology. Responsibility lies with the Indian agricultural sector itself, but the Netherlands is fully committed to support India in reaching these goals. ■



Maurício Antônio Lopes
President of
EMBRAPA

Brazil in Bio-economy

Sustainability is now a permanent item on society's agenda. A significant example is in how "corporate sustainability" has gained importance in recent years. Initially a vague concept, it has now become imperative for the success of companies that increasingly need to deliver value, and not just goods, to society. Sustainability, though intangible, with no physical existence, is now an essential value, one which becomes an asset and a competitive advantage in the business world.

"Corporate sustainability" requires business based on good governance practices and social and environmental benefits, with influence in economic gains, competitiveness and success of organizations. The number of companies issuing sustainability reports increased from less than 30 in the early 1990s to more than 7,000 in 2014. In operating this way, companies increase their

ability to compete in increasingly demanding and challenging markets. Additionally, they also extend their own durability, due to the strengthening of their brand, reputation and credibility.

Interest in sustainability is strengthened to the extent that society realizes the limits of a development model dependent on non-renewable resources, in a context of gradual change in the aspirations of society, in the search for energy security and in new production possibilities. As the population grows in number and consumption capacity, so does the desire for the economy to use more bio-based resources, recyclable and renewable, and, thus, more sustainable - this is the basis of bio-economy.

The sophisticated technical foundations of modern biotechnology has already enabled the creation of a vast range of new products





and processes, such as renewable energy, functional and bio-fortified foods, biopolymers, new materials, pharmaceuticals, and cosmetics. This gives Brazil the opportunity to participate meaningfully in this challenge, ensuring competitive space for innovative products and bio-based processes in vital sectors such as agriculture and health, as well as the chemical, materials, and energy industries.

Biodiversity is essential for the future of bio-industry, and Brazil has the largest biological diversity on the planet, with many assets of great commercial and economic interest. Through bio-economy, real opportunities emerge for the sustainable use of such biodiversity, which involves challenges in various fields – biological, economic, political, and cultural – all necessary to understand and anticipate plausible scenarios for the development of this new economic initiative.

A key step in building a national strategy for the integration of bio-economy was the entry into effect of Act No. 13123, of May 20, 2015, in Brazil, which streamlines and regulates access to the genetic heritage of the country and to associated traditional



knowledge for research purposes and technological development. The Act also determines the sharing of benefits with the holders of these resources, be it from economic exploitation or the development of reproductive material originated from such access, be they plants, animals or microorganisms.

Other steps must still be taken, such as the definition of a strategic agenda aiming at priority areas for bio-industrial development with high potential impact, an area in which Brazil may have major comparative advantages. Such an agenda will allow the country to direct investments and guide the expansion of its scientific and technological base, including the modernization of research and innovation infrastructure and incentives to entrepreneurship and public-private interactions.

With bio-economy, we can transform and streamline essential sectors such as agriculture, which already places Brazil at the forefront of food, fiber, and energy production in the world. The advances in biomass technology allow us to predict a future in which Brazilian sugar and alcohol mills become bio-refineries, producing a wide range of renewable chemicals. The Brazilian Agricultural Research Corporation (EMBRAPA) has already mastered the technology of bio-factories, with the production of pharmaceuticals and sophisticated industrial components in plant cells. Soon, integrated systems combining crops, livestock and forestry will enable us to produce meat, grains, fiber, and energy with very low net carbon emissions or, in some situations, with more carbon capture than emission.

What we see is only the tip of the iceberg, compared to what is announced, for example, in synthetic biology - a result of the convergence of the digital world with the organic world – which will clear the path for an unprecedented range of bio-pharmaceuticals, bio-inputs and bio-products. We must be prepared. The future will definitely be “bio”. ■



H.E. Mr. Grahame Morton
New Zealand High
Commissioner to India

New Zealand's Journey to Becoming a World-Class, Global Food Producer

New Zealand's economy has always been underpinned by a strong, vibrant and export-focused agricultural sector. Over the past half-century, our economy has diversified from this agricultural base, spawning for example a significant tourism industry, and a strong services sector. But it is our farmers and their ability to produce more food than New Zealanders can consume that continues to be our greatest exporting asset.

New Zealand's journey to becoming a world-class, global food producer began in 1882 with the first-ever shipment of frozen sheep carcasses to the United Kingdom. This shipment pioneered cold storage solutions which were necessary because of the distance to our major export market. New Zealand now exports quality agricultural products and technologies to more than 130 countries. While still a relatively small player on the international stage (produc-

ing 1 percent of the world's beef, 3 percent of dairy and 6 percent of sheep meat), New Zealand produces enough food to feed 40 million people. For a country of 4.5 million people, with a land area of a similar size to Uttar Pradesh, we have impressive productivity credentials.

The world demands much more food than is currently being produced. Over the next 35 years, global demand for food will nearly double. There will be another two billion mouths to feed, as well as the growing appetite of a surging middle class, including in India. New Zealand believes it is well positioned to respond to that demand by being a niche, high-quality food supplier. We produce world-class fruit and vegetables; have the right climate to produce award-winning wine; and enough space for our sheep and cattle. We have a sustainable supply of seafood, a creative spirit for culinary innovation, and the international experience required to understand and grow export markets.





In large part, the productivity, efficiency and innovation of our farmers is owed to the economic reforms we undertook 30 years ago. Until the 1980s, our economy was highly protected and our farmers were propped up by a huge number of inefficient and expensive government subsidies. (In the early 1980s, 40 percent of a New Zealand sheep or beef farmer's income came from government subsidies.) But when the United Kingdom joined the European Economic Community (EEC) in the 1970s, we lost significant access to our largest trading partner and our economy was overexposed and underprepared. Insulated from market signals, with limited incentive to innovate and with a heavy supply-side mind-set, our agricultural sector was suffering stress and stagnation. Very quickly, the New Zealand Government stripped away agricultural subsidies. New Zealand's Producer Support Estimate, a measure of government agricultural support, dropped from 34 percent in 1983 to

2.2 percent in 1989.

Despite the grimmest predictions, the sky did not fall. And while initially painful for some, it was ultimately the best decision for our farming community. Exposing domestic producers to competition and world price signals, actually improved New Zealand's overall production, efficiency and competitiveness. New Zealand farmers became astute business operators. Food and dairy production increased significantly. We now produce food far more efficiently than we did 30 years ago. For example, in the 1980s we had around 70 million sheep. We now have around 30 million sheep – less than half our 1980s flock – and yet we can still produce the same amount of sheep meat.

New Zealand's ability to produce more food than our population needs has opened up significant commercial opportunities for our farmers. Trade is critical for New Zealand's economic well-being and growth prospects and accounts for around 60 percent of New Zealand's total economic activ-

ity. Only by selling goods and services to other countries can New Zealand pay for the goods and services it imports from overseas. Given the importance of trade, and New Zealand's distance to its major markets, we know the value of global supply chains and the importance of cultivating strong trade and investment relationships better than most.

New Zealand has over the years formalised a number of trade and investment relationships through Free Trade Agreements (FTAs) and we are currently negotiating an FTA with India. FTAs make international trade easier and more efficient by improving access for exporters and investors to markets, reducing barriers to trade, and ensuring existing access is maintained. FTAs are also an endorsement by the governments who negotiate and sign them of their confidence in each other's markets. That message is powerful for companies looking for the confidence to explore different markets. For New Zealand companies, the vast majority of which are small, building a trading relationship under the auspices of an FTA is an important step towards a deeper trade and investment relationship. FTAs are also a valuable institutional framework to





underpin greater and broader cooperation in areas of mutual benefit.

New Zealand has seen this in action with a number of our FTA partners. A significant success story has been our relationship with China after signing our FTA in 2008. China is now New Zealand's number two trading partner, after Australia. Between 2008 and 2014, two-way trade more than doubled from less than \$9 billion to over \$18 billion and imports from China have increased almost 40% in the same period. New Zealand's investment in China is also steadily increasing, with our investment stock in China worth \$541 million. This compares to \$36 billion in Australia, still our largest investment partner. But the depth of the relationship has matured over the last seven years and China is also now New Zealand's largest education market, with more than 30,000 Chinese students coming to study in New Zealand each year. Additionally, Chinese tourists to New Zealand number more than 313,000 each year, making China our

second-largest tourism market. While education and tourism are the biggest service exports, New Zealand also exports our growing 'knowledge economy' services such as design, information technology, film and TV, and food safety.

New Zealand is confident that a similar story could, under the right conditions, be emulated with India. For New Zealand, FTAs are not just about trade figures. They are comprehensive government-to-government agreements that underpin, support and grow closer bilateral relationships that benefit from broader collaboration and partnership. New Zealand has the experience, skills and agri-technology to continue to be a valuable partner with India in her agricultural development story. New Zealand and India already enjoy a long history of sharing knowledge



and experience. Dr Kurian, known as "India's milkman" and a revered farmer, studied at Massey University in New Zealand in 1953. At that time he was particularly interested in learning about New Zealand's cooperative model. He returned to India and built up the Amul brand of dairy products with knowledge gained in part from his time in New Zealand.

The opportunities for our respective farmers to learn and benefit from a closer partnership are abundant and I look forward, during my time as High Commissioner, to exploring and progressing those opportunities. ■

There is always a reason to jive
when PNB Bonanza arrives



No processing/upfront/documentation fee

Housing | Car | Two-wheeler | Personal Loan

**50% processing/upfront fee
on mortgage loan**

**Special rate
for women
borrowers**

Sapno ke Rang pnb ke Sang

For details contact our nearest branch or Dial **0120-2490000** or All India Toll Free No. **1800 180 2222** Or SMS **PNB PROD** to **5607040**
www.pnbindia.in

पंजाब नैशनल बैंक
...भरोसे का प्रतीक !



punjab national bank
...the name you can BANK upon !

किसान हित यही प्राथमिकता

सन १९६४ में महिको की स्थापना से ही कंपनी का कृषि अनुसंधान पर जोर रहा है और आज तक ३० से ज्यादा फसल प्रजातियों में ११५ से अधिक संकर बीज किस्में विकसित कर चुकी हैं।

गत ५० वर्षों से महिको किसानों के लिए उन्नत बीज विकसित करने के साथ ही अधिक उत्पादन की सुनिश्चितता, नैतिक तथा अनैतिक तनाव के खिलाफ समाधान के लिए तत्पर रही है। महिको द्वारा विकसित व्यापक उत्पाद तथा देश के कोने-कोने तक फैली हुई विस्तृत श्रृंखला हमारे ६ करोड़ से अधिक किसान परिवारों के चेहरे पर मुस्कान बिखेरती है।

महिको परिवार अपनी सफलता का श्रेय इसी प्राथमिकता को देता है - किसान हित यही हमारा ध्येय एवं विधानधान।



महाराष्ट्र हाईब्रिड सीड्स कंपनी प्राइवेट लिमिटेड

ई-मेल : info@mahyco.com, वेब-साइट : www.mahyco.com

**FOOD SECURITY -
ISSUES AND
STRATEGIES**



PROF. M.S. SWAMINATHAN

Achieving the Zero Hunger Target

The Zero Hunger Challenge outlined by the UN Secretary General has the following five components:

- o 100% access to adequate food all year round
- o Zero stunted children less than 2 years of age
- o All food systems are sustainable
- o 100% increase in smallholder productivity & income
- o Zero loss or waste of food

Bridging the Gap between scientific know-how and field level do-how

I would like to indicate some priorities in the context of our goal for a hunger free India.

(1) Lab to lab: This involves collaboration among all the institutions working on a particular problem like the development of new varieties of wheat, and rice, among others. This kind of beneficial partnership is being achieved through the All India Coordinated Research Projects of the ICAR. Such coordinated projects help to bring together scientists working in agriculture universities, ICAR institutes and often the private sector for undertaking the evaluation of new varieties not only from the point of view of yield, but also from the point of

view of resistance to pests and diseases as well as to drought, floods and other abiotic stresses. The rapid progress which could be made in the early years of the green revolution in the 1960s was only because we could mobilise the power of partnership among scientists working under different agro-climatic and socio-economic conditions. This method of mobilising all the relevant institutions for undertaking joint varietal evaluation and release is one of the important factors responsible for our rapid progress in improving food production.

(2) Lab to land: The lab to land programme took the form of national demonstrations as well as the establishment of farm science centres, known as Krishi Vigyan Kendras (KVKs). There are now several hundred KVKs spread all over the country. These are attached to agriculture universities and research institutions which generate new technologies. The first KVK was established at Puducherry in the seventies. These institutions, which impart location specific knowledge, have become powerful instruments for the knowledge and skill empowerment of small farm families. Special attention is given to women farmers as well as to women in farming. As a result of such farmer-scientist collaboration, farmers converted a small government programme into a mass movement, leading to the green revolution.

(3) Land to lab: It is clear that there is considerable amount of traditional knowledge and wisdom available with farm families. Such knowledge and ecological prudence arise from practical experience. It is said that "one ounce of practice is worth tonnes of theory". Therefore, we should pay attention to farmers' own traditional practices and varieties. Fortunately, the Protection of Plant Variety and Farmers' Rights Authority (PPVFRA) has instituted genome saviour awards for recognising and rewarding the invaluable contributions of rural and tribal people to genetic resources conservation and enhancement. A good database is also being maintained on traditional knowledge and



technologies at the Indian Institute of Management, Ahmedabad, under the guidance of professor Anil Gupta.

PPVFRA recognizes the multiple roles of farmers. They are cultivators and guardians of the food security of the country not only because they are the ones who produce the food, but they also play an important intellectual role in agrobiodiversity, plant selection, plant hybridisation and so on. In fact, in China, it was the farmers of Hainan Island who identified the male sterile plants which provided the basis for hybrid rice. However, farmers' intellectual role in the evolution of new varieties and new technologies is usually unrecognised. This is why in the FAO forum, we asked for farmers' rights, not only breeders' rights. The Union for the Protection of New Varieties of Crops (UPOV), located in Geneva, along with the World Intellectual Property Rights Organisation (WIPO), recognises the intellectual property rights of plant breeders. I have been suggesting that they should recognise the rights of both breeders and farmers, but this has not yet happened. I am confident that someday UPOV will become the International Union for the Protection of Breeders and Farmers' Rights. In India, we have decided to emphasise farmers' rights alongside breeders' rights in the formulation of the Protection of Plant Varieties and Farmers' Rights Act, 2001. This is the only legislation in the world which recognises concurrently farmers' and breeders' rights.

(4) Land to land: This involves farmer to farmer learning. The National Commission of Farmers (NCF) had laid particular stress on promoting farmer to farmer learning through farm schools. Fortunately, industrial houses and financial institutions are promoting the establishment of



farm schools under their corporate social responsibility programme. For example, the M S Swaminathan Research Foundation has established seven farm schools with financial support from the Indian Overseas Bank. Farmer to farmer learning is an effective method of technology transfer due to the sound economics which guides farmers' decision making.

Land is a shrinking resource for agriculture and we have no option except to produce more from diminishing per capita land and water resources. It is in this context that bridging the know-how-do-how gap becomes both urgent and essential. Our Prime Minister has done a great service by emphasising the need for agricultural research institutions and farm universities to intensifying lab to land and other associated scientist-farmer technology sharing programmes.

The target date for achieving the UN Millennium Development Goals ends this year. The first goal is reducing poverty and hunger by half. The latest report indicates that India has halved the incidence of extreme poverty, from 49.4% in 1994 to 24.7% in 2011. However, our country still has

25% of the world's undernourished people and 33% of the global food insecure. Over one third of the world's underweight children are also in India. We should therefore review our past strategies for social protection against hunger and introduce community centered approaches for getting out of the hunger and malnutrition trap.

Among the community centric safety nets, the following five action points are important

- Training one woman and one male member of every Elected Body as Community Hunger Fighters
- Mainstreaming nutrition in farming systems through the Farming System for Nutrition methodology (FSN)
- Promotion of nutrition literacy through Village Knowledge Centres.
- Attention to food safety and clean drinking water
- Establishment of nutrition gardens with biofortified plants which can provide the needed protein and micronutrients. The nutrition garden will help to select plants for FSN.

From the experience of MSSRF, Community Hunger Fighters are very effective in promoting the adoption

of agricultural remedies to the nutritional maladies prevailing in the village and to dealing with hunger in a socially effective manner.

Children for Happiness

Marquis de Condorcet, a contemporary of Thomas Malthus wrote that population will stabilise itself if children are born for happiness. Unfortunately, according to a recent survey conducted by UNICEF, only Tamil Nadu, West Bengal, Uttarakhand and Tripura have been able to reduce the proportion of underweight adolescent girls. Some states have made good progress in overcoming child malnourishment while others, are stagnating. This is unfortunate since child malnutrition, particularly during the first thousand days in a child's life can have several adverse consequences in later life including impaired cognitive abilities. I had warned in as early as 1964, that malnutrition of the child both in mother's womb, as reflected in low birth weights, as well as during the

first two years of the child's life could lead to intellectual dwarfism. This is neither fair to the child nor good for the nation. Balanced nutrition is essential for the full development of the physical and mental potential of the child.

Overcoming child and malnutrition by introducing a lifecycle approach to nutrition with particular reference to the first thousand days in a child's life should receive the highest priority. This is mentioned in the National Food Security Act 2013, but needs to be operationalised at the ground level. This can be a very important part of our programme for achieving the zero hunger challenge.

Enlarging the Food Basket

A recent media report indicates that the acreage under Ragi and millets is likely to go up substantially in Karnataka as well as in several other states. Remunerative pricing and effective procurement are the keys to revive interest in such crops. The Karnataka government has

procured over 1 lakh tonnes of Ragi at Rs. 2000 per quintal. Farmers will produce more if procurement and consumption go up. From 1992 onwards, MSSRF has been working in Kolli Hills in Tamil Nadu as well as in Koraput in Odisha trying to promote the conservation of a wide range of minor millets through opportunities for commercialisation. The Food Security Act 2013 also includes millets like ragi, jowar, bajra etc in the food basket under the PDS. It is now known that such millets are not only nutritious but are also climate smart in the sense that they are more resilient to rainfall distribution. In order to ensure that these nutritious and climate resilient crops are again cultivated on a large scale in dry farming areas we should ensure that they have a market. Fortunately, many food processing companies are coming up with products based on ragi, bajra, jowar and a range of minor millets. We need to ensure that both under the Food Security Act and school meal programme, there is



sufficient off take of nutritious millets. Also, government should change the practice of referring to such crops as "coarse grains". They should be referred to as "climate smart nutri-millets". Also we should propose to the United Nations to declare one year of this decade as International Year of Underutilised and Biofortified Crops. Next year is the International Year of Pulses, and pulses are also climate smart and protein rich. Through suitable policy support for the cultivation and consumption of such crops, it should be possible to erase the image of our country as one with the largest number of malnourished children and women.

Another urgent requirement is greater investment in research on these "orphan crops", so that the yield potential is substantially enhanced. Both higher yield and assured marketing will increase the attractiveness of these crops to small farmers.

rainwater harvesting mandatory both in farms and homes. This will help to strengthen our water and food security system very considerably.

Another aspect which needs attention is the working together of the World Water Partnership and the World Soil Partnership, which was established by FAO a few years ago on my suggestion. Land use decisions are also water use decisions and hence the management of land and water should be handled in a symbiotic manner. We will then be able to ensure sustainable water and food security.



Water Security

Our Prime Minister has been placing considerable emphasis on the augmentation of irrigation facilities and water harvesting. The World Water Week held in August in Stockholm, Sweden, where one of our eminent water harvesting experts, Shri Rajendra Singh, was honoured with the prestigious Stockholm Water Prize. I have personally seen the work of Rajendra Singh in Rajasthan where he has tried to motivate local communities in saving all the rain water and using it economically and effectively. I hope this global recognition to one of our water security experts will stimulate state governments to make

Population Stabilisation

The data released on the occasion of the World Population Day revealed that India is likely to become the most populated nation in the world by 2050. At the moment, our population is above 127 crore which is 17.25% of the global population. Our population was only 30 crore in the 1940s when the freedom poet Subramania Bharathi sang that even one among the 30 crore population of that time should not go to bed hungry. Unfortunately, widespread hunger and malnutrition still persists, inspite of the progress in agricultural production. Fortunately, our farmers have not allowed the Malthusian prediction of human numbers

overtaking the human capacity to produce food to become a reality.

Although we are making progress in stabilizing population size, which is now growing at the rate of 1.6% per year, we have still a long way to go to improve the quality of the population in terms of education, healthcare, nutrition and sustainable livelihoods. In 1994, the report of the Population Committee set up by the Government of India under my Chairmanship recommended the involvement of village panchayats and schools in the preparation of a socio-demographic charter for their respective villages.

Such a charter is essentially intended to promote education and social mobilisation in areas such as, the study of the population supporting capacity of the ecosystem in terms of food, water and jobs, the ecological footprint per capita, the weight of children at birth (so as to measure the incidence of low birth weight babies), male – female sex ratio and the average lifespan. A purely technocratic approach to population stabilisation will not take us to the desired goal. We need a combination of easy access to acceptable and affordable contraceptives and at the same time, follow Marquis de Condorcet's principle that population will stabilise itself if children are born for happiness and not for mere existence.

July 14th is being observed as US Ecological Deficit Day. The aim of this programme is to create awareness of the need to strike a balance between the growing per capita human needs for food, water, land and jobs and the capacity of ecosystem services to meet them. The Global Footprint Network is publishing reports on the demand



we are making on ecosystem services through lifestyles which enlarge our footprint and thereby create an imbalance between the health of the ecosystem and its population supporting capacity.

It would be useful for our country also to organise an ecological deficit day. This can be organised at the level of each Panchayat so that there is an appreciation at the local level of the need to ensure that our footprint remains small and is within environmentally sustainable levels. Village schools and urban colleges in particular can play an important role in spreading the concept of ecological footprint thereby reminding each one of us from childhood that we should not make unsustainable demands on ecosystem services like soil, water, biodiversity, food security, livelihoods and income based on the exploitation of natural resources. May be the Ministries of Panchayati Raj, Human Resource Development and Environment, Forest and Climate Change could jointly organise a programme every year to highlight

the ecological deficit we are creating in different parts of the country. At the same time, the Day should draw attention to communities which are creating ecological surplus, so that ecological despair is replaced with ecological hope and pride.

World Youth Skills Day

Prime Minister launched the "Skill India" Movement on the occasion of World Youth Skills Day. In this connection I would like to share some experience in imparting new skills which can strengthen the quality of life as well as livelihoods 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 skills programmes for rural communities. Unfortunately, this principle is often forgotten in Government programmes like MGNREGA. For example NREGA 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, green house cultivation, biodiversity conservation and converting biodiversity hotspots into happy spots through the conservation, sustainable use and equitable sharing of benefits.

MSSRF designed in 1992 the Biovillage model of human centered 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 asset less women will grow mushrooms in a small space in their hut and this has now become a substantial income generating activity. If one goes to a village and ask the men and women what they are doing, the answers will be somewhat under the following lines

"I am a plant doctor; I am an academician 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. 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.

Biofortification and Overcoming Malnutrition

There is now growing realisation that linking agriculture and nutrition will have the maximum impact for overcoming the malnutrition affecting large numbers of children, women and men in our country. In this connection, the micronutrient properties of wheat, rice, tapioca, bajra, maize, bean and orange sweet potato have been substantially improved. A recent report of the International collaborative project titled Harvest

Plus contains very exciting information on the new opportunities opened up by Biofortification. MSSRF in its programme titled “Farming Systems for Nutrition (FSN)” has established Genetic Gardens of Biofortified Plants in Vidarbha and Koraput which are hotspots for the deficiency of iron, zinc and vitamin A. Such deficiencies are known as hidden hunger. The genetic gardens being established will serve as educational tools to make farm families aware of the plants they should introduce in FSN for overcoming deficiencies of specific micronutrients. This will help farmers to choose plants which can provide remedies to the nutritional maladies prevailing in the area. In addition, pulses will also be grown in the genetic gardens since they will help to overcome protein hunger. During this year, we should make a major effort to link agriculture, nutrition and health in a symbiotic manner.

Agenda for a Farmer Suicide Free India

The latest reports of the National Crimes Record Bureau (NCRB) as well as of several non-governmental 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 for alleviating 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:

- i. Establish in every Krishi Vigyan Kendra in farmer suicide prone areas an Agrarian Distress Consultancy Centre. Such a centre should have at least one male and one female advisor well versed in the art and science of advising these who feel hopeless and go to the extreme step.
- ii. Strengthen the coping mechanism of those cotton farmers who take to expensive new technologies by persuading the seed companies to give farmers insurance cover against unforeseen damage caused by unfavourable weather.
- iii. Strengthen the agriculture insurance mechanism and promote insurance literacy
- iv. Empower women farmers to have access to Kisan Credit Cards even if they do not have title to land.
- v. Promote farming systems involving pulses, millets and oil seeds which are high value but low water requiring.

Above all, in the various relief packages announced by governments, high priority should go to the care and education of the 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. ■





Dr. K. Ramasamy
Vice-Chancellor,
Tamil Nadu
Agricultural University

Microbial technologies for sustainable agriculture development and food security

Agricultural productivity needs to be increased by 70-100% to feed the estimated population of 1.5 billion by the year 2050. In this endeavour, sustainable development should meet the needs of the present without compromising the ability of future generations to meet their own needs. The link between sustainable agriculture and sustainable development relies on maintaining soil fertility, protecting groundwater, developing renewable energies and finding solutions to adapt farming systems to climate change, recycling agricultural wastes and urban sewage sludge and promoting rural employment. Hence, there is an enormous pressure built in to the agricultural soils to be resilient and deliver.

Challenges ahead

Indian agriculture currently faces the challenge of having to produce more farm commodities to meet the needs of the growing human and animal populations under conditions of diminishing per capita arable land and irrigation water resources, and expanding [environmental] stress. To achieve these,

India's nearly 110 million rural families – mostly peasant farmers owning up to two hectares of land – will have to be provided with the best available technologies including precision farming technologies and scientific organic farming methods to raise productivity, increase income and manage natural resources and environment

MICROBES - SUSTAINABLE FOOD PRODUCTION – CLEAN ENVIRONMENT TECHNOLOGIES

Microbes for food production

Microbes are the natural resources and essential partners in all aspects of plant life, but human efforts to improve plant productivity have focused solely on the plant. Recent AAM report (2012), suggests that improved understanding of plant-microbe interactions has the potential to increase crop productivity by 20% while reducing fertilizer and pesticide requirements by around 25% within 20 years. Hence, microbes and plants are intimate partners in virtually every life process.

Microbes for soil health

Microorganisms can supplement inorganic fertilizers and chemicals in crop production and protection. At present, however, the yield of many crops has reached a plateau. Moreover, the negative effects of heavy applications of chemical inputs are becoming apparent, in terms of both production and the environment. These occur due to physiological disturbance of plant metabolism due to the accumulation of excess plant nutrients in the soil. Pollution of underground and surface water by nitrates is sometimes reported from intensive crop producing areas. Quality deterioration due to decrease in the content of vitamins and sugars, is becoming a subject of concern. All these point to the need for utilization of microorganisms as a way of repairing the damage from the overuse of chemical inputs.



Soil Microbiome

Understanding the dynamics of soil resources and their subsequent quality in terms of sustainable productivity mainly rely on how much the soil biology is understood. It is estimated that there are one billion bacterial cells per gram of soil comprised of millions of individual species. The microbial biomass existing in the underground may be equal to the sum of all living biomass on the earth surface. A good “quality” soil or “healthy” soil is recognized to accept, hold and release nutrients, water and other chemical constituents; promote and sustain root growth; maintain suitable soil biotic habitat; respond to management and resist degradation. All these attributes of soil quality are function of soil biology. Hence in recent past, the emphasis is on soil biology for optimizing the solutions for reversing soil degradation, sustaining the soil health and productivity. The soil microorganisms catalyse the redox reactions and thereby directly mediate the bio-geo-chemical cycling of carbon, nutrient and trace elements. Such reactions also affect the atmospheric compositions, water chemistry and soil nutrient availability to crop plants. Hence the properties of soil (texture, aeration, available moisture and nutrients) that support the agricultural production are directly dependent on the biomass, metabolites and activities of microorganisms. Therefore, management practices that are followed for crop production, including tillage, nutrient management, crop rotation, mechanization and so on, should not harm the soil microbial diversity and functionality, so as sustain the soil health.



Plant Microbiome

Today we recognise the rhizosphere as a biologically active zone of the soil around plant roots that contains different living organisms such as, soil-borne microbes including bacteria, actinomycetes, fungi, microalgae, protozoa and invertebrates in their abiotic environment. As 5-20% of the carbon fixed by the plants is secreted as root exudates, these rhizosphere microorganisms benefit due to enormous nutrients provided by the plants. The concentration of bacteria present in the rhizosphere is 10 to 1000 times higher than the surrounding bulk soil. Decomposition, nutrient solubilization and cycling, secretion of plant growth hormones, antagonism and pathogenicity and induction of plant immune system are the direct or indirect effects due to rhizosphere microorganisms. The interaction between soil microorganisms, edaphic factors and the host plants, results in the overall crop productivity. Apart from being a predictor of soil quality, the soil microorganisms also impart increased disease suppressiveness against pathogens and alleviate the abiotic stresses to the crop plants.

Microbial inoculants

Rhizobacteria (also known as plant

growth promoting rhizobacteria - PGPR), the sub-group of rhizospheric bacteria, are characterized by their competitiveness to colonize the roots and promote growth of plants. PGPR involves important ecosystem processes such as; the biological control of plant pathogens, nutrient cycling and seedling growth. Functionally, PGPR have been divided into two groups: i) those involved in nutrient cycling and phyto-stimulation and those involved in bio-control of plant pathogens. The former is responsible for nitrogen fixation, increasing the availability of phosphate and other minerals (including potassium, zinc, iron, manganese) in the soil and regulation of plant hormones. The later is responsible for suppression of soil borne pathogens, inducing the plant immune systems and expressing induced systemic tolerance to abiotic stresses. Apart from these, in recent years it has also been postulated that applying PGPR could also alter the rhizosphere microbial communities as indirect mechanism through which plant growth promotion is possible.

The PGPR strains responsible to supply nutrients to the crop plants are referred as “Biofertilizers”, while the strains responsible for

controlling insect pests and diseases are called as "Biocontrol agents" and both together technically referred as "Inoculants". Bacterial genera including species of *Rhizobium*, *Bradyrhizobium*, *Pseudomonas*, *Azospirillum*, *Azotobacter*, *Bacillus*, *Klebsiella*, *Enterobacter*, *Serratia* and many others, have been shown to facilitate plant growth by various mechanisms. These inoculants play a major role in sustainable agriculture because they not only ensure the agronomical yield increase but also reduce the use of inorganic fertilizer inputs (nearly 25% of recommended dose), thereby reducing the risks to the environmental safety. Apart from these, continuous use of the microbial inoculants, also improve the soil health by improving soil biochemical processes. The global market for inoculants is growing at the rate of 10% per annum (Berg, 2009), had a value of \$440 million in 2012 and is expected to reach about \$1295 million by 2020. The Asian countries like India and China are promoting the use of inoculants through tax incentives and exemptions, grants to support the manufacture and distribution of bio-inoculants.

Nutrient substitution and yield increase by biofertilizers

In India, the use of biofertilizers has been in practice since 1950s, which started with the use of *Azotobacter* and *Phosphobacteria* imported from Russia. Later, significant progress has been made to use indigenous strains. *Rhizobium* inoculation of legumes helps in increasing the yield by 15-30% with an absolute yield increase of 50-200 kg per ha and in

some crops even up to 300 kg per ha. Due to rhizobial inoculation, plant N uptake can be enhanced by 10-15 kg per ha in legumes. Similarly, the inoculation of *Azotobacter* or *Azospirillum* in rice and wheat can increase yield by 8-10% and by 10-20% in millets and sunflower. These responses are equivalent to addition of 10-30 kg of fertilizer N per ha. The soil-based cyanobacterial inoculation to wetland rice can contribute 10-25 kg of N per ha with yield increase of 150 kg per ha. All these inoculant applications can substitute the chemical fertilizer (N) to the tune



of 25%. Similarly, inoculation with phosphorus solubilizing bacteria and/or arbuscular mycorrhiza (AM) can save 8-10 kg of chemical P per ha with an additional yield benefit of 10-15%.

Biofertilizers with organic manures

The biofertilizers along with organic manures work well for arid dryland legume crops. Use of *Rhizobium* and AM along with four tonnes of farmyard manure per ha for dryland legumes (redgram, clusterbean) can ensure the yield as well as soil enrichment. The results of long-term experiments confirm that continuous use (7 years in Vertisol soil) of *Rhizobium* for soybean and

Azospirillum for wheat can add soil nitrogen to a tune of 50 and 18 kg per ha per year, respectively. Similarly, the symbiotic nitrogen fixing potential in rice ecosystem (either by *Sesbania* or *Azolla*) ranged from 57-167 kg of N per ha per year.

When the biofertilizers were used as enrichment of organic amendments, particularly *Azotobacter* and *Phosphobacteria*, the enriched compost increased the yield by 8-21% in most of the irrigated vegetables. When biofertilizers are included in the integrated nutrient management, the fertilizer use efficiency has been improved in most of the crops inoculated. When *Azospirillum* or *Azotobacter* along with *phosphobacteria* were used along with chemical fertilizers, the fertilizer use efficiency improved by 12-36% for N, 18-28% for P, 9-15% for K and 16-18% for S. The biofertilizer usage can also improve the quality of the produce or the principal active compounds present in the crops. For example, the antioxidant lycopene increased by 13% in tomato, vitamin C by 27% in tomato and curcumin by 10% in turmeric due to biofertilizer application.

Disease control by biocontrol agents

With reference to biocontrol agents, *Pseudomonas fluorescens* is the key player in terms of suppression of broad-spectrum of soil borne diseases of various crops. It was first demonstrated to control Take-all disease of wheat. Further, the fluorescent Pseudomonads are effective against seedling blight, foot rot and head blight diseases caused by *Fusarium culmorum* in its early

stage. Application of *Pseudomonas* can reduce the blast incidence to the tune of 25 – 80% in rice. The incidence of rice sheath blight can also be reduced by Pseudomonads. The damping off diseases caused by various soil fungi in corn, barley, soybean, chickpea, cotton, sugar beet, tomato, cucumber can be effectively controlled by fluorescent Pseudomonads. Red-rot of sugarcane, root-knot nematode infection in tomato, black rot of tobacco, Fusarium wilt of cucumber and bunchy top of banana are the other diseases that can also be controlled using inoculation of *Pseudomonas*. The use of *Pseudomonas* was found to ensure yield increase of wheat (46-75%), rice (25-75%), maize (15-25%), tomato (18%), cucumber (18%) and potato tubers (14-33%).

Secondly, *Bacillus subtilis* has been successfully commercialized against *Rhizoctonia solani*, *Fusarium* spp., *Alternaria* spp. and *Aspergillus* spp. that attack roots, powdery mildew, downy mildew, *Cercospora* leaf spot, early blight, late blight, brown rot, fire blight diseases of various crops including cotton, groundnut, soybean, cucumber, grapes, and many vegetable crops. Important fungal bioinoculants that directly parasitize plant pathogens include; *Trichoderma* spp., *Paecilomyces lilacinus*, and *Pochonia chlamydosporia*. Among these fungal agents, *Trichoderma* sp. were highly explored for disease management of various crops. The species such as, *T. viride*, *T. harzianum*, *T. polysporum* have been commercially formulated and available as potential biocontrol agents against various diseases. The use of *Trichoderma* inoculant can control most of the soil borne diseases and some foliar diseases irrespective of crops. Seed treatment with *T. harzianum*

decreased incidence and severity of Fusarium wilt in chickpea by 30% and 60%, respectively. Likewise, *Trichoderma* application can control collar rot in mint by 67–100%, wilts of tomato by 75-100%, grape diseases by 48% and citrus canker by 48%. All these inoculants are now available as either powder or liquid formulations.

Microbes as rhizosphere engineers

When the inoculant is continuously used in an agricultural system, the soil health can be improved. As the inoculant changes the microbial community compositions, the tropic competition and synergistic or antagonistic interaction between them, the change of disease suppressiveness will be increased in due course of time. When mycorrhization is adopted for agro-forestry, in afforestation programmes, fruit trees and so on, the carbon sequestering capability can be improved in those soils, as the glomalin production by mycorrhiza increases the total carbon pool. Thus, microbial inoculants serve as 'Engineers' of rhizosphere for creating favourable environment for better nutrient acquisition, root growth and respiration and thereby the increase in grain yield.

Microbes for drought tolerance

Some PGPR possess certain unique abiotic stress alleviation traits. These strains enable plants to overcome the ill-effects of drought. The term Induced Systemic Tolerance (IST) has been coined to accommodate the microbial-induced physical and chemical changes in plants which result in enhanced tolerance to abiotic stresses. When inoculated with PGPR *Pseudomonas mendocina*

and AMF, high activity of antioxidant catalase in lettuce plants under severe drought conditions imports the tolerance. The bacterized plants were found to tolerate stress better. The rhizobacterial strain *Pseudomonas putida* GAP-P45 improves the plant biomass, relative water content, leaf water potential, proline sugars, and free amino acids of maize plants exposed to drought stress. *Methylobacterium* commonly referred as PPFM are able to induce the systemic tolerance to drought. Spraying this bacteria induced short-term drought tolerance in rice, to avoid the complete yield loss due to monsoon failure in 2011-12 in Tamil Nadu's Cauvery delta zone. These findings provide a new dimension in inoculant technology for sustainable development in agriculture. Exploring these bacteria could be an efficient sustainable approach for future agricultural sustainability by drought proofing.

Microbes for bio-based economy

The potential scope for industries based on the kinds of bio-transformations at which microbes excel is enormous, but two obstacles stand in the way of an explosion of this sector. First, relatively few scientifically inclined students are aware that microbe-powered industry is a potential career choice. Second, even if this awareness were greater, there are currently few academic programs aimed at educating the workforce that will be needed for this sector to thrive. Hence efforts should be made to bridge these gaps. Bio-based (Microbe) industries could help address all challenges in ways that are both environmentally and economically sound. At present, microbes are used commercially to

make products as diverse as vitamins, food components, fuels, plastics and many more. Such microbes can be highly efficient, versatile, and sophisticated manufacturing tools, and have the potential to serve as the backbone for a vibrant economic sector, especially in rural areas.

Biopower from waste

While anaerobic digestion is the traditional method of treatment for sewage sludge and solid wastes, microorganisms can also produce power directly via an electron generating process called electrogenesis in a reactor called a microbial fuel cell (MFC). This direct electricity production uses microbes to cleave organic materials under anaerobic conditions and uses electrodes as final electron acceptors. Additionally, a by-product of biofuel manufacture can power MFC to generate electricity cheaply and efficiently, enabling the direct conversion of chemical energy into electrical energy.

Sustainable Biofuel Production

Economic, environmental and energy security concerns resulting from ex-

cessive reliance on petroleum and its negative impact on the environment, particularly greenhouse gas emissions, has put pressure on society to find renewable fuel alternatives such as biofuels mostly derived from crop produces. But, a growing population means that more food is required, and inexpensive energy sources are essential for continued economic growth. Consequently, society faces a number of large, complex, and interconnected challenges. At the same time, destruction of forests to provide more agricultural land, use of cropland and other resources to grow biofuel stocks rather than food, and the urgent need to curb fossil fuel use to slow climate change, all make it exceptionally challenging to meet the goals of more food and more fuel without unacceptable environmental costs.

In such circumstances, using microbes to break down complex carbohydrates such as cellulose and hemi-cellulose into the simple sugars that microbes can ferment allows a great variety of agricultural and forestry products and wastes to be converted to ethanol. Second generation biofuels such as butanol, butanediol, and propanol; fatty

acids; isoprenoids; and alkanes may ultimately be better than ethanol. Both the research to develop these new approaches and the eventual implementation of lignocellulose-based bio-alcohol production will require a workforce with microbiology expertise.

In addition to the above products, a by-product of biofuel manufacture or any bio-waste can power MFC to generate electricity cheaply and efficiently, enabling the direct conversion of chemical energy into electrical energy.

A greater investment in research, taking up one or more grand challenges such as characterization of the complete microbiome of one important crop plant, and the establishment of a formal process for moving scientific discoveries from the lab to the field will be ideal as a sustainable means of future development. Manipulation of plant microbiome, specifically through formulation using proteins and small molecules has the potential to reduce the incidence of plant disease, increase agricultural production, reduce chemical inputs and reduce emission of greenhouse gases, resulting in more sustainable agricultural practices

Essential contributions of microbes to human and animal health, environmental resilience, and agricultural productivity are only now becoming more widely recognized. More importantly, the scientific understanding and technological capacity to put microbes to work continue to advance at an impressive pace. What is needed now is an effort to coordinate appropriately; prepared, basic and applied microbiologists, engineers, computational scientists, and modelers for sustainable growth of agriculture and bio-industries. ■



2,4-D Series

- 2,4-D Acid tech 98%
- 2,4-D Dimethylamine salt
 - 480g, 600g, 720g Acid Eq/lit
- 2,4-D Ethyl Hexyl Ester 98%, 680g/l
- 2,4-D Iso Butyl Ester 98%
- 2,4-D Ethyl Ester 96%
- 2,4-D Sodium salt 95%SP

Sulfonyl Ureas

- Metsulfuron Methyl tech, 20%WP, 60%WDG
- Sulfosulfuron tech, 75%WDG
- Chlorimuron Ethyl tech, 25%WP
- Metsulfuron Methyl 10% + Chlorimuron Ethyl 10%WP
- Nicosulfuron
- Tribenuron
- Thifensulfuron

Fungicides

- Isoprothiolane tech, 40%EC

Intermediates

- 2,4-DCP, 2,6-DCP, 2,4,6-TCP
- Phosgenated Intermediates
- Ethyl Centralite

Other Herbicides

- Clodinafop Propargyl tech, 8%EC, 15%WP
- Glyphosate tech, 41%SL, 71%SG

Insecticides

- Indoxacarb tech, 150SC
- Fipronil tech, 0.3%G, 5%SC





Dr. S. Rajendra Prasad,
Project Director and
Dr. Dinesh K. Agarwal
Principal Scientist
(Plant Breeding)
ICAR-Directorate of
Seed Research, Mau

Quality Seeds : Harbinger for Second Green Revolution in India



We are nearing completion of nearly five decades of the wonderful phenomenon called green revolution to have happened, and the changed demographic, climatic and geo-political scenario has been demanding a second green revolution for quite some time. Agricultural scientists need to intensify their efforts to expeditiously usher in Second Green revolution in the country. There are number of factors that, if addressed jointly, can make this long coveted dream of second green revolution benefitting the small and marginal resource poor farmers come true.

Adverse effects of climate change are looming large over vast tracts of the country as evident from recent trends of droughts and torrential floods. Time is ripe, when farmers of these regions are to be re-introduced to more resilient, nutrition rich conventional crops of bygone era such as millets. Pro-

PELLING agricultural productivity to next higher level requires urgent efforts to narrow the Yield Gap. NARS has been successful in developing a large number of region and situation specific crop varieties but the Varietal (VRR) and Seed Replacement Rates (SRR) still remain dismal. Adoption of improved cultivars and quality seeds can immediately provide a productivity boost of 15-20 %. Enhanced role of women in critical farm activities and decision making such as ensuring quality seeds for next crop cycle, engaging them in alternative livelihoods interwoven with farming would not only improve agricultural productivity but also enhance the

Increased Productivity Through Quality Seed Initiative

- *Climate resilient seed production technology*
- *Enhancement in Seed Replacement Rate (SRR) & Varietal Replacement Rate (VRR)*
- *Exploitation of genomics and proteomics approaches in seed research*
- *Employing community based seed models for different agro -ecosystems*

family's financial capabilities. Financing, farm women oriented activities could be done through establishing self help village based communities. Engaging rural work force into other livelihood earning means, entails the increased mechanization of farming. Formation of village based self help communities can help this. Adverse impact of climate change in the form of moisture stress (both, deficiency and excess in the single crop season) on crops, has necessitated the change in way farming has been done conventionally. Sowing in BBF (Broad Bed Furrows) and FIRBS (Furrows in Irrigated Raised Bed System) through suitable farm machines could be one of the ways of tackling it. Individual farmers may not be in a position to adopt these, but again self help communities may come in handy in solving this problem.

Quality seeds: for unleashing productivity potential

To have successful agriculture, quality seeds constitute the most important component. Seed is the most important input component for productive agriculture. The response of all other inputs depends on quality of seeds to a large extent. It is estimated that the direct contribution of quality seeds alone to the total production is about 15 – 20% depending upon the crop and it can be further raised up to 45% with efficient management of other inputs. The expansion of seed industry has occurred in parallel with growth in agricultural productivity. Given the fact that sustained growth to cope with increasing demand would depend more and more on the pace of development and adoption of innovative technologies, the seed would continue to be a vital component for decades to come.

Progress in Seed Replacement Rates (SRR) over the years across major crop species

Year	2007	2008	2009	2010	2011
Wheat	25.2	26.8	31.9	32.6	32.6
Paddy	25.9	30.0	33.6	37.5	40.4
Chick pea	11.9	14.4	22.0	18.4	19.4
Urd bean	23.9	26.3	30.9	29.2	34.4
Moong bean	21.7	21.9	23.0	26.7	30.3
Pigeon pea	16.0	16.0	27.8	17.5	22.2
Groundnut	14.3	17.0	22.9	24.5	22.5
Rapeseed & Mustard	58.6	52.7	74.8	63.6	78.9
Soybean	33.4	35.1	38.9	35.8	52.8

Source: Directorate of Economics & Statistics, Ministry of Agriculture, GOI

High Volume – Low Value Crops (Food grains- Cereals, Pulses, Oilseeds, Fibres and Forages) constitute the segment of agricultural crops that is the backbone of country's food and nutritional security.

Realizing the importance of seed and to keep pace with fast evolving policy initiative on seeds by Govt. of India, the ICAR launched the All India Coordinated Research Project on seed the National Seed Project in 1979. The development of high yielding dwarf varieties of wheat and rice; hybrids in maize, bajra and sorghum in early sixties was the landmark beginning for development of the seed programme in the country leading to establishment of giant seed corporations like National Seed Corporation, State Seeds Corporations and Seed Certification Agencies etc. During the past 5 years, the Indian Seed Industry has been growing at rate of 12% compared to global growth of 6-7%. The seed industry is poised to grow @ 11-14% and expected to touch USD\$ 3.2 billion by 2016.

Though AICRP-NSP (Crops) made rapid and giant strides in ensuring the production of breeder seed of field crops, to make use of excess land available with institutes and SAUs for

production of quality seeds and also to support the promotion of new varieties, ICAR launched "ICAR seed project" in 2005-06 and has continued it since then. Country's further advancement in agricultural production and productivity including field and horticultural crops to a considerable extent rests on higher Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR). Since, its inception, this project has continuously been aiming at enhancing the Seed Replacement Rate (SRR) & Varietal Replacement Rate (VRR) among crops and in the process has made a significant impact on the face of Indian seed sector during XI plan period and is continuing doing so with more vigour in ongoing XII Plan.

Factors Influencing Seed Production

Like any other agrarian enterprise, seed production is also vastly affected by the climatic conditions. Climate change scenario as evident from delayed and insufficient monsoon, mid-season flash floods and terminal drought, or excessive untimely rains at harvesting for past couple of years has given a setback to seed production programme in the country. Apart from

climate dependent agriculture, there are a number of other factors that determine the demand and supply of breeder seed in the country. Some of these are the inherent features of a crop species (Seed rate & Seed Multiplication Ratio) and, hence, cannot be altered beyond a certain point without a superior technological advancement; while other factors such as varietal preferences (Varietal Replacement Rate) and use of quality seeds (Seed Replacement Rate) may be manoeuvred favourably with strong and focussed efforts by various central and state governmental agencies.

Quality Seed Requirement of the country

Improved Seed Replacement Rate (SRR) in major field crops holds the key to improved agricultural productivity.

There has been some improvement during the past one decade as is evident from improvement in SRRs among various crops, still making the quality seed available to every farmer at reasonable price and time is a distant dream.

During the last two seasons, breeder seed indent for various reasons, without any doubt, has declined but the question that needs to be asked is actually how much quantity of breeder seed is truly required in the country? Already, every year there are numerous complaints from ICAR institutes and SAUs regarding non-lifting of breeder seed. It would only be appropriate, if the actual requirement for breeder seed is worked out considering the following multiplication chain.

From the table given above, it is evident that actual breeder seed

requirement is not very far from the quantity already being produced. The above said requirement is grossly over-estimated on account of two assumptions i.e. the seed replacement rate would be 100 % and the entire area under a given crop is planted with improved varieties of existing seed chain. Both of these requirements are neither practical nor desired. Planting entire crop area with improved varieties of seed chain replacing land races, traditional cultivars and farmers' varieties would lead to irreparable loss of genetic variability. The scenario painted above also ignores the ground reality of quality seed supply in the form of seed sale and exchange by local farming community and farmers themselves. Hence, as per the logic and information given in Table above, one may deduce with some certainty that the

Quality seed requirement of major crops in the country (Assumption 100% SRR)

Crops	Gross cultivated area (M.ha)	Seed Rate (Kg/ha)	Total certified seed requirement (in 000 tonnes)	SMR (ratio)	Foundation seed requirement (in 000 tonnes)	Breeder seed Requirement (in tonnes)	Breeder seed production 2013-14 (in tonnes)
Rice	45.60	50	2280.00	100	22.80	228.00	1937.48
Wheat	27.20	125	3400.00	20	170.00	8500.00	3051.67
Sorghum	7.70	15	115.50	160	0.72	4.51	36.88
Pearl millet	8.70	5	43.50	200	0.22	1.09	6.68
Maize	8.00	20	160.00	80	2.00	25.00	57.25
Pigeon pea	3.40	15	51.00	100	0.51	5.10	72.00
Chickpea	8.20	80	656.00	10	65.60	6560.00	597.57
Groundnut@	6.20	100	620.00	8	9.68	1210.93	1600.35
R&M	6.30	5	31.50	200	0.16	0.79	
Soybean	8.90	75	667.50	16	41.72	2607.42	954.16
Sunflower	1.90	10	19.00	50	0.38	7.60	8.57
Cotton	9.50	12	114.00	50	2.28	45.60	14.61
Jute	0.80	5	4.00	100	0.04	0.40	2.35
Total	142.40		8162.00		316.11	19196.44	8339.60

@: Groundnut foundation seed requirement is calculated on basis of two stage c/s production

Production / availability of certified / quality seeds (q) in the country

Year	KHARIF		RABI		TOTAL		
	Demand	Production/ Availability	Demand	Production/ Availability	Demand	Production/ Availability	Surplus Status
2008-09	96.04	105.53	111.23	144.80	207.28	250.34	43.06
2009-10	110.96	126.51	138.15	153.21	249.12	279.72	30.60
2010-11	123.11	141.93	167.64	179.42	290.75	321.35	30.60
2011-12	139.33	151.29	191.07	202.33	330.40	353.62	23.21
2012-13	129.64	141.81	185.53	186.77	315.18	328.58	13.40
2013-14	139.87	153.94	195.38	193.37	335.26	347.31	12.05
2014-15	145.66	149.46	197.89	202.30	343.55	351.76	8.21

(Source : compiled by Seeds Division of DAC)

actual requirement of breeder seed is already being produced in the country.

The contribution of public and private sector in making the quality seed available in 2012-13 was 49.05 & 50.94 %, respectively. Public sector is mostly taking care of High Volume-Low Value crops (Food Grains), which are the backbone of country's food and nutritional security; while private sector is mostly involved with profit rich Low Volume-High Value crops.

Poor varietal adoption rates : a reason of concern

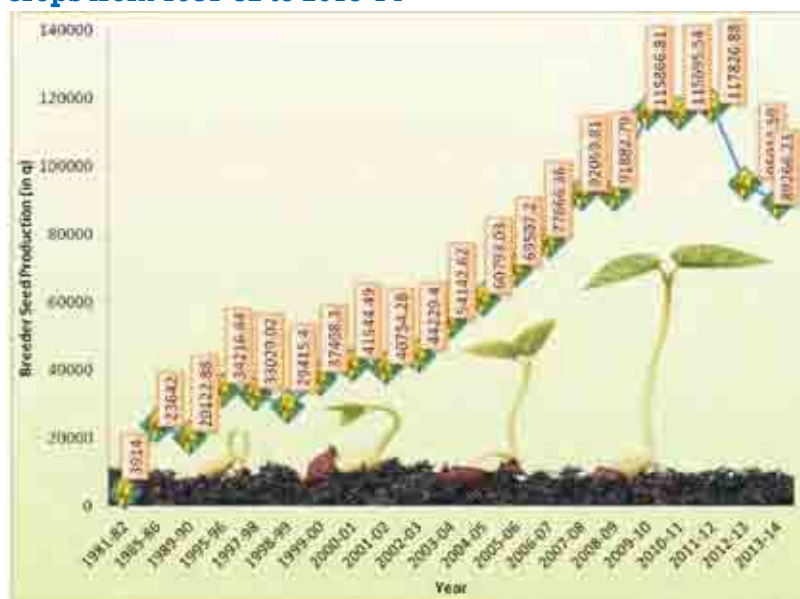
Another major problem due to which there is a significant lag in bridging the Yield Gap among major food crop is the poor Varietal Replacement Rate (VRR). Even though more than 4500 varieties have been notified and are available, indents for basic seed and its further multiplication is restricted to few varieties. Many improved varieties, which are location specific, resistant to biotic and abiotic stresses do not find a place in active seed chain. The problem may be with below par extension activities either in NARS system or abysmal outreach activities by agencies of agricultural departments but the truth that remains is the that farmers

are deprived of fruits of agricultural research (improved varieties). Hence special focus needs to be given on improvement of VRR, which will certainly pave the way for improved productivity levels manifested in the form of increased production. By addressing the mentioned challenges (SRR & VRR) broader goals of increasing agricultural productivity and food security can be attained.

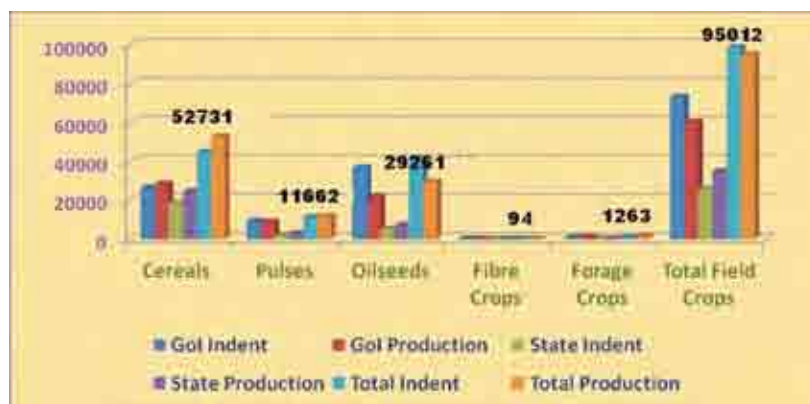
There are a good number of varieties in seed chain both in paddy as well as in wheat. Average age of top

10 indented varieties in wheat is 7 years which is a good sign and shows a high varietal replacement rate. While, the latest variety to be able to make place among top 10 in paddy and wheat are of years 2011 and 2014, respectively. Both, paddy and wheat still have varieties as old as 1985 and 1982 among the top 10 in terms of demand. In, paddy and barley, there is less varietal diversification as top 10 varieties constitute only 61.87 % & 76.27 % of indent; while in wheat top 10 varieties cover up almost the

Fig. 1 : Progress of Breeder Seed Production among field crops from 1981-82 to 2013-14



Field Crops- Breeder Seed Production under AICRP-NSP (Crops) during 2013-14 (Figures in quintals)



entire indent (97.02 %).

Among pulses, green gram (8 years) recorded the lowest average age of top 10 indented varieties, while in pigeon pea it was 17 years. Though the variety notified as late as 2009 has found a place among top, a variety notified in 1976 (39 years old) is also among the top 10 indented varieties in pigeon pea. Varietal Replacement Rate needs to be raised in pigeon pea in particular and all other pulses as well, which at present is on lower side in comparison to cereals.

Among oilseeds groundnut (9 years), Soybean (10 years) and sesame (10.5 years) recorded the low to moderate average age for most demanded varieties, while in rapeseed and mustard (16 years) it was recorded to be the highest. Both in rapeseed and mustard and sesame, very old varieties released in 1982 and 1984, respectively, were able to make place among top group, which needs a correction in years to come. In case of soybean, top 10 indented varieties have accounted for nearly 98 % of total indent, which again is not a desirable scenario and shows poor level of varietal diversification which needs rectification.

There are number of modern va-

rieties that are available for farmers. These varieties are not only location specific but have resistances to major biotic and abiotic stresses. Adoption of these modern varieties would definitely go a long way in ushering in the second green revolution in the country.

Achievements under Quality Seed Production by National Agricultural Research System (NARS) in the country

Breeder Seed Production under All India Coordinated Research Project-National Seed Project (AICRP-NSP) : The progress of breeder seed production of improved varieties with superior attributes and distribution is taking place at an incredibly faster pace, as witnessed in increased breeder seed production of 89266.23q as against the indent of 84788.60q in 2013-14 (Rabi/Summer 2013-14 and Kharif 2014) (Figure 1). The breeder seed availability has improved the quality of seeds in subsequent generations in the seed multiplication chain and also resulted in increased Seed Replacement Rate (SRR) of varied crops.

Difficulties in Breeder Seed

Production and Maintenance of Supply Chain

There are numerous constraints in achieving the perceived goals of ideal seed scenario of the country. Some of these are those that affect India's agriculture also; in addition there are other constraints that emerge from many other reasons. Important constraints are listed below:

- Adverse influence of climatic vagaries, declining soil fertility, elevated levels of biotic and stresses, poor availability of manpower and lack of mechanization. These factors individually and at times in combination affect the agricultural productivity.

- Deteriorating effects of Climate Change have already started affecting the seed production programmes. Delayed onset of monsoon coupled with uneven distribution of rainfall resulting in mid-season flash floods and terminal droughts have badly affected some of the important crops like soybean and pulses. Changed atmospheric CO₂ and temperature regime are altering the insect pest milieu that at times results in poor pollination and thus in turn may lower the seed yields.

- Agricultural technologies like ensuring the supply of quality seeds, need a considerably long gestation period for any immediate corrective measure to adopt. It is only pertinent to have a contingency plan in shape of a national facility like "Seed Bank" to ensure the steady supply of breeder seeds. This would be a "Fort Knox" for country's food and nutritional safeguard.

- Traceability of breeder seed source in multiplication chain is a vital link. This is a major factor in ensuring the redressal of quality issues as far as breeder seed production is concerned

and warrants an early settlement.

- Development of DNA based rapid detection protocol would save a lot of energy and time factor that goes into lengthy grow out tests.

- Issue of non-lifting of breeder seed from production centres is another serious management issue. Though recently a mechanism in form of monetary penalty for defaulters has been introduced, but still a complete solution to the problem is yet to be worked out.

- There has to be a strict uniformity in adoption of norms across the states in the country especially in terms of Uniformity in colour and size of breeder seed labels.

- At times indent for breeder seed received by DoAC from various State Governments are unrealistic for some of the varieties due to various reasons and do not truly represent the demand for these varieties. This often results in non-lifting of seeds and also hampers the process of achieving goals of enhancing the VRR and SRR.

- Any sudden upsurge in demand for a particular variety, for the reasons stated above, has many road blocks and constraints in fulfilling it in the

ensuing season.

Quality Seed Production under ICAR Seed Project

During the year 2013-14, total production of quality seed including all classes was 648325 quintals against the target of 475179 quintals. Production comprises 94953 quintals of breeder seed, 144369 quintals of foundation seed, 163465 quintals of certified seeds, 172351 quintals of truthfully labelled seed and 73185 quintals of planting material of field crops. In addition, 155.59 lakhs planting material and 5.60 lakh tissue culture plantlets of field crops were produced against the targets of 94.80 and 2.07 lakhs.

Impact of Quality Seed Production Programme

AICRP-NSP (Crops) in tandem with ICAR Seed Project has been instrumental in ameliorating the crop productivity of the country by enhancing SRR and VRR. Its impact on agricultural scenario could be summarised by following points :

- Surplus availability of breeder seed with appropriate research backdrop

- Availability and spread of quality seed to farmers has been enabled
- In enhancing area coverage under high yielding varieties.
- In enhancing crop productivity
- In raising availability and access of food grains and providing food and nutritional security through seed security

OECD Varietal Certification in India

The Organization for Economic Co-operation and Development (OECD) is an inter-governmental organization established in 1958 and is having its secretariat at Paris. OECD offers a multilateral forum to discuss, develop and reform economic and social policies. The OECD Seed Schemes provide an international framework for the certification of agriculture seed moving in international trade. Fifty eight countries including India, from Europe, North and South America, the Middle-East, Asia and Oceania are currently the members of OECD Seed Schemes. India's participation in OECD Seed Schemes would further bolster the seed industry in the country.

Keeping in view the food and nutritional security of the country in the future, ensuring the supply of quality seeds of highest standards is the most critical input of agrarian enterprise. Though we produce 100 % of Gol indent of breeder seed, there are limitations to breeder seed production and maintenance of supply chain but efforts are on to mitigate these and find a way forward to move ahead with increased vigour and enhanced efficiency. Hence, the National Seed Project has worked out certain key areas for further bolstering the seed scenario. ■



GSFC... Believes in "Transformation" &
Not in "Transaction"



Dr. S K Nanda, IAS,
Chairman & Managing Director, GSFC

Gujarat State Fertilizers & Chemicals Ltd. (GSFC) is a conglomerate which enriches the lives of millions of people on daily basis. GSFC's products and inputs touches all walks of life ranging from fertilizer products, industrial chemicals & gases; agro products & services, green power generation to education. Our flagship fertilizer brand **SARDAR** is the most trusted brand among farmers in India. We deliver a wide array of fertilizers including Nitrogenous and Phosphatic fertilizers. We have a prominent presence in Agro products through Liquid Bio-fertilizers Sardar Amin Granules/ Liquid, Plant Tissue culture, Seeds and Sardar Nirmal.

On the industrial front, we are the first to establish Melamine and Caprolactam plants in the country. Our major industrial products include Caprolactam, Melamine, Nylon-6, Polymer products, Nylon Filament Yarn, Industrial Acids and Gases.

Sustainability has always been at the core of our thinking. We have a strong base of Agro Services in terms of Crop Demonstration, Farm Youth Training Programs, mobile soil testing van, Krishi Jivan (our publication) and Sardar Agrinet Call Centre to provide free telephonic counselling to farmers about best agricultural practices.

We have over 200 depots in Gujarat, governed by agriculture graduates who conduct colossal extension service, field demonstrations at regular interval besides sales and promotion activities. In case of Crop demonstration, we select a farmer and provide him agricultural inputs and guidance from sowing to harvesting stage. Later, on a pre decided date villagers are accumulated and shown the best agricultural practices to increase productivity on Demonstration farm.

We also conduct Farm Youth Training Programs, where young farmers are given training for eight days on scientific developments and application of latest agro-techniques. The program is conducted in collaboration with Agricultural Universities of Gujarat. These trained young farmers help in propagating the best practices across the state which eventually increases productivity.



Recently we have launched Sardar Agri Package, our 3 Tier Green Initiative which is a package of integrated inputs for farmers in terms of Power (Solar), Water (micro-irrigation systems) and plant Nutrients (Water Soluble Fertilizers). Its main objective is to provide plethora of benefits to the farmer, his family, society, and sustainable environment.

Innovations at GSFC have always gained mileage over its peers. Polymer-Coated Urea is an innovation, which is in its advanced trial stage. It has polymer coated granules of urea with biodegradable film for controlled release of Nitrogen to Plants during its growth aimed at higher nutrient efficiency and higher yield with reduced fertilizer input.

We have an independent Corporate Social Responsibility (CSR) Cell focussed to improve quality of life among weaker sections of the society. It carries out programs related to Health, Education, Sanitation, Women Empowerment, and Livelihood Generation for Youth.

GSFC has been the recipient of many awards and accolades for its various achievements such as Golden Peacock Award - 2014 for Corporate Social Responsibility, Best PSU Award, FAI Environmental Protection Award, India's No. 1 Brand Award, Leadership Award and Udyog Rattan Award etc.



**GUJARAT STATE FERTILIZERS
& CHEMICALS LIMITED**

Fertilizemagar - 391 750, Vadodara, Gujarat, India.

www.gsfclimited.com

CIN : L99999GJ1962PLC001121



**CLIMATE CHANGE
AND
SUSTAINABLE
AGRICULTURE**

Overview

Sectors like agriculture, forestry and fisheries are a well known and significant source of global emissions of greenhouse gases. Activities in the farm sector that feed the Earth's human population of over 7 billion and provide livelihoods for billions of people across the globe also pollute the environment with greenhouse gasses and serves as one of the important reasons for cli-

mate change. The very carbon dioxide (CO₂) that the plants utilise from the atmosphere to make their own food and thereby helping to remove harmful CO₂ from the environment is released to the atmosphere in the form of CO₂ and other non-CO₂ greenhouse gases (GHG), largely methane (CH₄) and nitrous oxide (N₂O), in the form of plant respiration, by decomposition of dead plant biomass and soil organic matter and by combustion.

New production methods and intensified production systems in the field of agriculture is necessary to increase production from decreasing cultivable areas across the globe to feed the ever increasing world population. Increased use of energy, chemical products, and labor inputs are necessary to increase agro-ecosystem production and all these are inevitably altering natural biogeochemical cycles and contributing to global pollu-

Table 1: Emissions for agriculture, forestry and other land use

Sector	Source	Type of Pollution
Agriculture	Enteric Fermentation	Methane gas (CH ₄) produced in digestive systems of ruminants and to a lesser extent of non-ruminants
	Manure Management	Emissions of nitrogen from manure applied to cropland as organic fertilizer, left on pasture by grazing animals or processed in manure management systems
	Rice Cultivation	Methane released by anaerobic decomposition of organic matter in paddy fields
	Synthetic Fertilizers	Direct and indirect emission of nitrous oxide (N ₂ O) from nitrogen added to agricultural soils by farmers
	Crop Residues	Direct and indirect emissions of nitrous oxide from crop residues and forage-pasture left on agricultural fields by farmers
	Cultivation of Organic Soils	Emissions included in agriculture from the cultivation of organic soils are those associated with nitrous oxide emissions following drainage of agriculture land
	Burning – Savanna	CH ₄ and N ₂ O gases produced from the burning of biomass vegetation in the five land cover types (savanna, woody savanna, open shrub land, closed shrub land and grassland)
	Burning - Crop Residues	Consist of CH ₄ and N ₂ O gases produced by the combustion of crop residues burnt on-site
	Energy Use in Agriculture	Consist of carbon dioxide, methane and nitrous oxide gases associated with direct fuel burning and electricity generation for agriculture, including fisheries
Forestry and Other Land Use	Forest Land	Consists of net carbon stock change in the living biomass pool (above ground and underground biomass)
	Cropland	The emissions from cropland are those associated with the carbon dioxide following soil drainage due to the cultivation of organic soils for crop production
	Grassland	The emissions from grassland are those associated with the carbon dioxide following soil drainage due to the cultivation of organic soils for livestock production
	Biomass Burning	Emissions consist gases produced by the burning of biomass (CH ₄ , N ₂ O, CO ₂ etc.)



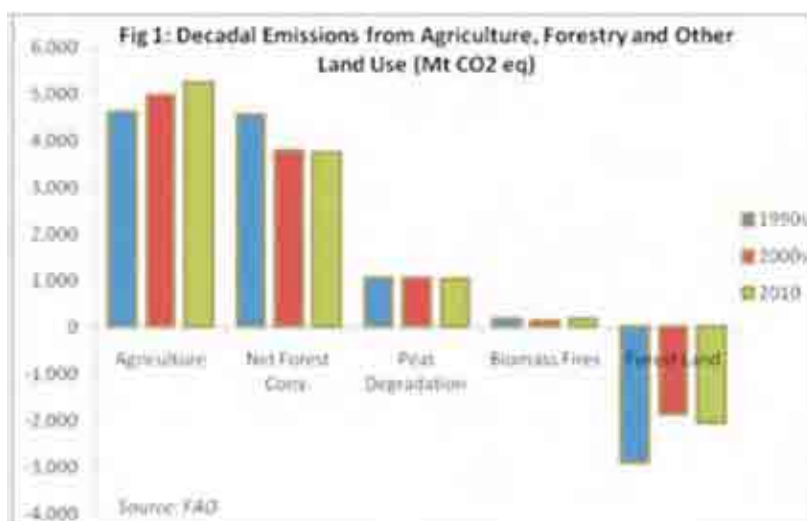
tion. Agricultural activities along with forestry are leading to increased green house gas (GHG) emissions and posing a serious threat for irreversible environmental damage. It is also leading to soil degradation, water pollution, loss of biodiversity and disruption of carbon sinks. It is currently estimated that the annual global anthropogenic greenhouse gas (GHG) emissions are over fifty billion metric tonnes of carbon-dioxide (CO₂). This has altered the atmospheric concentrations well beyond natural levels.

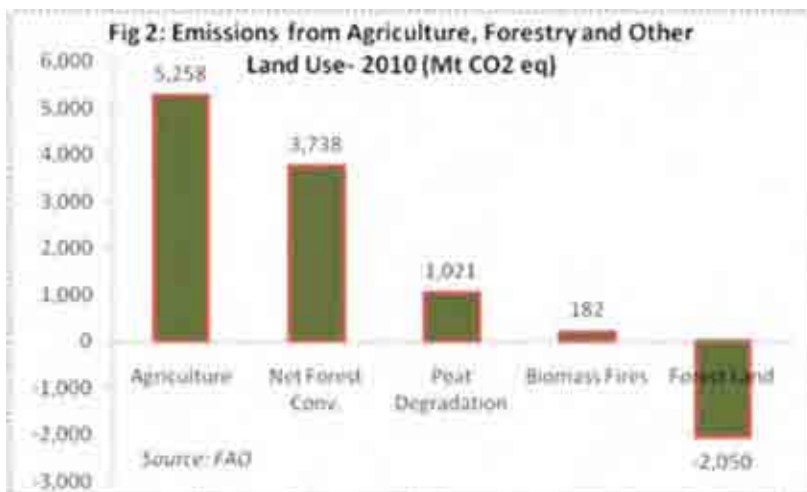
Estimated net emissions from the

agriculture, forestry and other land uses activities have registered a substantial increase of 8% between 1990 and 2010. In 1990, the total emissions from these activities were 7,497 metric tonnes equivalent of CO₂. This increased to an estimated 8,103 metric tonnes equivalent of CO₂ during the 2000s. In 2013, the total global atmospheric CO₂ concentrations have gone past 400 ppm and this is about 35% above their pre-industrial equilibrium levels. The emissions from the agriculture sector have increased by almost 14% during the period between 1990

and 2010. In 1990, the total emissions of different green house gasses from agricultural activities were 4613 Mt CO₂ equivalent. In 2010, the same increased to 5258 Mt CO₂ equivalent. On the other hand, contribution of green house gasses from net forest conversion activities across the globe decreased significantly by 18% during the time period ranging from 1990 to 2010. The net emissions from net forest conversion activities in 1990 were 4568 MT CO₂ equivalent which had decreased to 3738 MT CO₂ equivalent in 2010. Emissions from peat degradation also registered a decrease of about 3% in the GHG emissions from 1055 in 1990 to 1021 MT CO₂ equivalent in 2010 (Fig 1).

Interestingly, agriculture sector acts as both source and sink of various green house gasses like CO₂. As a result, efforts for reduction or prevention of emissions to the atmosphere from various agriculture activities along with efforts to enhance the uptake of carbon in terrestrial reservoirs are crucial to reduce the net emissions of various green house gasses. Demand side corrections like positive changes in lifestyle, reducing losses





and wastes of food, changes in human diet, changes in wood consumption etc. can significantly work towards reduction in emissions from the agriculture sector. As the society is emerging and globally there is a stress on meeting the increased needs of urbanisation, there is a lot of focus on reducing emissions from various agriculture, forestry and other land use activities.

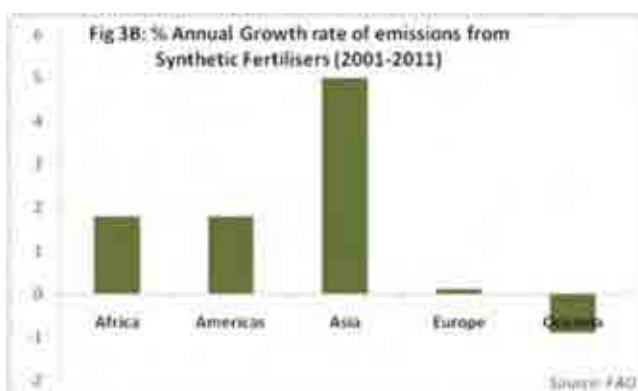
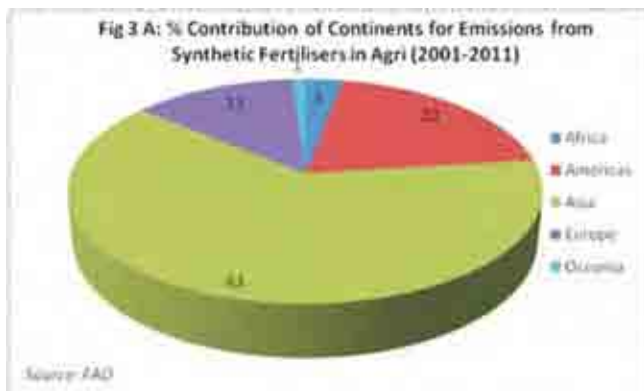
Agricultural activities in various parts of the world are showing increasing application of various synthetic fertilisers. It is becoming necessary from the point of view of increasing agricultural production and the requirement of feeding the burgeoning world population. Intensive high-yield agriculture is making it necessary for increased application of synthetic fertilizers, especially industrially produced NH₄ and NO₃. It is estimated that only 30 to 50% of the applied ni-

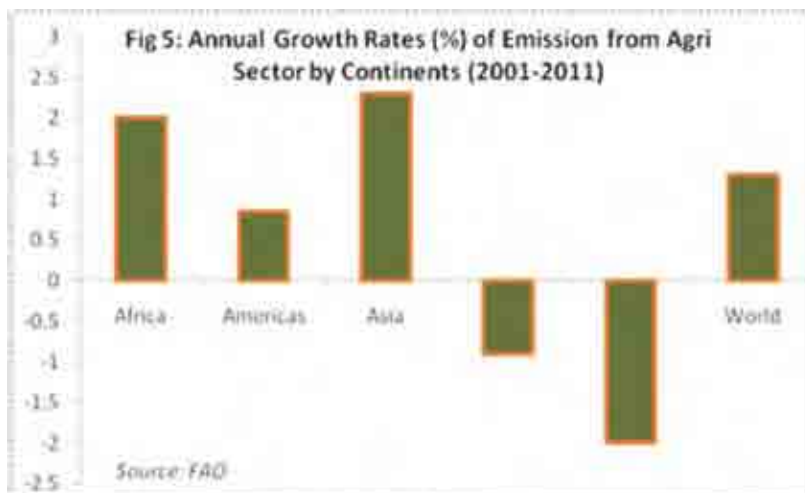
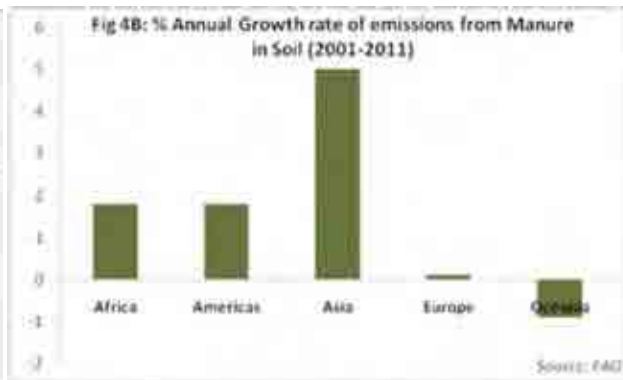
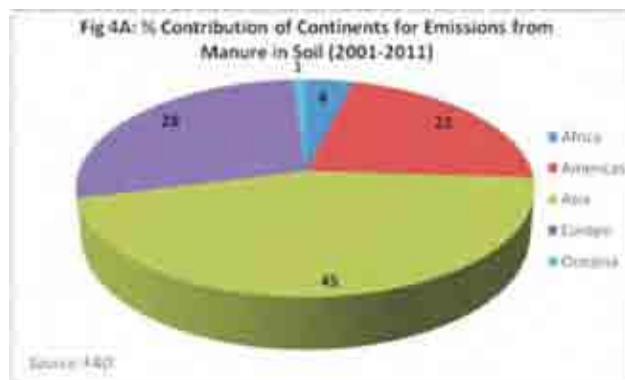
trogen fertilizer and approx 45% of the applied phosphorus fertilizer is taken up by crops and a significant amount of the applied nitrogen and a smaller portion of the applied phosphorus is lost from agricultural fields to the atmosphere, causing global warming in



the form of green house gasses. The release of various green house gases as a result of application of synthetic fertiliser across various continents, are shown in Fig 3A. From year 2001 to 2011, Asia has contributed the highest amount of emissions at a staggering 63% of all the global emissions from synthetic fertilisers. Second largest polluting continent in this category is the Americas, with 20% of the total emissions. Europe and African nations have contributed 13% and 3% of the total emissions from the application of synthetic fertilisers in agriculture. Oceania is the least contributing continent with just 1% of the emissions.

Along with the percentage contribution of various continents in emissions of green house gases from the application of synthetic fertilisers, it is also important to note the average





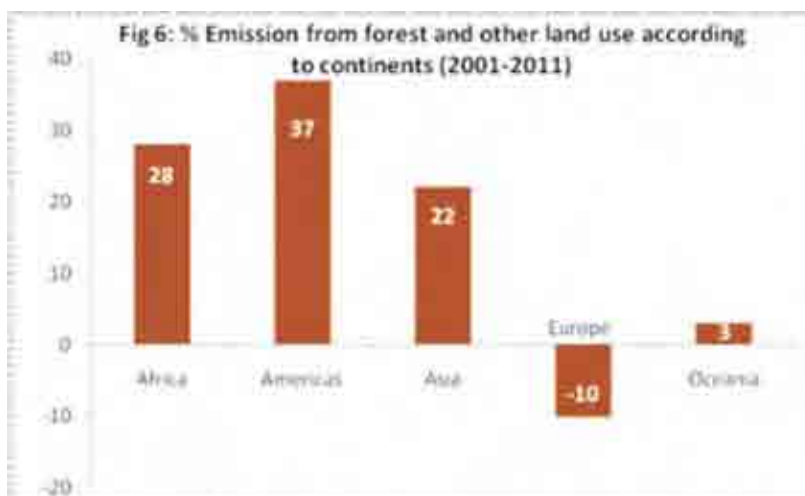
annual growth rate of emissions in these continents as a result of the use of synthetic fertilisers. Fig 3B shows that Asia along with the fact that it is the highest contributor of GHG from synthetic fertilisers, is also the fastest growing continent in terms of the

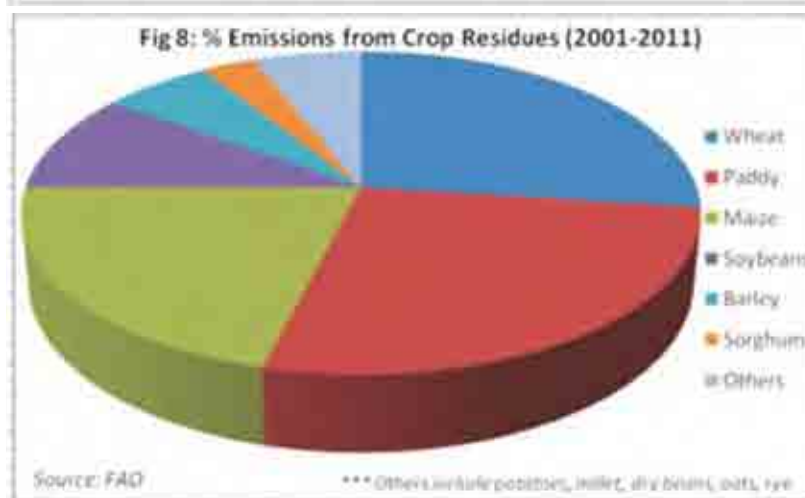
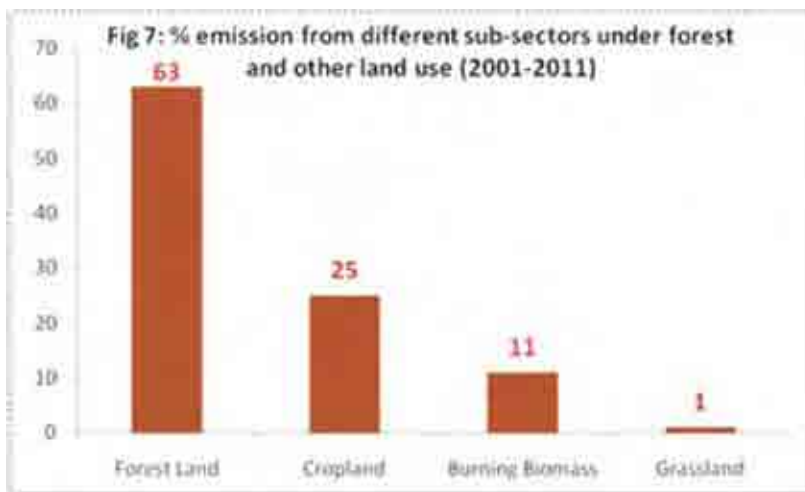
rate of increase of emissions. It has grown at an annual average rate of 5% between the years 2001 and 2011. Africa and Americas have respectively witnessed a growth rate of 1.8% each per year (Fig 3B). It is clear that Asian countries, apart from contributing the

maximum amount of emissions from synthetic fertilisers, is also exhibiting higher growth rate and is can only be mitigated with efficient and judicious application of chemical fertilisers. While Europe has shown negligible growth rate, Oceania has registered a negative growth rate of 0.9% annually between 2001 and 2011.

It is not just synthetic fertiliser that is contributing to the global emissions from the agriculture sector. Emissions from manure applied to the soil are also a significant contributor of GHG globally. According to estimates, Asian region contributed 45% of the total emissions of GHG globally from manure applied to the soil followed by the European region at 28% and the Americas at 22%. Africa and Oceania contribute 4% and 1% respectively. However, African continent has the highest growth rate with 3.7% annually between 2001 and 2011. Asia follows as the second highest growth rate in this sector of global emissions from agriculture with 2.5% growth per year during the same period. Europe showed a negative growth of 0.9% per year.

It is important to study the rate of growth of growth of emissions across different regions along with contribution from regions. Fig 4 shows that while Europe and the Oceania region has registered a negative growth in terms of emissions from agriculture sector, Africa, Americas and the





Asian region have registered high positive growth in the years from 2001 to 2011. Since the year 2000, the rate of growth of emissions of different GHG has been 2% per year till 2011. The approximate yearly rate of increase of emissions from agri activities in the Asian region has been 2.3% from 2001-2011. Asia is therefore the fastest continent in terms of growth rate of emissions from agriculture sector. The growth rate in the Americas has been contained to below one percent per annum from 2001 to 2011. The encouraging news was from Europe and Oceania region where a negative growth rate was witnessed (0.9% for Europe and -2% for Oceania). The average global growth rate from 2001- to 2011 for

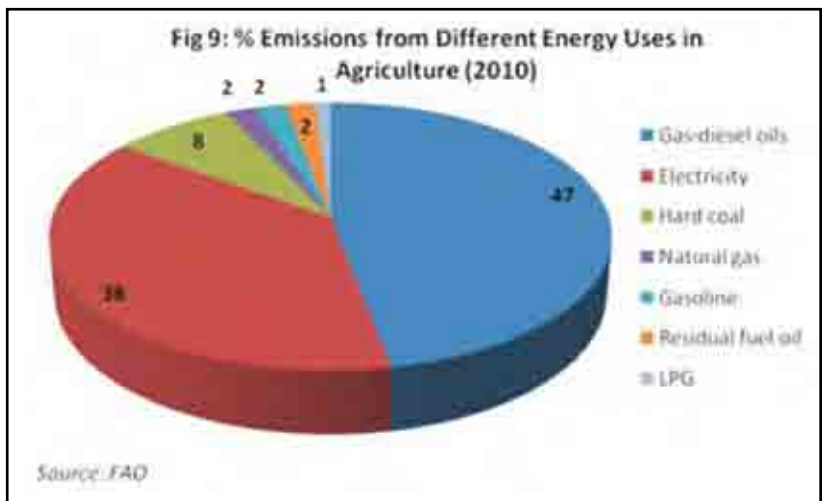
emissions from the agriculture sector was approximately 1.3%.

When it comes to emissions from the forestry and other land use, it emerges that the Americas is the largest polluting region. During 2001-2011, the average emissions from forest and other land use activities in the Americas contributed 37% of the total



emissions from the sector globally and was the highest. Human activities in the form of intensive land use, land-use change and affect changes in carbon stocks between the carbon pools of the terrestrial ecosystem and also between the terrestrial ecosystem and the atmosphere, leading to net release of GHG in the atmosphere. Africa is the second largest region in terms of release of GHG and from 2001 to 2011, this region contributed 20% of the total global emissions from forest and other land uses. Asian region contributed 22% of the global emissions from this sector during 2001 and 2011. Europe had a negative contribution of 10% while Oceania region contributed 3% of the total emissions from forest and other land uses.

The subsectors of forestry and other land uses that contribute to pollution are forest land, cropland, burning of biomass and grassland. Out of all these, forest land was the largest contributor of green house gasses across the globe. Loss of forests contributes considerably in the total global greenhouse-gas emissions each year. The world currently has about ten billion acres of forest and since 1990, the world has lost more than 3% of its total forest area. This has been as a result of deforestation caused by exploitation of natural resources that includes expanding populations, logging, agriculture, bio-fuel production, and wildfires. During the period between 2001- and 2011, forest land contributed 63% of the global emissions from forest and other land use (Fig 7). The greatest overall loss in forest area and concomitant contribution to emissions occurred in Latin America and the Caribbean, followed closely by in Africa. A country like China that has been witnessing rapid growth in the production of manufactured goods in last decades has shown increasing consumption of

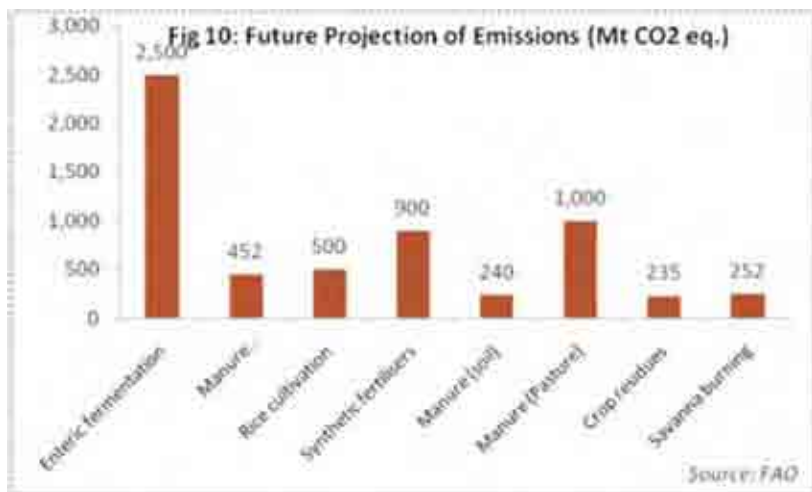


forest products and is currently the greatest in the world.

Wheat and paddy contribute the highest amount of emissions amongst all the different crop residues, at 27% in each case. Maize is the third largest contributor of GHG emissions at 21%. It is noteworthy that these three crops are very important as cereals and food grains across the world and is crucial for feeding the world population and providing food security. At the same time, these three crops are contributing 75% of the total emissions from crop residues in the agriculture sector. These crops, particularly paddy release GHG like carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). GHG emissions from conventional rice production are largely as-



sociated with its water through the embodied emissions associated with irrigation provision, and from flooded soils that create the anaerobic soil environments driving microbial methane production. Even when paddy is not grown in flooded conditions, there is GHG emissions from no-flooded rice where emission of nitrous oxide plays



an important role. Soybeans contribute 10% of the global emissions from crop residues, barley 6% and sorghum contributes 3% of the emissions from crop residues. Others like potato, millets, dry beans, oats and rye contribute the remaining 6% of the emissions.

Agriculture sector also uses various forms of fossil fuel burning for machinery, power irrigation, and fishing vessels. Emissions from energy use in agriculture consist mainly of CO₂ along with some minor emission of methane and nitrous oxide. Total annual GHG emissions from energy use in agriculture sector across the world in 2010 were 785 Mt CO₂ eq. This is a net increase of 20% as compared to 2000 when the emissions from this segment was 651 Mt CO₂ eq. In 2010, emissions from gas and diesel oils used in agriculture constituted 47% of the total emissions from various sources of energy used in the agriculture sector (Fig 10). Electricity sources used in agriculture sector contributed 38% of the total emissions. Hard coal (8%), natural gas, gasoline, residual fuel oil with 2% each and LPG with 1% were the other contributors.

Future Outlook

Considering the average data from 2001 to 2010, global agricultural emissions are projected to increase by 18% in 2030. The same would be 30% more in 2050 and would be reaching more than 6,300 Mt CO₂ eq in 2050. Talking about growth in emissions from specific subsectors, global emissions from enteric fermentation are projected to increase by 19% and 32% in 2030 and 2050, respectively, reaching more than 2,500 Mt CO₂ eq in 2050. Emissions from manure management are projected to be reaching more than 452 Mt CO₂ eq in 2050, that from rice cultivation reaching more than 500 Mt CO₂ eq in 2050. ■

Organic Farming

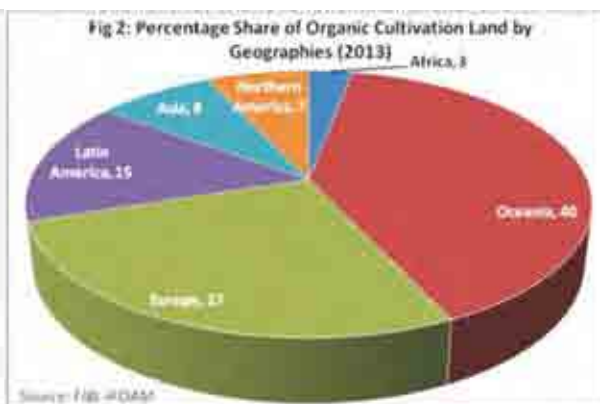
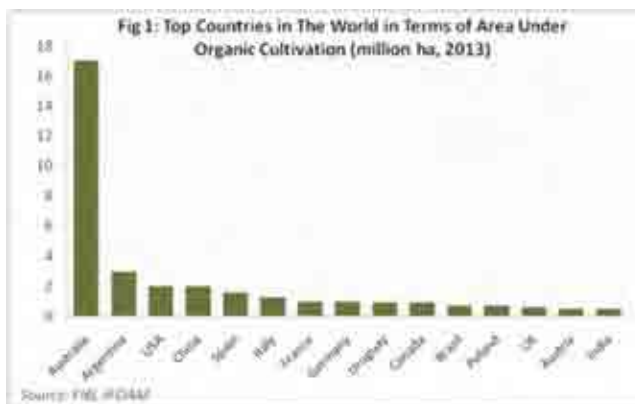
Organic Agriculture has assumed an increased momentum across the world. In 2013, total value of organic products sold globally was USD 72 billion, maintaining a growth rate of over 10 percent annually. In the current global scenario of climate change, rapid loss of biodiversity and the huge challenges on sustainable agriculture, the philosophy of organic food production assumes a great deal of significance. Essentially, organic farming maintains the principles of biodiversity, ecological balance, sustainability, natural plant fertilization, natural pest management and soil integrity. All these principles are indispensable in today's world where human existence is being challenged by irresponsible and unsustainable practices related to environment and agriculture.

Globally, land under organic farming in 2013 was 43.1 million hectares. Australia is leading the organic farming movement in the world and till 2013, it had 17 million hectares of land under organic farming. This is 39% of the total global area under organic farming and is way ahead of the second largest country Argentina in terms of area under organic cultivation. In 2013, Argentina had 3 million hectares of land under organic cultivation.



USA and China are the other major organic farming countries with about 2 million hectares each under its cultivation. India is fast emerging as an important country in the global map of organic cultivation and in 2013, the country had about 0.7 million hectares of land under organic cultivation. When compared to 2012, the global area under organic cultivation has increased by almost 6 million hectares which was largely as a result of a huge increase of about 6 million hectares between 2012 and 2013 in Australia.

In terms of different geographies, Oceania region has the largest share with 40% of the total global organic farming in 2013, largely due to the huge acreage in Australia (Fig 2). Oceania region had 17.3 million hectares of land under organic farming in the year under consideration. European region had a share of 27% of the organic area in the world with 11.5 million hectares of land under its cultivation in 2013. Latin American countries together had a share of 15% of the global organic cultivation with 6.6 million hectares of land. Asia and





er percentage of area, countries like Falkland Islands (36.3% of total agricultural area under organic), Liechtenstein (31% of total agricultural area under organic), Austria (19.5% of total agricultural area under organic) etc. have considerable area under organic cultivation with respect to the total area under farming in these countries.

Fig 3 provides a status of area under organic cultivation in some of the major organic growing states in India. Madhya Pradesh is the largest organic state in the country with 233 thousand hectares of land under certified organic cultivation in 2013-14. This is 33% of the total area under organic cultivation in the country in 2013-14. Maharashtra emerged as the second largest organic farming state in the country with 85 thousand hectares. 66 thousand hectares and 61 thousand hectares of land were under organic farming in the states of Rajasthan and Sikkim respectively. Sikkim has drawn up elaborate plans and schemes for promoting organic agriculture in the state in the recent years. The other important organic farming states are Gujarat (47000 ha), Karnataka (31000 ha), Odisha (50000 ha), Uttar Pradesh (45000 ha) and Uttaranchal (25000 ha).

Northern America shared 8% and 7% of the total global area under organic farming in 2013. While Asia had 3.4 million hectares of land under its cultivation, Northern American countries together shared 3 million hectares. In terms of share of the total agricultural land under organic farming, currently about one percent of the total agricultural land is under organic farming on a global scale. The highest share of organic farming area with respect to the total agricultural land is in Oceania with 4.1% share. Europe has 2.4% of the total agricultural land available in this region under organic cultivation. However, there is a large disparity within the European region amongst various countries in terms of percent-

age share of organic area out of the total agricultural area. While some of the European countries have low-



Many farmers in India are shifting to organic farming sensing the growing opportunity in domestic and international demand for organic food. Moreover, stringent standards for non-organic food in European and US markets along with rejection of many Indian food consignments in the recent past is motivating many farmers to shift to organic farming and take advantage of a better alternative to chemical farming. In 2013, India had the highest number of organic producers in the world with about 650000 farmers practicing organic farming. However, the future would expect proportionate increase in area under organic farming in the country. At a time when rampant use of chemical fertilisers and inorganic pesticides is making the soil weaker and adversely impacting the environment apart from causing direct health issues for human beings, more and more farmers turning to organic cultivation is a welcome sign. There has been a lot of focus from the government for encouraging organic cultivation in India and the results are encouraging. On one hand, government is promoting organic farming from a market perspective and on the other hand, by encouraging natural farming techniques, government is trying to reverse the effects of decades of unrestrictive and erratic use of pesticides and chemical fertilizers in water and soil. Government is promoting organic farming through various schemes/ programmes under National Mission for Sustainable Agriculture (NMSA)/ Paramapragat Krishi Vikas Yojana (PKVY), Rashtriya Krishi Vikas Yojana (RKVY), Mission for Integrated Development of Horticulture (MIDH), National Mission on Oilseeds & Oil Palm (NMOOP), Network Project on Organic Farming of ICAR.

Table 1: List of Major Crops Coming under Organic Cultivation in Different States

State	Major crops under organic farming
Arunachal Pradesh	Maize/sorghum, Pulses, oilseeds, tea/coffee, herbal/ medicinal plants
Andhra Pradesh	Cotton, maize, pulses, oilseeds, fruits and vegetables
Assam	Tea/coffee, fruits and vegetables
Chhattisgarh	Rice, wheat, vegetables
Delhi	Wheat, vegetables
Goa	Fruits, vegetables
Gujarat	Cotton, pulses, oilseeds, vegetables
Haryana	Basmati rice, wheat, maize, vegetables
Himachal Pradesh	Wheat, fruits, vegetables
Jammu and Kashmir	Spices, fruits and vegetables
Karnataka	Cotton, rainfed wheat, maize, sorghum, pulses, oilseeds, vegetables
Kerala	Spices, vegetables, herbals
Manipur	Spices, vegetables, herbals
Maharashtra	Cotton, rice, wheat, pulses, oilseeds, spices, vegetables
Madhya Pradesh	Soybean, wheat, vegetables
Meghalaya	Spices, vegetables
Punjab	Basmati rice, wheat, vegetables
Sikkim	Maize, sorghum, vegetables, spices, herbs
Rajasthan	Cotton, wheat, seed spices, vegetables
Tamil Nadu	Tea, herbs, spices
Uttar Pradesh	Rice, wheat, maize, vegetables
Uttarakhand	Basmati rice, vegetables, maize, sorghum, herbs, spices
West Bengal	Tea and vegetables

Special Focus on North East India for Organic Cultivation

Very recently, Government of India through the Ministry for Development of North Eastern Region has embarked upon an ambitious plan worth Rs 125 crore to convert the region into a hub of organic farming in India. States like Sikkim and Mizoram are emerging as the prominent states in the country in organic farming. Other north eastern states like Meghalaya is gradually doing away with chemical fertilisers and pesticides and providing free bio-pes-

ticides and bio-agents to farmers. The advantage with north eastern region in terms of organic farming is that this region has been naturally organic for ages and it's only in the recent years that chemical fertilisers and pesticides have found their way into the farming system of the region. States like Sikkim were traditionally organic, and adopting organic farming in the state would benefit not only the 62,000 farming families of the state who own an average of 1.9 hectares of farmland, but also maintain the quality of environment of the state. ■

crops &



more..



SHRIRAM FARM SOLUTIONS - BELIEF IN MORE!

We, at Shriram, believe that significant value creation in the Indian agriculture sector can be achieved through modern management practices and farming techniques. This is the belief behind our vision TO BE THE MOST TRUSTED HOUSEHOLD NAME IN THE FARMING COMMUNITY.

Our class leading range of inputs and pioneering extension services are provided under the brand Shriram, which symbolises trust, quality and reliability. We are focused at delivering end-to-end farming solutions, partnering with the farmer, increasing their productivity and improving their quality of life.

We believe in MORE! MORE CROPS & MORE PRODUCTIVITY

Basic Nutrients

- Urea
- DAP
- MOP
- SSP

Improved Seeds

- Hybrid Seeds
- Vegetable Seeds
- Research Seeds
- OP Seeds

Crop Care Chemicals

- Insecticides
- Herbicides
- Fungicides

Speciality Nutrients

- Water Soluble Nutrients
- Micro Nutrients
- Plant Growth Regulators
- Soil Nutrient Enhancer

Crop Advisory Services

Last Mile Delivery Services

Shriram Krishi Vikas Programme

SHRIRAM FERTILISERS & CHEMICALS

(A Unit of DCM Shriram Ltd.)
 (Formerly DCM Shriram Consolidated Ltd.)
 (An ISO 9001, ISO 14001, OHSAS 18001 Certified Organisation)
 Kirti Mahal, 19, Rajendra Place, New Delhi - 110 008
 Fax: 011-25781182, Customer Care No: 0120-4040188
 e-mail: sfs@dcmshriram.com, Toll Free Helpline No. 18001021188





C. Chattopadhyay,
Director;
N. Singh, Scientist;
and A. Birah
Sr. Scientist
ICAR - National
Research Centre
for Integrated Pest
Management, Pusa

ICT - BASED PEST MANAGEMENT FOR SUSTAINABLE AGRICULTURE



Integrated Pest Management is knowledge intensive, requires holistic approach, expert advice, well-timed decision making and fast track actions. Prevention of environmental toxicity due to pesticides and development of resistance in pests are the prime reasons behind IPM adoption. Globally IPM has been acknowledged as a desirable approach for pest control even if it has not been adopted so widely. Reason being, IPM is an information-intensive, site-specific, multi-tactic approach to pest control. Rates and levels of adoption of IPM are determined by the resultant interplay of regional players, their experience, influenced by promotional efforts of the agrochemical industry, moderated by public educational, outreach efforts and availability of extension support. In contrast to the rapid adoption of chemical pesticide technology worldwide, adoption of a newly developed IPM approach or technology has already taken enough years. Due to differences in climate, pests, soil, variety and other factors, a well-developed IPM programme for a crop in a particular location may not necessarily work well in another situation. Farmers need site-specific information. Generally, they

have to work with local IPM information providers (research and extension specialists, NGO's, private consultants) to acquire the information and knowledge necessary for developing an IPM program suited to their needs. Today farmers need variety of information for pest management from the research, public and private institutions. Thus, IPM is a diffuse technology not amenable to generalized prescriptions. Decisions must be made at the local, or at best, at the regional level.

Modern agriculture witnesses pressures of both increased need of productivity as well as higher stresses caused by plant pests under changing climate. Information and Communication Technology (ICT) can act as an accelerating force behind the productivity of agriculture. Knowledge is a useful resource and if backed by adequate technological infrastructure and appropriate strategies, it can become a transformational factor for overall development of agriculture. Agricultural extension is an essential mechanism for delivery of knowledge and advice as an input for modern farming. The need is to shift focus from delivery of technology to transfer of knowledge and information.

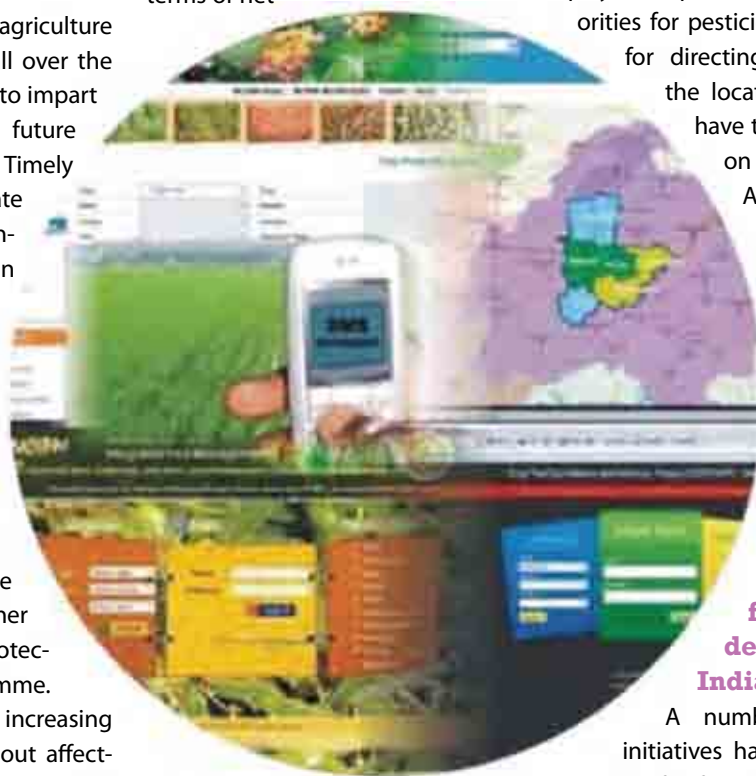
This is possible with the use of information technologies which can make agricultural extension a more diversified, knowledge-driven system for meeting farmers' information needs on demand. ICT can continuously introduce newer sets of information services to agricultural markets where farmers can have a better control. Access to such new information sources is a crucial requirement for the sustainable development of the farming systems.

Application of ICT in agriculture has already taken place all over the world and it will continue to impart tremendous influence on future agricultural strategies. Timely availability of appropriate information for decision-making can either result in saving crop worth crores of rupees or in non-application of pesticides saving the cost involved and the environment from being polluted besides saving beneficial organisms. Thus, in future there is need to exploit the potential of ICT for further improvement in crop protection in agricultural programme.

Hence, the solution for increasing the crop production without affecting the agro-ecological balance lies in adopting new research tools as related to ICT and combining them with conventional as well as frontier technologies like Geographic Information Systems (GIS).

Among the emerging technologies, Geographical Information System (GIS) has emerged as a powerful tool, which has the potential to systematize complex spatial environment in tabulated form, thereby helping in establishing relationship among different biotic and abiotic

factors. Use of GIS and remote sensing has been explored for analysis of satellite-based agro-met data products, mapping geographical distribution of pests and delineating the hotspot zones. Application of remote sensing in combination with spatial analyses can be of additional value in integrated pest management practices. Currently, remote sensing (ISRO) data is being used in developing weather forecasts, generating crop estimate in terms of net



shown area and yield in certain crops. Modern technological advances, especially high-resolution digital descriptions, have resulted in a number of new developments which could further be refined to manage agricultural pests. The tools not only provide valuable information in context of integrated pest management but could also enable understanding through remote mapping or spatial modelling of the characteristics of a crop in a particular field and provid-

ing information about pest situation that are prevailing, or likely to occur. Super-imposition of causative abiotic and biotic factors on visual pest maps can be utilized for pest forecasting. In addition, airborne sensors that sense differences in multispectral reflectance between crop canopies and other vegetation characteristics can identify variation in crop vigour vis-à-vis response to insect pests and plant pathogens. Thus, this technology can play an important role in setting priorities for pesticide application and for directing interventions to the locations where it can have the greatest impact on pest populations.

As this technology is gradually developing, it is likely that pesticide use will reduce with the change from whole-field to pest-location-specific applications.

ICT initiatives for agricultural development in India

A number of ICT-based initiatives have been taken up in India for farmers such as mKisan, e-Chaupal, e-Sagu, e-Krishi, Bhoomi, etc. Department of Agriculture and Cooperation (DAC), Min. Agriculture, GoI began with Kisan SMS portal "mKisan" (www.mkisan.gov.in) for enhancing production through dissemination of information in the form of advisories to farmers through SMS on their mobile telephones. Since its inception on 16 July 2013, nearly 72 crore messages or more than 210 crore SMSs have been sent to farmers throughout the length and

breadth of the country. Similarly ITC's Agri Business Division, one of India's largest exporters of agricultural commodities initiated e-Choupal as a more efficient supply chain aimed at delivering value to its customers around the world on a sustainable basis. "e-choupal" (www.echoupal.com/) was launched in June 2000, linking rural farmers directly for the procurement of agricultural / aquaculture produce like soybean, coffee, wheat, rice, pulses, shrimp, etc - in over 40,000 villages through 6500 kiosks across ten states (Madhya Pradesh, Haryana, Uttarakhand, Karnataka, Andhra Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Kerala and Tamil Nadu). Media lab asia and IIIT Hyderabad created "e-Sagu" (www.esagu.in/) to improve productivity and reduce cost of cultivation by farmers. E-Sagu means electronic cultivation. It exploits the advances in Information Technology to build a cost-effective agricultural information dissemination system to spread expert agriculture knowledge to the farming community to improve the crop productivity. Agrocom Software ASHA (www.assamagricbusiness.nic.in) and "Kissan Kerala" (www.kissankerala.net) provides an online interactive platform for the farmers to interact with the scientists and agricultural extension officers to get their problems solved. e-Krishi (www.e-krishi.org/web/main/) in Kerala State addresses the existing gap in agriculture information flow and transaction management. One of private sector (Nagarjuna Group) developed agricultural Web site "Ikisan" (<http://www.ikisan.com/>) which provides online information on knowledge and business requirements for workers and traders in the agricultural sector. Ikisan has been developed as a comprehensive agri-portal to address the information, knowledge and business requirements of various players in the agri arena including farmers, trade channel partners and agriculture input/output companies. Some of the other popular ICT initiatives taken by various states for agriculture are as follows.

net) provides an online interactive platform for the farmers to interact with the scientists and agricultural extension officers to get their problems solved. e-Krishi (www.e-krishi.org/web/main/) in Kerala State addresses the existing gap in agriculture information flow and transaction management. One of private sector (Nagarjuna Group) developed agricultural Web site "Ikisan" (<http://www.ikisan.com/>) which provides online information on knowledge and business requirements for workers and traders in the agricultural sector. Ikisan has been developed as a comprehensive agri-portal to address the information, knowledge and business requirements of various players in the agri arena including farmers, trade channel partners and agriculture input/output companies. Some of the other popular ICT initiatives taken by various states for agriculture are as follows.

- Nai Disha - Haryana (naidisha.nic.in/)
- Bhoomi (Karnataka) (bhoomi.karnataka.gov.in/)



- Community Information Centre (<http://www.cic.nic.in/>)
- Gyandoot Project in DHAR (M.P) (<http://gyandoot.nic.in/>)
- Lokmitra (H.P) (himachal.nic.in/lokmitra.htm)
- Janmitra Rajasthan (<http://emitra.gov.in/>)
- Mahiti Shakti - Gujarat (<http://www.mahitishakti.net>)
- E-Seva (A.P.) (<http://www.e sevaonline.com/>)
- Dairy Information System Kiosk -NDDB (www.iimahd.ernet.in/~egov)
- Rural e-seva(west godavari) (www.westgodavari.org/)
- Akshaya (<http://www.akshaya.kerala.gov.in/>)



ICT-based Pest Surveillance: A Path-breaking Initiative by NCIPM, New Delhi

Agricultural production continues to be constrained by a number of biotic and abiotic factors. Pest damage is one of the major biotic constraints of crop production. Hence, there is urgent need to increase the production by reducing pest damage. It could be achieved by coordinated efforts to keep track of pest dynamics for their timely management. Thus, it is imperative for different state agencies to record and monitor the pest

population to advise the farmers for effective and timely pest mitigation measures.

Pest surveillance is the foundation of plant protection for early alert, through which epidemic situations can be avoided by detecting damage prior to establishment of higher pest population. The basic purpose of surveillance is to determine whether pests are present in the field at a level to initiate pest management interventions. Through regular and systematic pest surveillance, epidemic situations can be avoided by detecting damage before endemic establishment of a pest in any area. So to automate the process of pest monitoring, ICAR: NCIPM, New Delhi took a path breaking initiative by developing an ICT-based system for pest surveillance called “e-pest surveillance system” by integrating the potential technical and administrative stakeholders of State and Central machinery involved in plant protection. Use of web technology helped in providing prompt and reliable pest reports to the concerned agencies and thus confirmed the operation of effective monitoring.

E-pest surveillance system is basically an internet-based system of capturing pest information from fields and producing – instant and customized pest reports in tabulated and graphical forms to pest management experts to advise the state agriculture agencies who further advise concerned farmers through SMS and the same information is also available for agricultural policy planners.

Potential of ICT has been witnessed by its impact on production and productivity under various programmes in different states as well as crops. There is dramatic reduction in outbreak of any major pest on selected crops since the inception of



ICT activity in different states. As the farmers are getting regular SMSs for IPM interventions, therefore, there is much awareness about IPM. Chemical pesticides are applied only when they are needed. The technology has already become an important component of IPM in different programmes implemented by state departments and it will continue to make significant impact on future strategies, where cloud computing may play a major role.

Needs of farmers in pest management revolves around pest diagnostics, surveillance, forecasting and dissemination of expert information in short time. Potential benefits of short-to-medium range weather forecast from numerical weather prediction (NWP) models or future climate projections have been least harnessed in India for regional crop protection services. Recent momentum to assimilate more updated satellite-based spatio-temporal atmospheric and land surface products from Indian geostationary satellites (Kalpana-1, INSAT 3A) for high resolution (5-15 km) weather forecasts from advanced NWP model such as WRF (Weather Research and Forecaster) is encouraging. Such regular high-resolution forecast products

are available for the registered users (<http://www.mosdac.gov.in>). The National Crop Forecasting Centre (NCFC) has started functioning at the Pusa Campus, New Delhi under the behest of MoA (DAC). Under the circumstances, precision pest management to reduce indiscriminate use of chemical pesticides could plan use of state-of-the-art technology through innovative and strategic research to enable devise Integrated Decision Support System (IDSS) for Crop Protection Services that suggests operational focus, research priorities and evolution in a phased manner, which could involve (A) periodic production of alarm zones encompassing 127 agro-climatic zones through well-tested models, weather forecast, high resolution remote sensing data and operational crop map in the GIS outline, (B) (i) forecast models for major pests, (ii) estimation and improvement in quality of well-validated satellite-based products, improved data assimilation approaches, (iii) field-to-satellite-based remote sensing with high-resolution observations to differentiate among crops, among phenological stages within crop growth period, biotic stresses from abiotic stresses (moisture and nutrients), normal health and (C) Human Re-

sources Development viz., (i) creation of experts on handling of spatial data, who could be brave enough to think differently, bold enough to believe that as a team they could bring a positive change in the present practices of pest management and talented enough to do it, (ii) adaptation of guideline makers with more of digital products for interpretation and (iii) regular feedback mechanism from farmers through network of Krishi Vigyan Kendras by using satellite communication; (iv) competence building at grassroots by increasing awareness of farmers.

Presently, crop protection or pest management in India starts post-quarantine or actions are initiated once the pest has entered the country, which ignores pre-border pest risk analysis and commensurate policy thereof, the border inspections and regulations; thus, the present system could be labelled as a second order pest management. Thus, our challenges in IPM also involve monitoring pre-border pest risk vis-a-vis possibilities of incursions for necessary policy and preparedness thereof. For the purpose, diagnostic systems need to be simple, autonomous, rapid and enrichment-free, field-operable, inexpensive, real-time, sensitive and specific with abilities for early detection. Challenges at leadership level, policy support for centralized crop protection umbrella like NCIPM – for national level coordination in technology generation, funding, monitoring, IT support, etc is required as a challenge for all the stakeholders with research, funding and partial merger of executive and research functions as IPM is a transition from research in lab to land. As an institution it has to evolve in its roles of multiple expectations linking producers, en-



trepreneurs, consumers considering political/social/environmental and financial implications. Bio-security (safeguarding of biological resources from external threats) should be perceived for better prevention and preparedness through proper flow of information in decision framework to ensure a bio secure country. This should be implemented at plot level, village, district, and state, regional and National levels for effective action against threats. The plot or village scale bio security could involve a system of pest risk analysis, policy thereof for border inspections, detection, etc. for inspection of vehicles, people and livestock carrying weed seeds, pathogens and insect-pests to regulate farm movement and assure movement of pest-free animals, fodder, food apart from spread of knowledge on pests for reporting their occurrence. Thus, this is an opportunity for development of a comprehensive National IPM Policy with peer groups/ institutions/ policy makers/ implementation agencies/ extension agencies/ industry/ allied departments/ ministries, etc. through appropriate legislation viz., strategies for bio security (pest risk analysis with ad-

equate policy and legislation for pre-border activities, border inspections and regulations and post-border movement within country, preparedness and incidence management) to prevent entry and establishment, manage invasive exotic biological threats through adequate quarantine, eradication, containment for preserving access to existing markets and expansion to newer ones, help food, fibre industry to remain globally competitive. Global e-Pest surveillance linked IPM/GAP programmes will give immense opportunities not only for training but also contractual /commercial production systems and track movement of invasive pathogens / insect-pests as pre-border bio security checks. Since pest invasions are irreversible and highly damaging for any community, environment, economy, livelihood, there is need for action linked to IPM getting initiated pre-border (forecast and manage monitoring human and cargo movement across globe) instead of waiting for the pest(s) to enter the country; the changed policy could safeguard biological resources in the country from external threats through provisions of bio-security. ■



**We cannot create water
But Yes! Surely we can save water**

You can also save water.....

in your homes, schools, factories, institutions & villages

For more information, please email to

savewater@dhanuka.com



Dhanuka Agritech Limited

14th Floor, Building 5A, Cyber City, DLF Phase-III, Gurgaon-122002 (Haryana) Phone No.: 0124-3838500,

Fax: 0124-3838888, Email id: headoffice@dhanuka.com , Web: www.dhanuka.com



Anjani Kumar and
P K Joshi

International Food
Policy Research
Institute, South Asia
Regional Office,
New Delhi, India

FOOD INTERVENTION PROGRAMMES AND POLICIES FOR FOOD SECURITY IN INDIA

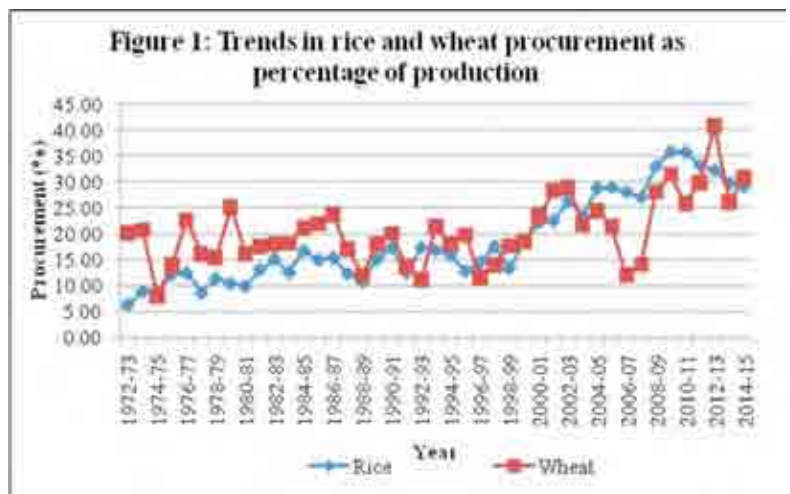
The food intervention programmes in India have evolved in the backdrop of worst famine in West Bengal in 1943, repeated bouts of natural calamities (floods & droughts) and the persistent challenge of feeding a huge and rising population. The journey from chronically food deficit to net exporters of foodgrains witnessed different waves of food management policies, but ensuring food security remained a central concern in India. A combination of both growth-led and support-led policies has been followed for improving the food security status in the country. The food management system is consisted of three main instruments: minimum support/procurement prices, buffer stocks and the public distribution system. These instruments have been in operation for the past six decades, with slight changes on emphasis and focus in tune with the contemporary economic policies of the country. Besides, there are several poverty alleviation programmes, especially for the rural areas which also aim at enhancing food-security status by strengthening the purchasing power of the poor households.

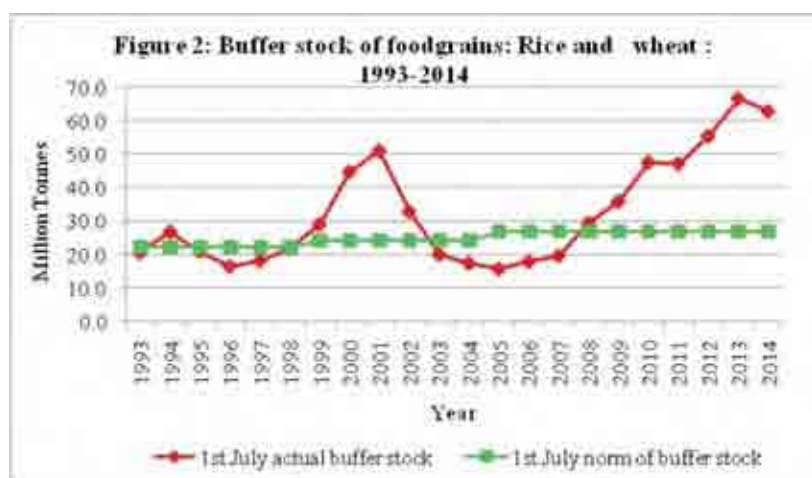
Procurement and Buffer Stock of Foodgrains

Agricultural price policy seeks to play twin roles of ensuring remunerative prices to the farmers

for their produce to augment production, and at the same time, safeguarding the interests of consumers by making available supplies at reasonable prices. The procurement of rice and wheat has increased significantly overtime, not only in absolute terms but the intensity of procurement as a proportion of total production has also increased considerably. Rice procurement as a proportion of total rice production in the country has increased from 6.4 per cent in 1972-73 to about 30 per cent in 2014-15 (Figure 1). The intensity of wheat procurement has also witnessed a similar trend. The intensity in the procurement of rice and wheat registered wide fluctuations especially before 1999-00. In recent years, the procurement has been consistent with the exception for wheat in 2006-07 and 2007-08.

Maintaining buffer stocks of two major food commodities, viz., rice and wheat, is another instrument of food management system in India. The actual level of and the norm for buffer stocks as on 1st July each year for the period from 1993-94 to 2014-15 is depicted in Figure 2. A continuous rise in procurement prices, along with the obligation to purchase all grains offered by the farmers together led to accumulation of rice and wheat stocks to the extent of 63 million tonnes by July 2002. These stocks of 63 million tonnes were much above the optimal stocks of



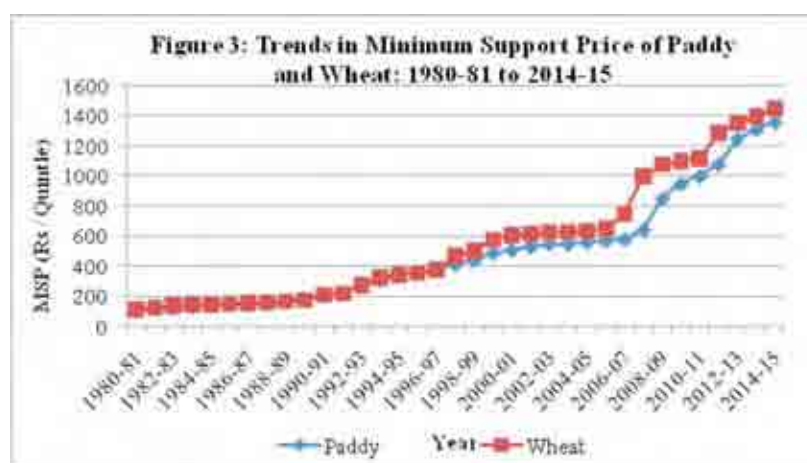


24.3 million tonnes. The drought in 2003 caused a reduction in the food stocks which continued to decline till 2006. In fact, the actual buffer stocks in 2006 and 2007 were below the norm and the country had to import wheat during 2006-08. However, the foodgrain stocks accumulated once again in 2008 and 2009 and became higher than the norm. Presently, the government has more than 63 million tonnes of foodgrains in its stock, which is much in excess of the norm, and pose high economic costs. Management of such huge stocks and avoiding wastage is a big challenge before the government. Burgeoning food subsidies has put a question mark on the rationality of maintaining such a huge stock. However, in view of the proposed enactment of National Food Security Act (NFSA), the higher stocks of foodgrains will have to be maintained and management strategies will have to be evolved to reduce the economic cost.

Functioning of Minimum Support Prices

Minimum support price is the basic pillar for food management policies in India. Minimum support prices are announced for a number of agricultural commodities (24) and the MSP intends to give signal to farmers for

allocation of their resources for cultivation. However, the procurement at MSP is confined mainly to rice and wheat among foodgrains and sugarcane and cotton among cash crops. The increasing MSP is often criticized to fuel food inflation in the country. However, the farming community always complains about the



inadequacy of MSP to cover its cost of production. The trends in real MSP reveal that the increase in MSP has been modest in real terms with varying trends during 1980s, 1990s and 2000s (Figure 2 and Table 1).

Public Distribution System

Public distribution system (PDS) is the most important intervention made by the Government of India towards ensuring food security. Although objectives and working of PDS underwent significant changes since its inception; it essentially continues to remain a food intervention programme. The Food Corporation of India procures foodgrains from the farmers at an administered price at harvest time and then ensures availability of these commodities to consumers at subsidized prices by allocating foodgrains to different states, who in turn manage their respective PDS. The proportion of foodgrains accessed through PDS in the total household consumption provides a snapshot of the role and effectiveness of PDS in ensuring food security in the country. The role of PDS in meeting the consumption requirement of households

Table 1: Compound Annual Growth Rate of MSP of Paddy and Wheat (real price)

Time-period	Annual growth rate (%)	
	Paddy	Wheat
1980-81 to 1990-91	0.3	-0.1
1990-91 to 2000-01	0.2	1.2
2000-01 to 2014-15	1.3	0.8



has increased over time. Outreach of PDS increased from 27.3 per cent in 1993-94 to 44.8 per cent in 2011-12 (Table 3). Similarly, the share of PDS in cereal consumption went up from 8.5 per cent in 1993-94 to 19.7 per cent in 2011-12. Though the contribution of PDS in cereal consumption increased in most of the states, the share of PDS in the cereal depicts wide inter-state variations. The PDS contributes one third or more to cereal consumption in Chhattisgarh, Mizoram, Sikkim, Tamil Nadu, Tripura, Himachal Pradesh, Jammu & Kashmir and Kerala. While, one fourth or more share of PDS in cereal consumption is there in Andhra Pradesh, Arunachal Pradesh, Goa, Karnataka, Meghalaya, Odisha and Uttarakhand.

The impressive improvement in beneficiaries' access to PDS foodgrains can be attributed to several factors. However, consistent fall in the diversion of PDS foodgrains and the widening divergence between market price and PDS price of foodgrains stand out to be the major factors for expanding the PDS outreach. The divergence between market and PDS prices of rice and wheat has widened and therefore PDS grains have become more lucrative for the people.

Table 2: Awareness about MSP across states in India, 2013 (%)

State	Paddy	Wheat
Andhra Pradesh	11.79	0.00
Arunachal Pradesh	18.49	0.44
Assam	5.15	0.02
Bihar	23.44	22.21
Chhattisgarh	58.00	0.25
Goa	7.20	0.00
Gujarat	0.71	1.19
Haryana	17.84	32.53
Himachal Pradesh	1.20	2.98
Jammu & Kashmir	5.54	7.64
Jharkhand	8.18	1.93
Karnataka	7.69	0.32
Kerala	7.99	0.00
Madhya Pradesh	7.15	38.32
Maharashtra	1.30	0.85
Manipur	0.30	0.00
Meghalaya	1.25	0.00
Mizoram	0.13	0.00
Nagaland	20.81	0.00
Odisha	41.07	0.00
Pondicherry	21.70	0.00
Punjab	39.81	48.51
Rajasthan	0.11	10.11
Tamil Nadu	11.37	0.00
Telangana	26.83	0.00
Tripura	19.60	0.00
Uttar Pradesh	14.11	18.24
Uttaranchal	7.78	9.95
West Bengal	34.48	1.24
All India	15.10	10.16

Source: Authors' estimates based on unit level data from NSS

Summing up

The food management policies and instruments in India have stood the test of time. Functioning of these instruments have also improved overtime. However, the time has come to revisit these instruments to make them broad-based. Also, the alternative methods like direct transfer of benefits instead of PDS, involvement of private sector in procurement of foodgrains etc. need to be tried. ■



We at Excel believe:

*Each work has to pass through three stages
- Ridicule, opposition and then acceptance.*

*Each man who thinks ahead of his time
is sure to be misunderstood.*

*So, opposition and persecution are welcome,
only he has to be steady and pure
and must have immense faith in God
and all these will vanish.*

EXCEL-THE INNOVATORS



Excel Crop Care Limited
Beyond crop protection. Behind every farmer

Excel Crop Care Limited

Registered Office: 184/87, S. V. Road, Jogeshwari (W),
Mumbai - 400 102.

E-mail: excelmumbai@excelcropcare.com

www.excelcropcare.com





S.K. Malhotra
Horticulture Commissioner,
Ministry of Agriculture,
Government of India

Horticulture for Food and Nutritional Sustenance and Livelihood Security

Being an important component of high value agriculture, the economic importance of horticultural produce has been increasing over the years due to increasing domestic and international demand. Area, production, productivity, availability and export have increased manifold. This has provided ample opportunities for utilization of waste lands, employment generation and effective land use planning. Diversification, recognised as one of the options for improving land use planning has had dramatic impact. If data from the production of various crops are compared with the base period of 1990-91, horticultural crops have grown much faster. Contribution of horticulture to GDP of Agriculture, which was only 0.58 percent during 1952-53, with total production of 25 million tonnes increased to 23.4 percent from 6% area in 1991-92, 26% from 8% area in 2005-06 and subsequently increased with total horticulture production of 275.9 million tonnes with contribution of 31 percent to agricultural GDP from 16 percent area in 2014-15 (Fig 1).

Among the horticulture crops, considering 1991-92 as base year, fruit crops recorded a 2.2

fold increase in area and 3.0 fold increase in production during 2014-15 (Fig. 2). India emerged as the second largest producer of fruits (86.2 million tonnes) obtained from 6.24 million ha area; contributing 11.3 per cent share in global fruit production. India occupies first place in the production of banana, guava, papaya, mango, pomegranate, sapota and aonla. The productivity of grapes is the highest in the world (21.8 MT/ha). Production and productivity of banana and sapota are the highest in the world. However, productivity in citrus, mango, apple, guava and pineapple continue to be lower than the world averages. Production of vegetables has increased manifold to the tune of 165.2 million tonnes from 9.4 million ha area. Commercial horticulture has recorded faster pace of growth during the last decade. Medicinal and aromatic plants, which have immense potential got due recognition in the decade. We continue to be the largest producer, consumer and exporter of spices and spice products in the world, producing more than 50 spices. India is also a leading producer of plantation crops in the world. The diversification through horticulture has proved to be the best option for the farmers to meet



the need for food, nutrition, health care besides providing better returns on farm land and employment. Resultantly, horticulture has been identified for inclusive growth of agriculture sector in the country.

Horticulture for nutrition and health care

Health care of people, at large, has been through modern medicine but still in Asia more than 80 percent people depend on herbs. Many of doctors now feel that modern medicines brings illness rather than wellness, and subscribe for balanced diet which protect against many diseases by enhancing self protective mechanism through many immunological advantages. The fruits (Indian goosberry, bael, jamun, papaya), vegetables (carrot, cauliflower, onion, garlic, leafy vegetables), spices (ginger, turmeric, black pepper, fenugreek, ajowan) and ornamental plants (ashoka, ficus, catharanthus) protects against various kinds of diseases. The spices like turmeric, chillies and cumin in the diet have been recognized to protect against cancer. Noni (*Morinda citrifolia*) with unique characteristics is recognized as best for health care, as it provides protection against various diseases including HIV. Virgin coconut oil protects from HIV and coconut water provides all nutrients to child apparently. Horticultural crops thus provide ample opportunities for health care. Fruits and vegetable provide wider option for meeting the energy requirement for the human system. Cereals are the main staple food which lacks various minerals and vitamins but to sustain and lead a healthy life, the food we eat should contain a wide range of nutrients in proper proportion i.e. it should be a well balanced diet. The nutrients include proteins, fat, carbohydrates, vitamins, fibre and minerals. Each nutrient has a definite function.

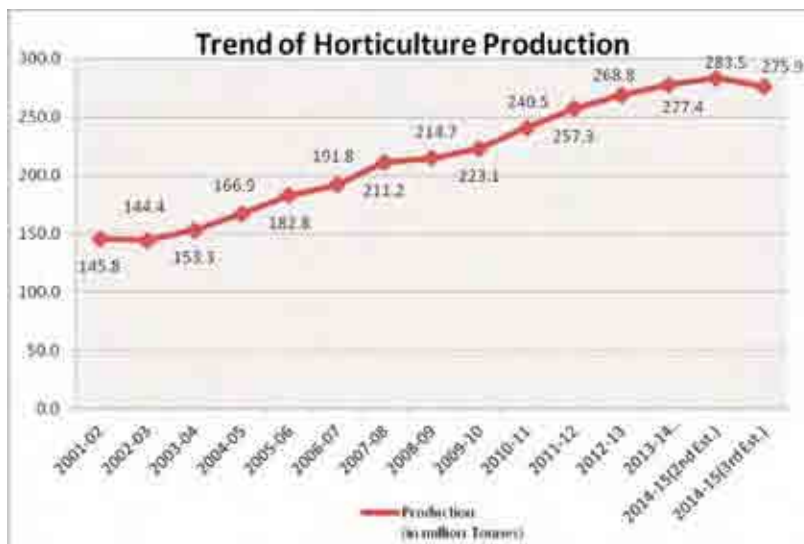


Fig. 1. Trend of horticulture production in India

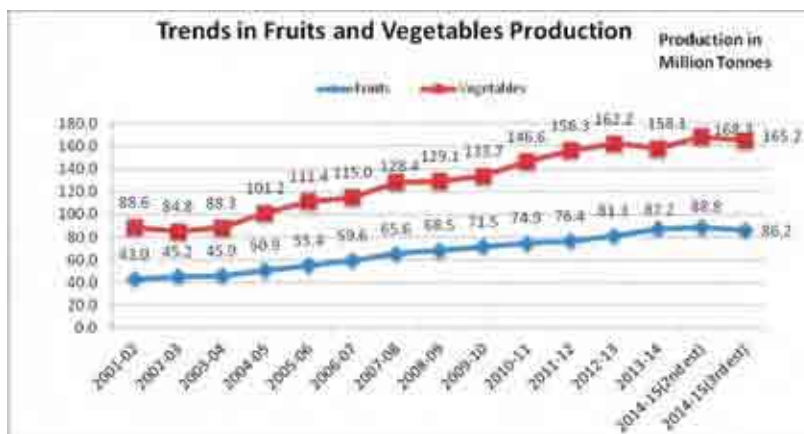


Fig. 2. Trends in fruits and vegetables production in India

No single fruit or vegetable can nourish the body with all the vital ingredients it requires. Hence it is important to consume a variety of fruits, vegetables, spices and condiments to derive required nutrition. Horticultural crops meet all the essential requirements for which these crops are rich sources of energy, proteins, vitamins, minerals antioxidants etc.

Food and Nutrition based health protection

While fruits and vegetables do not make a significant contribution to macronutrient intake, they make an important contribution to vitamins, minerals and dietary fibre. The legumes, especially the seed legumes,

are of major nutritional significance, particularly in the developing world as they are the main source of proteins. Rising income levels in developing countries like China, India and Brazil coupled with increase in production of many foods of plant and animal origin have made food more accessible and affordable.

The philosophy that food can be health promoting beyond its nutritional value is gaining acceptance within both the public arena and the scientific community. A balanced diet rich in fresh fruits and vegetables, is the single 'Mantra' being propagated world over for healthy living. Fruits yield larger quantities of food per hectare compared to cereals. For ex-

ample paddy yield (max.) is 3 tonnes/ha whereas it is 22 tonnes/ha in case of banana; 45 tonnes/ha in case of pineapple and 40 tonnes/ha in case of grapes. Much less area is required to obtain the calorific requirement per adult per year (11,00,000 kcal) from growing banana (0.03 hectare) or mango (0.16 hectare) than from growing wheat (0.44 hectare). Horticultural crops in general are poor sources of protein as they contain less than 2% protein. Fruits are a rich source of organic acids like citric acid in citrus fruits and tartaric acid in grapes, which stimulate appetite and help digestion. Papaya contains protein digesting enzymes. Many fruits and vegetables possess laxative property due to the presence of dietary fibre and pectin, which stimulate intestinal activity.

Due to poverty, micronutrient malnutrition, is posing a threat to vulnerable sections in Asia and the Pacific regions. This is manifested in the form of vitamin A deficiency, iron deficiency anemia and iodine deficiency disorders. The first two could be minimized through horticulture intervention and awareness drive. Vegetables and fruits appear to be playing a prominent role in prevention of several chronic diseases such as heart disease, cancer, cataract, osteoporosis, diabetes, etc. The active constituents responsible for this property have been shown to be a number of nutrients, phytochemicals and fibre.

A part
from

micronutrient related function, the bioactive phyto-chemicals prevent degenerative processes by antioxidant activity. In order to have protective effect, it is necessary to consume 400-600 g of fruits and vegetables every day. But, the consumption level of fruits is low and widely variable from region to region in India. Fruit consumption level is as low as 1 g/day/person in the states of Manipur and Nagaland to 70 g/day/person in the Union territory of Chandigarh. An increase in the intake of fruits along with vegetables will meet the required daily allowance (RDA) of many nutrients. India with more than 84 million tonnes of fruits and 162 million tonnes of vegetables is the second largest producer of fruits and vegetables in the world. However, per capita consumption of fruits and vegetables in India is only around 80 g and 280 g against a minimum of about 92 g and 300 g respectively recommended by Indian Council of Medical Research and National Institute of Nutrition, Hyderabad. With the present level of population, the annual requirement of horticulture

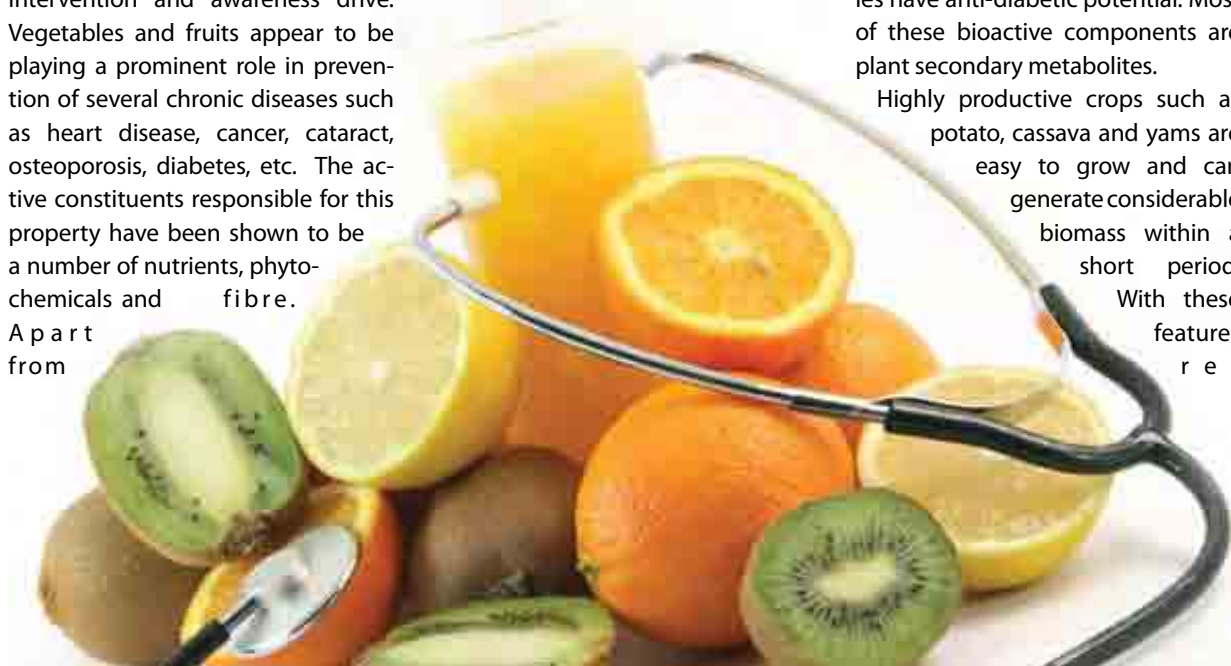
produce will be 320 million tonnes by 2016-17 as against the present level of production 275.9 million tonnes during 2014-15.

Horticultural crops - bioreactors

One of the most significant contributions of biotechnology is the improvements of nutritional status of horticultural crops. Several nutritional traits such as, carbohydrates, proteins, oils, fats, vitamins and amino acids constitute the main target of plant biotechnology. A new approach is to increase active components such as carotenoids from tomatoes, glucosinolates from Brassica vegetables, phytoestrogens from soybean and phenolics and antioxidants from various plants protect and prevent numerous disease such as cancer and cardiovascular disease. These antioxidants are also associated with slowing the ageing process and improving overall health. Phytoestrogens from Dioscorea species such as wild yam (*Dioscorea villosa*) also possess numerous physiological benefits. Some sweet potato varieties have anti-diabetic potential. Most of these bioactive components are plant secondary metabolites.

Highly productive crops such as potato, cassava and yams are easy to grow and can generate considerable biomass within a short period. With these features

re -



search has been carried out to determine whether transgenic plants of these crops can be exploited for the production of commercial proteins and biochemicals and recombinant biopharmaceuticals such as cytokines, hormones, monoclonal antibodies, enzymes and vaccines.

Advancement in horticulture production and consumption system

Diversification, market orientation and commercialization are the most important changes noticed in the recent past and have happened by introduction of new crops and varieties, increased share of horticulture in the cropping pattern, diversion into processing and export oriented production of a large number of crops. Several technological innovations have been advanced in the complete value chain involving technology for orchard establishment, availability of true to type planting material, plant architecture engineering and management, mulching, fruit thinning, integrated nutrient management, water management, integrated pest and disease management, post harvest technology, processing and marketing. The positive changes in horticulture sector have occurred because it has received importance from all the stakeholders, public sector, private sector and farmers during the last decade. This is primarily the result of realization that diversification to horticultural crops is now the major option to improve livelihood security and health care. Keeping in view the dynamic needs of diverse stakeholders under the National Agriculture Research System, the R&D on horticulture has been undertaken by 23 horticulture research institutes/directorates and NRCs, AICRPs and SAUs in several multi-crop and multi-disciplinary institutes and the several



technologies have emerged.

Value addition through dehydration of fruits and vegetables including freeze drying, dried and processed fruits, vegetables and spices and fermented products have been developed. Development of new products like juice punches, banana chips and fingers, mango nectar and fruit kernel derived cocoa substitute, essential oils from citrus, fruit wines, dehydrated products from grape, pomegranate, mango, apricot and coconut, grape and fruit wines, value-added coconut products like snowball tender coconut, coconut milk powder and pouched tender coconut water (Cocojal) etc. are getting popular day by day. Improved blending/ packaging of tea and coffee have opened new markets. New products such as tetra pack filled fruit juices are now house hold items.

As food consumption patterns are changing towards more convenient foods, the demand for products like pre-packed salads, packed mushrooms and baby corn frozen vegetables etc. are increasing and are sold in shopping malls. Consumer friendly products like frozen green peas, ready to use salad mixes, vegetable sprouts, ready-to-cook fresh cut vegetables are major retail items, which have already started peeping out of retail

windows. In order to reduce dependence on refrigerated storage, low cost eco-friendly cool chamber for on farm storage of fruits and vegetables has been developed. For preventing the post harvest losses proper storage, cold preservation, packaging and transport methods with Hazard analysis Critical Control Point norms have to be given more thrust. Standardization of Modified Atmosphere Packaging and Storage systems with greater emphasis on safety (pesticide free), nutrition and quality is getting emphasis.

Mission schemes for food, nutrition and livelihood security

Mission for Integrated Development of Horticulture (MIDH), a Centrally Sponsored Scheme has been launched for the holistic growth of the horticulture sector covering fruits, vegetables, root & tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa and bamboo. The scheme, which has taken off from 2014-15, integrates the ongoing schemes of National Horticulture Mission (launched 2005-06), Technology Mission for North East (TMNE) (launched 2001-02) later renamed as Horticulture Mission for North East and Himalayan

states (HMNEH) with addition of Himalayan states (launched 2002-03) and National Bamboo Mission (NBM) (launched 2006-07). The Central Sector Schemes included in MIDH are National Horticulture Board (NHB), Coconut Development Board (CDB) and Central Institute for Horticulture (CIH), Nagaland. MIDH also works closely with National Mission on Sustainable Agriculture (NMSA) towards development of Micro-Irrigation for all horticulture crops and protected cultivation on farmers' field. MIDH also provides technical advice and administrative support to State Governments/ State Horticulture Missions (SHMs) for the Saffron Mission and other horticulture related activities like Vegetable Initiative for Urban Clusters (VIUC), funded by Rashtriya Krishi Vikas Yojana (RKVY). Pradhan Mantri Krishi Sinchai Yojna (PMKSY) and Parampragat Krishi Vikas Yojna (PKVY) are the two new schemes being implemented for promotion of agriculture including horticulture (2015). The Mission (MIDH)

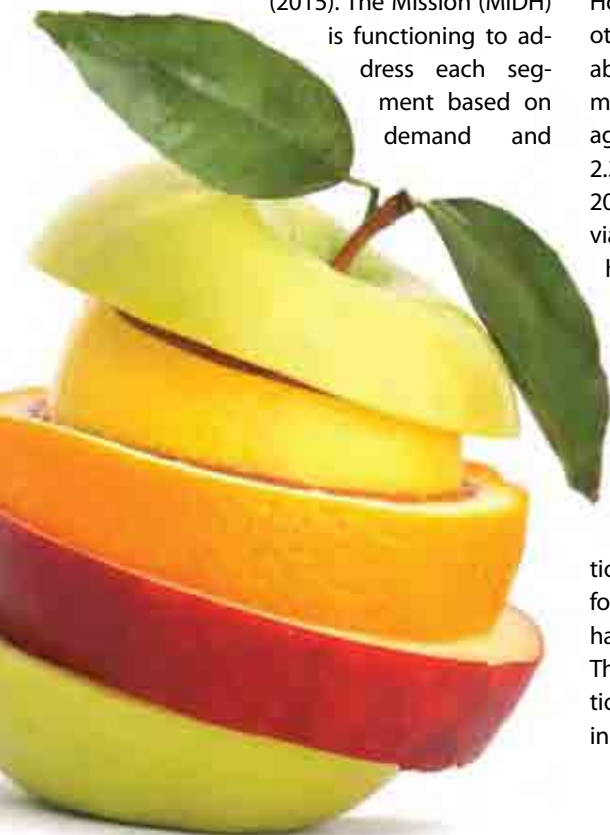
is functioning to address each segment based on demand and

need based approach for sustenance of food and nutritional security. Technologies such as Information Communication Technology (ICT), Remote Sensing and Geographic Information System are effectively used for planning and monitoring purposes including identification of sites for creating infrastructure facilities for post harvest management, markets and production forecasts. The interventions envisaged for achieving desired goals are varied and regionally differentiated with focus on potential crops to be developed in clusters by deploying modern and hi-tech interventions, duly ensuring backward and forward linkages.

Ensuring nutritional and livelihood security

Ensuring adequate food and nutrition supply, employment and income generation are some of the important facets of horticulture. New production techniques and their adoption are needed for sustainable livelihood. Horticultural crops, as opposed to other food crops, have a considerable yield potential and can provide more income per unit area. The average size of holding has shrunk from 2.3 ha to 1.10 ha between 1970 and 2013 reflecting the poor economic viability of the smaller holdings, but horticulture being high value crops has proved as best means for small farmers. Adoption of horticulture by small farmers gives them efficient production choices. Besides, horticulture based integrated farming system holds the key for ensuring income, employment, livelihood and nutritional security in a sustainable mode for small and marginal farmers who have 44% of total operational area. The nutritional status of the population can be improved through creating an environment in which house-

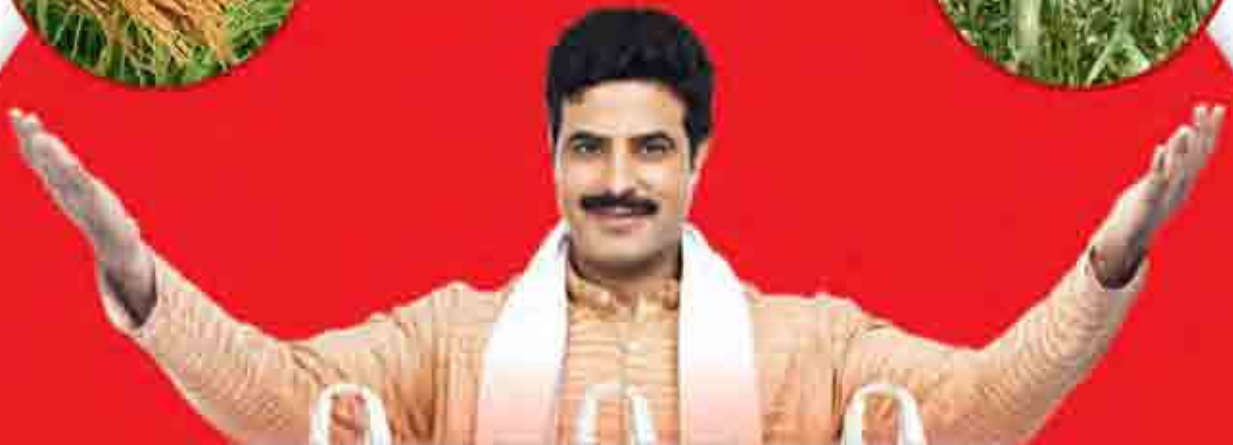
holds have sufficient access to fruits and vegetables at affordable prices throughout the year and the necessary knowledge and skills to prepare and consume foods to complement their diet, specifically targeting the poor women farmers and children. In this endeavour, there is need to enhance the level of food security and nutrition by improving the efficiency of the horticultural production system and associated support services through the application of modern technologies and diversified cropping patterns, that will promote the production and productivity, and provide higher incomes to the small and marginal farming communities in a sustainable manner. It is important to develop sustainable capability among low income communities in increasing productivity and year round production of horticultural crops (fruits, vegetables and spices) through the introduction of superior quality planting materials and seeds and the promotion of production skills. Also there is need to minimize post-harvest losses, improve post-harvest handling and maximize primary producer's profit and income through promotion of on-farm and community-based produce handling methods as well as to enhance marketing support services. Promotion of income-generating activities, including agro-processing, to enable the optimum utilization of horticultural produce to supplement family incomes, with additional support form micro-credit and food assistance programs, especially for poor and disadvantaged group. Increasing the nutritional awareness among the beneficiaries and developing a comprehensive food-based nutrition program to reduce malnutrition in the target groups comprising all groups of population with major focus on women and children is requisite. ■





INDIA'S NO. 1 SEED COMPANY

To be the most preferred seed brand in India.



NUZIVEEDU SEEDS LIMITED

Sy. No. 69, Kandlakoya, Gundiapochampalli (Village), Medchal (Mandal), R. R. Dist., Telangana - 501401, Ph: 08418-308888, www.nuziveeduseeds.com



Dr. B.S. Dhillon
Vice Chancellor
Punjab Agricultural
University, Ludhiana

Diversification – The Need for Agricultural Sustainability in Punjab

Punjab has played a pioneering role in Indian agriculture by implementing an agriculture led growth strategy that ushered in 'green revolution' in the mid-1960s.

As a result of development of new technologies in wheat and rice and their efficient transfer to the highly receptive and hard working peasantry, infrastructure development, assured pricing and procurement policy of the Central Government, the food grain production in the state increased from 3.2 million tonnes in 1960-61 to about 28.9 million tonnes in 2013-14. With contribution of 38-75 per cent of wheat and 25-45 per cent of rice to the central food grain pool, the state has become the mainstay of national food security and its contribution achieved greater significance during drought years.

With the introduction of new crop

technologies in mid-1960s, the rice-wheat cropping system rapidly came to dominate the State's agriculture. There has been tremendous increase in productivity of wheat, rice and other major crops over the years. The productivity of paddy and wheat increased four fold or even more. This led to increase in the area under wheat and rice manifold. It now covers about 80 % of the total cropped area in the State.

In the State, that once grew a large number of major and minor crops, expansion of rice-wheat cropping system aimed at fulfilling national food security needs started in 1970s. Less economical crops like pearl millet and groundnut have been largely replaced by rice in kharif season and chickpea and lentil by wheat in rabi season. Maize and rapeseed-mustard also yielded some acreage to rice and wheat, respectively. The area under mash and moong and sugarcane also decreased substantially



over time. There has been dramatic increase in area and production in rice. The area under rice in Punjab, which was just 2.3 lakh ha in 1960-61, increased to 28.9 lakh ha in 2014-15 and its production increased to more than 50 times.

Challenges in agriculture

The productivity enhancing technologies that were instrumental in boosting cereal production started displaying expected 'slow down trend' in the late 1980s. By 1990's, the crop productivity had gone up and its further increase expectedly slowed down, thereby, the net farm income started stagnating. Agricultural growth in Punjab slowed down from 4.6 per cent in 1980s to 2.5 per cent in 1990s and further to 2.3 per cent in 2000s. Rice-wheat cropping system, being highly productive and hence input intensive, has adversely affected water resources (both in terms of quantity and quality), soil health and environment.

Punjab has developed its agriculture to the stage where it has the largest proportion of irrigated area (99%), the highest cropping intensity (191%) and the most intensive use of chemical fertilizers (250 kg/ha) as compared to 45%, 141% and 128 kg/ha, respectively, at the national level. Expansion of area under rice cultivation turned out to be an ecologically unsound practice as intensive cropping of rice affected the natural resources and soil health, and excessive drawl of good quality water resulted in the depletion of ground water and formation of hard pan in about 70 per cent area of the State. Earlier there were array of local varieties. As the scientists developed improved

Table 1. Change in area under important crops in Punjab overtime

Crop	Cropped area (000' ha)	
	Maximum area (Year)	Area during 2013-14
KHARIF CROPS		
Maize	577 (1975-76)	130
Cotton	742 (1995-96)	446
Sugarcane	174 (1996-97)	89
Pearl millet	213 (1969-70)	3
Kharif pulses	903 (1960-61)	76
Groundnut	222 (1967-68)	3
RABI CROPS		
Gram	852 (1961-62)	1.8
Rapeseed - Mustard	178 (1987-88)	30
Barley	189 (1974-75)	12.4
Lentil	31 (1962-63)	1.0
Other crops*	882	562

*including fodder crops:

varieties, these were adopted by the farmers due to their higher yields and effective extension system, but their narrow genetic base led to the attack of diseases and pests. Environmental pollution due to excessive use of chemical fertilizers and pesticides and burning of crop residues has become a great cause of concern.

Need for crop diversification

For sustainable management of natural resources of Punjab in particular and North-Western regions in general, the diversification from rice to other less water requiring crops is of utmost necessity. As the other states progress in agriculture, they may encounter similar problems. For ensuring shift to alternative crops, foremost challenge is giving price as remunerative as paddy. For achieving diversification targets, technology back-up, policy development, and strong extension system are required.

Crops suitable for diversification

Maize is a viable option for diversifying some area under rice and single cross hybrids are available to obtain higher yields. Likewise, pulses and summer oilseeds are other options for diverting some area away from rice. Bt cotton is another alternative in the south-western districts. However, their procurement and marketing has to be ensured. Other crops suitable for diversification are mentioned in the diversification plan (Table 2).

Horticulture and agro-forestry can play an important role in agriculture diversification in the State. The net-house technology for production of vegetables and flowers has proved highly remunerative for the small farmers and has much scope for further expansion. Beyond crops, diversification toward dairy farming, poultry, piggery and fish farming are extremely important. Supplemental subsidiary occupations such as mushroom production and bee-

keeping can also play an important role in agriculture diversification and provide livelihood security to the small farmers on sustainable basis.

Diversification plan for agriculture in Punjab

Based on the report of the committee on crop diversification headed by Dr. G.S. Kalkat, Chairman of Punjab State Farmers Commission, the State Government submitted a plan to the Ministry of Agriculture, Govt. of India in 2012 outlining that the area under rice will be brought down from 28 to 16 lakh ha in phased manner over a period of five years. The key shift would be toward maize, cotton, sugarcane, fodder, pulses, fruits, vegetables and agro-forestry.

Key issues requiring attention in diversification programme

For achieving diversification targets, technology back-up, good governance, policy development, and strong extension system are required. Diversification would require fundamental changes in incentives, institutions and

Table 2. Diversification plan for Punjab's agriculture up to the year 2017

Crop	Area during 2012-13 (lakh/ha)	Potential area (lakh/ha)	Districts
Maize	1.3	5.5	Traditional areas
Cotton	4.8	7.0	South-western districts
Sugarcane	0.7	2.6	Majha and Doaba regions
Guar	Negligible	0.3	South-western districts
Kharif fodder	4.0	5.5	Throughout the State
Arhar	Negligible	0.6	Central districts
Mung bean	0.2	0.6	Central districts
Kinnow	0.4	0.8	Traditional areas
Guava, Pear	0.07	0.2	Hoshiarpur, Ferozepur and Amritsar
Agro-forestry	1.3	3.0	Kandi belt and central districts (Poplar); South-western districts (Eucalyptus)
Groundnut	Negligible	0.2	Hoshiarpur and S.B.S. Nagar
Turmeric, Chilli, Tomato, Garlic, Capsicum, kharif onion	0.2	0.05	Hoshiarpur, Kapurthala, Jalandhar, Amritsar

investments; however, these changes should not be at the cost of farmers' income.

- Policies equally favourable for

alternative crops viz., minimum support price (MSP) and assured marketing are required. For ensuring shift to alternative crops, foremost challenge is giving price above or at least as remunerative as paddy. Farmers will opt for alternate crops if these are as remunerative as paddy.

- For enhancing area under maize, there is need to augment its use as feed in poultry and dairy farming.

- For cotton, the state has proposed that the Cotton Corporation of India be asked to carry out MSP operations in all cotton markets in the state. Support of textile industries is also required for enhancing cotton production.

- For sugarcane, the crushing season of at least 180 days for sugar mills needs to be ensured through developing early maturing varieties



and reviewing sick cooperative sugar mills.

- Earlier, research in rice and wheat received greater attention than other crops from the Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs). There is need to strength technology development programmes for other alternative crops.

- Machines for alternative crops such as maize grain driers, cotton pickers, sugarcane harvesters, sugarcane trench planter, oilseed drill, vegetable pickers, garlic planter, potato planter, etc. would be required for acceleration of the diversification process.

- Collection centers/pack houses should be set up with facilities like washing, cooling, grading and packaging for marketing of fruits and vegetables. Punjab also requires infrastructure for export of perishables.

- The subsidies should be targeted on land development, underground water channels, improved implements, adoption of modern technologies, installation of tube wells for marginal farmers, infrastructure for export of vegetables, flowers, fruits, farmer training, etc.

- Niches need to be created to exploit specific adaptation, provide technical input and manage marketing and thereby enhancing profit of crops like basmati rice, groundnut, barley, chickpea, pea, muskmelon, watermelon, celery, kinnow, litchi, flowers, etc. The potential of Kandi area of the state for organic production of various crops needs to be exploited. Another alternative option is promoting vegetable cultivation under net houses and in peri-urban areas.



- Processing of fruits and vegetables, post-harvest storage and establishing cold chains is essential to ease out glut situation. Investment in agro-processing, market information, market development needs to be stepped up in a big way.

- There is need to provide adequate subsidy to overcome financial constraint, especially in case of small farmers.

- To expand area under agro-forestry, technology and infrastructure in the form of modern wood markets having facility of high-tech saw mills and seasoning plants and wood industries making laminated wood from poplar and eucalyptus are required.

- Beyond crops, diversification towards dairy farming, poultry, pig-gery and fish farming are extremely important. There has to be a more focused research on fodder crops for developing improved varieties and their production technology. Supplemental subsidiary occupations such as mushroom production and bee-keeping can also play an important role in agriculture diversification and provide livelihood security to the rural populations on sustainable basis.

These diversification options will provide regular income and are, therefore, more attractive for marginal and small farmers.

Conclusion

In view of the present scenario of underground water in Punjab, crop diversification away from rice-wheat cropping system particularly from rice is necessary. Once implemented on full scale, it would help to sustainably manage natural resources, especially ground water. The marketing issues will have to be thoroughly probed so as to make diversification a successful programme. It has to be ensured at the government level that the economic returns from the alternative crops are equal or higher to the crop being replaced (rice) and only then the farmers will get motivated to adopt these crops. Thus, the cultivation of the alternative crops needs to be incentivized. It is high time that the farmers, government departments, marketing agencies and even consumers understand the ground reality of depleting water table in the state and help it out from being converted into a barren desert land. ■

WORLD'S No. 1 DRIP IRRIGATION COMPANY

**IN 1965 WE INTRODUCED DRIP IRRIGATION
TO CHANGE THE FACE OF AGRICULTURE WORLDWIDE**

TODAY NETAFIM IS THE GLOBAL LEADER AND THE PREFERRED CHOICE OF FARMERS
IN PROVIDING SMART IRRIGATION SOLUTIONS, AND ENSURING
SUSTAINABLE AGRICULTURE GLOBALLY

- 110 Countries**
- 28 Subsidiaries**
- 50 Years of Experience**
- 16 Manufacturing Plants**

OUR WORLD CLASS OFFERINGS



Irrigation



Greenhouse



Field Automation

What NETAFIM Stands for...

PURPOSE

Helping the world Grow More with Less

VISION

As the world's leading irrigation company, we will drive mass adoption of drip irrigation to fight scarcity of water, land and food.

MISSION

We will make drip the irrigation solution of choice worldwide by increasing awareness and delivering comprehensive solutions that are reliable, simple and affordable.

We will provide our customers with world-class support to ensure outstanding results and peace of mind.

Leveraging our global leadership position, high-quality offering and pioneering spirit, our team commits its agronomic know-how, technological expertise, and deep passion to enhance the well-being of our customers.



CONTACT US TO HELP YOU GROW MORE WITH LESS

NETAFIM IRRIGATION INDIA PVT. LTD.

An ISO 9001:2008 and ISO 14001:2004 Certified Company

Irrigation | Greenhouse | Crop Management Technology

CIN-U01100GJ1997PTC050144 | Email ID: response@netafim-india.com

Visit us at www.netafimindia.com | Follow us on  

Head Office and Factory (Regd.):

268-270, 271-B, GIDC Manjisar (Tal.: Savli), Dist.: Vadodara - 391 775, Gujarat (India)

Tel.: 02667 264 601-4, 619 300, Fax: 02667 264 600/744

Chennai Factory : Tel. : 044 2746 0128

Regional Offices :

SBU West, Vadodara : 0265 232 0515/20 | SBU Central, Pune : 020 2528 6080

SBU South, Hyderabad : 040 2377 7753/63 | New Delhi : 011 3231 3249

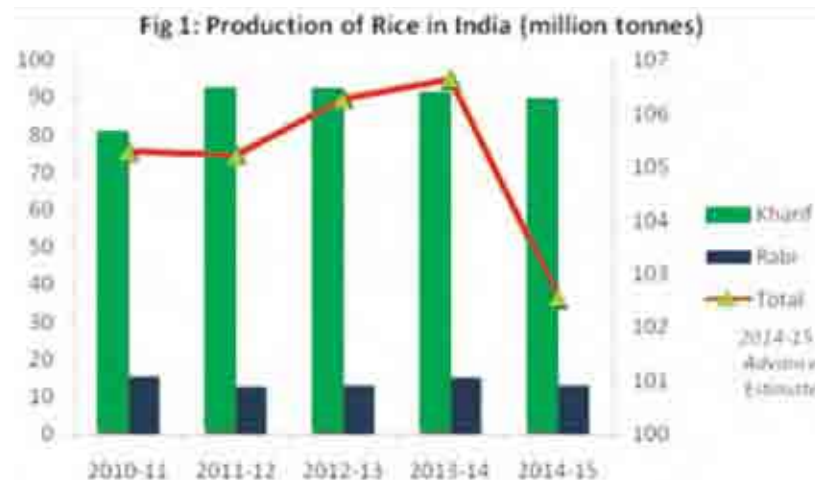
CROPS IN FOCUS

Overview

Share of agriculture in the GDP of India has been on a decline during the last several years. This is a natural consequence when a country starts its growth journey with structural changes towards industrialisation and economic reorientation. Even then, agriculture still holds a formidable position in the Indian economy, ensuring employment for a large section of the population and ensuring food security to the huge population. According to data available till 2010-11, out of the total geographical area of 328.7 million hectares, 141.6 million hectares is the net sown area. The gross cropped area is 198.9 million hectares with a cropping intensity of 140.5%. The net irrigated area is 63.6 million hectares. Every year, amount of crop production in the country holds a crucial importance to the economic growth and stability of the country.

Cereals Production Scenario in India

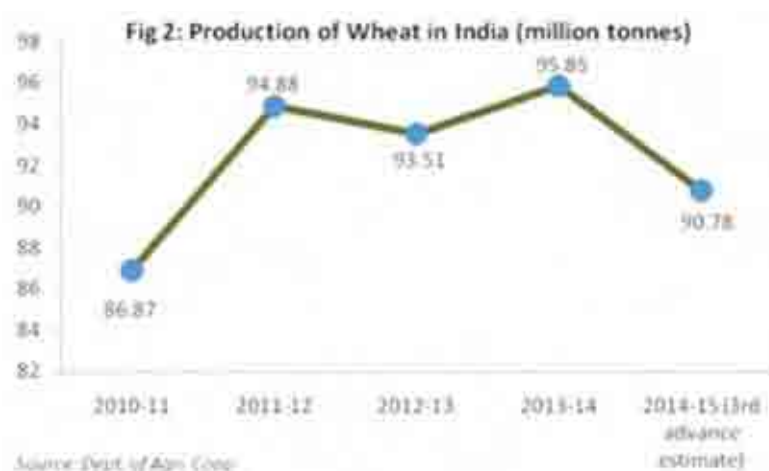
Rice is an important crop grown in India and it is the largest country in the world in terms of area under rice cultivation and the second largest



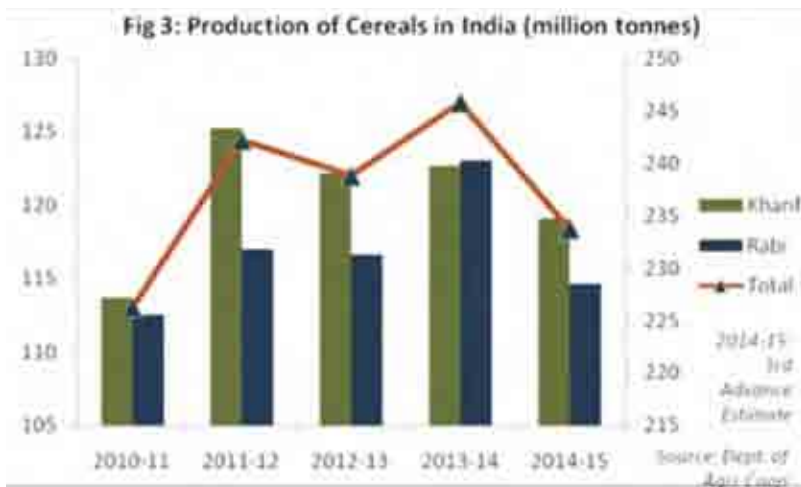
country in terms of production. In 2013-14, rice was cultivated in the country over an area of 43.5 million hectares. Between 2010-11 and 2013-14, the total kharif rice production in the country increased by 13.4%, from 80.65 million tonnes to 91.5 million tonnes. Rabi rice production declined marginally from 15.33 million tonnes in 2010-11 to 15.15 million tonnes in 2013-14. The total rice production in the country increased marginally by 1.2% from 2010-11 (95.98 million tonnes) to 2013-14 (106.65 million tonnes). According to the third advance estimate released by the department of agriculture and cooperation,

the total rice production in 2014-15 is 102.54 million tonnes, with kharif rice at 89.62 million tonnes and rabi rice at 12.91 million tonnes.

India is the largest country in the world in terms of area under wheat. In 2013-14, India cultivated about 31.5 million hectares of land with wheat. In 2010-11, India produced 86.87 million tonnes of wheat. This has been more or less on the increasing growth trend since then and in 2013-14, the total production of wheat in the country was 95.85 million tonnes, an increase by 10.3% when compared to the production figures of 2010-11. India is the third largest producer of wheat globally, behind China (125.3 million tonnes) and the European Union (154.1 million tonnes). According to the third advance estimate from the department of agriculture and cooperation, the total production of wheat for 2014-15 has been estimated at 90.78 million tonnes.



Total production of all cereals in the country has increased by almost 9% in between the period from 2010-11 and 2013-14, from 226.25 million tonnes (2010-11) to 245.74 million tonnes (2013-14). Rabi cereals increased by 9.3%, from 112.52 million

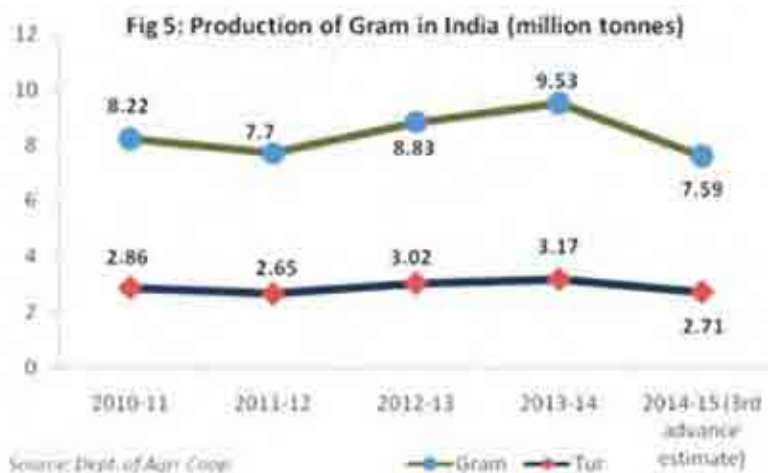


tonnes in 2010-11 to 123.09 million tonnes in 2013-14. The production of kharif cereals on the other hand increased by about 8%, but at a slower rate than rabi cereals. The production of total cereals in the country in 2014-15, according to the third advance estimate is 233.74 million tonnes.

Pulses Production Scenario in India

Pulses occupy a very important role in the country's crop production scenario. Besides acting as an important source of protein for a large section of our population, pulses are also important from export point of view and earning valuable foreign exchange for the country in the process. Various pulses like urad, moong and gram are

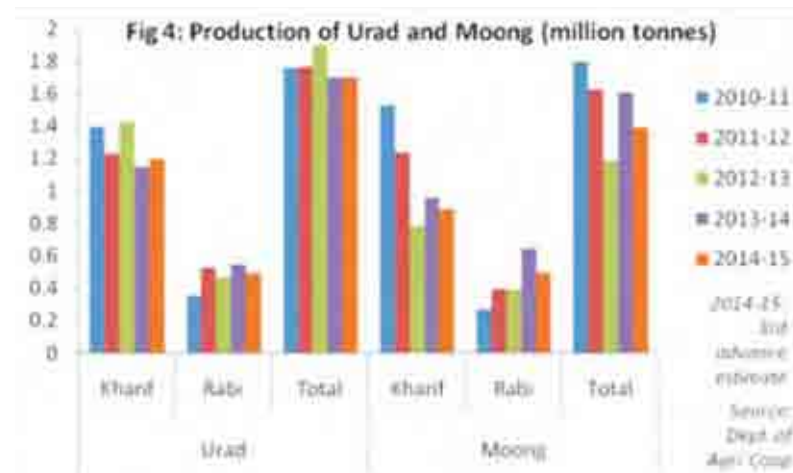
grown in large scale across the country. Production of pulses like urad and moong has decreased in India between 2010-11 and 2013-14. While total production of urad (rabi and kharif) de-



creased from 1.76 million tonnes in 2010-11 to 1.7 million tonnes in 2013-13, production of moong decreased from 1.8 million tonnes in 2010-11 to 1.61 million tonnes in 2013-14 (Fig 4). The advance estimates for total urad and moong production for 2014-15 are 1.7 million tonnes and 1.39 million tonnes respectively.

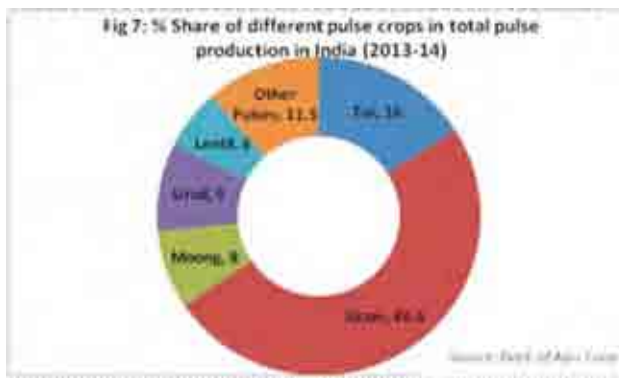
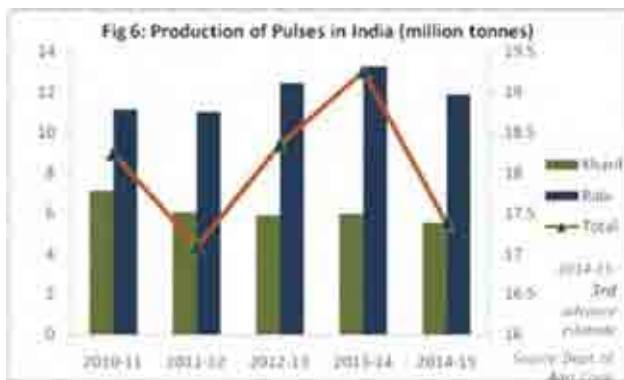
Gram occupies a major share of the total pulses production in the country. In 2010-11, total gram production in India was 8.22 million tonnes and it increased by almost 16% to 9.53 million tonnes in 2013-14. The third advance estimate released by department of agriculture and cooperation for 2014-15 puts the total production of gram in India at 7.59 million tonnes (Fig 5).

Fig 5 also shows the production



trend of other important pulses grown in India in the form of tur. Production of tur has increased consistently in the country from 2010-11 to 2013-14. The production of tur in 2013-14 (3.17 million tonnes) was almost 11% more when compared to the production figures of 2010-11 (2.86 million tonnes). In third advance estimates for 2014-15, the total production of tur has been estimated on a lower side at 2.71 million tonnes.

Study of the total pulses scenario in India (Fig 6) reveals that produc-



tion of kharif pulses decreased from 7.12 million tonnes in 2010-11 to 5.99 million tonnes in 2013-14. This represents a decrease by almost 16% between the period from 2010-11 and 2013-14. However, the total rabi pulses production increased in the country from 11.12 million tonnes in 2010-11 to 13.25 million tonnes in 2013-14, representing an increase of 19%. The third advance estimates for both rabi and kharif pulses depict a lower production scenario for the year 2014-15, at 5.52 million tonnes and 11.87 million tonnes respectively.

The total production of pulses in the country increased by 5.5% increasing from 18.24 million tonnes in 2010-11 to 19.25 million tonnes in 2013-14. The third advance estimate about production of pulses in the country is 17.38 million tonnes.

Gram is the largest constituent

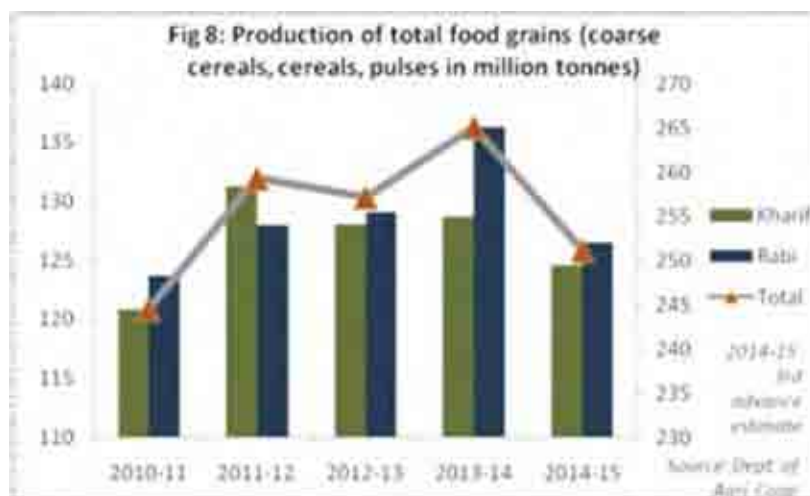
amongst all the pulses grown in India in terms of production. In 2013-14, gram production was 49.5% of the total pulses production in the country. Tur constituted 16 percent of the total pulses production in the country in the same year. Moong, Urad and Lentil constituted respectively 8%, 9%, 6% of the total production. All other pulses which are grown on a minor scale across the country shared the remaining 11.5% of the total pulses production.

Fig 8 depicts the production scenario of total cereals in the country from 2010-11 to 2013-14. Various cereals, coarse cereals and pulses are included in the food grains category. The trend during this period reveals that both kharif and rabi food grains have increased and in 2010-11, the production of kharif and rabi food grains was 120.85 million tonnes and

123.64 million tonnes respectively. The same increased to 128.69 million tonnes (kharif) and 136.35 million tonnes (rabi) in 2013-14. The highest increase in production of rabi food grains was 131.27 million tonnes in 2011-12 before decreasing in the subsequent years during the period in discussion. Rabi food grains in the country however showed a continuous growth trend during this period. Total production of pulses in the country in 2010-11 was 244.49 million tonnes which increased by about 3% to 265.04 million tonnes in 2013-14. According to third advance estimates, the pulses production is set to decrease in 2014-15 at 251.12 million tonnes.

Oilseeds Production Scenario in India

Compared to various countries globally like Malaysia, Italy etc., India's production of oilseeds are not encouraging and the country has to depend heavily on import of essential edible oil. The country imported around 11.8 million tonnes of edible oil from October 2013 to November 2014. This indicates that there is huge gap between production and requirement of oilseeds in the country. Fig 9 shows the status of production of various oilseeds in India from 2010-11 to 2014-15. Groundnuts has shown encouraging growth in production during this period. In 2010-11, the total production of groundnut in the country was



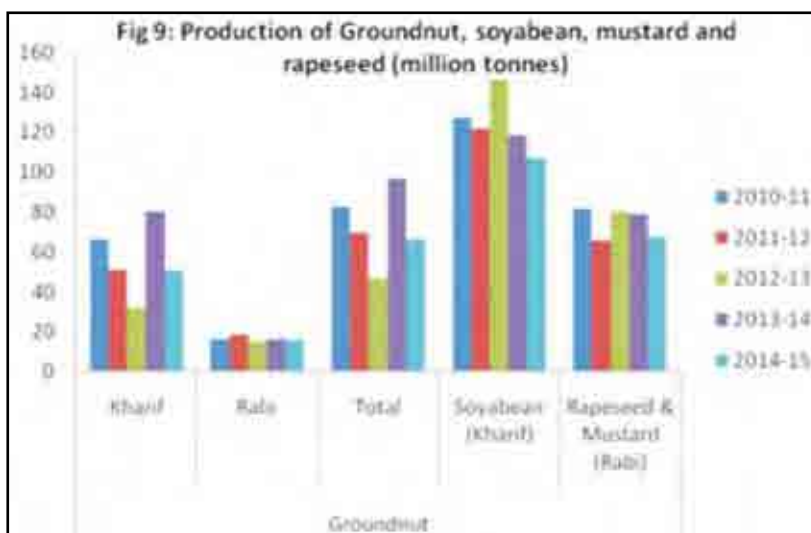
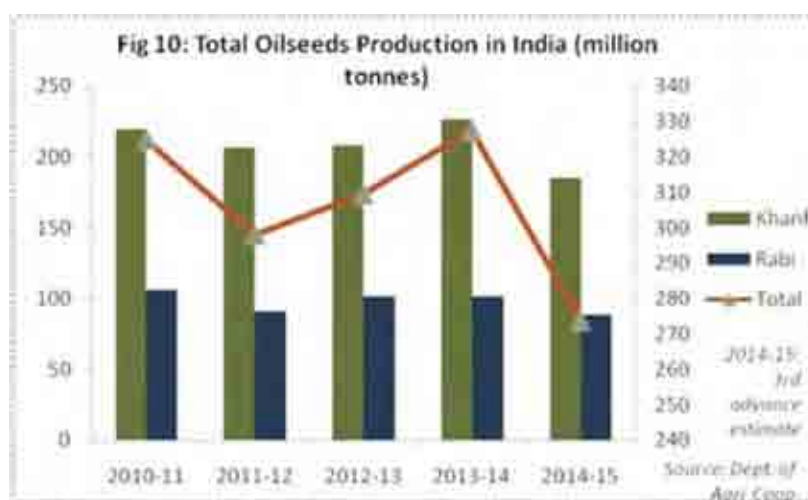


The production of soyabeans in the country in 2010 was 127.36 million tonnes which increased substantially to 146.66 million tonnes in 2012-13. However, the production witnessed a huge decline in the following year of 2013-14 when the total production of soyabeans was 118.81 million tonnes. Soyabean being a kharif crop seems to have borne the vagaries of uncertain monsoon in these different years. The third advance estimate for soyabeans production in 2014-15 is 107.05 million tonnes, further lower than that of the previous year production figures.

Like soyabeans, mustard and rapeseed have also witnessed fluctuating production in the country during the

82.65 million tonnes. Kharif and rabi groundnut production in this year was respectively 66.43 million tonnes and 16.22 million tonnes. The total production increased by 17.5% to 97.14 million tonnes in 2013-14. The kharif and rabi groundnut production in 2013-14 was respectively 80.85 million tonnes and 16.56 million tonnes. Thus, kharif ground nut exhibited substantial growth of 21% between 2010-11 and 2013-14.

Unlike groundnut, soyabeans production in the country as seen in Fig 9 has shown inconsistent production trend in the recent years.



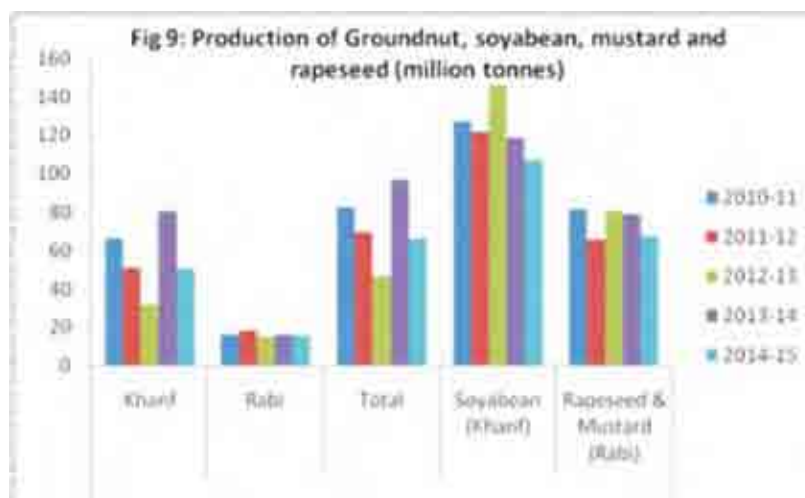
period between 2010-11 and 2014-15. Production of these two oilseeds together in 2010-11 was 81.79 million tonnes which dropped significantly in the following year to 66.04 million tonnes. However, the production picked up in 2012-13 and the total production of rapeseed and mustard in this year was 80.29 million tonnes. Production in 2013-14 was lower at 78.77 million tonnes and according is estimated to be further lowering down to 67.57 million tonnes in 2014-15 as per the third advance estimate from the department of agriculture.

Total oilseed production in India

is witnessing a fluctuating trend in the recent years, as shown in Fig 10. While the total kharif oilseed production in the country increased marginally by 3% between 2010-11 and 2014-15, the rabi decreased about 4% during this period. In 2010-11, the production of rabi and kharif oilseed was respectively 219.22 million tonnes and 105.57 million tonnes. In 2013-14, kharif and rabi oilseed production was respectively 226.12 million tonnes and 101.37 million tonnes. El Nino effect in the recent years had impacted the sowing of Rabi oilseeds adversely and it drastically decreased. Total production of oilseeds in India increased marginally from 324.79 million tonnes in 2010-11 to 327.49 million tonnes. Third advance estimate for total oilseed production in the country for 2014-15 shows a poor production scenario and its estimated to be 273.8 million tonnes, which is a substantial decrease by 16% when compared to 2013-14.

Commercial Crops Production Scenario in India

India has emerged as the highest producer of cotton in the world. In 2013-14, it surpassed China with about 36 million bales of cotton production. The production has been increasing



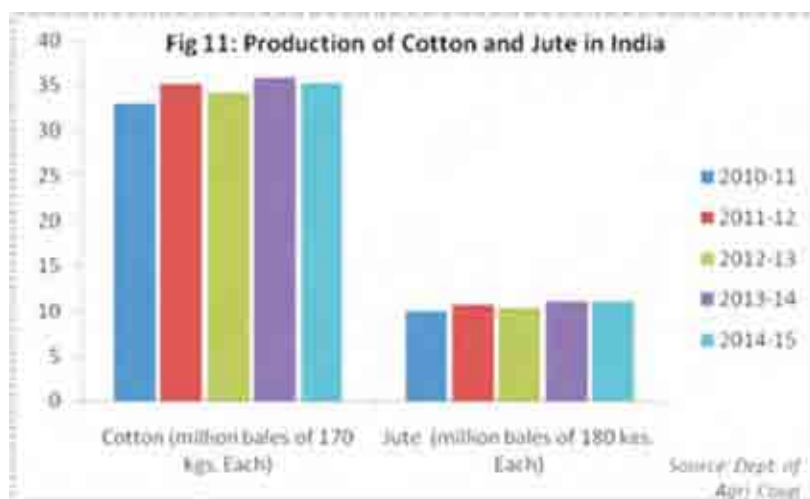
from 2010-11 to 2014-15 except for a marginal decrease in production in 2012-13. When compared to the production of cotton in India in 2010-11 with 33 million bales, production in-



creased by almost 9%. This has been possible largely because of increased area in acreage of Bt cotton in the recent years in the important cotton growing states of the country. Production of cotton in 2014-15 is estimated at 35.3 million bales.

Jute is another important and traditional fibre crop grown in the country. The total production of jute in the country in 2010-11 was 10 million bales. This has increased marginally to 11 million bales in 2013-14 and the same production is estimated in 2014-15 also.

Fig 12 shows the production trend of the other important commercial crop, sugarcane in India. It has witnessed a fluctuating production trend during the period between 2010-11 and 2014-15. In 2010-11, the production of sugarcane was 3423.82 million tonnes which showed a substantial increase in production in following year of 2011-12 at 3610.37 million tonnes. However, in the following year of 2012-13, production of sugarcane in the country suffered a huge decline to 3412 million tonnes. It recovered in 2013-14 and the production increased to 3521.42 million tonnes. Sugarcane production in 2014-15 is estimated at 3565.61 million tonnes. ■





Horticulture Crop Production in India

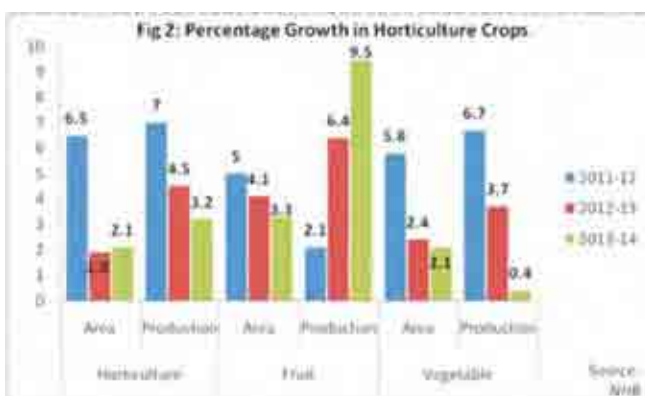
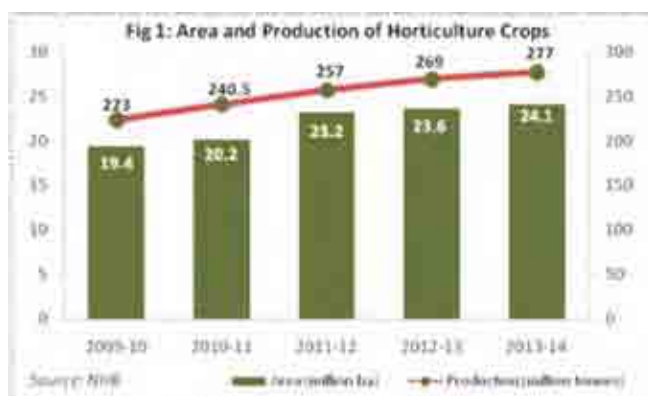
India is endowed with a remarkably heterogeneous area characterized by a great diversity of agro climatic zones. This provides a congenial condition for production of a variety of horticultural crops. A wide range of fruits, vegetables, flowers, spices, plantation crops, root and tuber crops, medicinal and aromatic crops are cultivated across various places in India. Horticulture accounts for almost 30% of the total GDP of the country. The sector has also importance from export point of view and the country exports a wide range of horticultural produce that include fruits, onion, mango pulp, fresh mangoes, dried walnuts, fresh grapes and others. India is a leading exporter of horticultural produce in the entire South Asian and

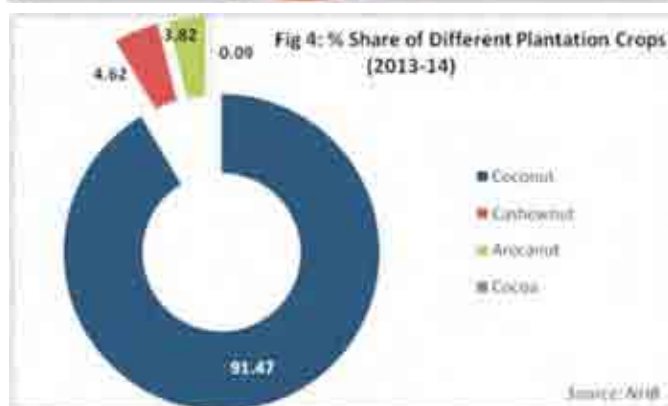
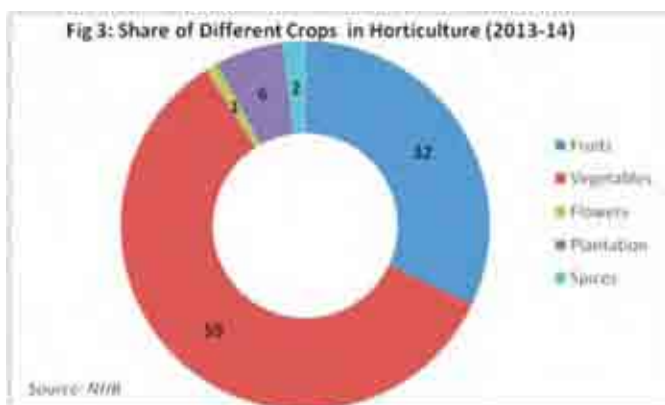
Middle East Countries. Recognising the growing importance of the sector in India and to tap maximum potential of the sector, government of India has initiated National Horticulture Mission (NHM) and Horticulture Mission for North East and Himalayan States (HMNEH). While HMNEH is focused on the development of horticulture sector in the Himalayan and the north-eastern states, NHM is operational in 344 districts out of 476 districts of 18 States and UTs, Andaman & Nicobar Islands, Lakshadweep.

With focussed government interventions through various schemes and programmes, the horticulture sector of the country has been on a growth path in the recent years. When compared to 2009-10, the area under horticultural crops in the country has increased by

more than 24 percent in 2013-14. Area in 2013-14 was 24.1 million hectares as compared to that of 19.4 million hectares in 2009-10 (Fig 1). The largest increase in area under horticultural crops was between 2010-11 and 2011-12 when the area increased from 20.2 million hectares to 23.2 million hectares. Production of various horticultural crops has also registered an increase of 24% between 2009-10 (223 million tonnes) and 2013-14 (277 million tonnes).

Figure 2 provides an overview of the year-on-year increase of area and production of various horticultural crops. When compared to 2010-11, area under fruit cultivation in the country increased by 5%. The rate of increase decreased in the next two years to 4.1% and 3.3% respectively





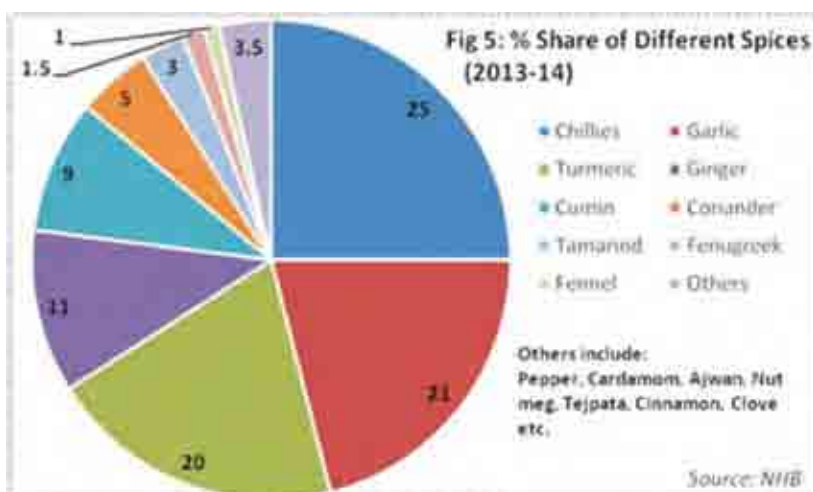
in 2012-13 and 2013-14. However, the production figures posted a continuously increasing trend. When compared to 2010-11, the production of horticultural crops had increased by 2.1% in 2011-12. In the next two years of 2012-13 and 2013-14, the growth was 6.4% and 9.5% respectively. The vegetable crop production in the country has not been showing consistent growth rate both in terms of area and production. The area under vegetables posted a growth of 5.8% in 2011-12 when compared to the previous year, but the growth decreased substantially in the following two years at 2.4% and 2.1% respectively in 2012-13 and 2013-14. Production of veg-

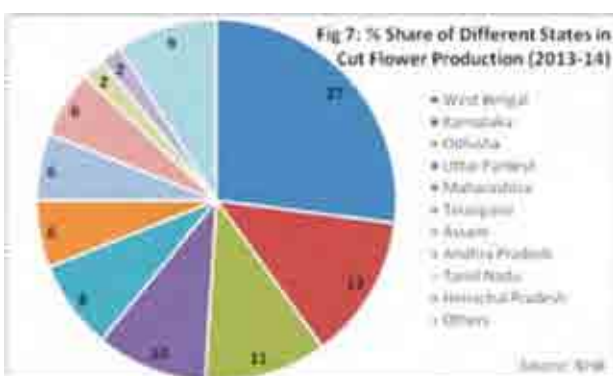
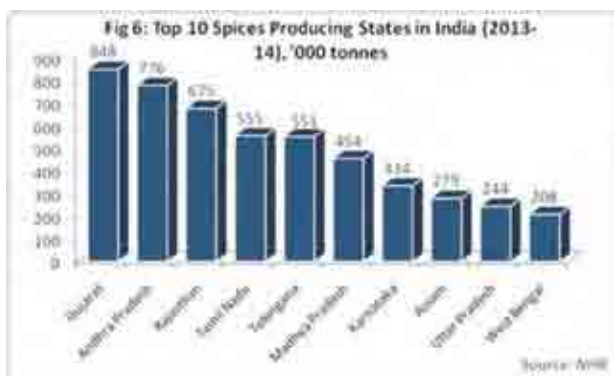
etables in India has increased by 6.7% in 2011-12 when compared to 2010-11. However, the growth rate decreased in the subsequent two years at 3.7% in 2012-13 and only 0.4% in 2013-14.

In the Indian horticulture production scenario, the dominant share is of vegetables, followed by fruits and plantation crops. In 2013-14, vegetables occupied 59% of the total horticulture crops in the country, fruits had a share of 32% and plantation crops has a share of 6%. Flowers (both cut and loose) and spices shared 1% and 2% respectively (Fig3).

Amongst various plantation crops, coconut had the largest share of production in 2013-14 at 91.47%. The major coconut growing states in the country are Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal, Goa, Andaman Nicobar Islands, Maharashtra, Gujarat, Assam and Bihar. These eleven states together produce almost 99% of the total coconut of the country. Other than coconut, cashewnut and arecanut shares respectively 4.62% and 3.83% of the total plantation crop production in the country while a meagre 0.09% is shared by cocoa.

India is the largest producer, consumer and exporter of spices in the world. India exports a wide variety of spices to various parts of the world. Spices like pepper, chilli, turmeric, ginger, cardamom, coriander, cumin, fennel, fenugreek, celery, nutmeg and garlic, tamarind, vanilla etc. are produced in India. A large number of countries across the world like USA, China, Vietnam, the UAE, Malaysia, Saudi Arabia, the UK, Germany, Singapore and Sri Lanka import spices from India. As shown in Fig 5, chillies occupy the largest share of spices grown in the country. In 2013-14, chillies had a share of 25% in the total spices production followed by garlic (21%),

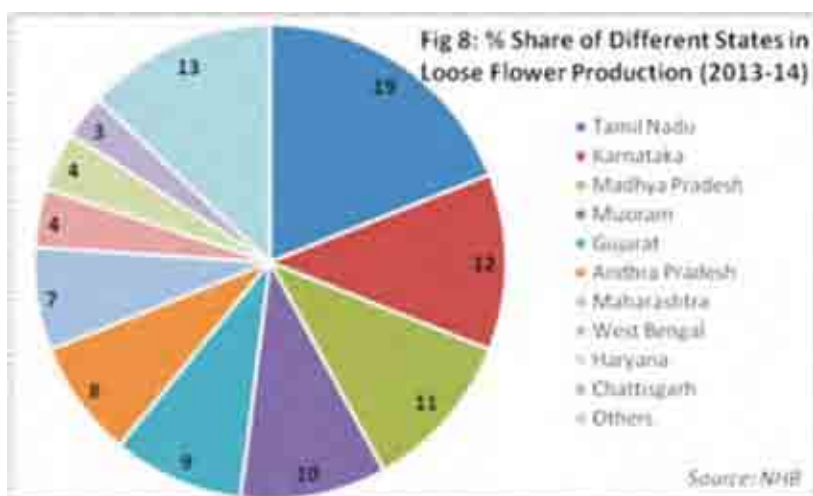




Turmeric (20%), Ginger (11%), Cumin (9%), Coriander (5%) etc.

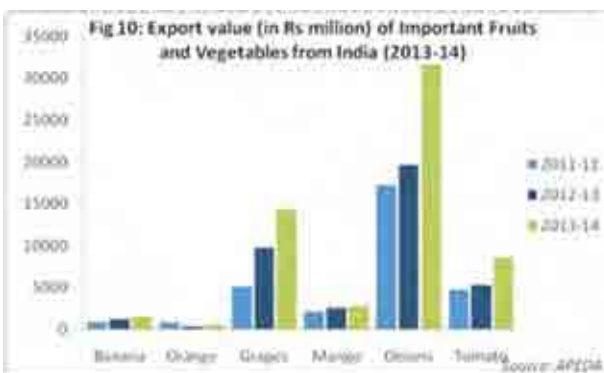
The top ten spice producing states in India produced 83% of the total spices in the country in 2013-14. Gujarat was the leading spices producing state in India with 848000 tonnes of production in 2013-14 (Fig 6). Gujarat leads in production of cumin seed in the country. It also produces considerable quantities of Fennel, Chilly, Coriander, Garlic etc. In the area of seeds spices, the state enjoys a monopoly. Andhra Pradesh is the second largest producer of spices in India with 776000 tonnes of production in 2013-14. Andhra Pradesh is the largest state in the country for chilli, both in terms of area and production. Andhra Pradesh is also the leader in the country in terms of productivity of chilli. Rajasthan is the third largest producer of spices in 2013-14 with a total production of 675 thousand tonnes. Like Gujarat, Rajasthan is also a major producer of cumin seeds, along with a whole range of other spices. The state of Rajasthan has also got a spices park set up by the spices board of India over an area of 60.07 acres with processing facilities for of seed spices such as cumin, coriander and fennel.

Floriculture is a focus area in the horticulture sector with government of India recognising floriculture as a sunrise industry. Currently, this sector enjoys 100% export oriented status. Demand of flower has been steadily



increasing in the recent years and with high commercial value in terms of export, floriculture has become one of the important commercial trades in agriculture. Currently, in various places across the country, commercial floriculture has emerged as hi-tech activity and growers are undertaking floriculture under controlled climatic

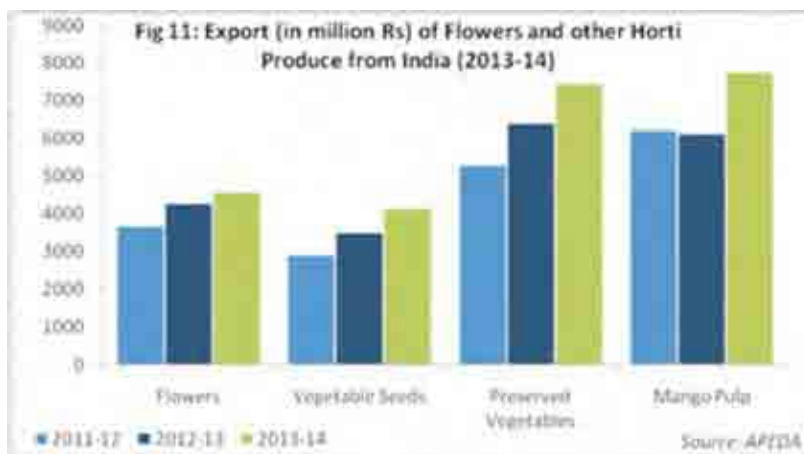
conditions inside greenhouse. In India, West Bengal is the largest producer of cut flower with 27% of the production coming from this state. Karnataka is the second largest producer of cut flowers with 13% while Odisha is currently the third largest producer with 11% of the national cut flower production (Fig 7). States like Uttar Pradesh, Maharashtra, Telangana, Assam, Andhra Pradesh, Tamil Nadu and Himachal Pradesh are also important cut flower producing states in the country. Percentage share of loose flower production is shown in Fig 8. In this category, Tamil Nadu has emerged as the state with highest production of loose flowers with 19% of the total loose flower production in the country. States like Karnataka (12% share), Madhya Pradesh (11% share), Mizoram (10% share) etc. are



the other major producers of loose flowers in the country.

The discussion on horticulture crop production is incomplete without discussing the importance of the sector in terms of export. A wide range of horticultural products ranging from flowers, mangoes, fresh and processed vegetables, grapes etc. is exported every year to various parts of the world. Fresh onions had the largest share in the export of different horticultural products in 2013-14 (Fig 9). Onions constituted 22% of the total share of exports. Fresh vegetables occupied 16% in export in 2013-14. Grapes occupied the third position with 12%.

Figure 10 shows the value derived from the export of some important fruits and vegetables by India. Export of grapes has witnessed unprecedented growth between 2011-12 and

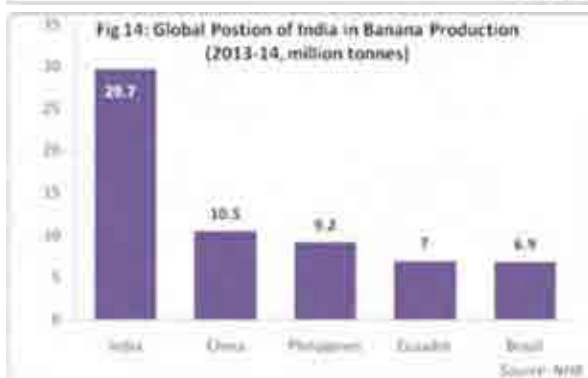
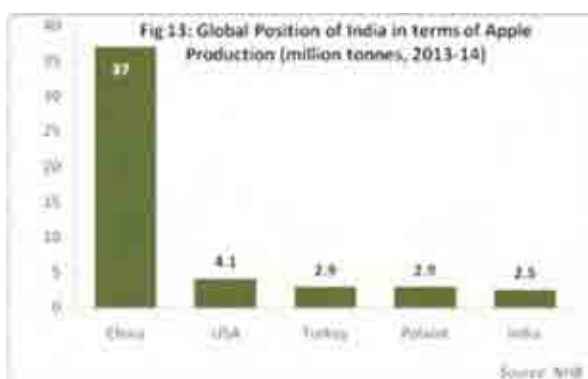
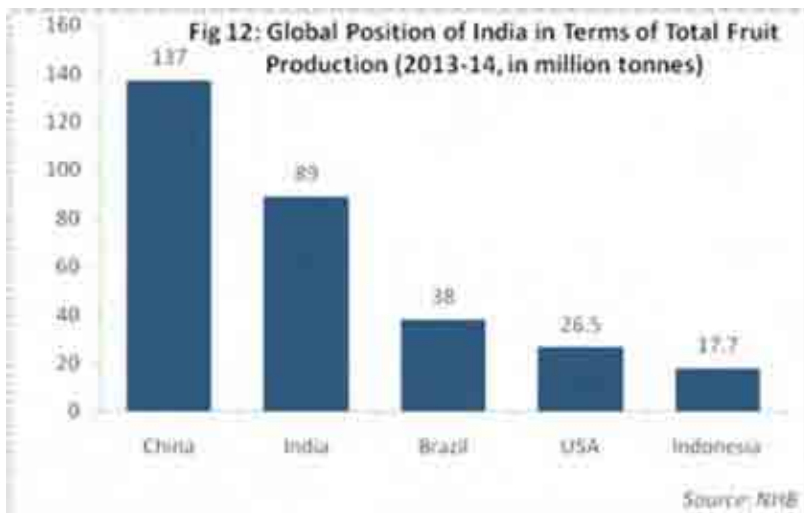


2013-14. Export of grapes in 2013-14 was Rs 14370.7 million, which was a massive 178% increase from the export figure of grapes in 2011-12 of Rs 5167.6 million. India has been exporting increasing quantities of banana. When compared to the export figure

of Rs 915.5 million, it increased by 71% in 2013-14 and the export value in this year for banana was Rs 1568.3 million. Among the major fruits being exported, orange witnessed a decline by 34% in export value. In 2011-12 the total export value of orange was Rs 849.3 million which increased to Rs 555.8 million in 2013-14. Export of onion increased substantially by about 84% between 2011-12 (Rs 17230 million) and 2013-14 (Rs 31696.1 million).

Export of flowers in India increased from Rs 3653.2 million in 2011-12 to Rs 4559.1 million in 2013-14, signifying an increase by about 25% during this period. Fresh vegetables and preserved vegetables witnessed substantial growth during the period in concern, growing at 43% and 41% respectively (Fig11). The value of fresh vegetables exported from India in 2011-12 was Rs 2877.6 million





which increased to Rs 4105.4 million in 2013-14. The value of preserved vegetables segment increased from Rs 5267.8 million in 2011-12 to Rs 7427.2 million in 2013-14. Export of Mango pulp witnessed an increase by 24.5%, increasing from Rs 6208.3 million in 2011-12 to Rs 7729.5 million in 2013-14.

India has acquired a leading position globally in the production of various horticultural crops. India is the second largest producer of fruits in the world, trailing behind China. In 2013-14, while China was the leader in global fruit production with a total production of 135 million tonnes, India occupied in the second position with a total production of 89 million tonnes of fruits (Fig 12). Brazil (38 million tonnes), USA (26.5 million tonnes) and Indonesia (17.7 million tonnes) were the other major countries in terms of fruit production in the world.

India ranks fifth in terms of global apple production and in 2013-14, total apple production in the country was 2.5 million tonnes. However, this is way lower than China which is the largest producer of apple in the world. In 2013-14, China produced 37 million tonnes of apples (Fig 13). India is the largest producer of banana in the world with 29.7 million tonnes of production in 2013-14. China ranked second in terms of banana production with 10.5 million tonnes, followed by Philippines (9.2 million tonnes), Ecuador (7 million tonnes) and Brazil (6.9 million tonnes) in 2013-14 (Fig 14).

India is the fourth largest producer of orange globally with 4 million tonnes of production in 2013-14. The highest producer of orange globally in 2013-14 was Brazil with 18 million tonnes of production. USA and China were the second and third largest producer with 8.2 million tonnes and 6.5 million tonnes of production respectively. ■



Dr. Indu Sharma,
Director and
Dr. Sendhil R, Scientist;
Dr. Karnam Venkatesh,
Scientist
ICAR-Indian
Institute of Wheat
and Barley Research,
Karnal

MANAGING RISK IN WHEAT PRODUCTION AGAINST WEATHER ANOMALIES

Agriculture is a serious livelihood activity fraught with day-to-day risks and uncertainties. In an agrarian economy like India, around 57 per cent of the people still depend on agriculture and derive their primary source of income. Inter alia, weather anomalies in the form of unseasonal excessive rains and temperature fluctuations play a major role in crop production. These irregularities hamper the production of winter cereal wheat which by and large affect the income and welfare of the farmers. Volatility in weather variables produce significant changes in the crop yield, product mix, sowing time, cropping system, scheduling of field operations, pest-disease infestation and grain moisture content owing to changes in the duration of solar radiation, minimum and maximum temperature, relative humidity, wind speed and precipitation. Literature on climate change foresees that increase in the mean temperature will be comparatively more during Rabi, the wheat growing season against Kharif. Further, increase in the quantum of precipitation and its erratic pattern will lead to more cloudy days resulting in the overall yield reduction. Several crop modelling studies predict that wheat produced in India will decrease by 4-6 million tonnes with every rise of

1 °C mean temperature. Also, the rainfed wheat will experience a decreased yield and profit loss between 9-25 per cent for a temperature increase of 2-3.5 °C. The current year's (2014-15) decline in wheat production by 7 million tonnes (7.21 %) to 88.94 million tonnes from last year's record production of 95.85 million tonnes may be largely attributed to the unseasonal, excessive rains clubbed with hail storms throughout the high productive northern plains in the month of February-March, 2015. Several lessons were to be learnt from this unexpected situation created by weather variables. Hence, to avoid or manage its volatility during the crop season, farmers have to adopt either a single or a combination of risk management strategies against the negative consequences created by the anomalies in weather.

Inter-year variations and instability in wheat

Inter-year fluctuations are prominent in wheat area, production and yield but of varying magnitude. A significant number of years have witnessed a decline in all the three parameters and it shall be largely attributed to the weather anomalies. Also, a drastic reduction to the tune of 7 million tonnes in wheat production has been noticed for a few years like 2014-15, 2002-



03 and 2000-01.

Production decline in the abnormal years is largely due to yield decline followed by fall in the crop acreage. It is one of the indications that variations in wheat yield should be countered by adopting one or more of risk management strategies. Supported by the instability measure (coefficient of variation in per cent), random variations in wheat production for all the decades between 1955-56 to 1964-65 and 2005-06 to 2014-15 is attributed to instability in yield followed by crop area (Table2) that suggests for suitable and relevant risk management strategies at micro level for stabilizing wheat yield and thereby production.

Risk Management Strategies

Strategically, there exists a bunch of risk management tools to counter the uncertainty in market prices during harvest. However, only a few strategies prevail to manage the negative impact of weather variability on crop production (Figure 1). Growing resistant genotypes, climate smart farming practices, crop diversification and insurance are the most widely followed strategies against weather aberrations during the crop season.

Resistant Genotypes: The most widely used as well as easy to adopt is growing resistant varieties against a host of biotic and abiotic stress resulting from climate change. Resistant genotypes that are tolerant to terminal stress, variations in diurnal temperature, lodging, pests and diseases infestation, weeds, drought, submergence, extreme cold, salinity and alkalinity have to be developed by the breeders utilizing the resistant stocks. However, development and

Table 1. Instability in wheat area, production and yield

Period	Coefficient of Variation (%)		
	Area	Production	Yield
1955-56 to 1964-65	4.86	13.22	10.40
1965-66 to 1974-75	15.07	28.07	15.78
1975-76 to 1984-85	5.75	16.89	11.50
1985-86 to 1994-95	3.94	12.54	9.06
1995-96 to 2004-05	3.24	5.83	3.97
2005-06 to 2014-15	4.87	10.52	6.45



adoption of resistant varieties is region-specific and hence the role of wheat breeding assumes greater significance.

Breeding strategies for management of risks associated with the weather anomalies:

1. Development of wheat varieties tolerant to weather anomalies such as increased temperature, heat, less and excessive rainfall.
2. Breeding programmes must aim to develop wheat varieties that fit into eco-system based practices like conservation agriculture and

zero tillage.

3. Widening the genetic base of breeding material by frequent and routine use of wild relatives, land races, and other non-adapted genetic materials for development of varieties suited to withstand weather anomalies.
4. Adaptation of modern concepts of precise phenotyping clubbed with tools of biotechnology such as high throughput genotyping, marker assisted selection, and transgenics which have been proved useful in quickly achieving the plant breeding goals in many crops.

Diversification: Crop diversification is another measure to manage the production risk. Farmers have to take more than one crop/livestock enterprise so that there will be a trade-off against revenue loss due to natural calamities. For instance, wheat crop sown between poplar trees, intercropping with pulses/oil-seeds, allocation of considerable area to other competing crops are suggested for minimising the revenue loss in one or other enterprise.

Adaptation Practices: Climate smart farming practices and

Figure 1: Risk management strategies



adaptation strategies are well recognised among researchers and policy makers. Adjusting the sowing time, crop spacing, zero tillage and soil moisture based irrigation etc are some of the popular climate change adaptation strategies suggested by researchers as well as followed by the farming community. Table 3 presents the risk management strategies in wheat production through breeding and agronomic interventions.

Crop Insurance: Crop insurance as a tool for risk management has been popular in Indian agriculture since the twentieth century. However, the scale of adoption is limited with respect to the farmers, especially in the case of small holders. The mechanism has grown sporadically since its implementation but is still progressing in terms of scope, methodology and application at field level. There are different types of agriculture insurance products offered both by public (<http://www.aicofindia.com>) and private sectors. However, public sector holds a major share owing to the extent of damage done by the natural calamities. Generally there are two types of agricultural insurance coverage: (1) Crop yield insurance has been envisaged to pay the indemnity to producers if yield levels fall below the insured yield, (2) On the contrary, crop revenue insurance has been intended to pay the indemnity to farmers based on the shortfall in gross revenue instead of the observed yield.

In India, several insurance plans are available for wheat (state specific) in most of the disaster prone areas of the country. The National Agricultural Insurance Scheme (NAIS) was the most popular scheme covering yield losses among all available insurance schemes. It has been made available to both loanee and non-loanee farmers. The insured amount

Table 2. Risk management interventions in wheat production

Risk	Interventions
Increased temperature and heat stress	1. Adjustment in package of practices like sowing dates, irrigation schedule, fertilizer application etc. 2. Genetic selection for more heat tolerant crop varieties
Decreased rainfall	1. Adjustment in package of practices 2. Development of drought tolerant varieties
Changes in timing and amount of rainfall	1. Development of lodging and waterlogging tolerant varieties 2. Adjustment in package of practices 3. Adopting soil erosion and waterlogging control strategies

generally extend to the value of the threshold yield of the insured crop. Yet, the farmer has the choice to insure his crop beyond the threshold yield value to the limit of 150 per cent of the average yield realised in the notified area. In the case of loanee farmers, the sum insured would be at least equal to the amount of sanctioned loan. The scheme has undergone several modifications in the recent past and now it is available as Modified NAIS, the component 1 under National Crop Insurance Scheme (NCIP).

The component 2 is the popular Weather Based Crop Insurance Scheme (WBCIS). It is also available for both loanee and non-loanee wheat producers. However, it is obligatory for loanee and voluntary for non-loanee farmers. Under this scheme, the farmers will get compensation against the loss resulted from adverse rainfall incidence such as deficit or excess rainfall. The risk coverage starts from sowing till harvest of wheat. Generally, the sum insured is equivalent to the cost of cultivation and is pre-declared and notified by the insurance companies. For instance, if a farmer grows wheat in five hectares of land, then the sum insured will be approximately five times the estimated cost of cultivation

in that region. Also, the premium to be paid by the insured farmer will be estimated by the insurance companies based on standard premium rating methodology and notified well ahead of the sowing time or crop season.

Primarily, agriculture is associated with risks and uncertainties and has been severely impacted by its vagaries especially in developing countries. These unpredictable and uncontrollable perils reduce significantly the Indian wheat production which was witnessed in the recent past due to unexpected rains and hailstorms during harvest period. Despite region specific, wheat producers are advised to adopt suitable and relevant risk management strategies to bank a stable growth of the crop sector as well as to improve their income. Further, off-farm/ non-farm employment by the farming households shall provide additional revenue to sustain the family. Climate smart wheat crop management practices and/or resource conservation technologies coupled with appropriate risk management strategies through national extension services will show a substantial and positive impact on the livelihood and welfare of the farming community. ■



Micro Irrigation Systems



Agri Pipes & Fittings



Submersible Pipes



Fields fill with Gold, when happiness flows...

Kisan Mouldings Ltd. (KML), under its twin brands, Kisan & KML Classic, manufactures Irrigation products like Micro - Irrigation Systems, Agricultural Pipes & Fittings and Submersible Pipes, that have been delighting farmers' for the last 33 years. Our products are manufactured in ISO certified manufacturing facilities & carry the coveted BIS mark as per relevant specifications, ensuring a long-life of trouble-free service, as seen in acres of farmlands spread across India.

Therefore, we say, not just water, happiness flows through our pipes. For lush, green fields, filled with the fruits of your labour, trust Kisan Mouldings Ltd.!



Kisan Mouldings Ltd

Tex Centre, K-Wing, 3rd Floor, 26'A' Chandivali Road, Andheri (East), Mumbai - 400 072. T : 022- 42009200/100 email : customercare@kisangroup.com



R. K. Solanki,
*Scientist cum
Cumin breeder; Y
K Sharma, Prin-
cipal Scientist; P
N Dubey, Senior Sci-
entist and Dr. Balraj
Singh, Director, ICAR
-National Research
Centre on Seed
Spices, Ajmer*

INDIAN CUMIN CULTIVATION – PROSPECTS AND CHALLENGES

Cumin one of the most important seed spices earns a good deal of export income, at the same time is plagued with huge challenges in cultivation and marketing. The crop is highly sensitive to biotic and abiotic problems and to manage the biotic problems considering the issue of pesticide residue is creating problems in trading with developed nations. Although, in the recent years cumin export has reached to a tune of Rs.1838 corers (2014-15) from Rs.396 corers (2010-11) bouncing nearly 364 percent, but simultaneously the problems of pesticide residue has also hampered export to western world.

Looking at the International demand potential, cumin crop, can be designated as 'Golden crop of Sands', as it is cultivated in the arid and semi arid regions of the country covering States of Rajasthan and Gujarat. To add upon, the best quality of cumin is produced in the deserts of Rajasthan due to cool and dry weather where the farmers are deprived of natural resources throughout the year. The sensitivity of the crop asks for high attention

to manage the problems for sustaining the incremental demand world over.

Inherent Challenges

The inherent challenges which limit the potential to breed new varieties are too high in cumin. Cumin belongs to genus *Cuminum* with only two species *cyminum* and *setifolium*. The former species is the cultivated one where as the latter is the wild type identified a few years back bearing hairs on seed. In general, cumin plant is of short stature with limited biomass; gene pool diversity is very limited and narrow, trait variability is observed high for quantitative traits like number of branches, number of umbels, seeds per umbel but the genus does not possess diverse characteristic differences for introgression in cultivar. Small flower size restricts manual emasculation and pollination, hence no successful reports are available deciphering the genetic architecture of the crop. Cumin has been exploited for genetic improvement in economic traits like seed yield only by performing selection in natural available population or in few instances by mutation



breeding. Being Umbelliferae crop it also carries the inherent problem of delayed germination, it is also susceptible to Fusarium wilt and Alternaria blight. Against Fusarium, resistance is available but no source is available against the most devastating problem of Alternaria blight caused by *Alternaria burnsii*. Due to high susceptibility to Alternaria blight, this crop is preferred to be grown under limited moisture conditions, reflecting upon minimum risk of Alternaria disease incidence under arid zones compared to semi arid and humid zones. Across the world it is cultivated in middle east and Indian sub-continent in large, within the country it has not spread beyond western arid and semi arid zone because of its susceptibility to Alternaria blight which occurs under humid conditions and causes cent percent loss.

Crop Management Challenges:

Cumin cultivation is considered as one the most risky practices, the inherent risk for raising a healthy crop has been recognized well by our ancestors. Cumin being highly susceptible to both biotic and abiotic problems needs to be nurtured for harvesting seeds. Rating of the problems in cultivation makes Alternaria blight management the most important biotic problem. In the past few years, advent of plant fungicides has significantly controlled the disease but the problem of fungicide toxicity remains. The development of Fusarium wilt resistant variety Gujarat Cumin-4 has been remarkable in developing confidence among farmers against wilt management, but on the other side the variety GC-4 due to high biomass and



spreading character, harbours humid microclimate beneath plant canopy favouring Alternaria multiplication and subsequently its spread. The mono-varietal cultivation of GC-4 is also a challenging issue, as this may lead to breakdown of the resistance against Fusarium wilt. Cumin crop has high yield potential but due to high susceptibility to both biotic and abiotic problems the yield is affected significantly depending upon the microclimatic conditions prevailing at the point of time, which further brings down the average yield of the country.

Market Challenges:

Though Indian cumin is in high demand in developed nations, the changing climatic scenario is creating challenging situations. In the past few years, untimely winter rains coupled with hailstorms have caused significant damage. Cloudy weather in the western regions has created congenial conditions for spread of Alternaria blight diseases causing heavy fungicidal spray for its management. Cumin is exported as raw crop to most parts of the world

and the bulk is checked for pesticide/fungicide residue very strictly. Consignments are rejected in turn affecting the trade value of Indian cumin. After the collapse of Syria and other countries as a result of civil war, the demand for Indian cumin has increased exponentially. To sustain upon the demand created by the gap in supply from Middle East countries, taking an opportunity, Indian cumin should be traded from the farm itself. The demand driven approach should be catalyzed to work upon good agricultural practices for raising pesticide free or pesticides under MRL as per the domestic and international demand. The export of raw produce, promotional schemes of government should be favouring creation of farmers' group to take up cumin cultivation and trading both. Value addition in cumin needs to be worked out at commercial scale. Whether value addition would take care of the residual toxicity with minimum expenditure for harnessing maximum value has to be worked out; products like essential oil and oleoresins need to be tested for marketable quality. An increase in export always favour

much to traders, farmers should be benefited simultaneously.

Climatic Challenges:

It may sound good that the arid regions of the country are slowly converting into semi-arid due to increase in the average rainfall and vegetation over the past few years as per the recent report published by NBSSLU&P, Nagpur. This situation is healthy for the farmers of western India, but in turn it's a challenge for the crop like cumin. Humid conditions are most dis-favoured by the crop, the crop has to be managed tactfully against Alternaria Blight and frost. There is need to identify new areas which can provide cool dry weather favourable for cumin cultivation.

Strategies to workup:

Looking at the present situation and future of the cumin crop, strategies should be worked out for systematic approach for enhancing the benefits from the crop. There are few key points which need major attention, the issue relates to research, development and other managerial aspects.

- Development of integrated protection modules including biocontrol mechanisms for effective and chemical residual free Alternaria blight management.
- Identification of new or novel molecules of fungicides which are systematic and can be more effective against Alternaria blight
- Large scale farmers awareness programme need to be conducted for making farmers aware of judicious use of pesticides/insecticides
- Alternaria blight is a seed borne disease, hence large scale seed production programme should



be taken up for healthy seed production free from Alternaria blight

- To think beyond boundaries, transgenics approach for developing varieties against Alternaria blight may be a futuristic approach, it will all depend upon the acceptability of transgenic in food crops within Indian and other countries of the world
- Identification of new and non-traditional areas for increasing the area under cumin should be taken up with the help of GIS, the areas should be cool dry and frost free
- The sites which are very much dry and cool offering unfavourable climate for Alternaria blight spread and favourable for cumin cultivation should be considered for converting them into export oriented zones
- Trade value of cumin can be increased by establishing correlation between the microclimate of the region and quality of cumin harvested from the region, this may help in endorsing GI's for cumin for trading and value addition
- Seed village concept and cooperative societies should be encouraged for cumin crop
- Cumin is exported as raw, hence primary level processing is sufficient enough to grade the seeds for trading, hence small equipments or small processing units can be promoted at farm level by training farmers self-help groups for seed processing, packaging and trading
- Most of the cumin is exported as raw seed, huge opportunity lies in converting the raw seed into value added products like essential oil, oleoresins etc., which is be exported at high price to western world
- As India is the world leader in cumin and to sustain upon, strong linkages are required between research, developmental and marketing agencies to work out models for promotion of cumin production, value additions and marketing. ■



Right Product, Right Acre

For over four decades, we have provided high quality seeds to ensure improved agricultural productivity for more than 4 million farmers in India. Our endeavour is to bring crop genetics, advanced seed technology and traditional farming practices together uniquely to deliver right product on the right acre.

Our world class scientists not only develop products considering crop diversity but also diverse growing conditions - such as resources availability, irrigation facility, disease incidences, land type, grain type preferences.

In India, Pioneer® brand product offerings include corn, rice, cotton, pearl millet, and mustard crop seeds - Each product delivering its promise of increasing the farmer's profitability through higher and better yield, every seed contributing towards making India one of the top agrarian economies.



Corporate Office : **PHI SEEDS PVT. LTD.,**

H.No.6-3-1099/1100, 3rd Floor, Babukhan's Millennium Centre, Rajbhavan Road, Somajiguda, Hyderabad - 500 082, Telangana, India,
Ph: +91-40-30434400. website: www.pioneer.com/India E-mail: communications.india@pioneer.com

©, SM, TM Trademarks and service marks of DuPont, Pioneer or their respective owners. © 2015 PHII.



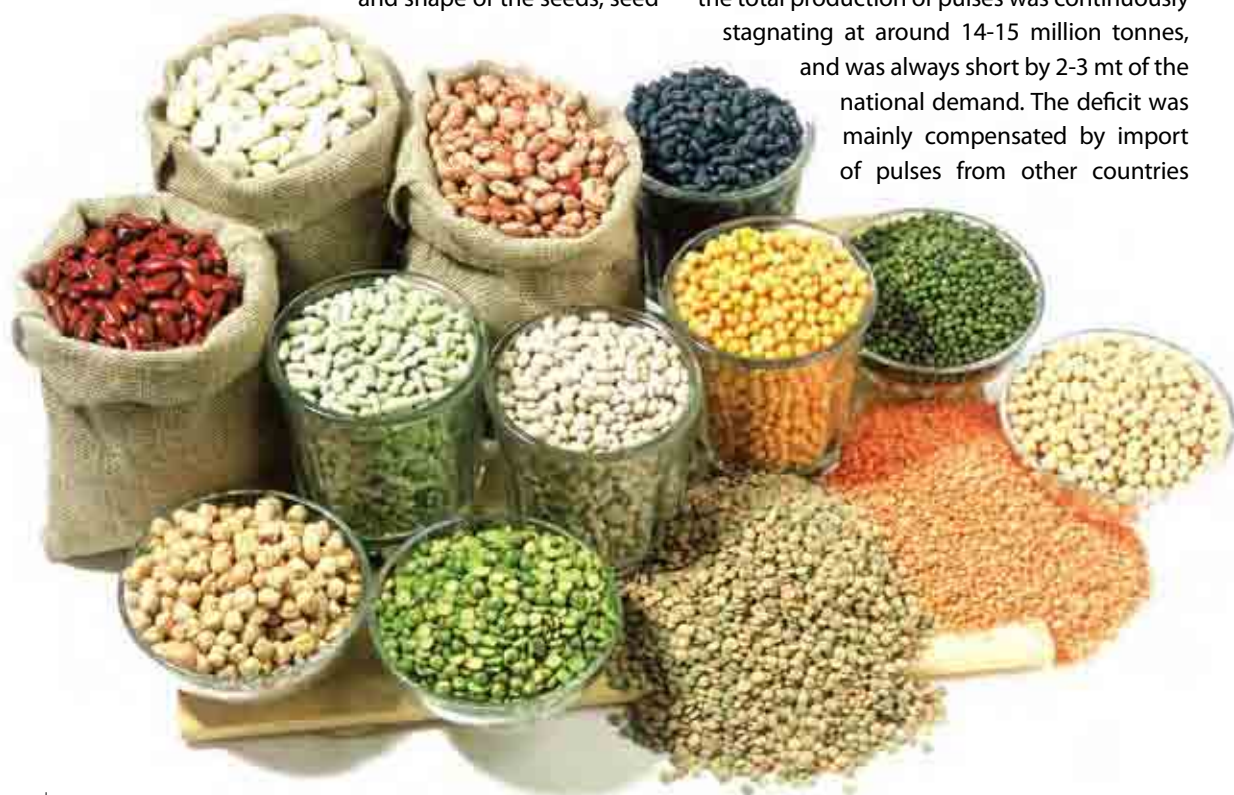
Dr. N.P. Singh,
Director and
Dr. Aditya Pratap,
Senior Scientist,
ICAR-Indian
Institute of Pulses
Research, Kanpur

Towards Achieving Self Sufficiency in Pulses

Pulses constitute a very important dietary constituent for humans and animals because of their richness with proteins (ranging from 15 to 34%, depending upon the crop species) and other essential minerals, vitamins and dietary fibres. The protein content of grain legumes is approximately double the protein content of wheat and three times that of rice. They are also high in iron and consequently help in alleviating iron-deficiency anemia. Such a wide range of attributes make grain food legumes an essential ingredient in predominantly vegetarian diets of vast majority of people in India and other countries of south-east Asia. Grain legumes are also used in Europe and America for gluten-free products, ready-to-eat baked goods, mixes, soups, sauces, and other foods with pulses as one of the ingredients. However, these are mostly consumed as natural food products in form of whole grains or dehulled or split grains in most of the world and hence, size and shape of the seeds, seed

coat appearance, cotyledon size and color, and uniformity are important for markets.

In India, over a dozen pulse crops including chickpea, pigeonpea, cowpea, mungbean, urdbean, lentil, French bean, horse gram, field pea, moth bean, lathyrus, etc. are grown in one or the other part of the country. However, the most important pulse crops grown here are chickpea (41%) followed by pigeonpea (15%), urdbean (10%), mungbean (9%), cowpea (7%) lentil (5%) and fieldpea (5%). The production of pulses in the country has witnessed an upward trend during the last few years and it has consistently remained at about >18 million tonnes since 2010. The production of 19.78 million tonnes of pulse grains for the year 2013-14 was an all time high. This was really encouraging for the pulses researchers as well as farmers and was a landmark year for the country towards achieving self sufficiency in pulses production. Not looking far beyond, the scenario was entirely different during the first decade of this century when the total production of pulses was continuously stagnating at around 14-15 million tonnes, and was always short by 2-3 mt of the national demand. The deficit was mainly compensated by import of pulses from other countries





casting a heavy burden on the public exchequer. However, encouraged by the accomplishment of last few years and tremendous opportunities available for vertical and horizontal expansion of pulses, the future seems to be promising towards achieving self sufficiency in pulses.

Area, Production and Productivity

India stands out as a leader in production as well as consumption of pulses in the world. During 2012-13, the total pulse production in India was 18.34 million tonnes (up by 7.31% over the previous year) which further increased by another 7.85% in 2013-14 with a production of 19.78 million tonnes, touching an all-time high record (Table 1). However, during 2014-15, the production is estimated to receive slight setback due to hostile weather conditions and consequently the production is predicted to tally at 17.20 million tonnes as per the fourth advanced estimates of Department of Agriculture and Cooperation. However, this appears to be a

momentary phase and is likely to be compensated by better production figures next year. The positive trend in production scenario has sustained since last four years. Looking retrospectively at the growth rate of area, production, yield and other important aspects of pulses, a positive and significant growth (1.17%) has been observed in area after 2000-01 although it was not significant for the overall period of three decades between 1970 to 2000. Similarly, the growth in case of production as well as for productivity during 2000 to 2012

was also positive and higher than that of the preceding three decades. Interestingly, the growth rate in pulse production (2.61%) during this decade has been even higher than the growth rate of rice (1.59%), wheat (1.89%) and all cereals together (1.88%). Among different pulses, the highest growth rate was observed in chickpea production (5.89%) followed by pigeonpea (2.61%). There are a number of factors which contributed together in significant rise of production in these crops including technology generation and its

Year	Area (m. ha)	Production (m. ton)	Yield (Kg/ha)
2007-08	23.63	14.76	625
2008-09	22.09	14.57	659
2009-10	23.28	14.66	630
2010-11	26.28	18.24	694
2011-12	24.78	17.09	690
2012-13	23.26	18.34	789
2013-14	25.21	19.78	785
2014-15 *	23.37	17.20	743

*As per 3rd advance estimates by Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India



dissemination due to the concerted efforts of researchers, policy initiative by the government and pro-active involvement of various government agencies and policy makers, adoption of technology by the farmers and favorable environmental conditions. More than 560 improved varieties in different pulses, availability of their quality seed, improved pulse production and protection technologies, active government involvement and policy support, led to an upward growth in pulses production in India.

Geographical shift

During the past three decades, the cultivation of pulses has witnessed an unprecedented geographical shift, catalyzed mainly by assured irrigation facilities being available in the Indo Gangetic plains, which once used to be the pulse basket of the country till the 1970s. The area under pulses in IGP was largely replaced by wheat, rice and maize due to assured irrigation facilities. However, reduction in area under pulses in IGP was compensated by an increase in central and southern parts of India, Andhra Pradesh

becoming the leader in total pulse production with an average increase in the yield of two of major pulses, chickpea and pigeonpea by about 81-100% during the last two decades (1991-2010). Consequently, the total pulses area in central and south India increased from 11.34 million hectares to 15.01 million hectares. The short duration chickpea varieties developed by ICAR-SAU played a key role in expanding the area and productivity of chickpea in southern India. Similarly, while the area of lentil



increased significantly in Madhya Pradesh, and pigeonpea in Andhra Pradesh and Karnataka, development and adoption of appropriate varieties led to increase in area, production and yield of lentil in Jharkhand and Rajasthan. An increasing trend was also observed in the area under mungbean and urdbean in north India which increased to almost double alongwith a significant increase in productivity.

During the XI Plan period alone, significant improvement in production and productivity of total pulses was observed in Jharkhand, Gujarat and Andhra Pradesh. In chickpea, there was a positive growth in area, production and productivity in Andhra Pradesh, Gujarat, and Maharashtra. Production of pigeonpea was enhanced by about 2.53 lakh tonnes in Karnataka, 1.26 lakh tonnes in Gujarat and 1.13 lakh tonnes in Andhra Pradesh. Similarly, significant area expansion of pigeonpea by 1.13 lakh ha was noticed in Karnataka, and 0.74 lakh ha in Andhra Pradesh. With the development of short-duration varieties, there was expansion of mungbean in summer season under rice-wheat system in north India. Similarly, in peas also, there was a significant increase in area and production in Uttar Pradesh (1.17 lakh ha and 1.8 lakh tonnes).

Constraints in increasing pulses production

The average productivity of pulse crops in India (780 kg/ha) still remains low as compared to their potential harvestable yields (1.2-2.0 t). This is mainly because of their cultivation on poor soils with minimum inputs and the confounding effects of various biotic and abiotic stresses. While minor pests and diseases may

become major in future, terminal heat and drought stresses may become more important. Other factors such as shifting rainfall pattern, untimely and erratic rains, extreme temperatures, etc. may also change the cultivation pattern of pulses. Among the biotic stresses, fusarium wilt coupled with root rot complex is the most widespread disease causing substantial losses to chickpea. In pigeonpea, fusarium wilt, sterility mosaic and phytophthora blight cause substantial losses and in mungbean and urdbean yellow mosaic, cercospora leaf spot and powdery mildew are considered as the most important diseases. In lentil, the rust, powdery mildew and wilt cause considerable damage. Among key insect-pests, gram pod borer (*Helicoverpa armigera*) in chickpea and pigeonpea, pod fly in pigeonpea, whitefly, jassids and thrips in dry beans cause severe damage to the respective crops. Weeds also cause substantial loss to pulses. Recently, nematodes have emerged as potential threat to the successful cultivation of pulses in many areas.

Technology initiatives

A large number of region-specific and widely adapted high yielding varieties of pulses with tolerance to biotic and abiotic stresses have been developed. Bio-intensification of pulse-based cropping systems and development of pulses production and protection techniques have led to a better technical know-how on increasing the production and productivity of pulses. New niches like rice-fallows have been explored for horizontal expansion of pulses. The whole genome sequencing of pigeonpea and chickpea and availability of draft genome sequence of mungbean

have widened the scope of targeting loci controlling complex traits such as stress tolerance and yield and nutritional quality improvement paving the way for development of varieties with desired attributes. Transgenic development against pod borer in chickpea and pigeonpea is underway. At the same time, efficient extension models like pulse-seed-



village have been implemented for dissemination of pulse-based technologies for farmers to make the pulse cultivation in the country productive and remunerative.

To bridge yield gaps a number of improved technologies have been put to use. These include availability of quality seeds of high yielding and input responsive varieties of different pulse crops, identification of suitable pre- and post emergence herbicide molecules for effective control of weeds, suitable state-of-the-art micro-irrigation systems, modern agronomic practices viz., raised bed planting, ridge sowing, optimum utilization of nutrients and interculture practices, use of farm machineries and equipments for efficient farm operations and reducing drudgery, and

state-of-art food processing and post harvest handling units of farm produce. Development in bio-intensive eco-friendly IPM modules to effectively manage major insect pests and diseases have had complimentary effects in the form of effective control of pests as well as saving the environment.

A number of new research initia-

tives have also been taken up viz., development of new plant types for different agro-climatic situations, exploitation of heterosis in pigeonpea through development of Cytoplasmic Male Sterility based hybrids, transgenic development in chickpea and pigeonpea for managing *Helicoverpa* pod borer, marker assisted selection for introgression of resistance genes and characterization of biotic and abiotic stresses that are expected to have tremendous impacts on improving productivity of pulses in the country. These developments will help in utilization of advanced technologies for improvement of pulses such as marker-assisted breeding, advanced backcross QTL (AB-QTL) breeding, development of MAGIC populations. Development of transgenics in pulses



for resistance to pod borer and tolerance to drought will have a long lasting impact on increasing production and productivity of pigeonpea and chickpea.

Futuristic technologies

With the development of efficient genetic transformation systems, it has now become possible to transfer desirable genes from alien sources into cultivated backgrounds. Realizing the potential of this technology, efforts have been initiated at IIPR to develop transgenics for pod borer resistance in chickpea. Over the year considerable progress has been made on this aspect. This technology is envisaged to play a major role in future for development of biotic and abiotic stress resistant cultivars in different food legumes. In case of transgenics, the transferred gene is usually derived from an alien species that is neither the recipient species nor a close, sexually compatible relative. This raises skepticism among a group of consumers as well as growers about the development and use of transgenics. With the aim of meeting these reservations and at the same

time ensuring an environmentally sound and efficient plant production, the two transformation concepts, intragenesis and cisgenesis, were developed as alternatives to transgenic crop development. In cisgenesis, the gene on interest, together with its promoter is taken from the species itself or a sexually compatible relative. Cisgenic plants have no extra risks as compared to plants from conventional breeding or mutation breeding. In the times to come the intragenesis and cisgenesis options will be the techniques of choice in case of legume species also and will be tremendously useful in transferring gene from wild relatives.

Information technology will underpin future progress and prosperity. Efforts must be made to strengthen the informatics in agriculture by developing databases, linking databases with international databases and adding value to information to facilitate decision making at various levels. Development of production models for various agro ecological regimes to forecast the production potential should assume greater importance. Using the remote sensing

and GIS technologies, natural and other agricultural resource should be mapped at micro and macro levels and effectively used for land and water use planning as well as agricultural forecasting, market intelligence and e business, contingency planning and prediction of disease and pest incidences.

Genomic tools provide comprehensive information on genes involved in biochemical pathways leading upto nutritional compounds and can be used to understand the genetics of traits of interest and consequently, helping in marker assisted breeding. During the last two decades powerful genetic and genomic tools such as establishment of genetic and physical maps, expressed sequence tags, bioinformatic tools, genome-wide sequence data, genomic and metabolomic platforms, etc. have been developed for many legume species. These efforts have led to development of large scale molecular markers, identification of various marker trait associations, construction of genetic and linkage maps, expressed sequence tags database, partial or whole genome sequences, physical and molecular maps, DNA chips and bacterial artificial chromosome (BAC) libraries. Genome sequence information is available in important pulses like pigeonpea and chickpea and this information can be tremendously useful in harnessing genomic resources for the improvement of not only these two crops, but also all other pulses.

Use of the conventional research methodologies, supplemented by the above-mentioned modern research tools will definitely go a long way in solving the problem of food and nutritional security to the mankind.

Policy support for increasing pulses production

Realizing the yield gaps due to poor seed replacement rate and inadequate dissemination of pulses cultivation technologies, several programmes viz., National Food Security Mission (NFSM) – Pulses, Accelerated Pulses Production Programme (A3P), Rashtriya Krishi Vikas Yojna (RKVY), 60,000 Pulses Villages, etc. were launched during the XI Plan period to boost pulses production in the country with technological back up and interventions of National Agricultural Research System and well planned financial support of Planning Commission and Ministry of Agriculture, Govt. of India. Region-specific, cost effective and system-based technological know-how and packages of pulses were disseminated among the farmers through farmers' participatory research and extension, on-farm demonstrations, front line demonstrations, and skill based training to bridge the gap between potential and realized yield in pulses. Inclusion and adoption of improved varieties of different pulse crops under different farming systems also helped in increasing productivity per unit area. The policy initiatives such as increasing the minimum support price by the Government also encouraged the farmers to take up pulse cultivation as a profitable venture.

Quality seed acts as a prime input to realize the potential of all other inputs. However, non-availability of quality seeds remains one of the greatest impediments in improving productivity. Under the National Food Security Mission, breeder seed production was doubled. Involvement of private seed agencies, NGOs

and farmers associations besides farmers' participatory seed production programme had been encouraged besides firming up public sector seed production.

Directions

Although the production of pulses in the country has tremendously improved during the last 4-5 years, it is still not sufficient to meet the present domestic requirement of about 22 million tonnes. Further, since major pulses are largely cultivated under rainfed and monsoon dependent areas where soil moisture is the critical factor determining the productivity, the production trends keep fluctuating every year depending upon rainfall. Assuming a moderate requirement of 35g pulses per capita per day with 10% additional need for seeds, feed, wastage, etc., the projected pulse requirement by the year 2050 will be about 39 million tonnes. This necessitates an annual growth rate of 2.14%. For achieving this goal, the average pulse productivity needs to be enhanced to about 1200 kg/ha and about 4-5 million hectare additional area has to be brought under pulses, besides ensuring a drastic reduction in post-harvest losses.

This requires a paradigm shift in research and technology generation, its dissemination as well as commercialization along with capacity building in frontier areas of research. Presently, chickpea alone shares about 45% of the total pulses production of the country followed by pigeonpea, mungbean, urdbean and other pulses. However, irrigated pulses comprising of greengram, blackgram and fieldpea can largely compensate the projected yield gap. Recently short duration varieties of pulses enabled

extensive cultivation of chickpea in central and south India, and summer mungbean in Rajasthan. The geographical shift in pulses area and production is an indication of potentialities of pulses to adapt under diverse climatic conditions and possible future expansion in new niches. High production of pulses during the last few years could be possible primarily due to availability of quality seeds and proven technological back up.

There is potential for expanding pulse cultivation in irrigated and rainfed regions through cropping system manipulation, crop intensification and new niches. At present, approximately 10.5 m ha area under rice-wheat system offers scope for introduction of pulses to sustain the system productivity. Likewise, rice fallows of eastern India and coastal regions can be efficiently utilized by utera (paira) cropping of lentil, urdbean and mungbean. There is scope to grow pulses in inter-row space of crops like sugarcane, pearl millets, and sorghum. It is expected that at least 2.5 million ha area can be brought under horizontal expansion through appropriate cropping systems.

The production of cereals has almost doubled since 1970. However, in case of pulses, the improvement is comparatively slow. With rising demand of vegetarian food due to ever-increasing population and diversification of food habits, demand of pulses is increasing at a fast pace. This will be further challenged by changing climate. Post-harvest losses of food legumes still remain a matter of great concern. Accordingly, pulses researchers have to remain prepared with a wide range of pulse genotypes which may adapt themselves across changing climates. ■



Dr. V. Krishnakumar,
Head, CPCRI,
Kayamkulam ;

Dr. S. Jayasekhar,
Scientist, CPCRI,
Kasargod and

Dr. P. Chowdappa,
Director, Central
Plantation Crops
Research Institute,
Kasragod

Sectoral strengths, issues and coping up strategies of coconut, arecanut and cocoa in India

Plantation crops in India are considered to be the major segment of the horticulture crops and the mainstay of agrarian economies in many States and Union Territories (UTs) of the country. They contribute a significant amount to the national exchequer and country's exports by way of excise and export earnings. The major plantation crops in India include coconut, arecanut, oil palm, cashew, tea, coffee, rubber and cocoa. India is the largest producer and consumer of cashew nut and arecanut. Tea and coffee are the main and oldest industries in the country, which provide ample employment opportunities to the people and hold immense potential for export. But, in India, plantation crops have been continuously facing the problem of lack of investment and depressed yields, and are in great need of modernization. Their total coverage is comparatively less and they are mostly confined to small holdings.

National production scenario

The area under coconut has been estimated to be 2.14 million ha (2013) and India stands third and first among the coconut growing countries in area and production, respectively. The estimated production of coconut in 2012-13 was 23 billion nuts, registering an increase of about 4.48% over the previous year. Out of the total production of 23 billion nuts of coconut in India, four states of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu together account for 91.30 per cent of the total production in the country. In terms of area, they contribute to 89.11 per cent.

In India, arecanut is cultivated in an area of 453,000 hectares with an annual production of 632,000 tonnes. The states of Karnataka, Kerala, Assam, West Bengal and Meghalaya are the major producers and account for more than 94% of the area and production.

In India, cocoa is cultivated mainly in the

states of Tamil Nadu, Andhra Pradesh, Kerala, and Karnataka. At present, demand for cocoa beans is higher than the domestic production, necessitating large scale imports to meet the national requirement. India produced 15,133 tonnes of cocoa from an area of 71,245 hectares. Tamil Nadu has the highest area under cocoa (33.6%), followed by Andhra Pradesh (31.1%), and while in the case of cocoa production, Kerala has the major share (41.8%) followed by Andhra Pradesh (37.0%). Indian productivity is 236 kg/ha whereas the world productivity is 504 kg/ha.

Trade aspects of coconut, arecanut and cocoa

The export of coconut and coconut products from India recorded an increase of 13.5 per cent during 2014-15, compared to the previous year. The earnings from the export of coconut products, excluding coir and coir products was Rs 1312.38 crore during the period compared to Rs 1156.12 crore in 2013-14. The share of activated carbon in the total exports was Rs 558 crore during the year, slightly lower than in the preceding year, mainly due to the drop in coconut production. The export declined also due to the higher domestic price of shell charcoal, the raw material used for the production of activated carbon, affecting the competitiveness of the product in the International market. The export of virgin coconut oil increased in both quantity and value (from Rs 4.81 crore in 2013-14 to Rs 24.72 crore during 2014-15). As regards coir and coir products, their exports touched a record high valued at Rs. 1476 crores during 2013-14.

Major destinations of arecanut export are Vietnam, Indonesia, Malaysia, UAE, Maldives, UK and Singapore. Supari/scented supari and pan masala are two major value added products of arecanut having sizeable quantity of export. From 1999 onwards, import of arecanut to India registered a significant increase due to change in global scenario in the context of trade liberaliza-

tion. Total imports were about 97316 tonnes of arecanut, which was valued at Rs 58979 lakhs during 2012-13.

Sectoral strength

In India, coconut research is vested with the ICAR-Central Plantation Crops Research Institute under the administrative control of Indian Council of Agricultural Research (ICAR). The All India Coordinated Research Centers on Palms (AICRP on Palms) managed by Agricultural/Horticultural Universities of different states also conducts research for the development of location-specific technologies for coconut. The developmental activities on coconut are taken up by the Coconut Development Board (CDB), Ministry of Agriculture, Government of



Coconut based high density cropping system for empowering for small and marginal farmers

India. Advancements in Research & Development in coconut sector in India are rated as number one among the coconut growing countries.

India has made significant progress in developing technology for crop improvement, crop production and crop protection. The country is also in the forefront of nations having large collection of coconut germplasm. Huge untapped domestic market, attractive domestic price, emergence of three tier farmer producer organization (FPO), high domestic demand for value added products, availability of indigenous processing technologies are the strengths of the Indian coconut sector.

The average national productivity of coconuts in India is around 63 nuts per palm per year. In contrast, certain elite coconut palms are reported to yield more than 400 coconuts per palm per year. With a focus to improve productivity and overall profitability to the farmers, research efforts have been focussed on development of high yielding coconut varieties and large number of high yielding varieties and hybrids have been evolved and released. The other technological advancements include standardization of various location-specific agronomic management packages including nursery techniques; input



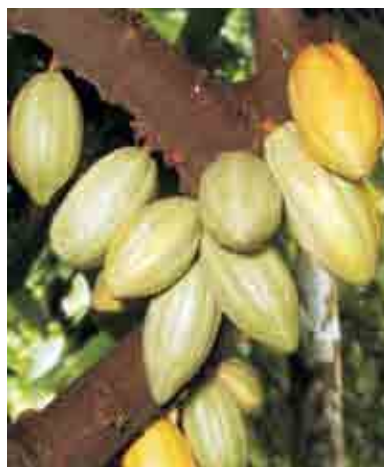
Chandra sankara, high yielding hybrid coconut variety



management techniques like integrated nutrition management, water management; plant health management techniques for pest and diseases); inter cropping,/mixed cropping/ multiple cropping/integrated farming in coconut based farming system etc. for increasing resource use efficiency and higher income and employment generation, which are being adopted by the coconut farmers across the country.

With respect to arecanut, many varieties have been released by different agencies like ICAR institutes and State Agricultural Universities. In the recent period, availability of skilled labourers has become a problem for operations like spraying fungicides and harvesting and hence, dwarf varieties/hybrids offer great potential. The protocol developed by ICAR-

CPCRI for somatic embryogenesis and plantlet regeneration could be exploited for mass multiplication of dwarf hybrids and identifying yellow leaf disease (YLD) field tolerant palms in endemic areas.



High yielding forastro cocoa variety suitable to palm based cropping systems

CPCRI has developed high yielding elite clones and hybrids, with yield range up to 2.5 kg dry bean /tree and with varying processing qualities suitable to arecanut, coconut and oilpalm gardens as an ideal inter crop

Mechanization, value addition and product diversification

Mechanization of farm operations is the immediate requirement to reduce the cost of production, especially in the context of high labour wages and their non availability for timely farm operations. The chember model climbing machine became an effective solution since it could be operated even by women with some training. The safety attachment, later incorporated by ICAR-CPCRI gives much required confidence to the climbers especially the beginners. Apart from this, manually and power operated coconut husking machines; coconut splitting device; de-shelling machine; tender coconut punch and cutter; coconut dryers of varying capacities and using different fuel sources; testa remover; coconut slicing machine and VCO cooker etc. are the other major contributions from the institute. Mechanization of unit operations in coir production has also played an important role in coir industry. India is the largest coir producer in the world accounting for more than 80 per cent of the total world production of coir fibre. The coir sector in India is very diverse and involves households, co-operatives, NGOs, manufacturers and exporters. Coconut processing and allied industries provides continuous employment to nearly 8 lakhs workers of which 80 per cent are women folk.

There exists a huge scope for coconut based agri-business in India in

order to increase the present 8% level of value addition to 25%, thereby value added products becoming a deciding factor in the price movement of coconut to ensure fair, reasonable and steady price to coconut farmers. In an effort towards value addition, ICAR-CPCRI has developed complete package of practices for the production of virgin coconut oil (hot and fermentation process), coconut chips, coconut honey, jaggery and sugar. The estimated annual monetary benefits in hot process VCO, fermentation process VCO and coconut chips are Rs.13,70,000, Rs.8,12,500 and Rs.47,35,800 respectively. CPCRI has developed a technology for collecting coconut inflorescence sap by using a device. The sap thus collected is called Kalparasa. Kalparasa can be preserved up to 45 days under cold condition (in refrigerator) without adding any preservatives and additives with the bottling technology. It has been demonstrated that a farmer tapping 15 coconut palms for Kalparasa

could earn on an average Rs. 45,000 a month, while a tapper can earn about Rs. 20,000 per month. Several value added technologies are available for arecanut by-product utilization such as making of eco-friendly disposable plates and bowls from areca leaf sheath, leaf sheath fodder, oyster mushroom production from leaf and bunch wastes and vermicomposting. Skill development/capacity building for women SHGs and rural youth for efficient by-product utilization in arecanut by various means is necessary to ensure value addition and income generation.

Challenges confronted by the sector

The fact that the plantation crops sector in the country is dominated by millions of small and marginal farmers and mainly confined to the economically and ecologically vulnerable regions, plays a crucial role as far as the issue of sustainability is concerned. In order to address

the challenges and convert the weaknesses to opportunities, concerted efforts from all stakeholders is very much essential. In India, most of the coconut plantations are old and senile. While world consumption of coconut products is growing more than 10% a year, production is increasing by only 2%. To maximize the productivity from such coconut gardens, care should be taken to replant with quality planting materials. Considering the replanting needs of old and senile coconut plantations, replacing the diseased palms in traditional coconut growing areas and expanding the cultivation in non-traditional areas, about 22 million seedlings per year would be required for the country. The present annual production of seedlings is estimated to be around 20 million, resulting in a likely annual deficit to the tune of 2 million seedlings. Further, the present quantum of production of planting material from the governmental sector works out to about six million seedlings, and accounts for only 25% of the total planting material requirement in the country.

Monocropping of coconut very often fails to produce maximum returns from unit area and results in poor resource use efficiency. In order to increase the total farm productivity, coconut based inter/mixed, multi-storied multi-species cropping as well as mixed farming systems by integrating livestock components for different agro ecological zones are to be adopted by the farmers.

The spread of root (wilt) disease, outbreak of *Phytophthora* and *Ganoderma* wilt or basal stem rot disease are the major concerns in the coconut sector. Some minor diseases like leaf spot or leaf blight and stem bleeding



Value added products of coconut



Utilization of arecanut leaf sheaths for production of eco-friendly plates and cups.

are also becoming severe, probably with changing climate and difficulty in adopting the management strategies in time due to various socio-economic reasons.

Considering the growing threat to coconut production and productivity from alien invasive species, there is an urgent need to formulate and establish an efficient 'Biosecurity System' to regularly monitor quarantine and contain the invasive pests in porous borders. Non-availability of skilled climbers for application of the biocontrol agents or chemicals to the crown regions of the tall coconut palm is the main reason for non-adoption of many of the crop protection technologies.

Fruit rot caused by *Phytophthora* and Yellow Leaf Disease (YLD) caused by phytoplasma are currently the most important yield limiting factors in arecanut. The increasing incidence of other diseases like inflorescence dieback and basal stem rot are other major concerns.

Even though the area under cocoa cultivation in India, when compared to other countries, is limited, many efforts are being initiated by the Directorate of Cocoa and Cashew, Govt. of India for area expansion and other production related aspects. It is necessary to develop and refine minimal

cocoa bean processing techniques on priority basis to facilitate the small farmers.

Coping up strategies

It is of paramount importance to develop an exclusive policy by each state for production and supply of elite planting materials for the area expansion and rejuvenation programmes. Considering the requirement of planting material in the coming decades, there is urgent need for doubling the planting material production capability of governmental agencies viz., ICAR-CPCRI, Coconut Development Board, State Agricultural Universities and Department of Agriculture/Horticulture in different states. In order to make available quality seedlings for the farmers, it is necessary to develop coconut seed gardens in a Private Public Partnership (PPP) mode and this could be assigned to Coconut Producers Societies, accredited Coconut Nurseries and NGO's, through a decentralized seedling production programmes. Imparting appropriate training on hybridization technique to the technical personnel involved in the planting material production programme also becomes necessary. It is also essential to develop a system of mandatory accreditation of all

coconut nurseries to ensure that supply of quality seedlings alone takes place. Ensuring the quality of planting material also envisages the development of variety-specific standards and implementation of suitable certification process.

Considering the limitations in meeting the demand for elite planting material of improved varieties through conventional techniques, application of in vitro techniques, assumes importance as a plausible technique to produce large number of genetically uniform plantlets. Hence, research organizations in the country should focus on development of reliable and robust protocols for rapid multiplication of elite high yielding and disease resistant coconut palms and hybrids.

To counter the outbreaks of minor pests like scale insects, mealy bugs, inflorescence caterpillar and slug caterpillar, the surveillance mechanisms as well as forecasting and forewarning systems for pests and diseases of coconut are to be strengthened. Development of an effective and easy way of delivery of biocontrol agents or chemicals with machineries for the management of the diseases like bud rot, leaf rot, leaf blight or basal stem rot, is to be given top most priority to achieve success in plant health man-

agement in the scenario of labour constraints in the agricultural sector.

Further, value added products from coconut inflorescence sap, endosperm and tender nut water need to be refined and popularized to tap the market for health foods and nutraceuticals and improve profitability of the sector. At the same time, conversion of coconut shells into charcoal and subsequent conversion of the charcoal thus produced into activated carbon opens up an avenue for community level processing for value addition of these by-products.

Streamlining of extension approaches is to be undertaken to suit the fragmented small and marginal holdings. Participatory research, involving farmer groups for refining and fine tuning of technologies for higher efficiency of the sector is to be given greater emphasis. Farmer organizations are to be facilitated for meaningful partnership in technology generation and transfer and for achieving efficiency in commodity value chain. Integrating youth/women farmers organizations with other main stream groups in agriculture with leadership roles and mainstreaming functions should be supported with policy prioritizing, for empowerment of the target groups and sustained development of the coconut sector.

Any further area expansion of arecanut, both in traditional and non-traditional areas is to be strictly prohibited and simultaneously the arecanut based cropping systems should be encouraged in the existing arecanut plantations in the country. We need to have a futuristic vision to evolve integrated and scientifically planned

areca based cropping models in the country which include livestock, fishery component, and staple food/nutritional components. Evolving region specific arecanut-based sustainable cropping system models and promoting multi-species cropping system in collaboration with Directorate of Arecanut and Spices Development should be given emphasis.

About 23 lakh ha area is available in India under coconut and arecanut plantations for cultivation of cocoa plants as intercrop and around 35% of this land is under irrigation. Availability of such areas in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and



Orissa, therefore, offers ample scope for newer area expansion of cocoa. At present the area of cocoa is around 71 thousand ha and it could be possible to introduce an additional 40 thousand ha into cocoa plantation by 2020. Meanwhile the productivity should be increased to 700 kg/ha, and if 60% of the newly introduced area will give full potential yield, it could produce 46 thousand tonnes of cocoa beans by the year 2020.

It is of utmost importance to establish village level primary processing units and capacity building for fermentation and drying of cocoa beans with the formation of strong farmer aggregates, women SHG's and rural

youth. Development of exclusive market yards and assembling places for cocoa beans along with the adoption of high quality food safety standards would be a pro-active step for better realization of bean prices. Assured buy-back systems developed in the frame of contract farming facilitated by leading chocolate manufacturers under the stake of government can also help the growth of the sector.

Plantation sector in India, represented by crops such as coconut, arecanut and cocoa, has inherent strength of varied agro-climatic conditions, huge domestic demand, comparatively higher productivity, strong R&D support, and technology delivery systems. In spite of these positive aspects, concerted efforts are deficient to effectively utilize the possible linkage between them for increasing the production and marketing efficiencies. Sustainable economy of these crops could be achieved through integrated development of cultivation and industry coupled with a stable market. The new initiatives such as formation of farmers' collectives, for group activities, collaborative research for production of high yielding and hybrid seedlings, skill up gradation of farming community and creating more skilled labourers for farming, harvesting and processing operations aimed at enhancing production, processing and value addition, etc. will definitely place Indian coconut, arecanut and cocoa sectors at forefront in the world. Above all, as food safety standards are becoming more stringent in the world, to be competitive in the trade, one should give adequate importance to the Good Management Practices (GMP) in the plantation sector. ■

CONCEPT AGROTECH CONSULTANTS LIMITED

Catalysing agribusiness growth ...

Mission

To be the prime movers of business growth in agriculture sector with our widening role in information management, research & studies, business consulting and human resource services



*We fulfill staffing needs of blue chip companies.
Visit us to see details...*

www.agrijobs.in

*We provide complete business consulting solutions to
agri sector. Visit us to see details.....*

www.cacl.in

*We provide comprehensive information solutions to
agri sector. Visit us to see details.....*

www.agriculturetoday.in

Some of our esteemed clients

- ◆ Tata Chemicals Ltd.
- ◆ Deepak Fertiliser and Petrochemicals Corporation Ltd.
- ◆ ACME Group
- ◆ Netafim Irrigation India (P) Ltd.
- ◆ Naziveeds Seeds Ltd.
- ◆ Reliance Industries Ltd.
- ◆ Nagarjuna Fert. & Chem. Ltd.
- ◆ DCM Srinam Consolidated Ltd.
- ◆ FIE Industries Ltd.
- ◆ PI Industries Ltd.
- ◆ Multi Commodity Exchange of India Ltd.
- ◆ J.K. Seeds Ltd.
- ◆ Advanta India Ltd.
- ◆ El DuPont (I) Pvt. Ltd.
- ◆ Excel Crop Care Ltd.
- ◆ Indofil Chemicals Co-opery
- ◆ Jubilant Organosys Ltd.
- ◆ Mahyco Monsanto Biotech Ltd.
- ◆ Sudarshan Chemical Industries
- ◆ Government of Uttaranchal
- ◆ AP State Remote Sensing Agency
- ◆ Indo-Gulf Corporation
- ◆ United Phosphorous Ltd.
- ◆ IFFCO Limited
- ◆ Field Fresh Ltd.

We till
Concept
till Harvest



NS
AGRI NEWS SERVICE
A unique information tool

*Agri news information is exploding,
but now it's easy to manage and
available on a single stick...*

306, Rohit House, Tolstoy Road, New Delhi - 110001, Tel: 011-23731129, 23353406
Email: ceo@cacl.in agriHR@cacl.in research@cacl.in Website: www.cacl.in www.agrijobs.in

**ANIMAL
HUSBANDRY,
DAIRY AND
FISHERIES**

Overview

India has the largest livestock population in the world, accounting for about 57.3 per cent of the world's buffalo population and 14.7 per cent of the cattle population. Having made significant advancements in production and processing during the last decade, India is currently focussing to upgrade the quality of production, for example in case of milk, by increasing the efficiency of procurement as well as the testing of milk for quality. Significant progress has been achieved in broiler production during the last three decades and currently, India is one of the top five broiler meat producing countries in the world.

Importance of the livestock sector as a whole can be gauged from its increasing contribution to the GDP of the country (Fig1). In 2008-09, the total contribution of the livestock sector to the GDP of the country was Rs. 2004 billion. This has been consistently increasing since then, and in 2012-13, the total value of the contribution was Rs. 3862 billion, with a compound annual growth rate (CAGR) of 14%. The highest percentage of year-on-year growth was witnessed from 2009-10 to 2010-11, when the growth in contribution in terms of value increased



by 20.5% from Rs 2371 billion in 2009-10 to Rs 2858 billion in 2010-11. The contribution of this sector to the national economy in terms of percentage is 4.1% at current prices during 2012-13. The combined percentage contribution of the livestock and fishing sector to the GDP contributed by agriculture, fisheries and forestry sector as a whole to the country's total GDP at constant price in 2012-13 was 30%.

Dairy Sector of India

India is currently the world's largest producer and consumer of milk. During the 11th five year Plan running from 2007-08 to 2011-12, the average annual growth rate of milk production

was 4.5% and the total milk production during the period increased from 107.9 million tonnes in 2007-08 to 127.9 million tonnes in 2011-12. In 2012-13, the total milk production reached 132.4 million tonnes. The milk production increased from 127.9 million tonnes in 2011-12 to 132.4 in 2012-13 registering a growth of 3.5%. With a projected figure of 137.6 million tonnes milk production during 2013-14 compared to 132.4 million tonnes during 2012-13, per capita availability of milk is likely to cross 300 grams per day. The percentage year-on-year growth of milk production and per capita availability of milk in the country has been shown in Fig 2.

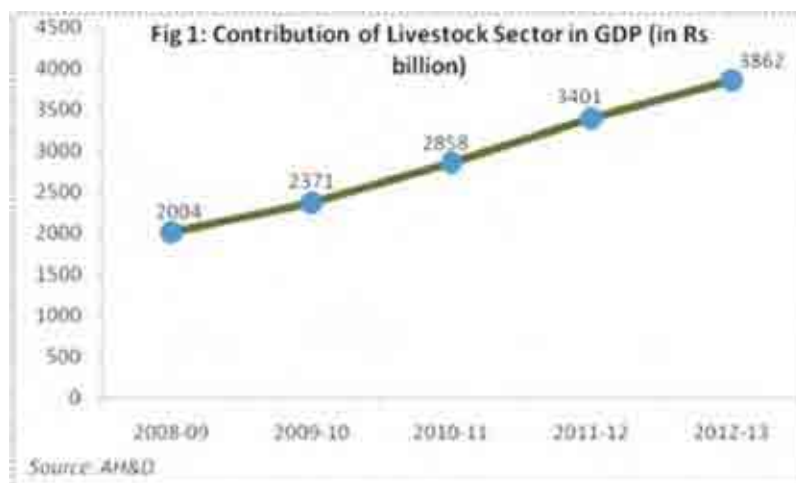
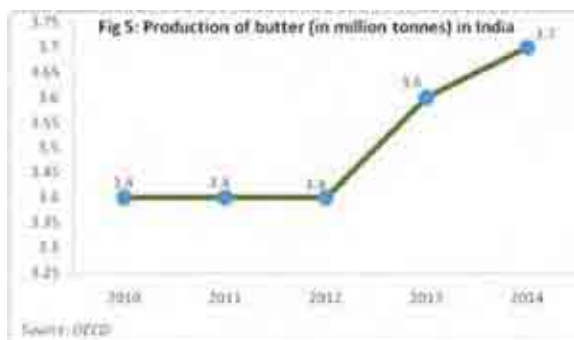
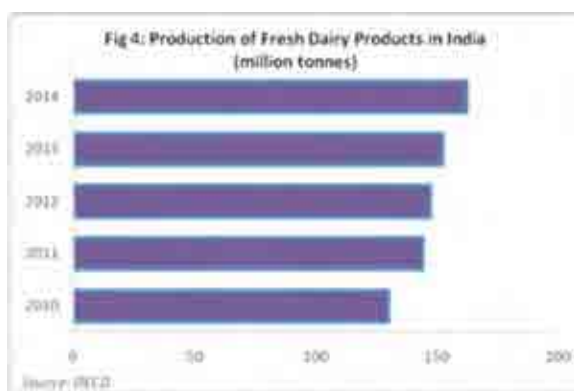
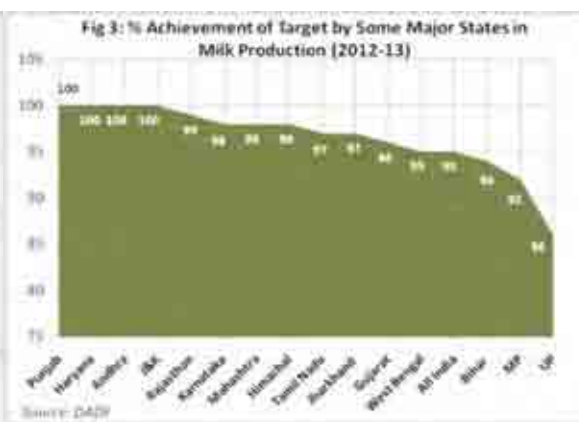
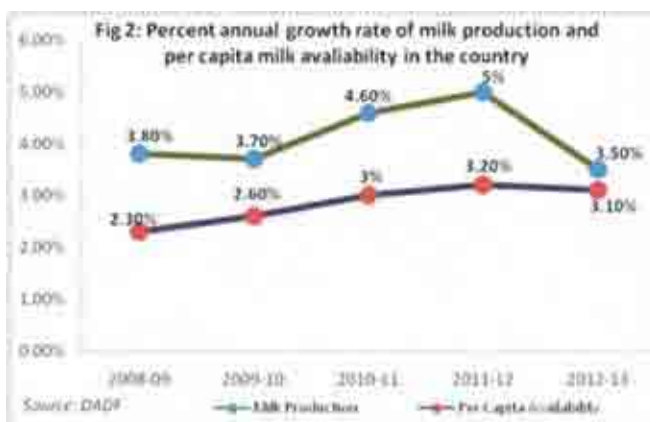


Figure 3 shows the percentage of achievement of target by some of the major milk producing states in the country against the targets in 2012-13. The all India achievement against the production target was 95% in the year in concern. It is interesting to note that the largest producer of milk, Uttar Pradesh which produced 17.6% of the total milk produced in the country in 2012-13, achieved only 86% of the production target in 2012-13 with other leading producer states like Madhya Pradesh and Bihar achieving respectively 92% and 94% of the pro-



duction target in this year. States like Punjab, Haryana, Andhra Pradesh and J&K achieved 100% of the production targets while Rajasthan achieved 99% of the production target in 2012-13. Karnataka, Maharashtra and Himachal each achieved 98% of the target.

According to Fig 4, production of fresh dairy products in India in 2014 was 162 million tonnes. This represents an increase by almost 25% when compared to the production figure of 130 million tonnes in 2010. India is currently the world's largest producer

and consumer of milk and the dairy sector is providing a fillip to the entrepreneurial activities of various people into the dairy business. Various corporate entities are also entering the sector and increasing their presence. Through a concerted effort and through agencies like National Dairy Development Board, efforts are on to increase the production of dairy to meet the rapidly growing demand.

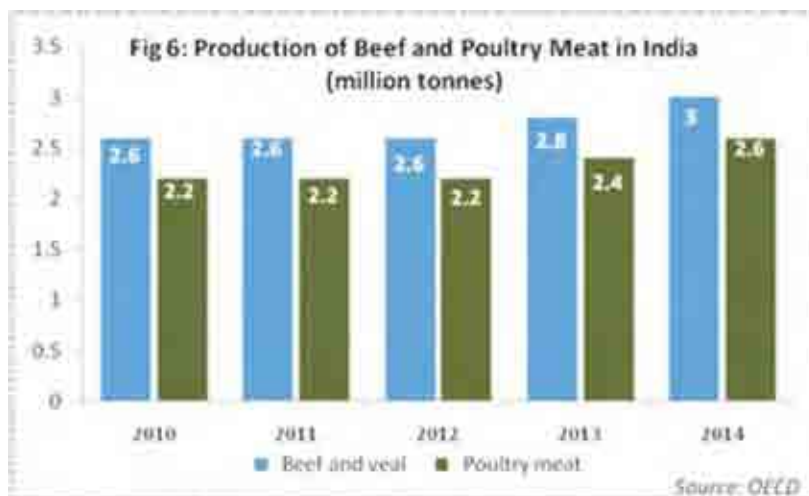
Amongst various milk products, butter holds an important position with various enterprises operating in the sector. In 2014, total production of butter in the country was 3.7 million tonnes, increasing from 3.4 million tonnes in 2010. The sector is dominated by brands like Amul from Gujarat Co-operative Milk Marketing Federation (GCMMF) along with other major players like the Mother Dairy. As income levels are increasing, more Indians are purchasing less grain and more higher-value, nutritious products like butter to supplement the family nutrition requirements. This in turn is lead-

ing to an increased demand for safe, higher quality dairy products which in turn is acting as a growth driver for the formal dairy sector to expand.

Indian Meat Sector

The total meat production in the country for the year 2012-13 was almost 6 million tonnes. During the period between 2008-09 and 2012-13, meat production experienced an average annual growth rate of 8.2%. Currently, India ranks fifth in the world in beef production while in terms of domestic consumption, it ranks seventh. India is also the leader in terms of export of beef meat. Production of beef and veal meat in the country in 2010 was 2.6 million tonnes which has increased to 3 million tonnes in 2014. The poultry meat production in 2010 was 2.2 million tonnes which has increased marginally to 2.6 million tonnes in 2014 (Fig 6).

Pig and goat/sheep meat are also important contributors to the total meat production scenario of the country. As seen in Fig 7, pig meat production in the country was 332 thousand tonnes and during the period between 2010 and 2014, its production has witnessed fluctuating trend. In 2014, the total production of pig meat in the country was 327 thousand tonnes. However, the production of sheep and goat meat has maintained a consistently increasing trend. The total pro-



duction of sheep and goat meat in India in 2010 was 880 thousand tonnes which increased to 923 million tonnes in 2014.

India's Fisheries Sector

India's is the second-largest fish producer in the world next to China. However, production of fish in India is just one tenth of what is produced in China. In 2014, production of fish from capture in India was 4.7 million tonnes with equal amount of production of fish from aquaculture, thus totalling a production of about 9.4 million tonnes. Fig 8 shows that the production of fish in the country during the recent years has not witnessed any notable increase in production as a whole. Production of fish from aquaculture has increased a little from 3.9 million tonnes in 2010 to 4.7 million

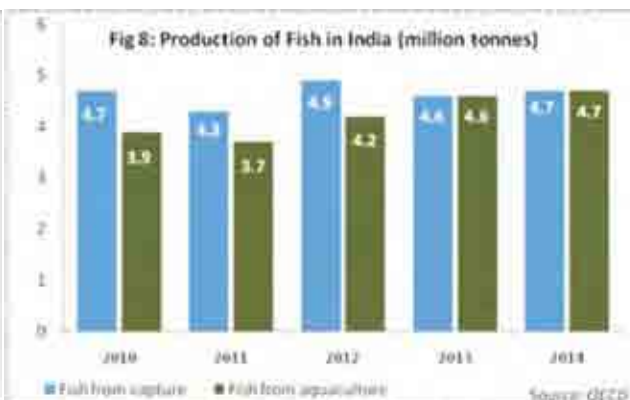
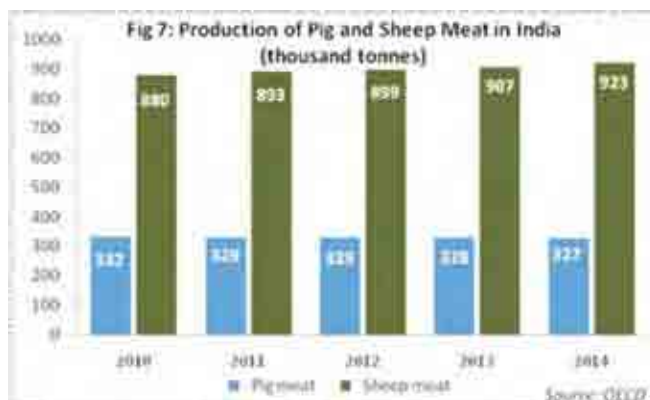
tonnes in 2014. However, India can be considered as a sleeping giant in terms of fish production with significant scope of increase of production and development of the sector in the coming years.

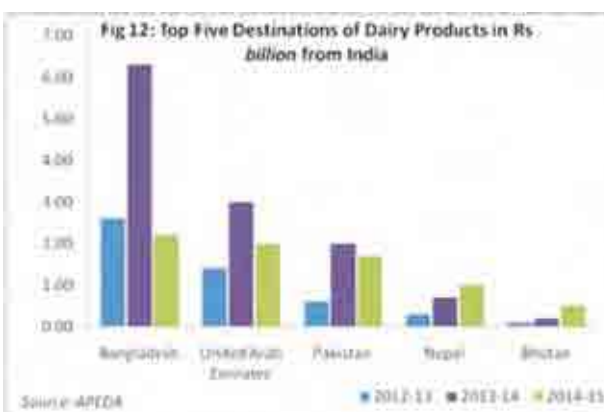
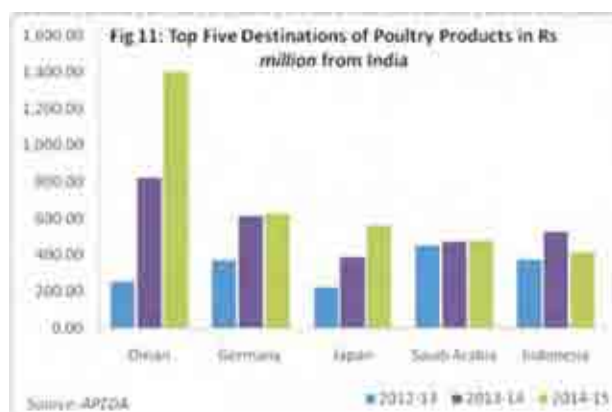
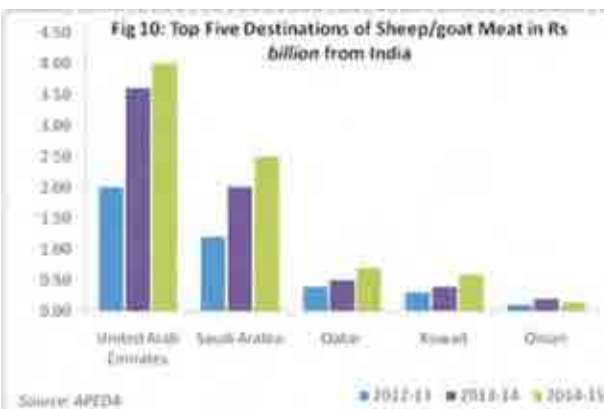
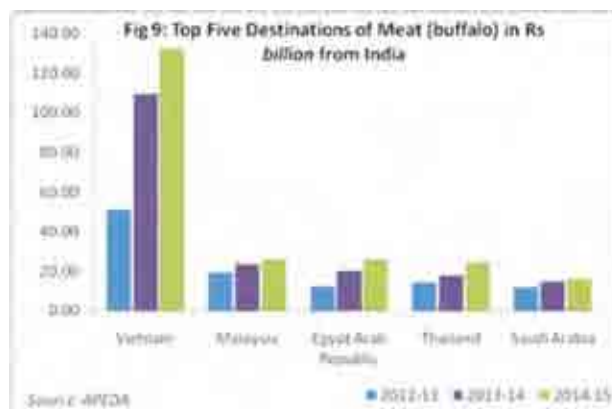
Export-Import Status of India's Dairy and Livestock Sector

Dairy and livestock sector of the country is important from export point of view. Considerable amount of foreign exchange is earned by the country through export of various products from these sectors to a large number of countries spread across the globe. India is an important exporter of buffalo meat. In 2014-15, India exported about Rs 293 billion worth of buffalo meat to various countries. This

is a significant increase from Rs 174 billion export just two years back in 2012-13, increasing by 86% between these years. Vietnam has been the leading importer of buffalo meat from India and in 2014-15, the total import of buffalo meat from India by Vietnam was Rs 132 billion, constituting 45% of the total buffalo meat export by India. The percentage increase of total buffalo meat import by Vietnam between 2012-13 and 2014-15 was a massive 157.5%. In 2012-13, Rs 51.25 billion worth of buffalo meat was imported by Vietnam from India. Fig 9 provides the top five destinations for buffalo meat from India. Malaysia was the second largest country in terms of export in this category with Rs 25.86 billion, followed by Egypt and Arab Republic (Rs 25.72 billion), Thailand (Rs 24.23 billion) and Saudi Arabia (Rs 15.85 billion).

While Vietnam was the largest importer of buffalo meat from India, United Arab Emirates (UAE) is the largest importer of Sheep and goat meat from India (Fig 10). In 2014-15, India exported Rs 8.2 billion worth of sheep and goat meat. This is almost double the figure of Rs 4.2 billion worth of export in this category in 2012-13. Almost fifty percent of the total export of sheep and goat meat goes to UAE and in 2014-15, India exported Rs 4 billion worth of meat to UAE. Export of sheep and goat





meat to UAE has been consistent and significantly increasing in the recent years. In 2012-13, export value of this meat to UAE was Rs 2 billion which increased to 3.6 billion in the following year of 2013-14. The second largest country for India in terms of export of sheep and goat meat during the recent years is Saudi Arabia. In 2014-15, India exported Rs 2.5 billion worth of sheep and goat meat to Saudi Arabia. In 2012-13, India has exported Rs 1.2 billion worth of sheep and goat meat to the country. The other major export destinations for India in this category in 2014 were Qatar (Rs 0.7 billion), Kuwait (Rs 0.6 billion) and Oman (Rs 0.15 billion).

In 2014-15, India exported a total value of Rs 6.5 billion poultry products. Fig 11 shows the major export destinations for India in this category. In 2012-13, Saudi Arabia, Indonesia and Germany were the leading desti-

nations with Saudi Arabia being the largest. However, in the very recent years between 2012-13 and 2014-15, Oman has emerged as a major and leading destination for poultry products from India. In 2012-13, total export of poultry products to Oman was just Rs 255 million, while Saudi Arabia was then the top export destination with Rs 450 million followed by Indonesia (Rs 375 million) and Germany (Rs 370 million). By the end of 2014-15, export of poultry products to Oman increased more than four times to Rs 1405 million, while Saudi Arabia slipped to the third position in terms of poultry product import from India with Rs 4771 million worth of exports. Germany was the second largest country in terms of export of poultry products with a value of Rs 627 million.

In 2014-15, India exported about Rs 12 billion worth of dairy products

to various countries. Currently, India has turned into a net exporter of dairy products from a past position of being a net importer. Bangladesh was the largest export destination for dairy products and in 2014-15, the total value of exports in this segment from India to Bangladesh was Rs 2.2 billion. It is interesting to note that the export value to Bangladesh touched a record level of Rs 6.3 billion in 2013-14. One of the possible reasons could be Bangladesh's ban on import of certain dairy products from China. With the detection of Malamine in various Chinese dairy products few years back, several countries including India had banned import of dairy products from China. The other important export destinations for dairy products from India in 2014-15 were UAE (Rs 2 billion), Pakistan (Rs 1.7 billion), Nepal (Rs 1 billion) and Bhutan (Rs 0.5 billion). ■



Dr. R. S. Gandhi
Assistant Director
General, (Animal
Production &
Breeding)
Indian Council of
Agricultural Research

Indian Livestock: An Asset under Smallholder Production System

India is a country of villages (640930 villages) and about 66% population of India is living in villages. Livestock has been an integral component of the agriculture and rearing of livestock for milk/meat/milk & meat products and draft power has been the tradition of ancient rural India. Further, 33.8% rural population is below poverty line as compared to 20.9% urban population. The livestock rearing has been a vital component of smallholder's production system comprising marginal, small and semi-medium farmers. Majority of these animal keepers are below poverty line and livestock rearing provides nutrient and social security to these livestock keepers against natural calamities. Subsistence farming communities depend directly on livestock and ecosystem biodiversity for their livelihoods. Further, at higher altitudes (3000 & above MSL) where crop cultivation is virtually non-existent, the highlanders totally depend on livestock for their survival. Livestock resources supply about

30% of total human requirements for food and agriculture production. Livestock also contributes towards environmental sustainability in a well-balanced mixed farming system. The country has 512 million livestock population and 729 million poultry birds. Presently, India has 151 registered breeds of livestock and poultry including 39 breeds of cattle, 13 of buffaloes, 40 of sheep, 24 of goat, 6 of horse and ponies, 9 of camel, 3 of pig, 1 of donkey and 16 of poultry besides populations/breeds of other species like mules, yaks, mithun, ducks, quails, etc. are yet to be classified. About 20-25% of total livestock population in our country comprises descript and well recognized breeds. The remaining population of livestock is non-descript which has not been characterized systematically. Various livestock breeds in our country have been evolved over centuries endowed with many desirable attributes like disease resistance, tolerance to heat stress, adaptability to environmental fluctuations, ability



to utilize coarse fibres and crop residues. The biomolecules produced by Indian livestock are considered of paramount importance in terms of therapeutic and nutraceutical value.

Smallholder Production System

The rearing of livestock has been the source of sustainable livelihood security for rural masses having small holdings. The farming and livestock have been the main source of livelihood for landless and smallholders - mostly landless, marginal, small and semi-medium farmers - living under poverty and not having access to quality inputs for agriculture and livestock rearing, attributed to scarcity of funds and other resources. The lack of awareness about the improved resources, technologies and other inputs due to lower literacy adds further to the woes of this stratum of the rural population. Whenever the crops have failed miserably due to natural calamities, the livestock has emerged as the saviour of farmers providing livelihood security in rural India.

The marginal, small and semi-medium farmers are rearing 88% of total livestock. This is a well-established fact that livestock is the best insurance against starvation and acute malnutrition in adverse climatic conditions to small holders. The number of holdings owned by these farmers constitutes 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. It indicates



that compared with distribution of land, the livestock resources are more equitably distributed. Hence, livestock plays pivotal role for livelihood and nutritional security of smallholder farmers. It is obvious that these smallholders are playing significant role in the animal production scenario of the country and contributing to the national gross domestic product.

Production Scenario: A Paradigm Shift from Deficiency to Sufficiency

Milk, eggs, meat and wool have been the major livestock products in our country. 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 tonnes during 1950-51 to 132 million tonnes during 2011-12. 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 tonnes during 2000-01 to 5.5 million tonnes during 2011-12. The compound decadal growth rates during the last seven decades in milk, eggs and wool indicated that milk production increased drastically from 1.15% (1960-61 to 1973-74) to 4.51% (1973-74 to 1980-81) attributed to 'Operation Flood'. 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). However, the compound decadal growth rate in wool production has not been so encouraging in the past.

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 to the needs of livestock produce and products of about

1.27 billion population of 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 chores 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. 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. 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 so-

cial 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.



Endurance of Indigenous Livestock to Thermal Stress

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 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. Indian breeds from Rajasthan and Gujarat have the innate potential to tolerate desert conditions and temperature up to 50°C. About 6-9 months (60-75% of days) in a year are either stressful or not congenial for optimum productivity of livestock 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) resulting in overall productivity of the livestock.

Assets for Livestock Production:

- Higher rate of contribution of livestock sector to agriculture sector during the last several 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.
- 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.
- 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 centers, 191 frozen semen banks, 77765 AI centers, 10217 veterinary hospitals/polyclinics, 22713 veterinary dispensaries, 24794 veterinary aid centers 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.



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 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 lakh cows maintained in 4355 gaushalas. Some of gaushalas having good number of indigenous cattle should be used for in-situ conservation of these cattle.
- Declare all the livestock farms of state/central govt. as in-situ conservation and breeding centers for indigenous breeds.
- 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.



- 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 36 million semen doses per annum are required to cover 40% population through AI of indigenous cattle. For production of these semen doses, about 3600 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 2030. Provide AI services at the doorsteps of farmers.
- Effective use of reproductive biotechnologies like ET, ONBS, Ovum Pick-up and IVF under field conditions.
- Develop infrastructure for semen sexing of indigenous cattle breeds (to start with) to save male wastage amounting to about Rs.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

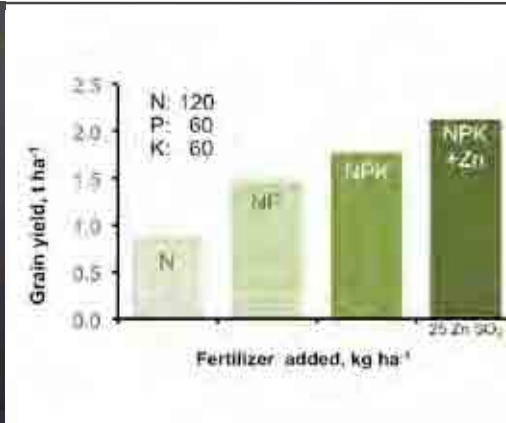
feedbacks and preventive programs for timely diagnosis of animal diseases.

- Design capacity building programs for providing higher numbers of veterinary and para veterinary professionals.
- Importing sexed semen/embryos from elite indigenous breeds of livestock with other countries.
- Explore inter-country collaboration for breed improvement programs for indigenous livestock with neighboring countries.

Livestock has been an insurance to livelihood security in the face of natural calamities to livestock keepers. 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, 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. ■

Zinc in Fertilizers

Immediate results...long-term benefits



Zinc increases crop yield 20-50%.

Crops grown on zinc-deficient soils have low zinc concentration. Thus, people depending on crops grown on zinc deficient soils receive less zinc in their diets and are therefore at risk for zinc deficiency--an especially critical problem in India, where a third of the population is zinc-deficient.

Adding zinc to fertilizer increases crop productivity and nutritional content, which in turn increases zinc intake by humans, ultimately boosting food and nutritional security.



Zinc
...essential for life

For more information on how you should be participating in this rapidly growing market, contact:

Dr. Soumitra Das, Director, ZNI-India, International Zinc Association
+91-11-2651-8001 | sdas@zinc.org | zinc.org/crops

Zinc Nutrient Initiative Affiliate Members and Partners





Hand held soil pH pen
Combo EC/pH meter
EC & ppm pen
pH pen
Nutrient meter

Agriculture
Greenhouses
Hydroponics
Aquaculture

manage crop productivity





GLORIA

Made in Germany



High Quality Sprayers

hand/battery/compressor

Fertilizer/Insecticide
Acid spraying
Foaming
Oil spraying

Agriculture
Horticulture
Cleaning
Pesticide
Construction
Automotive

India Distributor : MERSTEGIEN (P) LTD. 0484 2805082, email : info@merstegien.com - WANTED DISTRIBUTORS

I would like to subscribe to **Agriculture Today**

	institutions & Library	Individuals	Students
<input type="checkbox"/> One Year	₹ 800	₹ 500	₹ 300
<input type="checkbox"/> Three Years	₹ 2000	₹ 1200	₹ 700
<input type="checkbox"/> Life Membership		₹ 6000	

I will Pay with

Demand Draft Cheque Cash

No. Bank Draw Dated

DD should be drawn in favour of Agriculture Today

Name: Ms/Mr:

Organization Name:


City: office:

Ph: (Resi.): Fax:

Mobile No: E-mail:

Terms & Conditions: Rates and offer is valid in India only please allow one weeks time for the delivery of magazine by post. For the subscription related queries please contact: 306 Rohit House Tolstoy Marg, New Delhi- 110001, Ph: 91-11-23353406, 91-11-23731129, E-mail: subscription@agriculturetoday.in.

www.agriculturetoday.in



**AGRICULTURE
AND
INDIAN ECONOMY**

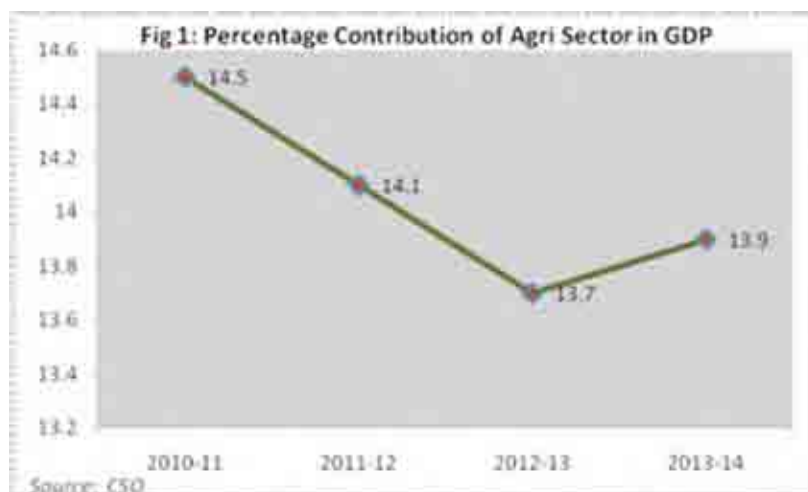
Overview



Importance of Agriculture sector in Indian economy is well known. It still holds a crucial position as a basic economic indicator of the country and the ripple effect of any adverse or positive effect on the agriculture sector is felt across various other sectors. It is because of this reason that perhaps the policy makers, economists, central and several state governments and the general public eagerly look forward every year towards the timely arrival of monsoon and adequate amount of rainfall, so crucial for agriculture production in the country and keeping the giant economy moving ahead.

The contribution of the agriculture sector in the Gross Domestic Product (GDP) of the country in the recent

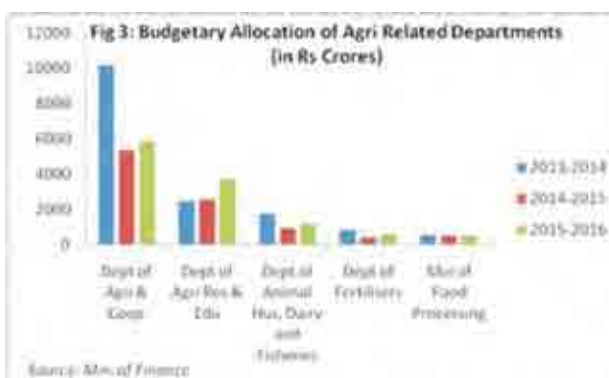
years has witnessed a continuous decline in the recent years before marginally increasing in 2013-14. It was 14.5% in 2010-11, thereafter decreasing consistently to 14.1% and 13.7% in the consecutive years 2011-12 and 2012-13 respectively before increasing to 13.9% in 2013-14 (Fig 1). According to latest estimates by the Department of Agriculture and Cooperation (DAC), compiling the estimate of GDP from agriculture in 2014-15, production of food grains is expected to decline by 2.9 per cent as compared to increase of 3.0 per cent in the previous agriculture year. Production of pulses and oilseeds is also expected to decline by 3.4 and 9.6 per cent respectively as compared to increase of 5.0 and 6.3 per cent in the previous agri-



culture year.

When the contribution of the agriculture sector is compared to that of the other sectors like the services and the industry in terms of the Gross Value Added (GVA), it's seen that the contribution of agriculture sector to the GVA has decreased by about 7% between 2011-12 and 2014-15 (Fig 2). GVA which is a measure of the output minus intermediate consumption related to any sector, is an important indication of the performance of various sectors in the economy of a country. Percentage contribution of the industry to the GDP also fell by almost 10% during the same period. Its only the services sector in the country that has been increasing consistently in the recent years and between 2011-12 and 2014-15, the contribution of this sector to the GVA increased by 9.3%. Contribution of the agriculture sector to the GVA decreased from 18.9% in 2011-12 to 17.6% in 2014-15. This GVA is calculated at factor cost that includes GVA at basic prices less production taxes less production subsidies

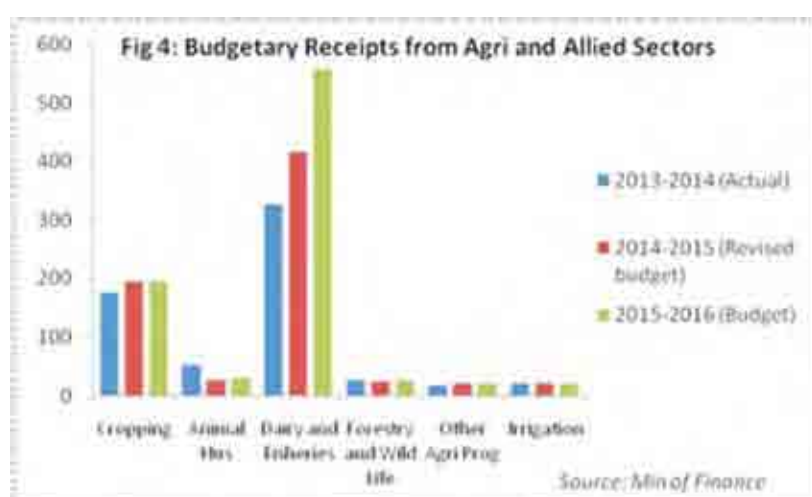
Budgetary allocation of different departments related to the agriculture sector of the country is shown in Fig 3. The allocation for department of agriculture and cooperation in the budget of 2013 was Rs 10163 crores. This has decreased by 42.4% in the budgetary allocation in 2015-16 at Rs 5846 crores. Except Department of agriculture research and education, other sectors also witnessed decreased budgetary allocation during the recent years. Department of animal husbandry, dairy and fisheries witnessed a decrease of 35% in the budgetary allocation between 2013-14 and 2015-16 whereas department of fertilisers and department of food processing witnessed decrease by 35% and 9%



respectively during the same period. Department of agriculture research and education witnessed a substantial increase of 50.5% in the budgetary allocation between 2013-14 and 2015-16, when it increased from Rs 2451 crores in 2013-14 to Rs 3691 crores in 2015-16.

Table 1 provides the allocation in different budgets of the country to various departments related to the agriculture sector in terms of percentage of the total allocation to all the sectors combined.

Out of the various agri and allied sectors, dairy sector has been the largest contributing sector in terms of budgetary receipts. The receipts from dairy along with fisheries sectors increased from Rs 326.5 crores in the actual budget statement of 2013-14 to Rs 557 crores in 2015-16 budget forecast. This marks an increase of 70.5%. Cropping husbandry in the country increased by 11.2% in terms of total receipts when it increased



from Rs 175.4 crores in 2013-14 to Rs 195 crores in 2015-16 budget forecast. The sub-sector within agri and allied sectors that has been not performing well in terms of receipts was animal husbandry which witnessed a significant net decline of 43% between the year 2013-14 and 2015-16 (budget forecast). In 2013-14, receipt from animal husbandry was Rs 50.55 crores which declined to Rs 28.75 crores in

2015-16 budget forecast.

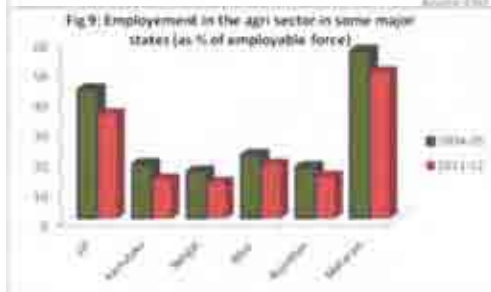
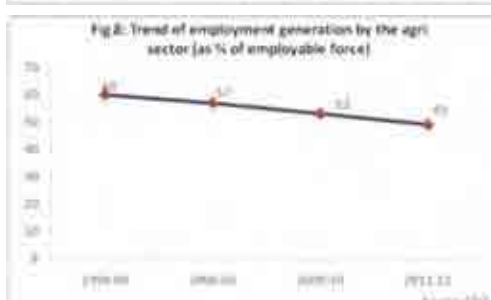
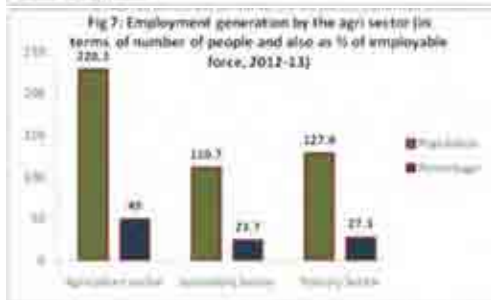
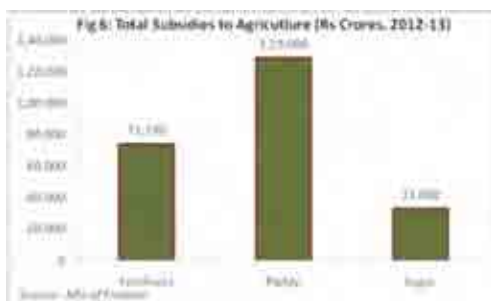
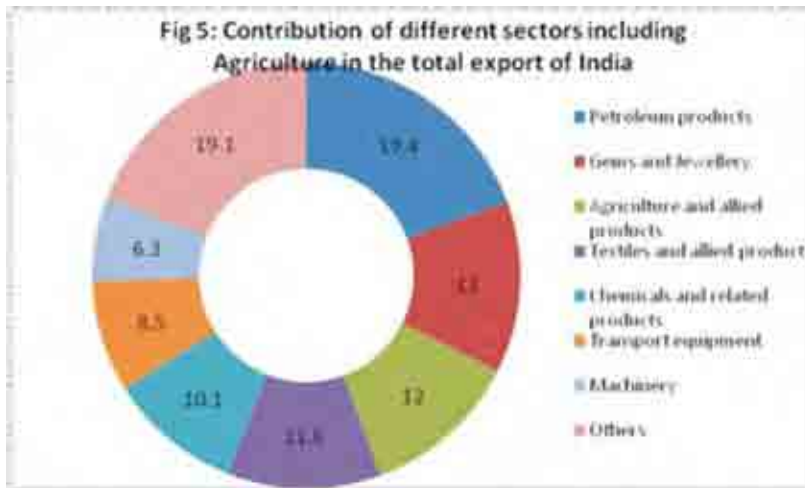
Agriculture sector is crucial for Indian economy from the point of view of exports and foreign exchange earnings. In 2013, the contribution of the agriculture sector in the total exports of the country was a significant 13% which is just behind the export figure of petroleum products which was 19.4%. The overall exports of agriculture and processed food products have reached USD 11,023.79 million in the period ranging from April to September 2014. Exports of fruits and vegetables, both processed and fresh, have touched USD 1,153.81 million, while animal products registered USD 2,570.82 million of exports in the same period of 2014.

Every year, Agriculture sector like many other sectors, receives substantial amount of subsidies every year that is having crucial

Table 1: Allocation to different departments related to the agriculture sector as percentage of total annual budgetary allocation

	2013-2014	2014-2015	2014-2015	2015-2016
Dept of Agri & Coop	1.7	1.2	1.2	1
Dept of Agri Res & Edu	0.4	0.8	0.05	0.06
Dept of Animal Hus, Dairy and Fisheries	0.2	0.2	0.02	0.02
Dept of Fertilizers	0.01	0.01	0.01	0.01
Min of Food Processing	0.01	0.01	0.01	0.01

Source: Min. of Finance



overbearing on the national economy of the country. Areas like fertilizers, crops like paddy, wheat, pulses etc. and sugarcane along with the sugar mills receives subsidies every year through budgetary allocations. During the financial year 2012-13, the total subsidy going out to the fertiliser sector was Rs 73, 790 crores. Subsidies for crops like paddy go in the form of Minimum Support Price (MSP) and also towards subsidising rice through the public distribution system (PDS). The total subsidies incurred by the government of India on these accounts for rice was Rs 129000 crores. Sugarcane MSP along with subsidies given to the sugar mills across the country accounted for Rs 33000 crores.

The importance of the agriculture sector in the national economy can be gauged by its huge contribution to employment generation for the vast pool of employable population in the country. In 2012, the country had a total workforce of 467

million. Out of that, 228.3 million was employed in the agriculture sector which is 49 percent of the total workforce (Fig 7). The secondary and the tertiary sectors respectively employed 110.7 million and 127.8 million. In terms of percentage of employable force, the secondary and the tertiary sector employed 23.7% and 27.3% of the employable force.

Although agriculture sector is still the largest employer in the nation, its trend in terms of employment as percentage of total employable force in the country has been continuously declining in the past decades. In 1999-00, agriculture sector employed 60% of the total employable workforce. Over the subsequent years it declined and in 2004-05, agriculture was employing 57% of the employable force in the country. This further declined to 53% and 40% respectively in 2009-10 and 2011-12 (Fig 8). The decline can be attributed to various factors some of which are migration of rural people dependent on agriculture as profession migrating to urban areas and taking up jobs in the secondary and tertiary sectors.

When some of the states are studied individually in terms of employment by the agriculture sector as percentage of total employable force, in 2012, Maharashtra came first state in terms of people working in the agriculture sector at 49%. Uttar Pradesh was employing 35% whereas other major states like Karnataka, West Bengal, Bihar and Rajasthan were employing 13%, 12%, 18% and 14% respectively. It is to be noted that states like Maharashtra and Uttar Pradesh have witnessed a substantial decline in the number of people employed with the agriculture sector between 2004-05 and 2011-12. In Uttar Pradesh the percentage came down from 43% (2004-05) the present level whereas in Maharashtra, it was 56% in 2011-12. ■



Unleashing a second green revolution

When India began its drive to achieve self-sufficiency in food production, Zuari contributed by producing fertilizers and nutrients. As the nation prepares for a second green revolution, Zuari is back in full force. With a wider range of fertilizers and nutrients. More support for the farming community with innovative initiatives such as Jai Kisaan Sangam, Hello Jai Kisaan service, the Zuari Agri Parks and more. Bringing greater prosperity to the farming community and enhancing the nation's food security.

ZUARI AGRO CHEMICALS LTD.

FERTILIZERS | SPECIALITY FERTILIZERS | CROP CARE | SEEDS | SERVICES

Corporate Office: Tower - A, 5th Floor, Global Business Park, M. G. Road, Sector 26, Gurgaon - 122002. | www.zuari.in



Dr. Ajit Kumar,
Ph.D. IIT-D, IAS (Retd.)
Vice Chancellor,
National Institute
of Food Technology
Entrepreneurship
& Management
(NIFTEM)

NIFTEM'S MODEL OF RURAL DEVELOPMENT

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 on 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:

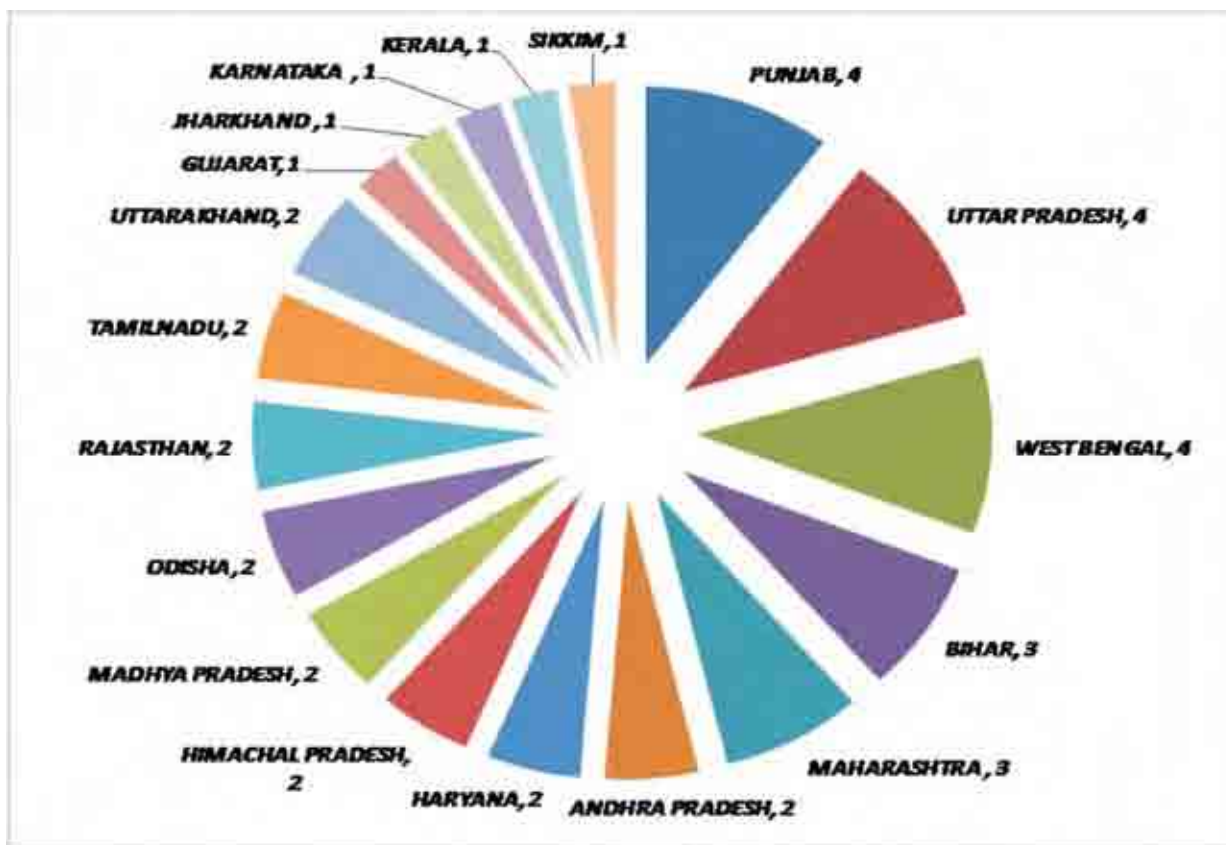
Under this programme, B. Tech (Food Technology & Management) and M. Tech students are divided into groups of 10 to 12 students at the time of joining NIFTEM. Each group is led by a Faculty member (Mentor) and adopts a village anywhere in India and nurses it during the entire programme of study. The Groups 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 explore future possibilities of food processing among them, students obtain first hand experience on Indian rural scenario and understand traditional processing technologies adopted by the villagers. Students gain general awareness on the village life and facilitate the process of integrating the underprivileged sections of our population with the main stream. Students thus 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 four 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, government 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 have 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 SALIENT ACHIEVEMENTS

A. Food Processing



Interactive session of villagers with KVK representatives on Food processing opportunities in Kure, Bhusawal Maharashtra



Lecture on Food Processing opportunities in Seoni, Madhya Pradesh



Demonstration of Bakery product preparation during a training session in the village in Madhya Pradesh

promotional Initiatives

About 500 programmes including Trainings and Expert Lectures, Awareness Camps in food processing and value addition, postharvest management, product development, entrepreneurship development etc. have been conducted.

B. Entrepreneurship Development (Identification of Entrepreneurs)

In phase I, more than 125 potential entrepreneurs were associated with different teams and in processes of finalizing their ventures in agro food processing and few have already initiated the work. In Phase II, VAP teams identified about 50 prospective entrepreneurs in their respective village and adjoining areas



Members of team NIFTEM working closely with rural women in the village on Papad Making Initiative, Jhalarpatan, Rajasthan

who will be further given training to establish ventures in agro-food processing (Total about 1546). They will be imparted one week training programme and the selected ones will be taken up for one month EDP programme in regional centers followed by three months of industrial training programme. During VAP 8, about 250 such entrepreneurs were

trained in selected pilot locations by imparting one week training programme.

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 mentors have carried out 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 f akes, bakery products like biscuits, cakes, fried snacks like bread pakora, bread rolls etc. and also shared one to two page leaf ets indicating the process f ow charts and estimated expenses.



Demonstration of Tomato cocktail preparation in mobile processing van arranged by Team NIFTEM , Kalupatti, Tamilnadu



Training program on Banana flower pickle making by Members of Team NIF-TEM in Alanganallur, Tamilnadu



Demonstration on making and packing of Mango products like Aam panna and pickle by Team NIFTEM in village Pulicunnoo, Kerala



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 led 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

Almost all the existing groups

have completed the process of cataloguing the traditional recipes of their respective locations and has documented it in the form of small booklet. There are about 500 such recipes which are unique, and with scientific intervention can be standardized for mass production and sold in domestic as well as export markets.

• Preparation of booklets on traditional food preservation practices

Various groups have compiled information on traditionally existing Food Preservation Practice and documented them in the form of booklets. About 200 such methods

have been documented by various teams.

G. Make in India initiative through VAP

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 the process of finalizing few best recipes to initiate the research project on scientific interventions, quality management, protocol development and standardization for commercial production. 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,



Efforts of Team NIFTEM under VAP leading to construction of Pukka Road in village Kalavacharla, Rajahmundry/East Godavari, Andhra Pradesh

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.

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.

In a very unique initiative, Team



Swachh Bharat Abhiyan undertaken at a Village Karkambadi, Chittoor, AP

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 exams, 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 villages and nearby locations. Teams also created Core teams in Village schools to sustain the campaign.



Nukkad Nakak 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



1. Damng Ist 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

K. Initiatives on promotion of Renewable energy utilization

VAP teams laid due emphasis on 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 solar lights. Sarpanchs and Panchayats were made aware about subsidies available for them to take solar lighting 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 of renewable energy, about 99 awareness campaigns and 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.

Future Programmes

Now we are in the process of planning the launch of a programme



Installation of Solar lights in Hariharpur, Bihar



for skill development for the entrepreneurs by starting five days training programme in the village location itself followed by a follow up in advanced training of four weeks on entrepreneurship development for 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 equipment and machinery, marketing tie ups, etc.

Our efforts will be directed towards establishing Primary Processing cum Pre-Cooling centres 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 centres. ■



Prof. S.K. Patil
Vice Chancellor,
Indira Gandhi Krishi
Vishwavidyalaya,
Raipur

Strengthening Family Farms- Policy Changes

India is a land of family farmers, about half of all farms are less than 1 ha in size, and another 20 % are less than 2 ha. Agriculture's contribution in the gross domestic product is declining, and touched 12.3% in 2010-11 from about 30% in 1990-91. During the last two decades, the average annual growth of agriculture sector was less than half (around 3%) of the overall average growth of the economy (6-7 %). Industrial and service sectors have outpaced performance of agriculture sector during the last two decades. However, still this sector is the single largest sector supporting 52% of the workforce. There are several challenges these unorganized family farms are facing, which includes increasing cost of production resulting in reduced profit margin, inadequate information support system, inadequate market facility and lack of proper support price system for fragmented holdings. Further, limited investment capacity, poor risk bearing ability, lack of credit, and poor resources preventing round the year activities on farm, are other bottlenecks. Therefore, it is imperative to reorient the research and development focus in the country in a way to develop and promote those technologies that raise agricultural in-

come and ensure employment opportunities in the agri-supply chain to a vast majority of the workforce involved in family farms, and ensures sustainability of production systems.

Holding Size of Family Farms

The holding size is continuously decreasing. Average farm holding size declined from 2.26 in 1970-71 to 1.16 ha in 2010-11. The marginal and small farmers constitute 85% of the farming community in India. Out of this 67% are marginal farms. These 85% farmers hold only 44% of cultivated area. Further, the 67% marginal farms hold only 22% area. Total number of farm holdings has almost doubled from 71 million in 1970-71 to 137.8 million in 2010-11. If this trend continues, farm holdings in 2020-21 would number around 154 million. Fragmentation of holding is another very serious issue facing these farmers. In past, there was an acceptance of low yields of small holders. However, in future small holder's improvement is very critical to address poverty and regional and national food hunger. It is also important in order to stop diversion of small farms in to non-farm activities.



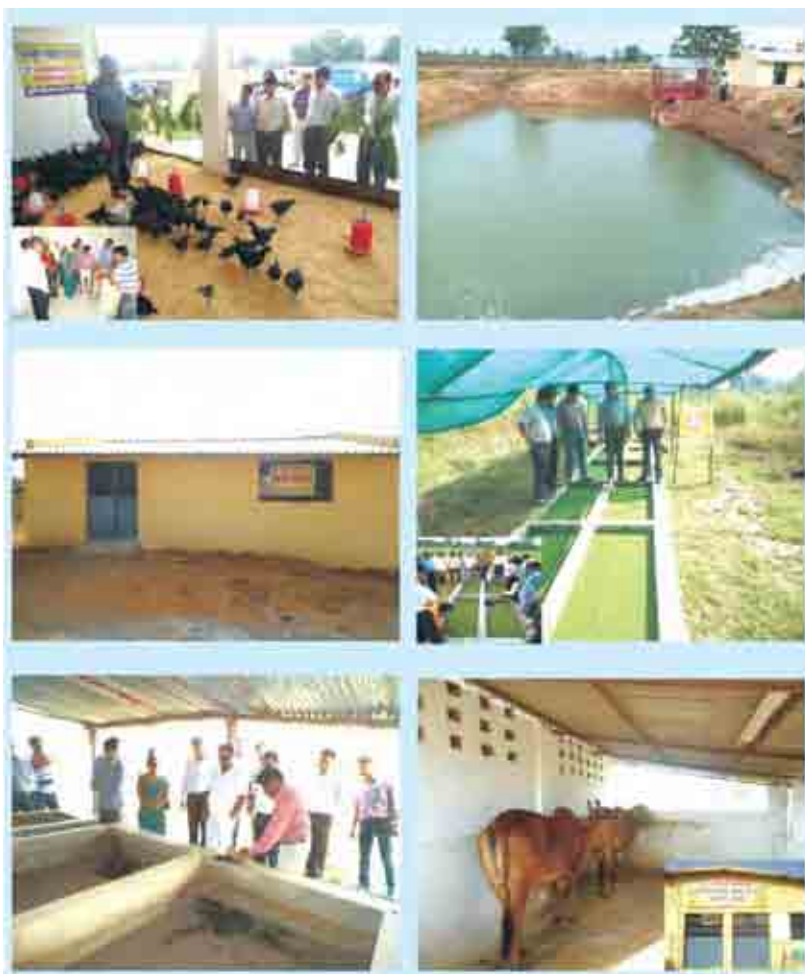
Implications of small family farms

A small farm has the potential for intensive agriculture, but a small farmer suffers from the cost, risk and return structure of farming. There is a very high farm population per hectare in family farms particularly belonging to marginal category and obviously per capita farm income will be less. Providing credit facilities to such a large number of small farms has become a great challenge. Scaling of technology, including farm mechanization, is most difficult task. Due to fragmentation of family farms, providing and managing quality inputs for production and getting marketable surplus of uniform quality, its grading sorting and packaging is a great challenge.

Way forward

Increasing productivity and profitability per hectare of area and ensuring sustainability in family farms is the key to address the issues of small farms. There is an urgent need of adoption of integrated farming systems and providing the power of technology and economy of scale to small producers at production, post-harvest, and marketing ends of farming. The changes are required towards small holder's green revolution with robust commercial agriculture. A shift is required from farming for livelihood to farming as business. The socio-economic constraints that need to be addressed are farmer's resource limitation, risk avoidance attitude due to lack of credit facility and timely availability of quality inputs. This will however, require large investment and promotion of contract / cooperative farming. This will have economic benefits by lifting greatest number of people out of

Integrated Farming System Model adopted in Kanker district of Chhattisgarh



poverty. It will provide opportunity to implement improved irrigation and fertilizer management practices at scale. Increased productivity of small holders will reduce pressure on forest and thus will bring in environmental sustainability.

It is needed to identify production systems, programs and policies which are leading to potential unsustainability, and gradually rolling out such programs. Compilation and validation of IFS models and eco-system approach that address sustainable productivity increase and converting them into area, action plan is required. A common action plan cannot be prepared for ecosystem farming. Location spe-

cific practices which are adoptable hold the key, and hence study and validation of ITKs are very important.

Innovations will be required for development and adoption of suitable models at this scale. The models must incorporate conservation agriculture and organic farming, self sustained, least external input dependent, integrated farming systems. This will help in profitability enhancement, and reduction in cost of cultivation through adoption of integrated nutrient and pest management principles. Recycling nutrients as efficiently as possible and increasing input use efficiency are a necessity for smallholder producers. Appropriate

models for increasing resource use efficiencies through water harvesting models, precision farming tools and approaches, and small farmer's mechanization needs to be worked out. In order to generate economic opportunities and provide additional income, post harvest processing and value addition, and development of suitable models with allied enterprises (horticulture, floriculture, sericulture, pisciculture, poultry farming, mushroom cultivation, bee and lac cultivation and dairy, piggery, goatery) will be of immense importance.

Small size of family farms is one of the most important hindrances in the adoption of modern tools and machines. Even if a small farmer invests in machinery, he is unable to use it round the year, and it remains idle for most of the time due to limited operations for a limited period of time. Therefore, it is required to promote new type of farming involving community, contract, cooperative, and concept of producer companies. The role of traditional village organizations like Panchayats need revitalization in agriculture and allied sectors. Social engineering will be required to a great extent in order to consolidate holdings for community/contract farming, farmer's companies, self-help groups, development of infrastructure, and sharing of resources. This will help in efficient use of natural resources and production of marketable surplus of selected commodities. This will also help in addressing issues related to input arrangements and marketing. One of the very important areas is linkage of family farms with market by adoption of proper post harvest and value addition. Community custom hiring centres, post harvest processing, grading, sorting, packaging facilities at village level at the door step of

farmers need to be developed.

The country is passing through a phase of knowledge and technology based agricultural revolution. An innovative dynamic extension network that facilitates and promotes widespread dissemination of agricultural practices, implements and technology particularly suitable for small farms is essential for agricultural growth and prosperity. Further, how quickly and effectively this knowledge reaches large number of farmers can bring in the major breakthroughs in agricultural productivity. Use of ICT is very much desired for development of new knowledge management system.

The technological solutions to address these issues are available which can be used for risk reduction, reduction in cost of production and increased input use efficiency. There is need for large investments on small farms for mechanization, fencing, irrigation system development, electricity and land development. It is also important to create avenues of investment in this area.

Capacity building of small farms by making available biotic and abiotic stress tolerant improved crop varieties with seed banks and NRM technologies is required. Organization and consolidation of the fragmented family farms need immediate attention. Making farming high tech to attract youth in farming and providing special support to educated youth for infrastructure development on their farms like green houses, nurseries, high tech orchards is required. This will help in attracting youth in agriculture.

Farming systems

Sustainable high crop yields are possible in small family farms by the adoption of farming system

approach. It offers a range of products and productivity, socio-economic and environmental benefits. It involves conservation agriculture practices, scientific natural resource management, using quality seeds of high-yielding biotic and abiotic stress tolerant varieties, integrated pest and nutrient management, efficient water management, and the integration of agriculture, horticulture, forestry and livestock. The farming system offers a wide range of options to farmers according to their farming situations and according to their local conditions and constraints. The adoption of IFS is knowledge-intensive and often requires in-situ production of inputs and specialized tools. Policies are required to build capacity through new extension approaches such as farmer field schools, and facilitate local production of specialized farm inputs.

Concepts and procedures in farming system

In rainfed farming development program, consideration of regional variability at micro level is very important. Thus, one requires identifying and grouping similar situations as target unit. It can effectively be done through identification and delineation of specific farming situations in a particular village or developmental block. A farming situation is a group of farm holdings which has similar strengths and weaknesses. After identification of farming situations integrated farming systems need to be adopted according to the capabilities of the land and requirement of the farm family. The different enterprises may be agriculture, horticulture, animal husbandry and aquaculture. It is an innovative approach to agricultural

research and development that attempts to deal more effectively with the problems of complex, diverse and risk prone agriculture, and disadvantaged small and marginal farmers which is a predominant feature of rainfed regions.

The farming system, as a concept, takes into account the components of soil, water, crops, livestock, labour, capital, energy and other resources, with the farm family at the center managing agricultural and related activities. The farm family functions within the limitations of its capability and resources, the socio cultural setting, and the interaction of these components with the physical, biological and economic factors. It is an approach to agricultural research and development that views the whole farm as a system, and focuses on: i) the interdependencies between the components under the control of members of the household; and ii) how these components interact with the physical, biological, and socio-economic factors that are not under the household's control. This type of research and development is most appropriate and needs to be carried out by interdisciplinary teams of scientists who, in association with extensionists, continually interact with the farmers in the identification of problems and in devising ways of solving them. It aims at generating and transferring technologies to increase the resource productivity for an identified group of farmers.

Convergence of all rural and agricultural development schemes is very much desired for this purpose. At present there is practically no scheme which helps in adoption of complete farming system according to the farming situation of farmer. A farmer has to choose from different schemes of different departments ac-

Integrated Farming System Model adopted in Kanker district of Chhattisgarh



ording to his wisdom which is often very difficult for him.

Policy Changes

Land, water, forest, fisheries, biodiversity, plant and animal genetic resources have been subject of continued neglect in policies and programmes. There is a need to formulate an overarching policy in view of criticality to the family farms livelihood and the larger ecological functions these resources play. This is more crucial in the changing social and economic atmosphere where the increasing pressures of competing and conflicting demands are likely to increase the conflict

over the management of the local resources with an associated increase of complexity in governance. What is to be done to improve family farming is known, but the change in governance is required so as to prepare, implement and monitor programs for improvement in family farming.

To improve family farming and to adopt integrated farming system, fundamental changes are needed in policies and institutions. The only way of making family farms viable is increased productivity and profitability. This will be possible from intensification of agriculture and allied activities of small farms. This means

there will be tremendous pressure on land, water and environment. Therefore, entire production system has to be shifted towards sustainability by promotion and adoption of integrated farming systems.

This will require fundamental shift in the policies and administration of agriculture in the country. The issue of convergence is most critical in adoption and development of IFS. It is one of the most talked and least addressed issues in India. The developmental departments have separated and there is very little coordination on the ground. These departments implement different programs for the same farmer with little or no coordination. In fact if we want to improve family farms, policies should be framed for preparation of schemes or program which is customized according to farming situations for a group of farmers. Institutional mechanism is needed which promotes convergence of different programmes and schemes with focus on natural resource management, agriculture and livelihood development in rainfed areas which are mostly family farming type. This will help in setting up a strong natural resource management agenda, improve planning process, address issues of community rights and undertake natural resource management activities in an integrated manner to build up sustainable rainfed ecosystem. The structure would also help in developing coherence and strengthen convergence between different programmes and schemes.

Improved policies for new institutions for helping associations in farming for specific commodities like

biofuel growers association, fruits, vegetables, and flower growers association, organic farming Farmers Association, fish farmers and agro-processing association is needed.

Policies should be framed to facilitate availability of quality inputs at affordable price to family farmers. Fixing reasonable price for products for marginal farmers can also be useful. The concept of "smart subsidies" on inputs, targeted to low-income producers (FAO, 2011) can also be ad-



opted. Incentives can also be given to marginal and small farmers to use natural resources wisely eg. through payments for environmental services like water harvesting, soil conservation, and carbon sequestration. Major investment will be needed to rebuild research in IFS mode and technology transfer capacity over large area in order to provide farmers with appropriate technologies and to enhance their skills. New institutions created like ATMA and FFS need review to increase its effectiveness.

The emphasis on land use planning at cadastral level is very much desired. This will help in planning according to the agro-ecological sub

region and will help in delineation of minimum size of development unit. The plans formulated in country have been sartorial and mostly a compilation of plans of various departments. Natural resource management being a cross cutting theme across the various departments/sectors has not derived the requisite importance. Therefore, there is need to emphasize on the preparation of a comprehensive land and water use policy based on the agro-ecological characteristics at village and farmer level using remote sensing and GIS technologies.

Key areas for action on policy include: establishing and protecting rights to resources in order to promote community, contract and producer companies, especially for the marginal farms, incentives for sustainable consumption and production into food systems, promoting fair and well-functioning agricultural and food markets, risk reduction and increased resilience of family farms, and increased public investment in required infrastructure. Who will invest in family farms, and how investor will be benefited are two very important questions that need answer from policy makers. New policies are also required for reaching millions of family farms quickly and efficiently by adoption of ICT, and a fundamental change is needed in management and blending of traditional and modern day knowledge. There is need of providing complementary support to smallholders and income generation opportunities in order to improve risk bearing ability by suitably converging cash for work and cash transfer programs with local production and consumption activities. ■

NIDA

NABARD Infrastructure Development Assistance
Financing new possibilities
in rural infrastructure.



Taking Rural India Forward

www.nabard.org

Follow us on [Facebook](#) / [nabardonline](#)

WHAT IS NIDA?

Rural infrastructure development is critical for economic and social well-being of more than 70% of the population of the country. In India, its growth largely depends upon public funding which has been traditionally limited due to budgetary constraints of Governments. NABARD Infrastructure Development Assistance (NIDA) has been created to address this very gap.

NIDA aims to fund State owned institutions/ corporations for both on-budget as well as off budget projects with a specific goal of accelerating and supporting infrastructure development in rural areas.



What are the channels available for funding under NIDA?

There are four channels of funding available under NIDA

- Direct funding to State Government and State owned Institutions
- In PPP mode with State-owned institutions, cooperatives, local bodies, companies, SHG federations, NGO/ Producer Organizations and Special Purpose Vehicles (SPV)
- In non-PPP mode with registered entities like companies and co-operatives.
- Financing NBFC (Infrastructure Finance Companies) and Public Financial Institutions/Companies.

What is the broad eligibility criteria under NIDA?

- Registered body
- In profit during the last three years with no accumulated losses
- Professional Management
- No history of defaults in repayment of loans
- Credit rating of 'A' for PPP and 'AA' for non PPP projects.

What are the types of projects funded under NIDA?

NIDA aims to fund infrastructure projects largely benefiting rural areas and which are covered in a harmonized list of projects as approved by the GOI/RBI.

- **Agriculture:** Irrigation, production infrastructure, storage & marketing infrastructure, extension, processing, services, custom hiring and farm mechanization etc. for agriculture and allied sector.
- **Transport:** Roads, bridges and rural transportation.
- **Energy:** Renewable energy, electricity transmission, agriculture demand side management, systems improvement.
- **Drinking water and Sanitation:** Solid waste management, water supply pipelines and treatment plants, sewage collection, treatment and disposal system, storm water drainage system.
- **Social and Commercial Infrastructure:** Rural education institutions, rural hospitals, rural housing, common infrastructure for industrial parks, Special Economic Zones, tourism facilities, etc.

What are the terms of funding under NIDA?

- **Quantum of Loan:** The maximum quantum of loan is presently pegged at 90 % of the eligible project cost for Govt. entities and at 75% for all other borrowers. Loan and Margin components are as per the guidelines issued by RBI from time to time.
- **Tenor of the loan:** Repayment period is linked with projected cash flows and repaying capacity. Presently repayment period is not more than 25 years including a maximum of 5 year moratorium.
- **Rate of Interest:** Rate of Interest will depend upon the type of borrower, security offered, type of project, credit rating of the entity and the prevailing market conditions. Interest resetting option is available under NIDA.
- **Security for Loan:** Security requirement will be project specific depending upon the rating of the borrowing entity, project viability etc., and as per regulations laid down by RBI from time to time.
- **Appraisal Fee/ upfront fee:** Appraisal fee / upfront fee including legal fee etc. will be borrower and project specific.

Contact us : Chief General Manager, Business Initiatives Department, NABARD, HO, Bandra-Kurla Complex, Bandra (E), Mumbai-400051. Email: bid@nabard.org, Tel: 022-26524693, Fax: 022-26530067



Pawan Malik
Agribusiness Consultant,
former President,
Fertilisers & Agribusiness,
Aditya Birla Nuvo

Five Events that Transformed Rural India

Rural India is on the move- it has woken up from centuries of slumber. During the last four decades, there has been a dramatic transformation in the size, nature and characteristics of this market. Today rural India accounts for almost half of the total Indian economy. The two Trillion \$ Indian economy has two distinct halves – one Trillion \$ in the urban space, built around the 400 million emerging middle class and one Trillion \$ in the rural space, built around 850 million aspiring Indians.

In this article, I will attempt to look back at the last 35 years and identify some of the key events that helped catapult rural India into a new orbit of growth. I feel privileged that I have had the opportunity of seeing this awakening from very close quarters, and may be in some small way have also made my humble contribution in this process.

1: 1980s THE WINDOW OPENS

The decade of the 1980s is when the window of rural India opened to the first rays of a new dawn. Two sporting events one in Delhi and the other in London set the ball rolling – Nov 1982 Asian Games, Delhi and June 1983 India's unexpected win of the World Cup of Cricket, Lords London. The first bringing colour television to India and the second getting millions of viewers glued to this medium. It was the vision of Rajiv Gandhi and the passion of Kapil Dev's daredevils, that kick started this revolution. The proud moment when Kapil Dev kissed the World Cup is etched in our memory. This opened the food gates to the expansion of the TV network in the country, first with Doordarshan's expansion of their terrestrial network and thereafter with the entry of cable television, from programming in English & Hindi to regional languages – 1992 entry of Sun TV, Star TV and Enaadu TV, from drab news



and documentaries to block buster soap operas like Hum Log and Buniyad – the nation stopped to see Ramayana and Mahabharata every Sunday morning through 1987, 1988 and 1989. From a viewership of less than 1 million in 1980, the viewership grew to over 300 million by the turn of the century and is now over 700 million.

While we were enjoying this change in Urban India, in rural India, these events were the beginning of a dramatic transformation in their lives. A society which was closed for centuries, where nothing seems to have ever changed, where life continued exactly the same way as it had for generations, were now suddenly exposed to the latest and the best in the world in terms of lifestyles – homes, food, fashion, better schools, reliable healthcare, modern agriculture, healthier cattle, new technology and gadgets From an era, where the only source of information was the good old radio, the films division documentaries and sprinkling of Bollywood movies, the rural masses now had an opportunity to see at close quarters the amazing changes that had taken place all over the world. The television set became the meeting point for village chaupals and addas. Soon it moved from the public viewing places to the privacy of the rural living rooms, giving 24X7 infotainment for the entire family – young and old, men and women Today the number of households owning TV sets, exceeds that in the urban areas.

The window had been opened to the new world – the ever changing world. This was the birth of the



'Aspiring Indian' – asking the question, as to "why is my world so different?", "why have I been left behind?", "how do I catch up?" These were very powerful questions, which would change the face of rural India.

2: 1990s THE PHYSICAL CONNECT

The 80's got the 'Aspiring India' to see the world, the 90's got the physical connect. We have to thank the government bankruptcy in 1990, the IMF push and the clarity of thought of Narasimha Rao and Manmohan Singh for liberating the country from the shackles of the licensing raj. This saw the death of 'Hamara Bajaj' – the scooter that middle class urban Indian had to endure to wait in a queue for 15 years, and opened up the two wheeler market to global competition - the Hondas and Yamahas along with their Indian partners Munjals of Hero and Nandas of Escorts.

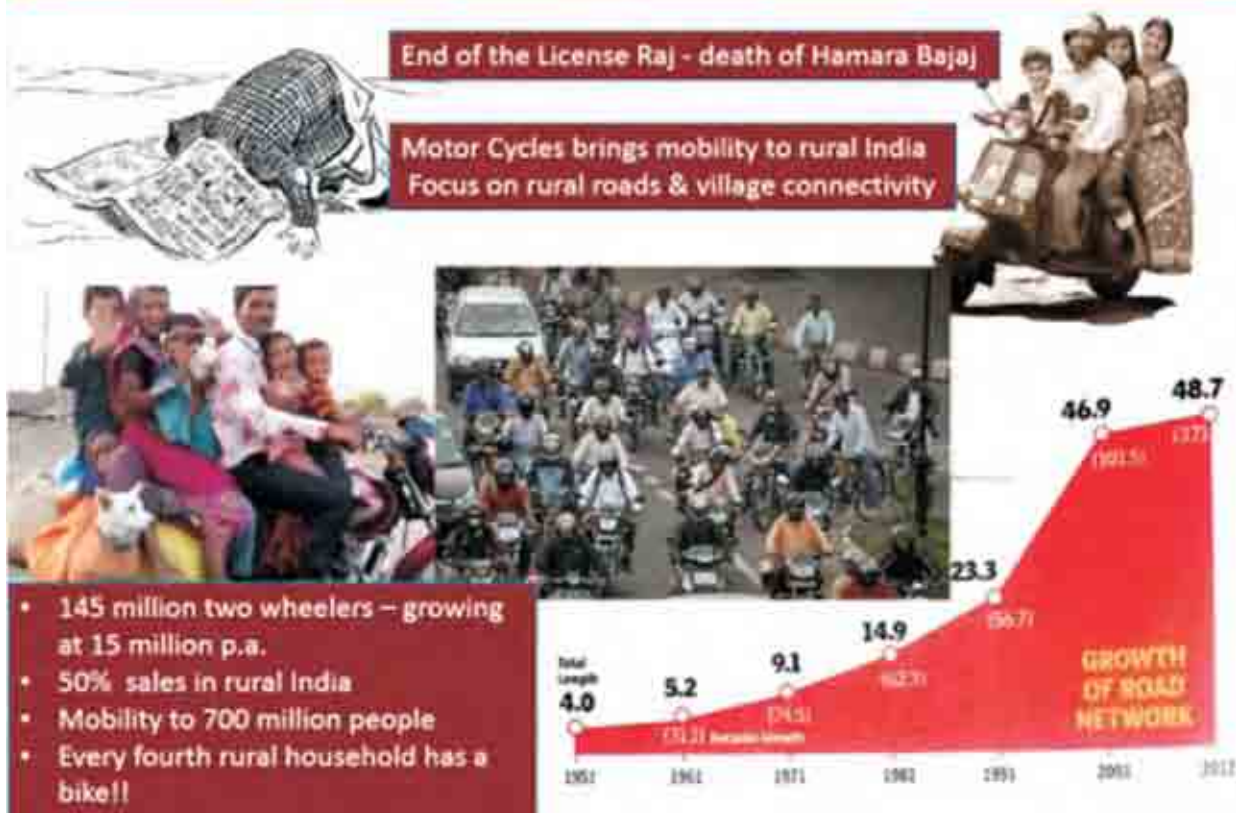
Rajdoot from the Yamaha/ Escorts stable became the preferred bike for rural India, with the legendary '*Mera Gaon Mera Desh*' campaign with He-

Man Dharmendra. This provided a quantum jump in the pace at which the rural Indian moved, his speed went up 10 fold from the bullock cart of Teesri Kasam to the bike of Sholay. Rajdoot sales peaked in 1992 at 100,000 units' p.a. This was equivalent to what Bajaj sold in the first 15 years of its monopolistic existence!!

Thereafter it was Hero Honda which radically transformed this market. Building customised products – high reliability, value for money and rural service networks. In the 1990s Hero Honda sold over 4 million motor cycles – over a third of this in the rural space. And today Hero Honda has become the world's largest two wheeler manufacturer. The number of Hero Hondas on the road today exceed 50 million – an amazing story of growth.

India today has over 145 million registered two wheelers and this number is growing by approximately 15 million every year, around half of these are in the rural space. Today every fourth rural household has a motor cycle and every year 8 million

2 : 1990s – the physical connect



more household are getting mobility. In rural India, the bicycle has been replaced by the motor bike, the bullock cart by the tractor trolley.

With an average family size of 5, the two wheelers have provided mobility to over 700 million Indian.

1990s also saw a tremendous thrust in improving road connectivity in India. Atal Bihari Vajpayee's dream of connecting India through the golden quadrilateral and the thrust on building rural roads through the Pradhan Mantri Gram Sadak Yojna, the schemes has helped more than double the length of rural road from 13 lakh km to 28 lakh km, during this decade.

The two wheeler revolution and the rural roads have enabled the 'aspiring Indian' to move out of his

villages and provided the 'physical connect' to the District headquarters to the Tier 2 and 3 town. This is what caused the boom in FMCG market in Tier 2 and 3 town in the 1990s. This is when marketers suddenly realised the huge business possibilities of rural India.

The party had just begun, this was only the tip of the iceberg.....

3: 2000s WORLD IS ONE

The turn of the century saw the mobile communication technology changing the world. While the bikes took rural Indian to the District HQ, the cell phone opened up the whole world to the aspiring Indian. The rural Indian, could now move out to the unknown world, while always remaining connected. Distances

meant nothing, the fear of the world outside was gone, and everyone was available 24X7 at the press of a button. This has totally changed the mind sets and enabled the 'argumentative Indian' to channelize his energies to exploiting opportunities far and wide.

This has meant, that men were seizing opportunities much beyond their village, district, state and even the country; women felt more confident to leave the safety of their homes and are able to join hands to add to the families income streams, and for the children a whole new world of learning and fun possibilities has opened up.

The pace at which rural India has taken to cellular technology is a reflection of the huge difference it

has made in their lives. Today over three fourth of the rural males have cell phones. The overall rural teledensity has grown from under one per cent in 2000 to almost 50 per cent now. There are over 400 million cell phone subscribers in rural India – 42 per cent of the total subscribers.

States like Punjab, Tamilnadu, Kerala, Karnataka, Maharashtra, Gujarat and HP have a more than 90 per cent tele-density, with 50 per cent of the households having internet access. Other states are catching up.

It's been an amazing journey from ignorance to enlightenment, never before seen in the history of mankind.

4: 2010s FINANCIAL INCLUSION

The Prime Minister's Pradhan Mantri Jan Dhan Yojna has given a huge boost to the process of financial inclusion. By the end of July 2015, over 17 Cr new bank accounts have been opened, with a balance of more than Rs 20,000 Cr and 15 Cr Rupay Debit cards have been issued with an overdraft facility. A mammoth

achievement.

This process started in 2005, through the UPA Government's much maligned rural unemployment guarantee scheme MNREGA, when the payments were directly credited to the person's bank account. Over 5 Cr bank accounts were opened and approximately Rs 30,000 Cr transferred to these accounts.

Today there are more Kisan Credit Cards than the total number of cards issued by commercial banks in the urban space. Over 10 Cr Kisan Credit cards have been issued and around Rs 70,000 Cr credit has been made available to the farmers.

The linkage of all these Jan Dhan accounts to Aadhar and the government programme of direct transfer of subsidy to the individual's bank account will bring a focused approach to the poverty alleviation efforts and lot more transparency into the system.

Universal banking has brought all the rural Indian into the mainstream of banking and business – opening the doors to the next revolution of e-commerce.

5: THE AGRI BOOM

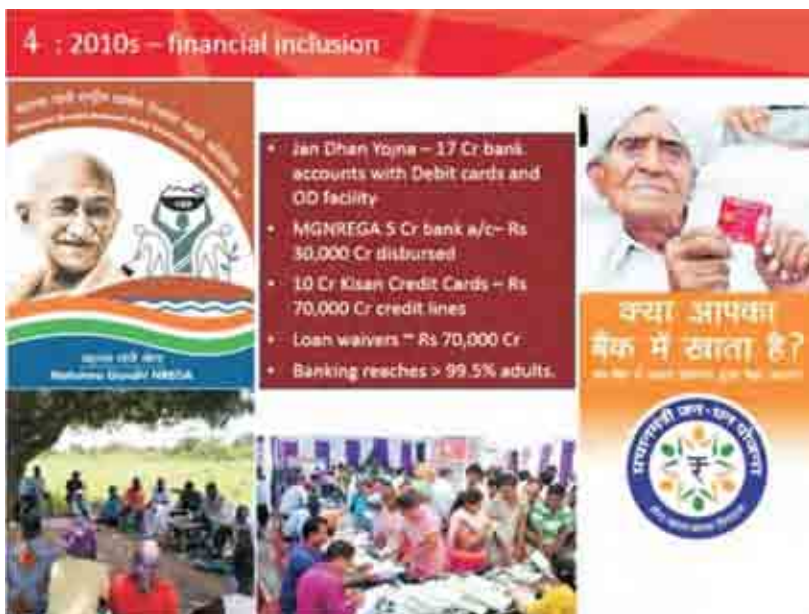
These changes in the rural environment have come at a perfect time of a global boom in agricultural commodities.

The demand for agricultural products has been growing as we move towards better food – from cereals and pulses to fruits and vegetables and animal products. Agriculture has moved from merely being a provider of food to fibre (cotton) and now even fuel (biofuels).

New technology in agriculture is beginning to change the rural landscape. In the late 60s and 70s we saw the dwarf high yielding varieties bringing the green revolution in wheat. Now the second green revolution is happening - GM cotton led the tripling of India's cotton production in last ten years and has transformed us from an importer to the world's largest exporter of cotton. Single cross hybrid corn seeds have catapulted North Bihar's yields to match the best in the world. Area under fruits and vegetables cultivation has doubled in the last 10 years, transforming the economy of areas in close proximity to the urban consuming centres. The clear shift toward cash crops has improved the farmers' cash flows.

Micro irrigation – drips and sprinklers - have opened up new possibilities in rain starved areas for dry land farming. Development of appropriate farm mechanisation – harvester/combines, small tractors, etc. are changing the face of Indian agriculture. Over a third of the farmers have now supplementary incomes from animal husbandry, dairying, poultry, fisheries, etc. Rural spending is now less dependent on





farm income, which is now less than 50 per cent of the total income. The wheels of change are chugging fast and these pockets of innovation are spreading and transforming the face of rural India.

We need to credit the government for pushing this process, dramatically increasing the Minimum support prices for all the agricultural products. During the eight year period from

2005-06 to 2013-14, the MSP of wheat, rice, sugarcane, cotton, pulses, etc. have all doubled to tripled. This has made a huge contribution in increasing the farmers' income over this period.

The rain Gods too have been kind and the old days of drought and famine are almost forgotten.

With increasing urbanisation and industrialisation, the land available

for agriculture is shrinking. This has opened up new opportunities for agri economies like India and Brazil.

The opportunities in the agri space are huge. India has the potential to become a major supplier of agricultural products to the world. This is possible with the right government interventions, appropriate technology and an enabling environment.

SHRINKING RURAL – URBAN DIVIDE

With increased rural incomes the 'aspiring rural Indian' is bridging the gap with the urban customers. In 1951 the literacy rate in rural India was barely 12%, a third of that in urban India which was at 35%. The 2011 census shows that rural India has now almost caught with a literacy rate of 69%, as against 85% in urban areas. Over 95% of the 640,000 villages have electricity and two third of the households have access to power, 50% have television sets, a third have refrigerators, a fourth have motor cycles,.....During the last 15 years since 2000, the GDP of rural India has grown at a CAGR of 6.2%, as against 4.7% in Urban India. During the last five years, for the first time the rural consumption growth has outpaced urban consumption growth. Economist forecast that these trend will continue and as a result the size of the rural economy would soon be bigger than the urban economy!!

The developments of the last three decades have been truly historic and we have seen 850 million rural India break their centuries old bondage and are poised to realise their true potential. Therein lies the Dream of a prosperous Bharat. ■





Founded on Trust. Envisioning Infinite Possibilities. Agri Input | Custom Synthesis

Becoming a leading Agri Input and Custom Synthesis company took us foresight, acumen and ability. But it all started with our foundation of trust. Our principles of complete business transparency and an adherence to the highest standards have made us global experts and a partner of choice in our business. We are confident that our belief in trust will lead us to infinite possibilities in the world of chemistry in time to come.

OUR BUSINESS PRINCIPLES



ADAPTABILITY

Constantly transforming ourselves like water, we are nimble, focused and highly responsive to change.



TRUST

We work with integrity of purpose, honesty, full disclosure and fairness in all our dealings.



SPEED

Setting the pace, we consistently give forward with speed in the way we operate, think and act.



INNOVATION

The constant quest for better, the never-ending search for a better, new way to do things, innovation is a way of life for us.



Inspired by Science

PI Industries Ltd

www.piindustries.com | info@piindustries.com



Sudhanshu Jangir,
Head India
Operations, Group
Axereal
and
Vikram Yogi (Ph.D
Scholar), IARI

Rural development through Agricultural co-operatives

Agriculture is a backbone of the Indian economy. It employs 52 percent of the Indian population. Population census (2011) has shown that nearly 68.84 percent of the aggregate population of the nation lives in the rural areas. Subsistence is the inclination underway and the accentuation is still on meeting nourishment security needs. The smallholder ranch part in creating nations is to a great extent left without vital bolster game plans in framework, augmentation administrations and neighborhood handling limits, essential human services and training. They have not been incorporated in arrangements to improve their organizations in the changed business settings.

During recent years, farmers' high hog on the organizations around the world have been promoting a new agenda for rural development and the development of farmer-owned organizations and farm enterprises. Developments in recent time have also shown that, although cooperatives have been affected

by many problems, they are still the most relevant organizational form for small and medium-scale farmers. Cooperatives have shown resilience in periods of crisis. Cooperatives have resisted the negative impacts of a rapidly changing environment. Cooperatives have been a privileged forum for discussing and finding solutions to common problems. Many new initiatives give hope for a renewed, member - owned, community - committed and independent agricultural cooperative movement. The cooperative farming is the best approach to fortify the provincial economy and accommodating to inspire the farmer from destitution trap. Cooperative farming is a type of business association in which individual unites willfully, pool their assets and develop the area.

Why cooperative is essential in India

- Presently, 27 per cent of the population is living in poverty; livelihood security for the rural poor continues to be a cause of concern in India.



- The last four decades have witnessed a sharp decline in the average size of operational land holdings in India. The average size of operational land holdings has reduced by half from 2.28 ha in 1970-71 to 1.16 ha in 2010-11. Land holdings in the marginal category (less than one ha.) constitute 67 per cent of the operational holdings in the country (2010-11). Small and marginal holdings together, constitute 85 per cent in terms of number of operational holdings and 44 per cent of the operated area in the country. This is reflective of the immense population pressure on the limited land resource available for cultivation.
- Due to small land holding and labour shortage farm mechanization is difficult for individual farmer.
- Due to smaller quantity of produce farmers are unable to bargain for his product
- Due to small holding and less quantity of production by farmer, lack of will power to become farm entrepreneur
- Dependence on the monsoon, which make farm business as highly risky enterprises.
- Cartels or predetermined market sharing by private enterprises can be harmful for free and fair trade. Cooperatives by their very presence would help to maintain the balance in terms of price and quality. For this reason cooperatives need to enter all those areas where full domination by the private corporate might eventually spell bad news to the consumers.
- Inadequate availability of electricity, fertilizers, irrigation and pesticides

Share of Cooperatives in National Economy

Rural network covered	97 %
Agriculture credit disturbed by cooperative	19%
Fertilizer distributed by cooperative	36%
Fisherman in cooperative	23%
Milk procurement to total production	8.19%
Handlooms in cooperative	54%
Self employment generated	15.47 million
Direct employment generated	1.22 million

data collected from NCU

- Poor access of the farmers to good roads, market infrastructure, refrigerated transportation of goods.
- Better negotiation with Industry, government and real estate business for land prices at time of acquisition and sales of land. Unity tends to decrease harassment by land mafia or industry.

Under the circumstances, there is a need for resurgence of cooperatives as important instruments. "In terms of the decent work paradigm, cooperatives could lead the way by demonstrating what we really mean by freedom, equity, security and human dignity. Thus cooperatives by being true to their basic principles provide locally-based answers to globalization. Therefore, contrary to the belief that globalization impedes the growth of cooperatives; cooperatives are the vital agencies to face the challenges posed by globalization.

Cooperatives, in all spheres, today cover approximately 97% of Indian villages and 71% of total rural households in the country. Their contribution to the national economy may be seen from the following table

The Co-operative societies operating in India can be categorised into four major categories:

- **Production Cooperatives** which deal with agricultural and industrial production, such as Farming Cooperatives, Industrial Cooperatives and Processing Cooperatives.
- **Marketing Cooperatives** which are engaged in marketing of agricultural produce, such as Agricultural Marketing Societies and Consumer Cooperatives.
- **Service Cooperatives** which provide services necessary for their members, such as Cooperative Credit Societies and Cooperative Banks and also Housing Cooperatives,
- **Allied Service Cooperatives** which are dealing with activities necessary for daily life and business of the agriculturists, artisans, etc

Axereal: one of the most successful French cooperative of Europe; dealing from Farm to Fork

Axereal cooperative is a French cooperative group which includes 13,000 member farmers, based at Orleans in center France. Group Axereal is active in integrated supply chain from agriculture to agro industry. Axereal is grain industry expert in France and abroad. Group Axereal is dealing in seed selling, contract

farming, cereal storage, commodity trading and first transformation process. Group also produces wheat four (420000 tonnes production in Europe, 4th largest in France), malt (1.1 million ton in Europe, 5th largest in the world), vegetable oil and cattle feed. In year 2013 Group collected 4.5 million tonnes of cereals in 373 silos owned by the group itself. Group also has marketed 8 to 9 million tonnes of cereals. It is actively working in France, UK, Ireland, Belgium and central European countries (Serbia, Croatia, Hungary, and Romania), Algeria and India with total turnover of 3.4 Billion Euro in 2012. In these countries, this operates on cooperative contract farming model.

Axereal business model in India

Axereal Operations in India, which commenced on August 2010, included, Malting barley production, research program, varieties trial (barley, corn, fodder beet), Agronomy trial, consulting activities, Testing of European farm equipments for suitability in Indian condition and modifying them according to farmers' needs, testing of sprayers, testing of



agrochemicals, India practice research to make farm economy as viable and profitable.

Axereal co-operative Franchise model- Step towards agri entrepreneurship

Axereal group has developed an entrepreneurship model for Indian farmer, to make farming as a profitable entrepreneur.

Agri entrepreneurship for the farmers, by the Farmers

Axereal is working on above model in India. The main motto of Axereal is, to develop entrepreneurship in farmer and make farming business a viable activity.

Government initiation for development of community or cooperative based enterprises in India. 'Small Farmers' Agribusiness Consortium (SFAC) and Farmers

Producer organization

Small Farmers' Agribusiness Consortium (SFAC) is society promoted by Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India. The main aim of society is to promote agri-business by encouraging institutional and private sector investments and linkages to ensure the empowerment of all farmers in the country. The mission of SFAC is to link small farmers to technology as well as to the markets in association with private, corporate or cooperative sector and if necessary, by providing backward and forward linkages.

Farmers will be organized in small neighborhood informal groups which would be supported under the programme to form associations/ organizations relevant to their context including confederating them into FPOs for improved input and output market access and negotiating power. Different case studies on FPO have shown that FAO has been successful





in achieving their objective. Although FPO has succeeded but there are some challenges which are of major concern. The main loopholes of the Farmer producers company (FPC) is shortage of working capital- bank does not give loan to the Producer committee as it demands three year balance sheet, legal formalities like making Permanent Account Number (PAN) card of the member farmers who don't have proper date of birth proof, no proper awareness about the FPCs among the government departments who consider them as private firms. Also, farmers feel that the PC only purchases seed from selected member farmers in every season. Farmers want to sell their grain through the PC but due to shortage of capital, FPC can't buy. Lack of centralized storage facility is also another problem, due to which they have to sell their produce at the prevailing price and can't wait for better price.

Problems in cooperative sector in India

- The role of Governments in the cooperatives is so dominant that the members consider the societies not their own, but as a

player of the State. To them the cooperatives appear as a source from which they can borrow Government funds.

- The impact of politics upon the cooperatives seems to be getting heavier and more direct day by day. In several states the leadership of the cooperatives is heavily sprinkled with active politicians. So, politician use cooperative societies for their own benefit.
- A very large number of cooperative societies are, in effect, owned exclusively by influential families with a bogus membership of some outsiders to give them the appearance of cooperative bodies. This reduces the credibility of these societies.
- Inability to ensure active membership, speedy exit of non-user members, lack of member communication and awareness building measures are the major problems of the society.
- Serious inadequacies in governance including that related to Boards' roles and responsibilities.
- A general lack of recognition

of cooperatives as economic institutions both amongst the policy makers and public.

- Lack of cost competitiveness arising out of issues such as overstaffing a general top-down approach in forming cooperatives including the tiered structure Politicization and excessive role of the government chief arising out of the loopholes and restrictive provisions in the Cooperative Acts
- In addition to the above, there is also a serious problem of a large number of cooperatives that are sick/non viable.

Way ahead

Cooperatives have a significant role to play in the future setting of our economy. It is the cooperatives again who are equipped to work as pressure groups to voice peoples' views in the market. Apart from employment generation, they create a conducive business environment private entrepreneurship and investment in the development of value chains, in the provision of infrastructure and services and participation in sector-specific policy-making processes. Cooperatives are the exceptional channels to keep the poise of communism and democracy af oat. Delivering profitable governance is another critical requirement that can insure a harmonious trickling of benefits to the targeted beneficiaries. For the development of cooperative farming or cooperative organization government should provide adequate source of strength facilities to these institutions. Government should provide monetary and technical support to these institutions. Government should cut back the long formalities for this type of institution. ■

Dr. K. Singh, Deputy
 Director General
 (Agricultural Extension),
 ICAR, **Dr. P Adhiguru**
 Principal Scientist
 (Agricultural Extension),
 ICAR and
Dr. R R Burman, Senior
 Scientist (Agricultural
 Extension), IARI

Futuristic Frontline Extension for Transforming Indian Agriculture

India accounts for about 2.4 per cent of the world's geographical area and 4 per cent of its water resources, but has to support about 17 per cent of the world's human population and 15 per cent of the livestock. Agriculture is an important sector of the Indian economy, accounting for 14 per cent of the nation's GDP. The agricultural economy, the biggest private enterprise in India, engages over 145 million rural households spread over 6.50 lakh villages. For accelerating the growth of agriculture, the extension system has to be robust to foster agricultural development and inclusive growth.

Frontline extension system

The broad typology of the extension systems are mainly Frontline Extension System and Field Extension System. Front Line Extension is a catalytic force for the Field Extension, which

involves a higher level of extension interaction by highly qualified staff of the research and educational system. Field extension system is concerned with large-scale agricultural technology dissemination to the large number of Indian farmers by development departments and agencies. Frontline extension system of ICAR and State Agricultural Universities (SAUs) focus on the assessment and demonstration of the technologies and capacity building of the related stakeholders. The main extension players include viz., the Department of Agriculture and Cooperation (DAC) and the related ministries of rural development through its network of agricultural and related departments at state, district, block and village level; frontline extension systems by KVKs, ICAR institutes and SAUs; Extension services by different commodity boards; Agribusiness houses and input agencies and extension services



by the Voluntary Organizations of the country. In addition, farmers' organizations and producers' companies are also emerging as part of extension system.

Krishi Vigyan Kendra – A Frontline Extension Model

Krishi Vigyan Kendra an Institutional Innovation inspiring the World in 21st Century has been designed and nurtured by ICAR for the past four decades. At present there are 642 KVKs across 8 Zones in the country, which include 435 under State Agricultural Universities (SAU) and Central Agricultural University (CAU), 55 under ICAR Institute, 99 under NGOs, 35 under State Governments, and the remaining 18 under other educational institutions.

KVK at present aims at assessment and demonstration of location specific technology in agriculture and allied enterprises and capacity building of stakeholders. There has been change in the emphasis in the approach and functioning of the KVKs as on vocational training (1974), technology demonstration (1987), technology assessment and refinement (1997), knowledge and resource centre (2009) technology application and capacity development (2014).

Performance of KVK

KVKs have played significant role in substantially augmenting production of food grains, pulses, oilseeds, fruits, vegetables, sugarcane, milk, poultry, meat, fish and other products. For instance, during the period 2001-02 to 2012-13, the total food grain production increased from 212.85 mt to 257.13 mt; pulses production increased from 13.37 mt to 18.34 mt; oilseeds production increased from 20.66 mt to 30.94 mt; sugarcane



production increased from 297.21 million tonnes to 341.20 million tonnes; and cotton production increased from 9.99 million bales to 34.22 million bales. Similarly, in horticulture sector, the country has achieved significant increase in production of various crops. e.g. production of fruits and vegetables has increased from 145.77 mt to 267.93 mt during the same period. The production of livestock sector have also shown tremendous increase during the last decade (2001-02 to 2011-12) i.e. milk production increased from 84.40 mt to 127.97 mt; egg production increased from 38729 million to 66450 million; meat production increased from 1.9 mt to 5.5 mt.

During the first three years of XII Plan, KVKs conducted 91834 on-farm trials and 3.95 lakh frontline demonstrations for technology update and its application in farmers field; organized large number of training programmes to enhance knowledge and skill of 46.46 lakh farmers and 3.67 lakh extension personnel; created awareness on improved technologies among 364.04 lakh farmers and other stakeholders through frontline extension programmes and mass media coverage. The KVKs also pro-

duced 6.75 lakh quintal seed; 577.14 lakh planting material; 356.79 lakh fish fingerlings and analyzed 10.33 lakh samples of soil, water, plants and manure. Besides, Kisan Mobile Advisory (KMA) in the form of short text messages was provided to 43.70 lakh farmers. During the last one-year, 90 KVKs have also implemented fodder demonstration programme in the farmer's field.

Impact of frontline extension interventions of KVKs Harnessing pulses for protein

Over 6000 demonstrations on five major pulses viz., gram, lentil, pigeon pea, black gram and mung bean were planned and conducted in 137 districts of 11 states with the technological backstopping of ICAR institutes/SAUs. There was yield enhancement up to about 40 per cent over farmers' practices. Since the year 2010, the production of pulses has gone up from 14 million tonnes to 19 million tonnes with concerted efforts of concerned agencies.

Summer Moong intensification in rice-wheat cropping systems: Summer mungbean has been incorpo-

rated as additional crop in rice-wheat system in Haryana, Punjab, and Uttar Pradesh and economic gains of Rs25,000 to 30,000 per ha are being realized by the farmers.

Upscaling of Malviya-13 variety of Pigeonpea: KVK Munger, Bihar has been able to upscale Malviya-13 variety in 13 districts of Bihar in more than 1000 ha with the involvement of 13670 farmers. The variety has recorded 83 per cent more yield and 111 per cent more net return.

Summer Groundnut Introduction: KVK-Mainpuri, Uttar Pradesh experimented on summer groundnut with average yield of 26.15 q/ha, gross return of Rs. 53500/ha & net return of Rs. 31500/ha. The technology has spread to 16 districts and about 2.00 lakh ha area in Uttar Pradesh.

Reducing pesticide spray on Cotton: Integrated Pest Management technology has spread in more than 75 villages of district-Jalna, Maharashtra and adopted on more than 10,000 ha by 5000 farmers in the district. Cost on plant protection reduced by 42 per cent and average yield increased by 35 per cent.

Climate Resilient Agriculture

100 KVKs worked on resilient technologies with focus on suitable crops, varieties, natural resource management, farm mechanization and custom hiring services, and also sensitized stakeholders on drought, food, frost, soil related issues and ground water depletion. KVKs have developed climate smart villages which are weather smart, water smart, carbon smart, nutrient smart, energy smart, and knowledge smart.

Resource Conservation: The technologies have been introduced in Haryana and Punjab, Uttar Pradesh, Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh and Andhra Pradesh. In Chandauli, Uttar Pradesh, 60,000 ha area has been brought under zero tillage wheat cultivation.

Rainwater harvesting through land shaping: To overcome the three major constraints of Sundarbans such as low lying mono cropped area, soil salinity and impeded drainage system, the KVK, Nimpith has developed the sustainable technology.

Water Conservation in drought prone areas: Water conservation measures were promoted in district Gadag, Karnataka through trainings and demonstrations in 11 villages covering 1660 farmers, in an area of 1331 ha. The major impact were increased area under irrigated rice, increased groundwater table, increase in yield of pulses and oilseeds.

Effective Convergence

ATMA, Department of Agriculture, Horticulture and other line departments, National Horticulture Mission, RKVY all are running at the district level with the technical support of KVKs.

District plan: KVKs assisted in preparation of Comprehensive Dis-

trict Agriculture Plan(CDAP) of 615 districts.

Convergence platform: A convergence platform of 12 different departments/ organizations under the leadership of KVKs in the state of Madhya Pradesh involved 5000 farmers from each district. The Govt. of Madhya Pradesh has appreciated the efforts of KVKs and recognized the role of KVKs by conferring Krishi Kramana Award.

Institutional innovations: Ten KVKs in Madhya Pradesh in collaboration with state Government support Krishi Tirth Yojana for technology showcasing, Krishi Mohotsava in 46 districts have been organized at Naya Panchayat level covering 20,000 villages in 310 blocks.

Convergence through focused production program-Maize: 150 KVKs implemented a special program on single cross hybrids with technological backstopping of ICAR-Directorate of Maize Research.

Convergence through focused production program-Wheat: In collaboration with ICAR-Directorate of Wheat Research (DWR), 67 KVKs are working on assessment, and demonstration of wheat varieties and related technologies.

Convergence through Integrated Pest Management (IPM):



With the technology backstopping by ICAR-National Centre for IPM, New Delhi, 141 KVKs are working for skill development in Integrated Pest Management.

ICT mediated approach: Most of the KVKs are providing farm advisory to the farmers and around 22, 62,913 farmers are being reached through Farmer Portal.

Empowering tribal farmers

About 125 KVKs are working in Tribal districts facilitating technology support and related inputs to the tribal farmers and about 7.28 lakh tribal farmers benefited.

Institutional Innovation for Farm Mechanization

Women Working Group: With the support and supervision of KVK Malappuram, 11 women formed the group named Krishi Sahayi during 2007-08 which deal with mat nursery preparation, transplanting paddy etc.

Paddy Task Force: There are 12 Paddy Task Force functioning in Kannur district; Kerala and they cover 17-grampanchyats in the district and facilitating scientific rice production .

KVK system has played a key role in transfer of modern technologies in agriculture and allied sectors leading to increase in production and productivity, development of high value agriculture like horticulture, livestock and fisheries, introduction of newer varieties for pulses and oilseeds leading to increase in income of farmers and promotion of farm-based enterprises.

Way forward in strengthening of KVKs

Strengthening is proposed in XII Plan for existing KVKs and there is provision for new KVKs in remaining and newly



created districts; one additional KVKs in larger districts; establishment of Integrated Farming System Module; Technology Information Unit; Mini Seed Processing Facility; Rain Water Harvesting Units; Soil and Water Testing Laboratories Micro Nutrient Analysis Facilities; Minimal Processing Facility; Portable Carp Hatchery; operation of e-Extension; e-FARMERS; Specialized KVKs; ICT in Agriculture including mobile and web platform, Farm Innovation and managing unforeseen calamities; infrastructure strengthening like boundary wall, power support and farm equipment.

New initiatives in frontline extension

FIRST

The new proposed project – ‘Farmer FIRST’ is an ICAR initiative to move beyond the production and productivity and the focus is on farmer’s farm, innovations, resources, science and technology (FIRST). ‘Farmer FIRST’ aims at enhancing farmers-scientists interface for technology development and

application. The objectives are to take up technology development based on feedback with the participation of farmers; to build a network of linkages with different entities around the farm households; to find out the technical, socio-economic and environmental impact of the project to develop a database on performance of NARS technologies; to identify and integrate economically viable and socially acceptable entrepreneurial activities as models; to initiate special modules for farm women to enhance their participation in agricultural activities for higher earnings and livelihood security and to utilize the strength of the technology institution (partners) to develop commodity specific contents for knowledge sharing. This project is to be implemented in research mode by 100 ICAR Institutes/ Agricultural Universities. Each Institute will identify 4-5 villages. The project will cover about one lakh farm households during the project implementation.

Krishi Dak

Indian Institute of Agricultural

Research, New Delhi has provided quality seeds of various crop varieties to the farmers of different remote areas in the country through Post Offices and Postman. Under the Scheme, rural Postman and farmers have been trained on improved agricultural practices by the regional KVKs. These Postmen/farmers demonstrated improved Pusa varieties in their field which became the source of practical training for other farmers.

The initial trial of this model was carried out in Sitapur district of Uttar Pradesh through seven rural Post Offices. Thereafter, its validation was done with the help of 20 rural post offices. By adopting this practice and easy availability of high quality seeds and crop production skill, 11 to 30 % increase in productivity was observed in the projected areas. It is proposed that this model should be extended to 100 districts of 14 states (Jammu & Kashmir, Punjab, Himachal Pradesh, Haryana, Utrtrakhand, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Orissa, Chhatisgarh, Madhya Pradesh, Rajasthan and Gujrat) during the 12th plan.

Mera Gaon Mera Gaurav

The objective of "Mera gaon Mera Gaurav" is to provide farmers with required information, knowledge and advisories on regular basis. Under this scheme, scientists will select a village as per their convenience and will remain in touch with that village and provide information to farmers on technical and other related aspects in a time frame through personal visits or on telephone. In this way, 20,000 scientists of National Agricultural Research and Education System (NARES) can work by selecting

villages as "Sampark Gaon". Under this initiative, it is required that groups of 3-4 scientists each consisting of different disciplines at every Institute/ University should adopt one village. Quarterly performance report and Benchmark survey report of the village will be generated.



Attracting and Retaining Youth in Agriculture (ARYA)

The objectives of "Attracting and Retaining Youth in Agriculture (ARYA) project are to attract and empower the Youth in Rural Areas to take up various Agriculture, allied and service sector enterprises for sustainable income and gainful employment in selected districts; to enable the Farm Youth to establish network groups to take up resource and capital intensive activities like processing, value addition and marketing; and to demonstrate functional linkage with different institutions and stakeholders for convergence of opportunities available under various schemes/ program for sustainable development of youth. ARYA project will be implemented in 25 States through KVKs, one district from each State. In one district, 200-300 rural youths will be identified for their skill development in entrepreneurial activities and establishment of related micro-enterprise units in the area of

Apiary, Mushroom, Seed Processing, Soil testing, Poultry, Dairy, Goatry, Carp-hatchery, Vermi-compost etc., At KVKs also one or two enterprise units will be established so that they serve as entrepreneurial training units for farmers. The trained youth groups will function as role model for other youths and will demonstrate the potentiality of the agri-based enterprises and also give training to other farmers.

Conclusion

Frontline extension in India has evolved itself over the years as vibrant system to provide technical backstopping to field extension. KVK as light house of agricultural technology at district level, effectively links research and extension, and is playing crucial role in showcasing the appropriate technologies, capacity development of stakeholders, making available critical technological information, planting materials and seeds, assessing technologies to suit different agro-climatic conditions. Notable impact of KVKs is evident in agriculture and allied sectors in terms of augmenting production, productivity, ensuring nutritional security by increasing protein availability through pulses, cost-effective resource conservation and enhancing income through value addition and skilling the farmers to be successful entrepreneurs. XII plan new initiatives in front line viz., Farmer FIRST, *Krishi Dak*, *Mera Gaon Mera Gaurav*, Attracting and Retaining Youth in Agriculture (ARYA) will substantially strengthen the front line extension system to be futuristic and transform Indian Agriculture to ensure food and nutritional security while ensuring Farmers welfare. ■

MANGALA



Mangala Brand Fertilizers
Products for Soil Health Management
Plant Nutrition & Plant Protection Products



MCF

Mangalore Chemicals
& Fertilizers Limited

No. 5, Crescent Road, High Grounds, Bangalore 560 001
www:mangalorechemicals.com • Ph. 080-2220 8990/93



MCF/2015



Ashok K Patra,
Director and
Sanjay Srivastava
ICAR-Indian
Institute of Soil
Science, Bhopal

Status of Soil Health in India and its Management

Soil health is critically important to sustainable agricultural productivity and environmental wellbeing. Healthy Soils provide a range of environmental services including water infiltration, habitat provision and profitable and sustainable agriculture. Despite significant growth in agriculture during the last five decades, most of our important soil based production systems are now showing signs of fatigue. Non judicious use of chemical fertilizers over the years has resulted in multi-nutrients deficiencies, decline in soil organic matter, and pollution of water bodies which has led to not only decline in soil productivity but also in the development of human and animal health disorders. It is suggested that promoting Integrated Plant Nutrition System (IPNS), and soil test based fertilizer nutrients additions would reverse the decline in soil productivity and restore the soil health.

In India, the conservative estimates showed that the demand for food grains would increase from 257 million tonnes in 2012-13 to 355 million tonnes in 2030. Contrary to increasing food demands, the factor productivity and rate of response of crops to applied fertilizers under intensive cropping systems are declining year

after year. The current status of nutrient use efficiency is quite low in case of N (30-50%), P (15-20%), S (8-12%), Zn (2-5%), Fe (1-2%) and Cu (1-2%) due to deterioration in physical, chemical and biological health of soils. The major reasons for soil health deterioration are: wide nutrient gap between nutrient demand and supply, high nutrient turnover in soil-plant system coupled with low and imbalanced fertilizer use, emerging deficiencies of secondary and micronutrients in soil, soil acidity, nutrient leaching in sandy soils, nutrient fixation in red, lateritic and clayey soils, impeded drainage in swell-shrink soils, soil salinization and sodification, etc. Soil test based fertilizer recommendation can provide a plausible solution to the problem. In India, a considerable portion of soils is suffering from poor soil health. The deterioration in soil health can be caused by nature or it may be anthropogenic. The soil health degradation is of many kinds. Physical degradation is due to water erosion (82.57 m ha), wind erosion (12.40 m ha), compaction, crusting and water logging. Chemical degradation is due to process of salinization and alkalization (6.74 m ha), acidification (17.94 m ha) and nutrient depletion. Biological degradation is caused by the reduction of soil biota and organic





matter, degradation of vegetation and impairment of activities of micro-f ora and fauna. Even though all forms of soil degradation are important and need to be addressed, it is the chemical soil degradation that is agriculturally most important. Chemical soil degradation which emerges as a result of indiscriminate fertilizer additions and poor nutrient management practices, not only affects the crop yields but also impacts biological soil health besides inducing environmental pollution. Hence, one of the most important reasons of assessing the health of a particular soil/field is to have a fair idea about its future management, most importantly the fertilizer/manure management. This aspect is especially important for India because a huge amount of foreign exchange is spent every year on import of fertilizers. Potassic fertilizers are entirely imported and almost 90% of the phosphatic fertilizers are also imported either as finished product or in the form of raw materials like rock phosphate, phosphoric acid, and sulphur. Though urea is manufactured in India, still a large part of it is imported. Fertilizers, on account of high import cost, have

to be subsidized. The total fertilizer subsidy in India in 2013-14 was around Rs. 68 thousand crore. Hence, soil fertility management and soil test based balanced fertilizer applications are most important aspects in the assessment of soil health.

IMPACT OF IMBALANCED FERTILIZER APPLICATION ON SOIL HEALTH

Multinutrient deficiencies

Improper nutrient management has led to multi-nutrient deficiencies in Indian soils. In the early sixties, when fertilizer responsive varieties were introduced in India, optimum yields could be obtained with the application of nitrogenous fertilizers alone. However, intensive cropping with bumper harvests soon depleted other nutrients. With nutrient application/additions hardly keeping pace with their removals by crops, the fertility status of Indian soils has been declining fast under intensive agriculture and are now showing signs of fatigue. The partial factor productivity has gone down, necessitating additional inputs to obtain similar crop yields. The inadequate and imbalanced nutrient

use coupled with neglect of organic manures has caused multi-nutrient deficiencies in many areas with time.

Declining soil organic matter

Soil organic matter plays a key role in soil health sustenance. Organic matter (OM) is the source of energy for soil biota. Because of limited supply of OM and imbalanced fertilization, organic carbon (C) in soil is often less than 0.5%, and a major constraint for soil fertility and productivity. Thus, assessing soil organic carbon (SOC) accretions/sequestration under intensive cropping with different management practices plays an important role in long-term maintenance of soil quality. The carbon sequestration research is gaining credence worldwide in the context of sustainable management of land and soil resources and arresting the deterioration of the environment. The future research should take lead in modeling carbon sequestration potential of different soils and land use systems and establishing benchmarks and standards for carbon trading.

Human and animal health disorders

Inadequate use of micronutrient fertilizers is aggravating trace element deficiencies in soils in many areas. The crops grown on these soils are, generally, deficient in micronutrients. These deficiencies are linked with malnutrition and health disorders in humans and animals. The problem is more serious in young children, women of child bearing age and livestock. The Zn deficiency has become a big public health issue in India and is second in importance to Fe. It is assumed that around 25 % of Indian population is under risk of Zn deficiency related problems. The dietary intake of 0.2 - 0.3 mg

Zn/day is regarded as deficient. Its deficiency impairs the immune system and increases the incidence of infectious diseases such as diarrhea and pneumonia. The Zn deficiency related disorders like parakeratosis disease, associated with bone and joint disorders and thickening of skin, have been reported from Punjab and Haryana in animals feeding continuously on forages deficient in. Iron malnutrition is yet another problem in many parts of India, where poor people depend largely for their food on cereals containing low iron. Iron deficiency is associated with anemia, fatigue, nervousness, reduced appetite, lower weight gain, sore tongue and memory loss etc. Deficiencies have been reported in livestock of north-western Rajasthan and sheep and goats in West Bengal. Deficiencies of Cu, especially in sandy soils or soils having large content of organic matter, have also been reported to affect crop productivity and human health in India. Research at ICAR-IISS has shown that the Zn deficiency in as many as 48% of soil samples followed by B (33%), Mo (13%), Fe (12%), Mn (5%), and Cu (3%).

Pollution of water resources

A concern is being voiced, of late, regarding pollution of groundwater with nitrates due to more use of nitrogenous fertilizers. The problem is thought to be more in areas having light textured soils consuming higher doses of N followed by heavy irrigations. There are reports of nitrate pollution of ground water above the permissible levels (10 mg NO₃-N/L of water as safe limit in drinking waters) in agriculturally intensive areas of Punjab, Haryana, Gujarat, Maharashtra and Andhra Pradesh. Nonpoint source pollution of surface/river water due to flow of applied fertilizers and pesticides has

also been reported. Split application synchronizing the demand of growing plant instead of one time heavy dose, placement of fertilizer, use of slow releasing N-fertilizers and nitrification inhibitors, inclusion of leguminous crops with deep and extensive root system in crop rotation with shallow rooted crops are some of the measures recommended to mitigate such problems.

Greenhouse Gas Emission

Nitrous oxide (N₂O) is a potent greenhouse gas which has been calculated to have 298 times the global warming potential of CO₂ over a 100 year period. Fertilizer is the largest source contributing around



77% of the total direct nitrous oxide emissions from agricultural soils. The most efficient management practices to reduce nitrous oxide emission are site specific integrated nutrient management, use of nitrification inhibitors, supplementation of nitrogenous fertilizers by biofertilizers, organic manures, demand driven N application using Leaf Colour Chart (LCC), intercropping with legumes and use of deep embedded urea super granules. The mitigation strategies have twin benefits; first, raising N use efficiency thus reducing the consumption of nitrogenous fertilizers and secondly, lowering the nitrous oxide gas emission vis-à-vis global warming.

Management Strategies to Improve Soil Health

Management of soil fertility is going to be crucial to supply adequate amounts of nutrients for the targeted levels of food production. This requires a re-look at the growth and infrastructure needs of fertilizer industry, fertilizer pricing and subsidy patterns and integrated nutrient management systems for varying soil and crop situations.

Restructuring fertilizer pricing and subsidy

The Government is committed to supply fertilizers to the farmers at affordable prices and, accordingly, provides subsidy on certain fertilizers. At the same time, the Government is concerned over the large fiscally unsustainable subsidy bill. The pricing pattern of fertilizers, hitherto, has also contributed to imbalanced fertilizer use and deterioration of soil health. Therefore, restructuring of fertilizer pricing and subsidy, providing for reduction in subsidy and promotion of balanced fertilizer use, became quite relevant. The Govt. of India has, accordingly, taken historical policy decision of introduction of Nutrient Based Subsidy (NBS) w.e.f. 1.4.2010. The move would broaden the basket of fertilizers and enable fertilizer use as per soil and crop requirements. Primary nutrients, viz., N, P and K and nutrient Sulphur 'S' contained in the fertilizers are eligible for NBS. The NBS to be paid on each nutrient, viz. N, P, K and S, will be decided annually by the Govt. and will be converted into subsidy per tonne for each subsidized fertilizer. Additional subsidy for fertilizers fortified with zinc and boron will be paid at the rate of Rs.500 and Rs 300 per tonne, respectively. The Govt. of India has also included SSP under NBS

w.e.f. 1.5.2010 to promote its use. The Government is also promoting customized fertilizers based on area and crop specificities.

In spite of these measures, the major objective of NBS policy of balanced fertilization is yet to be achieved. Exclusion of urea from NBS and decontrol of P & K fertilizers has also led to imbalanced application of nitrogen vis-à-vis phosphatic and potassic fertilizers (NPK consumption ratio: 8.2:3.2:1 and 6.9:2.4:1 in 2012-13 and 2013-14 respectively).

Integrated nutrient management system

Integrated nutrient management (INM) encompassing conjunctive use of chemical fertilizers including secondary and micronutrients, organic manures, composts/vermicomposts, biofertilizers and green manures demands adoption on a large scale. The Long Term Fertilizer Experiments in vogue for the last 42 years, under the aegis of All India Coordinated Project on Long term fertilizer experiment, have indicated very clearly that the response to the fertilizers could be raised significantly with balanced application of fertilizer nutrients along with organic manures. The system enhances nutrient-use efficiency (which is low for majority of nutrients), maintains soil health and enhances crop yields and farmers' profitability. The ICAR-Indian Institute of Soil Science, Bhopal has made significant contributions towards promotion of INM in the country by running many All India Coordinated Projects throughout the country. The Council has so far generated GIS based soil fertility maps in respect of macro, secondary and micro nutrients for 172 districts. These geo-referenced maps can be useful in monitoring soil fertility, fertilizer recommendations

for balanced nutrient application in various parts of the country. The institute has also generated integrated nutrient management packages for major cropping systems of the country and the information has been passed on to different states through Department of Agriculture and Cooperation of the Ministry of Agriculture.

Following soil test crop response based fertilizer nutrient application

It is important to promote soil test crop response based fertilizer nutrient applications for maintaining a good soil health. Recently, GOI has initiated a mammoth programme of preparing and distributing soil health cards to about 14 crore farmers in the country. These soil health cards will contain the information about soil fertility and soil test based fertilizer nutrient recommendation. The programme is expected to be executed in three years and will be recurring in nature. However, the existing infrastructure of around 1206 soil testing laboratories is not sufficient if field of every land holding is to be analyzed. Obviously, new technologies of faster analysis of soil health parameters with outreach to last mile are required. In this direction, ICAR-IISS has developed a mini laboratory "Mridaparikshak" that can estimate all the essential soil parameters. This is a digital quantitative soil test mini lab which can provide soil testing service at farmers' doorstep. It also provides the fertilizer nutrient recommendations that are crop and soil specific. ICAR-IISS has also developed a user-friendly software which can be used by the soil testing laboratories to have fertilizer recommendations online.

Enhancing biota for soil

fertility and efficient biocultures

Physical disturbance of the soil caused by tillage and residue management is a crucial factor in determining soil biotic activity and species diversity. The activity of soil microbes influences nutrient availability directly and indirectly. A direct effect is the breakdown of organic matter and subsequent release of nutrients not used in cell building and maintenance processes. These 'extra' nutrients are available to plants. Also, since the microbial biomass itself is a relatively labile fraction of the soil organic matter, nutrients in biomass become available as dead microbial cells and are attacked by other microbes. Indirect effects result from the interaction of microbial by-products with soil constituents and nutrients. Systems that increase below-ground inputs of C and N through inclusion of legumes and/or fibrous rooted crops in rotations often increase microbial populations and activity to greater extent than conventional systems using commercial fertilizers. It is well-recognized that microbial inoculants constitute an important component of integrated nutrient management that leads to sustainable agriculture.

Conclusions and future thrusts

Integrated Plant Nutrition System (IPNS) needs to be promoted by pooling all the available organic resources in the country. Maps of essential elements including trace elements deficiency and toxicity need to be produced to create awareness among people, planners and policy makers. It is also important to calibrate and promote the low cost rapid mini laboratories of soil fertility evaluation and management. ■



Rita Sharma,
former Secretary,
Government of India,
Ministry of Rural
Development; former
Secretary National
Advisory Council, former
Extension Commissioner,
Ministry of Agriculture

Extension for Agriculture and Farmers' Welfare

A highlight of the Prime Minister's Independence Day address to the nation was the spotlight on kisaan kalyan or farmers' welfare. This was clearly in response to the prevailing farmers' distress. The 70 year old Agriculture Ministry is being renamed as the 'Ministry of Agriculture and Farmers' Welfare'. This will signal to the farming community that the government proposes to focus not only on agricultural production and productivity but also in bringing to the centre-stage issues of farmers' welfare.

The nature and scope of agricultural extension and delivery systems has been undergoing transformation over the past two decades. Earlier the systems were geared primarily towards increasing production, improving yields, training farmers and transferring technology, especially for staple crops. By embedding "Farmers Welfare" firmly into the nomenclature of the Ministry, it is expected that a more holistic approach will be taken towards extension.

A more inclusive agricultural extension service would be responsive to farmers' demands related to (i) applying most appropriate science and technology options; (ii) optimizing use of inputs; (iii) sourcing reputable input suppliers; (iv) diversifying farming systems; (v) developing value chain interventions; (vi) identifying quality specifications for produce; (vii) assessing consumer and market demands for products; (viii) facilitating access to remunerative markets, price information and trade; (ix) working with farmers toward sustainable natural resource management practices; (x) helping build resilience against weather variability and coping with climate change; (xi) improving access to loans and credit; (xii) developing human and social capital; (xiii) planning for food and nutrition security; (xiv) enhancing skills and knowledge for production and processing; (xv) organizing farmers and producer collectives; (xvi) providing information regarding various government economic and welfare schemes; (xvii) facilitating business plans, building entrepreneurial skills



and exploring off-farm employment options; (xviii) assisting in insurance coverage; (xix) providing social security, safety nets, pension; (xx) dealing with natural disasters (xxi) obtaining a fair compensation in the event of land acquisition; (xxii) receiving entitlements under the National Food Security Act, and such others.

It is clear that in this expanded role, the canvas of information that agricultural extension needs to cater to—through provision and facilitating access and sharing—is much wider. The question is, where will we find such a single super-extension service to effectively perform these multiple roles, which not only addresses issues of enhancing production but is also responsive to the welfare needs of farmers?

The answer lies in recognizing and coordinating the multi-agency extension service providers existing today, each with their own expertise, strengths and niche areas of operation. As the nature and scope of agricultural extension undergoes fundamental changes, and financial constraints force governments to shrink their state extension bureaucracies, agro-service delivery is reforming from a primarily public sector monopoly to a pluralistic system comprising of a mix of public and private sector actors, as well as public-private partnerships. A parallel explosion in information and communication technologies has provided a potent tool for leap-frogging over the old, inter-personal mode of imparting information and knowledge.

Technology transfer and provision of other agri-services to farmers is occurring increasingly through five categories of service providers besides the well-established public sector, namely, (i) farmer collectives,



member-based agencies, e.g., farmers' organizations, cooperative societies, self-help groups (SHGs), water users' associations, farmer producer companies (FPCs), etc.; (ii) private for-profit firms, e.g., corporate sector, input suppliers, agri-businesses, small agri-startups, contract farming arrangements; (iii) private not-for-profit agencies such as community based organizations, NGOs, foundations and trusts (iv) public-private partnerships, e.g. progressive farmers as extensionists, para-extension workers; (v) mass media and ICT, e.g. radio, television, mobile telephony, internet, kisan call centres, information and extension portals, e-chaupals, print media etc. The latest is the 24x7 dedicated Kisan Channel on Doordarshan.

Farmer collectives have burgeoned into a major player. Cooperative societies have played and continue to play a significant role in the delivery of agricultural inputs as well as in the marketing of farm produce. Cooperative milk procurement and marketing is an old and successful example. There are some 6 lakh cooperative societies with a 25 crore membership. Some 25 lakh SHGs under the National Rural

Livelihoods Mission and NABARD are involved in skill development, capacity building and management of micro-finance to small producers for both on-farm and off-farm activities. The Water User Associations under the Integrated Watershed Management Programme are practicing conservation agriculture. About one lakh mitra kisans or "farmer friends" under the Agriculture Technology Management Agencies (ATMAs) are undertaking farmer-to-farmer extension which is found to be very effective. Government proposes to mobilize a further 6 lakh "farmer friends" in the next 2-3 years. The latest entrants are FPCs, supported by the Small Farmers Agribusiness Consortium (SFAC) and NABARD to provide comprehensive extension services to their members, making forays into the latest in organic farming and labeling of produce. Presently there are about 1000 registered FPCs. NABARD is facilitating another 2000. The Panchayati Raj Institutions empowered under the National Rural Employment Guarantee Scheme (NREGA) are creating employment for the rural poor and also facilitating creation of rural assets through rejuvenation of the natural resource



base -- water conservation, land development and tree plantation.

NGOs, publicly or privately funded are increasingly being mobilized for technology transfer and other extension services. Their strength lies in awareness creation, grassroots' capacity building, hand-holding and mentoring. Para-extension workers, providing artificial insemination services at farmers' doorsteps, supplement the stockmen centres of the government animal husbandry department and fill the historical gap in livestock extension. Agri-businesses being set up by agri-entrepreneurs privately or through support under the State's Agri-clinics scheme, provide a whole gamut of agri-services to the farmers, including assistance in obtaining credit, insurance and other welfare services for a fee. Innovative, performance-linked small agri-businesses and start-ups are finding expression in the new enabling environment.

In an era where mere technology

transfer will no longer suffice and farmers seek a more comprehensive set of services for their empowerment, public extension systems are gradually reorienting themselves into new pathways. Proliferation of an increasingly complex, pluralistic institutional environment is redefining government's role, away from direct intervention in production, service provision and markets, towards one of coordination, facilitation, collaboration, convergence, partnerships and empowerment. In an expanding universe of service providers both suppliers and consumers will benefit from the Government's initiatives in creating an enabling environment and level playing field through suitable legislation, norms and regulation, guidelines and protocols, effective enforcement, impartial conflict resolution, and quality control.

Government's role as coordinator, regulator and facilitator is not all about control mechanisms, but more about

promoting exchange of information, providing a platform for discussion, creating a forum for interface, collaborating with partners and bringing different actors together to address common issues of farmer empowerment through technology transfer and other livelihood requirements. The ATMAs at the district level were envisaged to perform this function.

Part of the changing role of the government would also be to address the downside of the

expanding world of private service delivery. Not all extension needs will be covered in the new emerging dispensation, as firms and agri-businesses enter markets only when there is profit to be made. Remote and backward regions as well as poor and marginal farmers will continue to require services of the public sector. The latter in its reformed avatar will be leaner, but more sharply focused towards the disadvantaged areas and vulnerable communities.

The challenge before the new Krishi Evam Kisan Kalyan Mantralaya will be to trigger the metamorphosis of the old linear and supply driven extension service into a multi-dimensional "Agricultural Extension and Farmer Advisory Service" (AE&FAS). The idea is to coordinate and interlink various players to achieve the twin objectives of sustainable agricultural production and a heightened orientation to farmers' welfare. This is a step towards ushering in a change for our farmers. ■

RURAL CREDIT

Overview



In the recent years, India has undertaken several initiatives to expand the reach of formal banking facilities to all and most importantly, the underserved sections of the society. Elaborate roadmap has been designed to provide banking outlets in unbanked villages with less than 2,000 population.

Agriculture credit is one of the major drivers fostering agricultural production and equitable growth in the country. Government has been fixing targets for flow of credit to agriculture by the banking sector every year and the basic objective is to making credit easily available to farmers. The priority sector comprises of a vast section of the population engaged in sectors such as agriculture, medium and small enterprises (MSEs), education and housing. Public sector banks have been traditionally the most important vehicle of providing credit to the priority sector. In 2013, the total

loan disbursed by public sector banks was Rs 12822 billion whereas in 2014, lending increased to Rs 16190 billion. The figure for private sector Indian banks for the two years, (2013 and

2014) was Rs 3274 billion and 4645 billion respectively.

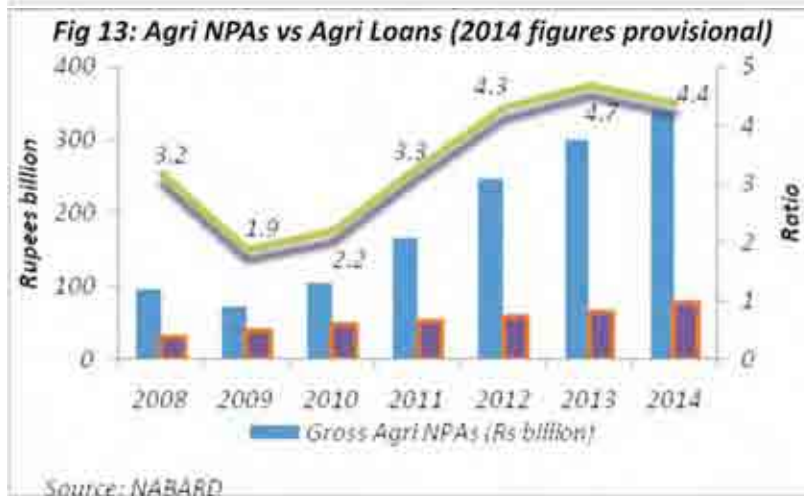
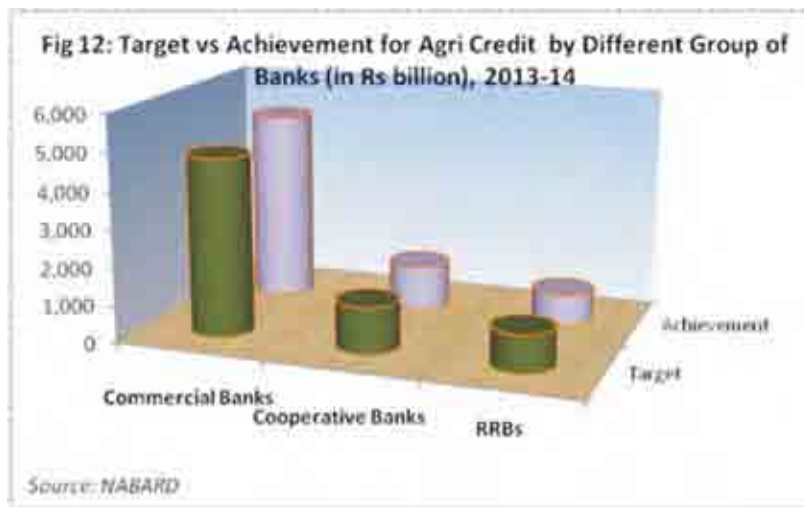
Credit to the agriculture sector has been higher than targets in recent years. In 2010-11, the total target of



agri-credit was Rs 3750 billion and the achievement was Rs 4683 billion. In 2011-12, the achievement of total agri credit was Rs 5110 billion against a total target of Rs 4750 billion. The total agri loan disbursed in 2012-13 was Rs 6074 billion, which was almost 6% higher than the target of Rs 5750 billion for the year. In 2013-14, the target and achievement for agri loans were Rs 7000 billion and Rs 7116 billion respectively.

When we analyse the target vs achievement of agri credit according to the categories of different banks in India in 2013-14, we find that it's the commercial banks which have exceeded their targets of agri credit whereas both cooperative banks and the Regional Rural Banks (RRBs) have fallen short of their targets. In 2013-14, all the commercial banks in the country together achieved a total agri credit disbursement of Rs 5090 billion against the target of Rs 4750 billion. In case of the cooperative banks, the target in the same year was Rs 1250 but the achievement was Rs 1199 billion, a marginal shortfall than the targets. RRBs achieved a total agri related credit disbursement of only Rs 827 billion as against a target of Rs 1000 billion.

A crucial performance indicator of banks is Non Performing Assets (NPAs). A study of the agri NPAs along with the agri loans disbursed by various banks provides understanding



of how the loans have been effective in creating productive assets in the agrarian society as well as their effective utilisation. The gross agri related NPA for banks in India in the year 2014 was a substantial Rs 340 billion. What is

worrying and needs immediate attention is the fact that the NPAs related to agriculture borne by the banking sector as a whole is increasing at an alarming rate. Compared to 2008 when the agri NPA was Rs 97 billion, total agri NPA in 2014 indicates a huge increase of about 250% in a span of just seven years. When studied as a ratio of gross NPAs to agri loans, there has been a substantial increase during the period ranging between 2008 and 2014. In 2008, the ratio of gross NPAs to agri loans was 3.2, which had decreased to 1.9 in 2009. However, after 2009, the ratio continued a steep upward trend and in 2014, the ratio of gross NPAs to agri loans was 4.4.

In 2011, as against a total demand of Rs 1822 billion for direct agriculture advances, total recovery was Rs

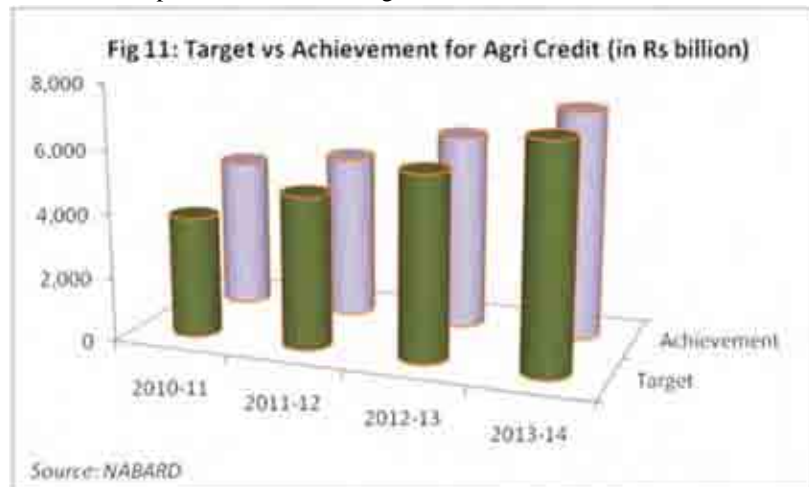
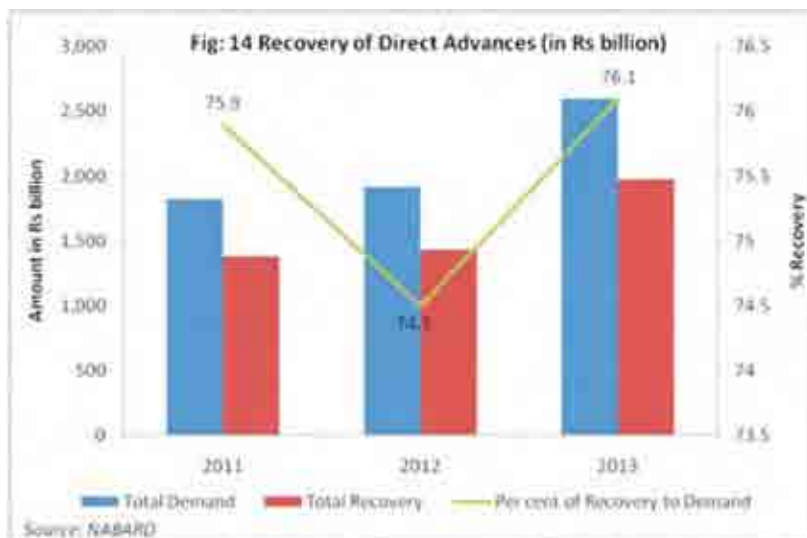


Table 1: Financial Inclusion Plan-Summary Progress of all Banks including RRBs

Particulars	Year ended	Year ended	Year ended	Progress April 2013-March 2014
	March 2010	March 2013	March 2014	
Banking Outlets in Villages – Branches	33,378	40,837	46,126	5,289
Banking Outlets in Villages – Branchless Mode	34,316	2,27,617	3,37,678	1,10,061
Banking Outlets in Villages –Total	67,694	2,68,454	3,83,804	1,15,350
Kissan Credit Cards (KCC) – (No. in millions)	24.3	33.8	39.9	6.2
KCCs – (Amt. in Rs billion)	1240.1	2623	3684.5	1061.5
General Credit Card (GCC)- (No. in million)	1.4	3.6	7.4	3.8
GCC - (Amt. in Rs billion)	35.1	76.3	1096.9	1020.6

Source: RBI



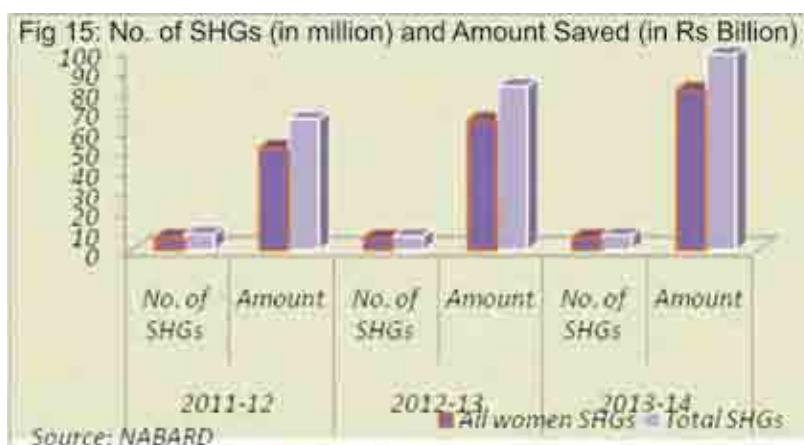
1383 billion, which is about 76% of the total advances. In the following year, the percentage recovery was 74.5% (Rs 1918 billion as advances and Rs 1429 as total recovery). In 2013, as against a total of Rs 2596 billion as direct agricultural advances, the total amount of recovery recorded was Rs 1976 billion, indicating at a recovery of 76%.

Long Term Rural Credit Fund- Catalysing Capital Formation

It is the investment credit which catalyses capital formation going a long way in promoting agriculture production & productivity. In September 2014, NABARD launched the Long Term Rural Credit Fund, in line with the announcements made in the last Union Budget 2014-15. The basic aim of creating this credit fund is to motivate the Cooperative Banks and the RRBs to extend term loans and other investment credit to their clients of the agri sector at concessional rates. Share of Cooperative Banks and RRBs in investment credit in agriculture and allied sectors was an only 13% in 2013-14, which was substantially lower than what was desired. Union budget of 2014-15 had an initial allocation of Rs. 5,000 crore to boost long term investment credit at the ground level. NABARD shall provide refinance facility with repayment period of 5 years at 7.85% per annum to Cooperative Banks and RRBs and stated that NABARD will advise these banks to provide long term credit at concessional rates.

Self Help Group (SHG) and Bank Linkage Model- An Effective Tool for Financial Inclusion

In the recent years, SHG-Bank Linkage model of NABARD, has emerged as an outstanding example of an innovation leveraging on community based structures and existing banking institutions. Though a lot has been achieved





further in this direction in terms of penetration and effective utilisation funds, this model has gained initial momentum as a partnership model between three agencies, the SHGs, banks and Non Governmental Organisations (NGOs) in order to achieve financial inclusion of the underserved section of the society.

Although the total number of SHGs formed has marginally dropped when compared between 2011-12 and 2013-14, the amount of money saved has recorded an increase during this period. The total number of all women SHGs in 2011-12 was 6.3 million out of a total number of 8 million. The savings done by all women SHGs in the same year was Rs 51 billion out of a total SHG savings of Rs 65.5 billion. In 2013-14, the number of all women SHGs and total SHGs were 6.25 million and 7.4 million which is marginally lower than what it was in 2011-12. However, the saving done by all women SHGs in 2013-14 was Rs 80 billion out of the total SHG savings of Rs 98 billion, recording a substantial increase when compared to that of 2011-12.

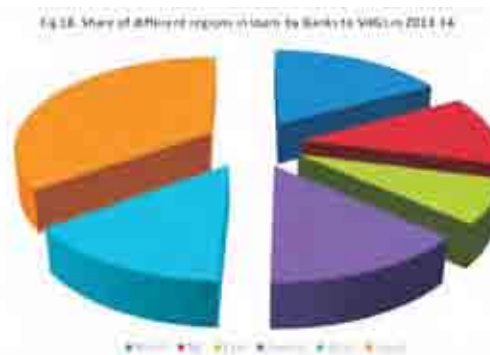
The cumulative loan outstanding for various SHGs across the country is increasing every year, a trend that needs to be taken care of seriously in order to achieve the desired efficiency of banks and also the effectiveness of the loans. In 2011-12, there was a cumulative total loan outstanding of more than Rs 36 thousand crores. The total loan disbursed during that year

was Rs 16.5 thousand crores. In the following year 2012-13, the cumulative loan outstanding increased to almost Rs 40 thousand crores. The total loans disbursed to various SHGs in 2012-13 increased to Rs. 20.5 thousand crores. By the end of the financial year 2013-14, the total loan outstanding to SHGs was a whopping Rs 43 thousand crores and the loans disbursed during the same year was Rs 24 thousand crores.

It is observed that there is a great deal of variation in loans disbursed by banks to SHGs across different regions in the country. A status report in 2013-14 shows that the southern region of the country recorded the highest amount of loans. In terms of percentage share, southern region had 35% of the total share of loans followed by the northern region with 17% of the share.

Pradhan Mantri Jan Dhan Yojana

Pradhan Mantri Jan-Dhan Yojana (PMJDY) is National Mission for Financial Inclusion to ensure access to financial services in the form of banking, savings, deposit accounts, remittance, credit, insurance, pension in an affordable manner for the underserved section of the society. The schemes



comes with a number of special benefits to the account holders in terms of interest, accidental insurance, direct benefit transfer (DBT), possession of RuPay cards among many others.

As on 31 January, 2015, the total number of accounts opened under the scheme was about 1255 lakh, out of which 750 lakh were rural accounts. The public sector banks account for a majority 78% of all the accounts opened under PMJDY, followed by RRBs with about 17% of the share with the rest of the accounts opened with private banks. However, the RRBs emerged as quite instrumental for the scheme by opening almost 185 lakh accounts in the rural areas, giving a major thrust to the scheme.

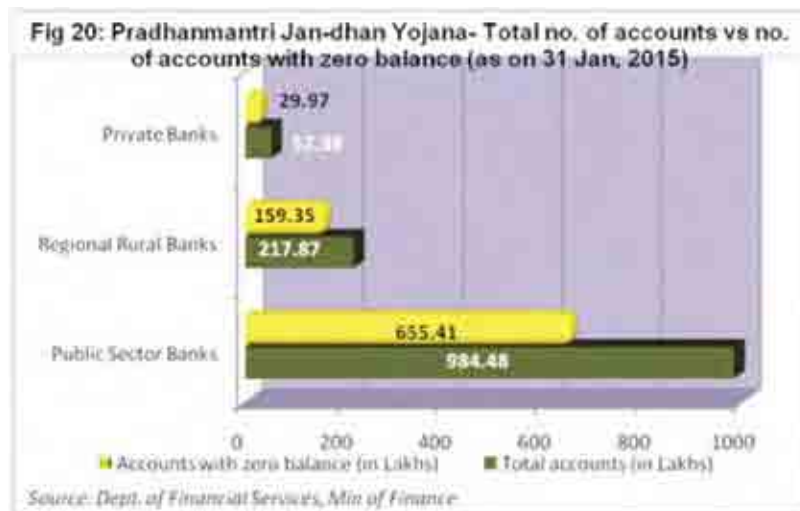
Experts in the sector opines that for the PMJDY scheme to be more effective, one has to be careful about the ultimate operative accounts and also accounts which are not opened with zero balance. There is a possibility that a majority of the zero balance accounts that has been opened due to an aggressive campaign by the

Special Benefits under PMJDY

- No minimum balance required
- Interest on deposit
- Accidental insurance cover of Rs.1.00 lakh
- Life insurance cover of Rs.30,000/-
- Easy Transfer of money across India
- Beneficiaries of Government Schemes will get Direct Benefit Transfer in these accounts.
- After satisfactory operation of the account for 6 months, an overdraft facility will be permitted
- Access to Pension, insurance products
- Accidental Insurance Cover, RuPay Debit Card must be used at least once in 45 days
- Overdraft facility upto Rs.5000/- is available in only one account per household, preferably lady of the household

Source: Dept of Financial Services, Min. of Finance

government machineries become idle and non-operative in the long run, and in the process not helping the scheme to reach its ultimate objective. Almost 66% of the total accounts opened by the public sector



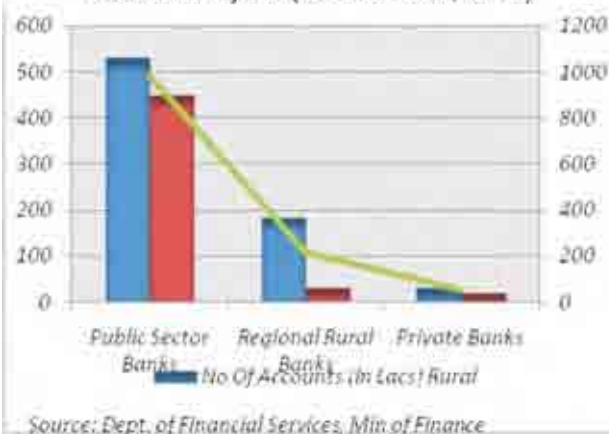
banks are under the PMJDY scheme are with zero balance whereas 73% of the accounts opened by the RRBs are with zero balance.

It is essential that the country achieves an equitable growth by bringing all sections of the society and that no part of the country is left behind while marching towards the goal of making India a socially and economically strong nation within the paradigm of a vibrant democracy. Various Government initiatives are directed towards this goal and in the past, through various Five Year plans and the yearly budgets, this has been articulated. Availability of rural credit, allocation of budgetary support to the agriculture sector, efficient disbursement of loans, timely recovery of loans, financial inclusion and financial literacy of the underserved sections of the society are important for an all round and equitable development of the country. Experience with SHGs and bank credit linkages has shown that the “poor are bankable”. Poor, when organised under platforms like that of SHGs,

are ready and willing to partner with mainstream financial institutions and banks to achieve financial inclusion and financial literacy. Through easy availability of rural credit, budgetary initiatives and various schemes, poor should be encouraged to save in a variety of ways and the creative harnessing of such savings shall emerge as a key success factor over a period of time.

It is also to be noted from various learnings in the past in the areas of rural credit, support to the agriculture sector and budgetary allocations is that we do not always need to introduce new institutional set-up or new regulatory or legal framework for effective delivery of rural credit, financial inclusion of the underserved and the overall development of the agriculture sector. Programme can be built on existing structures, leveraging all strengths from the convergence of various sectors, schemes and policies. With the present Union government enjoying a clear mandate of the nation, it would be interesting to note the manner in which efficiency and effectiveness of rural credit delivery is increased, budgetary support for the agriculture sector is enhanced judiciously and the aim of financial inclusion and asset creation in the rural sector is achieved in the years to follow. ■

Fig 19: Accounts opened under Pradhanmantri Jan-dhan Yojana (as on 31 Jan, 2015)



heralding a revolution in Agriculture



Kisan Samraksha
(construction, purchase
& repair of
Rural Godown)

Surya Shakthi
(ignitining non-
conventional energy)



Food Processing
(conservation of
nutrition for a rainy day)



towards the Goal of nurturing Humanity



www.andhrabank.in

Toll Free No: 1800 425 1515



Sri D Durga Prasad
General Manager
(Priority Sector)

ANDHRA BANK - Triumphant on Strategies

Andhra Bank is one of the fastest growing public Sector Banks in the country with its major base in Andhra Pradesh, Telangana, a larger part of Odisha and now agriculturally expanding to reach other parts of the country. Now the bank is fast expanding its presence Pan-India, as it has already opened 8 circle offices at Hyderabad, Bangalore, Warangal, Vijayawada, Vizag, Bhubaneswar, Mumbai and New Delhi and 4 new zonal offices were created. Currently the bank has presence in 26 states and 3 union territories through nearly 5600 delivery channels which comprise of 2600+ branches, 4 extension counters, 3000+ ATMs and 34 satellite offices. This year bank is planning to open another 300+ branches to cater to the needs of larger clientele in the country for reaching un-reached.

At the end of the first quarter of the current FY the bank's total business stood at

Rs 2.79 trillion and the period ahead it expected to see further improvement. We have a proactive attitude towards serving the people at the bottom of the pyramid.

As the bank is moving closer to farmers by virtue of opening more branches in rural areas, we have a deep concern about the needs of farming community and their credit requirements. Our bank constantly interact with the farmers, members of Self Help groups and their organizations etc., and extend credit requirement for enabling them to improve their standard of living the rural community.

The priority sector advances rose further to Rs 49,077 Crore at the end of June,2015 constituting a growth of 15.62% on year-on-year basis.

The volume of the credit in the agricultural segment so disbursed, which has been on a consistent growth trajectory, speaks of Bank's care and concern of farming community.

Establishment of Rural Self Employment Training Institutes by the bank is another mile stone in empowerment of rural unemployed youth. Bank has set up 11 Rural Self Employment Training Institutes (RSETIs) at various centres (in the states of Andhra Pradesh, Odisha and Kerala) and is imparting need based training for capacity building/entrepreneurial development



and dissemination of knowledge to farmers, SHG women, Rural unemployed youth and artisans.

In the field of empowering the rural youth in imparting vocational training, Bank secured First prize in the All India Competition for the year 2013-14 under Small Banks category as recognition of excellence in the RSETI movement in the country. Bank was honoured at a function "RSETI DIWAS" organized by MoRD, Government of India in New Delhi on 15.07.2015.

Since their inception, RSETIs have trained 141101 candidates through 4746 programs by the Institutes and around 79% of the trained candidates have been engaged in gainful ventures. During the last quarter, these institutes imparted training to 2329 candidates through 109 programs.

Financial Inclusion enables the banks to channelize the savings of the unbanked population of the country and offers new business avenues for lending this group. In the priority banking segment, the bank took lot of initiatives in consonance with guidelines of Gol for effective implementation of Financial Inclusion. With the objective of inclusive growth and systematic development among the masses, Andhra Bank's ecosystem comprises of technology, BCs' products and manpower to deliver the banking products at the doorstep of the excluded. The bank delivers deposit, loan and other financial services by engaging BCs who use hand-held mobile devices and issue Smart Cards to the customers.

Bank has submitted financial inclusion plan for 2013-2016 to RBI on the lines suggested. The focus areas include coverage of all the allotted areas in less than 2000 population



segment with BC agents, opening of brick & mortar branches in these habitations, ensuring BC agent viability through improvement in the number of transactions, rollout of products to suit to the FI customers, Financial literacy drives with an ultimate aim of business development through growth in CASA of Bank from these outlets. We have followed a planned and structured approach to address the twin issues of demand and supply under Financial Inclusion. Regulations have been formulated with an objective of providing banking services to six lakh plus villages and to create an enabling environment for banks to do so. We are furthering financial inclusion in a mission mode through a combination of strategies ranging from relaxation of regulatory guidelines, provision of new products and supportive measures to achieve sustainable and scalable Financial Inclusion.

Bank is in the forefront in implementing social security Schemes announced by the Government of India in its ambitious initiative in "Making India Insured" in a big way. Bank's brilliant performance in the PMJDY (Pradhan Mantri Jan-

Dhan Yojana) initiative last year yielded our Bank a pride of place in the Government's apex Strategic Committee on Pradhan Mantri Jan Dhan Yojana. Also we have secured a respectable place in the Payment Architecture Committee for DBTL.

Steps initiated by our Bank under the ambitious national 'Pradhan Mantri Jan-Dhan Yojana' on Financial Inclusion:

- Deployed Business Correspondents in all our allocated villages to extend door step banking.
- Customers can transact most of their banking transactions through PoS machine provided to BCAs.
- All transactions are online and with biometric authentication.
- Account opening is made simple with simplified KYC norms.
- Issue of Rupay card to each of account holder.
- The customer can conduct transaction at Branch, ATM, Micro-ATM with BCAs, PoS with merchant establishment. The Rupay card is provided with free accidental insurance coverage of Rs. 1 lakh. ■

SUSTAINING GREENER SOLUTIONS

Dow AgroSciences India is a leading research-based agri-solutions company, providing innovative and sustainable technologies to enhance farmer prosperity and contributing to meet the food and nutritional security goals of India.

Crop Protection | Seeds | Biotechnology



Dow AgroSciences

Solutions for the Growing World

INDUSTRY

Overview



AGROCHEMICALS

Population of India by the end of 2020 is projected to be 1.4 billion which is projected to further increase to 1.6 billion by 2050 and the responsibility of feeding this huge population solely lies on our hardworking farmers. These farmers, overwhelming majority of who are small and marginal, need to be strengthened in terms of technology and better cropping practices to enhance agricultural productivity. In a situation where every year, a huge amount of crops are damaged by an array of different pests and diseases

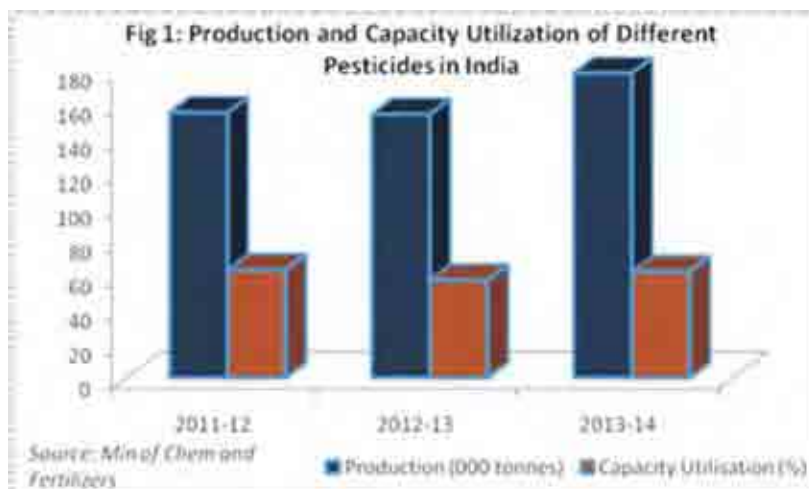
of crops, the role of agrochemicals becomes crucial.

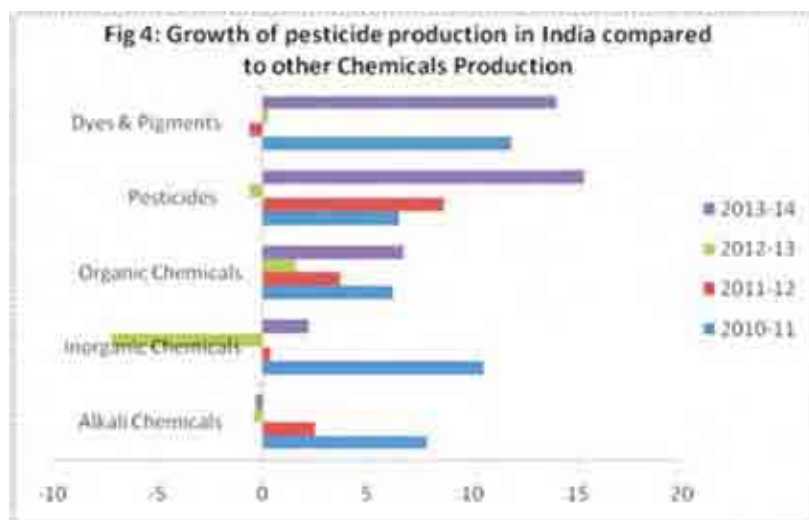
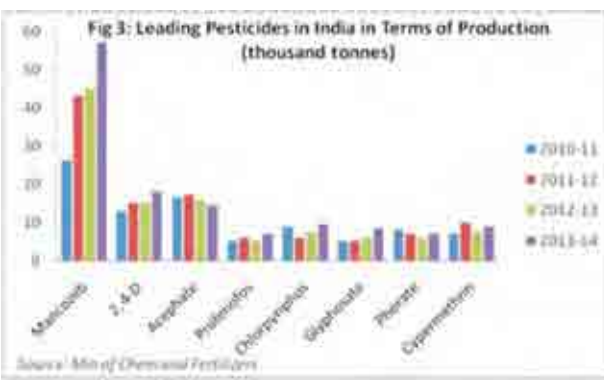
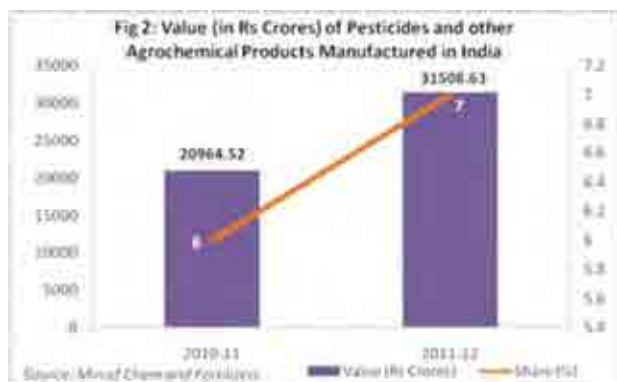
Indian pesticides & agrochemical industry is estimated at USD 4.25 billion in 2013-14 and is expected to grow at 12-13 per cent per annum and is projected to reach USD 7.5 billion by 2018-19. India is currently the third largest producer of agro-chemicals globally and it exports about 50% of its current production. Production of different grades of technical pesticides in the country in 2013-14 was 178 thousand metric tonnes with 62% of the total capacity utilization. Over

the last decade, the pesticide industry has witnessed hectic business activities with some of the biggest multinationals like Bayer, Syngenta, Dupont, BASF etc. along with the strong presence of various Indian pesticide companies like United Phosphorus Ltd (UPL), PI Industries, Dhanuka etc.

The total value of pesticide products manufactured in various manufacturing units across India in 2011-12 was Rs 31508.63 crores (Fig 2). This constituted 7% of the total chemical industry production in India in the year concerned. It is worth noting that the total value of the chemicals sector in the country has witnessed a substantial growth in between 2010-11 and 2011-12. The total value of pesticides produced in the country in 2010-11 was Rs. 20964.52 crores. Despite the fact that this is 50% less than the production value in 2011-12, it occupies 6% of the total value of the chemicals sector as a whole.

Some of the leading pesticides produced in the country are shown in Fig 3. Amongst various pesticides, mancozeb was produced in the highest quantity and in 2013-14, the total production of mancozeb in India was





57000 tonnes, posting a substantial increase from 45000 tonnes in 2012-13. 2,4- D was the second largest pesticide in terms of quantity of production with 18000 tonnes in 2013-14. The total production of acephate in the country in 2013-14 was 14500 tonnes. Though it was the third largest pesticide in terms of production, its volume has decreased in the years between 2010-11 and 2013-14. Total production of chlorpyrifos and glyphosate in 2013-14 was 9500 and 8500 tonnes respectively.

Fig 4 shows the growth status of pesticides in India in comparison to some of the other major subsectors of the total chemical industry in India. The year-on-year growth of pesticides production in the country has been the highest in 2013-14 and has also witnessed a massive increase when compared to other years, particularly when compared to 2012-13 when the pro-

duction witnessed a negative growth of -0.6%. Data in this figure clearly shows that while other subsectors of the chemicals industry witnessed sluggish or negative yearly growth between 2010-11 and 2013-14, pesticides industry barring one year has maintained a robust growth in terms of production, which is a clear indicator that the sector holds potential and importance for Indian economy.

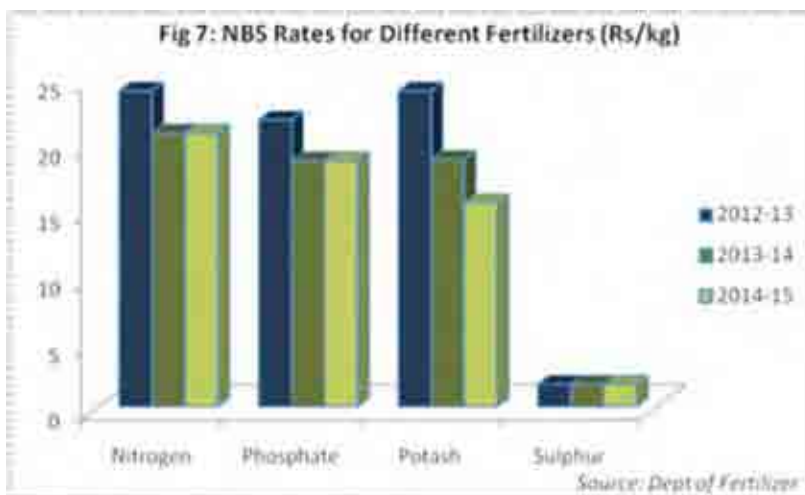
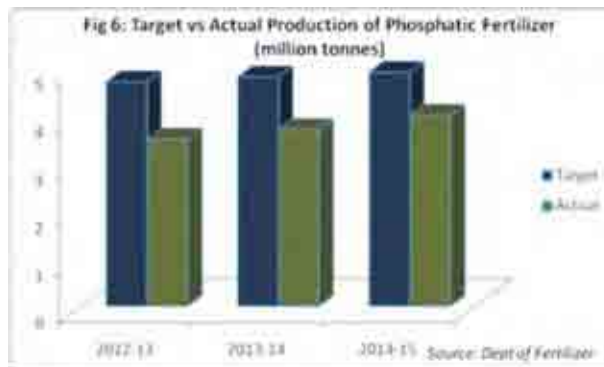
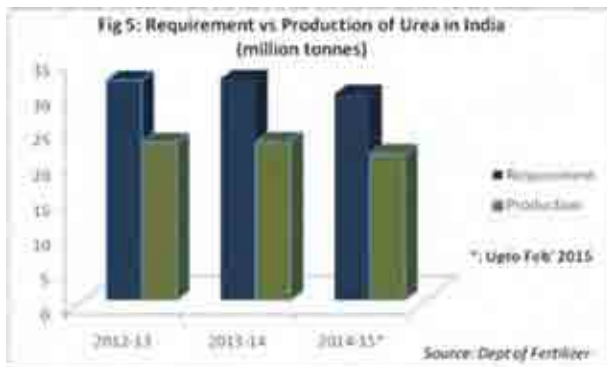
FERTILIZERS

For a sustained growth of the agriculture sector in terms of production, it is necessary that farmers have easy and affordable access to various types of essential fertilizers and also that they adopt balanced nutrient application. There has been some critical reforms in the fertilizer sector in the last decade like introduction of New Pricing Scheme (NPS)- I in 2003, NPS-II in

2004, NPS-III in 2007 etc. As recently as 2014, Government of India has introduced the Modified NPS-III with an aim to address the issue of under recoveries of the existing urea units due to freezing of fixed cost at the level of base year 2002-03. A new Investment Policy was also introduced in 2013 to facilitate fresh investment in urea sector in future to reduce India's import dependency in urea production.

As seen in Fig 5, India is still deficient in terms of indigenous production capacity for urea, one of the important and major fertilizers required for crop production. In 2013-14, as against a total requirement of 29.6 million tonnes of urea in the country, only 21 million tonnes was produced. The remaining was supplemented through imports. Over the years, the production capacity has not improved much despite various efforts from policy makers. In 2012-13, the production of urea in the country was 22.6 million tonnes as against a total requirement of 31.5 million tonnes.

Production of phosphatic fertilizers in the country is still not sufficient for domestic consumption needs of the agriculture sector, and a considerable quantity is imported every year. Fig 6 provides an overview of the target versus actual production of phosphatic fertilizers in the country. The production has increased meagerly in the recent years. In 2012-13, the total production of phosphatic fertilizers in the country was 3.5 million tonnes



against a target of 4.7 million tonnes. The production increased negligibly to 3.7 million tonnes in the following year against a production target of 4.8 million tonnes. In 2014-15, total production of phosphatic fertilizers in the country was 4 million tonnes. The target in this year was 4.9 million tonnes. However, India is able to meet only 10% of its requirements through production of phosphatic fertilizers in the country with the remaining 90% being imported from abroad. As far as potassic fertilizers are concerned, our country is fully dependent on imports.

Currently in India, under the NBS policy, fertilizer companies are allowed to fix the MRP of various fertilizers on their own. This has been done with an aim to increase competition among the fertilizer companies and to facilitate availability of diversified products in the market at reasonable

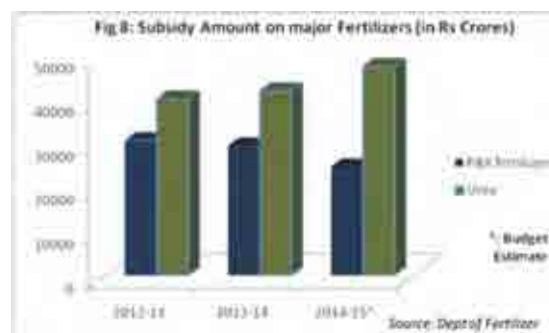
prices. Prices of fertilizers are also crucial for avoiding imbalanced application of fertilizers. In 2012-13, the NBS rate of nitrogenous fertilizers per kilo was Rs 24 which dropped to Rs 20.8 per kilo in the following years of 2013-14 and 2014-15. Prices of phosphatic fertilizers also decreased. In 2012-13, NBS rate for every kilogram of phosphatic fertilizers was fixed at Rs 21.8 which dropped in the subsequent years to Rs 18.7 per kilo. The maximum drop in the NBS rate was witnessed in case of potassic fertilizer, from Rs 24 per kilo in 2012-13 to Rs 18.8 per kilo in 2013-14 which further dropped to Rs 15.5 per kilo in the subsequent year of 2014-15. Price of sulphur based fertilizer re-

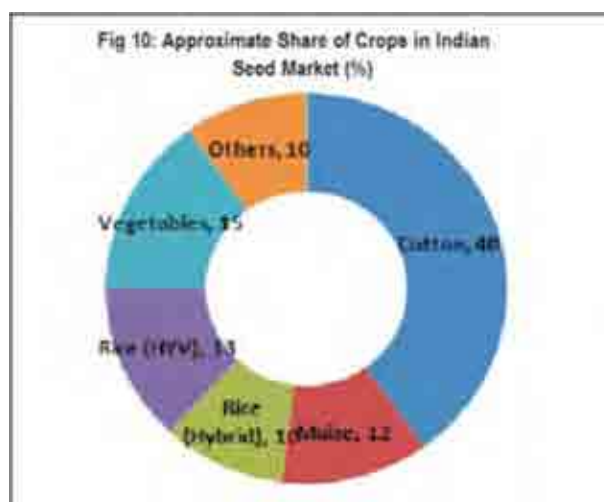
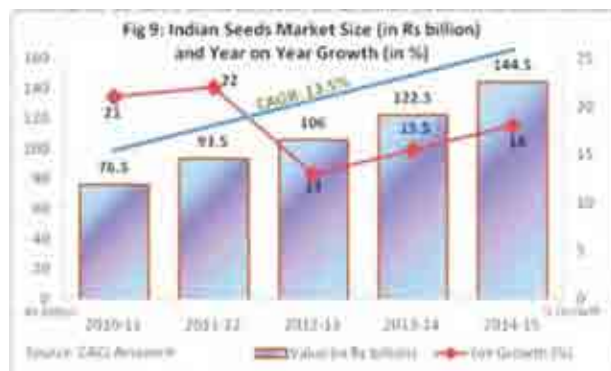
mained constant in the recent years at Rs 1.7 per kilogram.

For decades, subsidy schemes for fertilizers have been an integral part of Government policy with an aim to make the essential agriculture inputs available to the farmer at affordable prices and increase productivity of the agriculture sector. As seen in Fig 8, government of India paid a total amount of Rs 70592 crores in 2014-15 (according to budget estimates) towards subsidies on urea and phosphatic and potassic fertilizers. While subsidies on urea in 2014-15 was Rs 30576 crores, a total amount of Rs 40016 crores were spent on subsidies for phosphatic and potassic fertilizers. In 2013-14, the amount paid as subsidy for urea in the country was Rs 29426 crores while for P and K fertilizers together, it was Rs 41853 crores.

SEEDS

The Indian seed industry has entered into a phase of hectic growth activities and come a long way since its formative years from the time of the green revolution in the 1960s. There was a





time when the government-funded agencies used to develop and distribute hybrid seeds with just a few private players. After the Seed Act was introduced in 1988 and with many restrictions on seed development and trade being lifted, the seed industry saw a spate of private players. Currently, the sector is abuzz with private equity investments, mergers and acquisitions with various international and domestic agribusiness houses taking active interest to enter the growing seed market of the country. Currently, the seed industry is estimated to be about Rs 144.5 billion (Fig 9). It is growing at a CAGR of 13.5%. The situation that existed during the sixties and the seventies where only the public seed organizations used to hold the lion's share of the market has undergone a

complete reversal and more than 70% of the market is now dominated by the private players. With cultivation of hybrid crops and various vegetables increasing consistently, Indian seed market is poised for a decent growth in the coming years. However, the Indian seed market is still minuscule when compared to the matured markets of countries like the USA, China or the European Union.

Indian seed market is still very much cotton dominated with 40% of the total seed market being occupied by cotton (Fig 10). Cotton is still one of the few crops, which gives both volumes and better realizations and the importance of cotton for any top-line seed companies is huge. High-yielding hybrid cotton seeds or Bt cotton seeds fetch much higher value per packet than similar rice, maize, bajra or vegetable seeds. However, this also poses a risk factor for many companies as any changes in area under cotton cultivation due to vagaries of weather or non-realization of expected prices in the previous year influences the sale and reduces sales volume for companies. Cultivation of maize is increasing in the country and maize seed business is gaining an important place for many companies. Currently, approximately 12% of the Indian seed market is occupied by maize and its growth rate is high. This is driving many companies to concentrate on

maize seed business. Hybrid rice constitutes 10% of the seed industry, while high yielding varieties (HYV) of rice is estimated to occupy 13% of the share.

The Indian seed market in the recent years has witnessed entry of various foreign seed companies through mergers and acquisitions. The top 10 seed companies in the country currently shares more than 50% of the total seed market with a large number of smaller players, mostly family hold business units operating in various parts of the country. Table 1 shows the approximate turnover of some of the leading seed companies in India.

The hallmark of any seed company is its R&D activities and various Indian companies, bigger or smaller are elevated investments in research and development of new varieties. Building a formidable pipeline of promising products is challenging for various companies as it needs investments and requires a long gestation period. R&D activities also need to be market oriented in terms of taking into account the needs of the cultivator in terms of size, shape, shelf life etc. apart from of course the yield and duration factors. Once a hybrid seed variety of a particular crop is developed after investing a lot of money and time, seed companies face the challenge of a product life cycle of about eight to ten years until a better and new variety takes its place. ■

Table 1: Approximate Turnover of Major Indian Seed Players in (Rs Million, 2014)

Monsanto	3400
Dupont (Pioneer)	3700
Syngenta	6000
Advanta (Year ending December 2014)	15190
Nuziveedu (nine months till December 2014)	12549
Kaveri Seeds	10110
MAHYCO	8000
Rasi Seeds	5500
Ankur Seeds	3500
Source: CACL Research	

Micro Irrigation

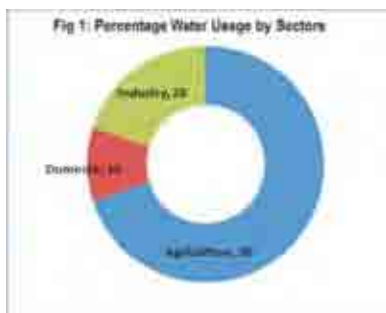
It is increasingly recognised by experts and researchers across the globe that water scarcity will be a major threat to human society in the twenty-first century. Rate of water use has been growing at more than twice the rate of population increase in the last century. Despite the fact that there is no immediate global water scarcity as such, increasing number of regions are becoming chronically short of usable water. Water is consumed by humans in all major spheres of activities, with agriculture activities consuming the maximum percentage of water globally, at 70% (Fig 1). 20% and 10% of water is used for industry and domestic purposes respectively. Currently, according to the report from United

Nations Department of Economic and Social Affairs (UNDESA), around 1.2 billion people, who constitute almost 20 percent of the world's population, live in areas of physical water scarcity with another 500 million people approaching a situation of water scarcity. 1.6 billion people or 25% of the world's population face economic

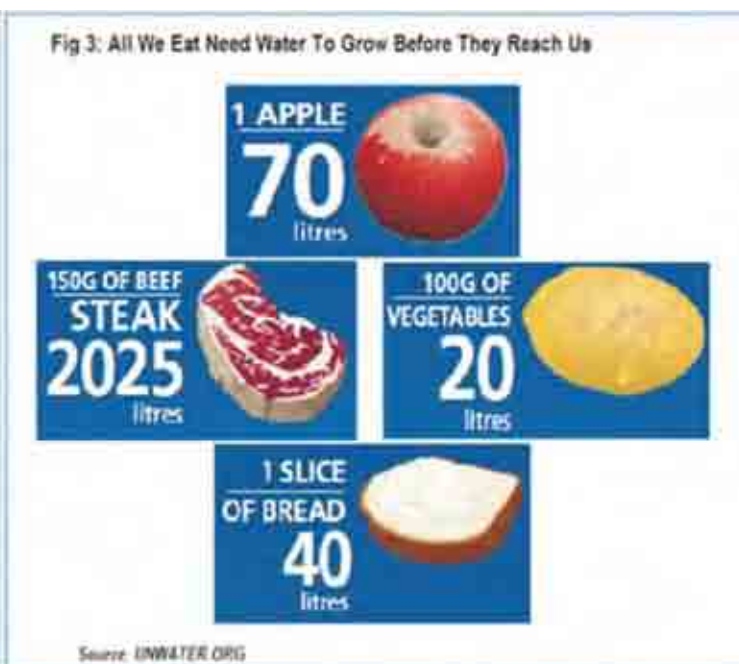
water shortage resulting from the lack of necessary infrastructure to take water from rivers and aquifers.

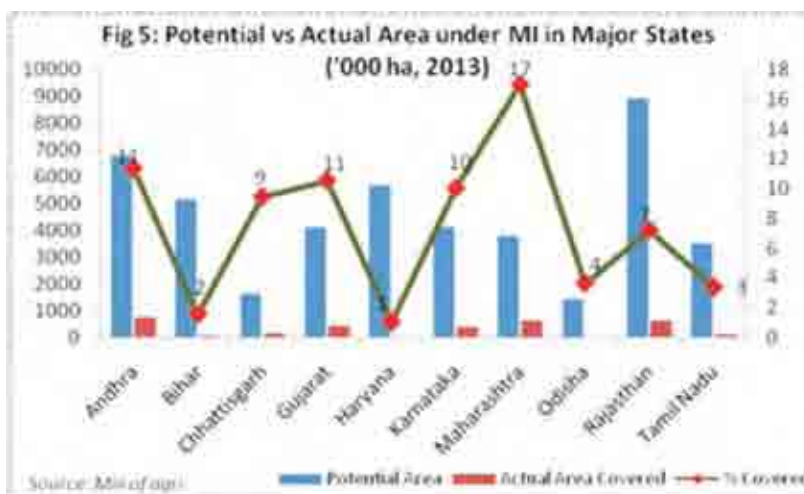
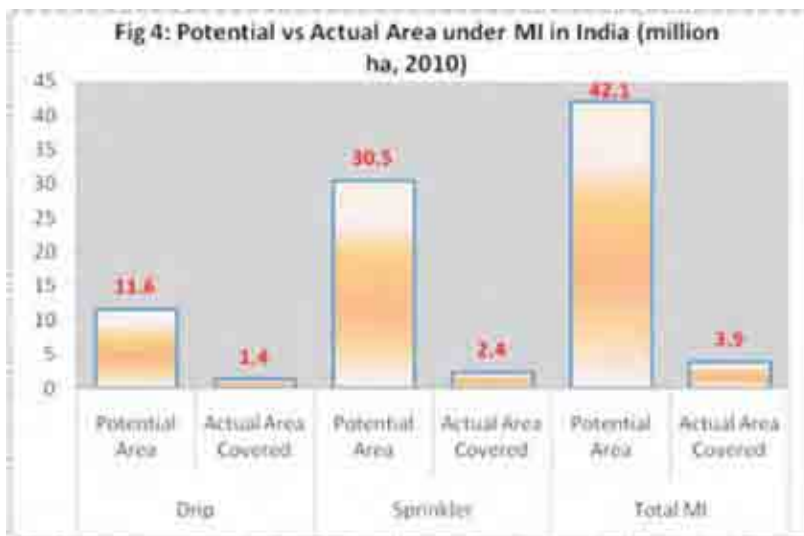
Water scarcity that human race is currently facing is the result of both a natural and a human-made phenomenon. It is a fact that there is enough freshwater on the planet for seven billion people but scarcity arises due to its uneven distribution across different places on the earth and most importantly, due to mindless wastage of water by human beings..

Agriculture sector is the biggest user of water in the world, while being engaged continuously in feeding the huge population of the world. Agriculture consumes large quantities of water for irrigation and of good quality for various production processes, ranging from a variety of food crops to producing a diverse range of non-food crops such as cotton, rubber and industrial oils. As a result, an immediate need is felt towards judicious and economical ways of water usage in the agriculture sector and Micro Irrigation (MI) is an indispensable tool for achieving this objective.



“Over the coming decades, feeding a growing global population and ensuring food and nutrition security for all will depend on increasing food production. This, in turn, means ensuring the sustainable use of our most critical finite source water” Ban Ki-moon, UN Secretary General





India with over 1.2 billion population needs to produce crops in order to meet global and domestic food grain consumption demand. One indispensable input for successful crop production is irrigation and the country is facing huge challenges in terms of depleting levels of ground water and increasing cost of expanding the area under irrigation. According to various studies, total potential utilisable volume of water in the country is estimated to be around 105 million hectare meters. Even in an ideal situation where we have the liberty for full exploitation of this potential, it will not be sufficient to meet the irrigation needs of vast agricultural operations of the country and a vast part of In-

dia's cultivated area will remain rain-fed unless technologies in irrigation are not adopted.

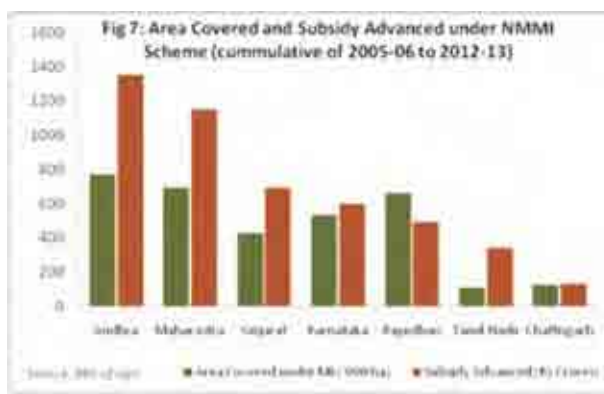
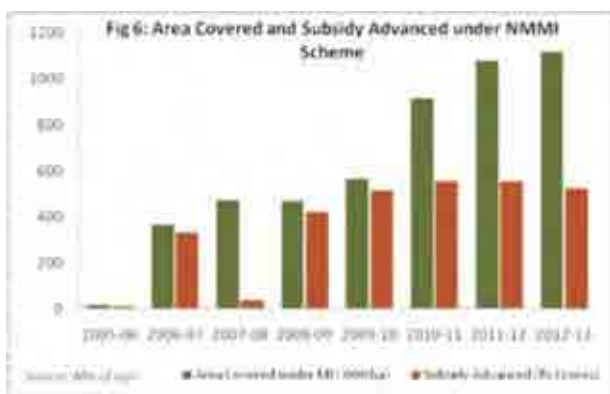
Even though micro irrigation technologies was introduced in India more than four decades ago, its adoption in the country for large scale agricultural activities has been way behind than what it should have been. Going back to the recent history of government initiatives in encouraging adoption of micro-irrigation techniques in the country considering its need, Rs. 11.96 crores was released to some state governments under centrally sponsored schemes between 1982-83 and 1991-92 in order to promote drip and sprinkler irrigation. Thereafter, various support systems were introduced by

the government before finally coming out with the National Mission on Micro Irrigation (NMMI) about a decade back which is still continuing with an aim to expand the area under micro irrigation in the country. Despite all these efforts and schemes, the growth of micro irrigation has been very sluggish in the country. Fig 4 depicts the reality of the status of micro irrigation currently in the country, where there is a huge gap still existing between potential area that could have been brought under MI. The actual area covered under MI till 2010 was just 3.9 million hectares as against a potential area of 42.1 million hectares.

Whatever growth in area under MI has taken place in the recent years, it has been widely inequitable ; while some parts of the country has adopted this technology, there are several other areas which are left out of it. Some of the major states which have adopted MI in the recent years include Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, Bihar, Chhattisgarh etc. Even in these states, there is a huge gap between the potential area to be brought under MI and the actual area so far under MI, as seen in Fig 5. The highest adoption in terms of percentage of potential area has taken place in the state of Maharashtra. The total area under MI in the state till 2013 was about 648000 hectares, which is 17% of the potential area of 3806000 hectares. Andhra Pradesh and Gujarat has respectively brought 11% of its potential area under actual micro irrigation, while Karnataka has 10%.

National Mission on Micro Irrigation (NMMI) in India

Government of India constituted a National Task Force on Micro Irrigation in 2004 with an objective to emphasize and increase the adoption of all aspects of water conservation and to improve the water use efficiency to achieve "More Crop per Drop". It was to recognize the fact that use of



modern irrigation methods like drip and sprinkler irrigation is the only alternative for efficient use of surface as well as ground water resources. Following this, National Mission on Micro Irrigation was introduced. Under this centrally sponsored scheme, 40% cost of the total cost of installing MI by any beneficiary will be borne by the Central Government, 10% by the State Government and the remaining 50% will be borne by the beneficiary. However, the beneficiary can invest either through his or her own resources or through soft loan from various financial institutions.

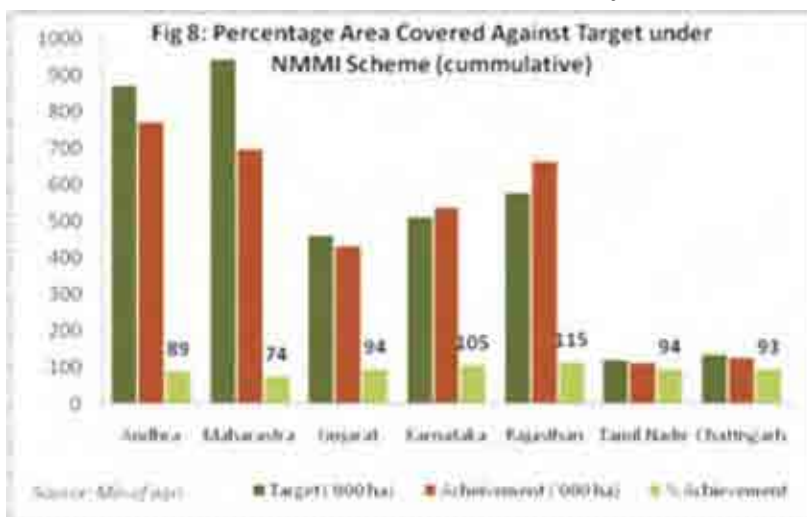
Since the inception of the NMMI scheme, there has been an increase in the adoption of MI in some parts of the country, though the speed has been much slower than expected. The total area under MI in the country has increased to 1119 thousand hectares

till 2012-13, from 16 thousand hectares in 2005-06, the initial year of the scheme. NMMI scheme provides subsidies to all categories of farmers limited to a maximum area of five ha per beneficiary. Both drip and sprinkler irrigation for wide spaced as well as close spaced crops are included in this scheme assistance with a condition that assistance for sprinkler irrigation will be available only for those crops where drip irrigation is uneconomical. People engaged with protected cultivation including greenhouses, poly-houses and shade-net structures are also eligible for financial assistance. The total subsidy advance increased from Rs 16 crores in 2005-06 to Rs 526 crores in 2012-13.

Some of the states who have taken advantage of the NMMI scheme are Andhra Pradesh, Maharashtra, Gujarat, Karnataka, Rajasthan, Tamil Nadu

and Chhattisgarh. Andhra Pradesh was the leading state in terms of area brought under MI since the launch of the scheme in 2005-06. Till 2012-13, a total area of 772 thousand hectares has been brought under MI in the state and the total subsidy gone to the beneficiaries is Rs 1352 crores. Maharashtra was the second highest state in terms of area brought under MI since the inception of the scheme and till 2012-13, 696 thousand hectares of land was irrigated with micro irrigation techniques. Rajasthan (663000 ha), Karnataka (537000 ha), Gujarat (432000 ha), Tamil Nadu (112000 ha) and Chhattisgarh (126000 ha) were the other major states (Fig 7).

However, except few states, most of the other states where the scheme has gained some popularity are trailing behind the respective targets. Amongst the major states taking benefit of the scheme, only Rajasthan and Karnataka have exceeded their targets. As against a target of 576 thousand hectares, Rajasthan had a total area of 663 thousand hectares till 2012-13 under micro irrigation while in case of Karnataka, the total area under MI was 537 thousand hectares, exceeding the target of 511 thousand hectares (Fig 8). Lack of awareness regarding subsidies, lack of technical knowledge, high capital cost, inefficient implementation and follow up action of officials on applications etc. are some of the major impediments towards the faster adoption of MI under the scheme. ■



BREEDING TRUST GROWING TOGETHER

Over the last 30 years, we have changed the lives of millions in rural India. Our motto 'Breeding Trust, Growing Together' has been the guiding philosophy of our growth. We are committed to the growth of farmers, rural communities, associates, channel partners, employees and the Poultry industry. Suguna's pioneering efforts in 'Contract Farming' has helped thousands of farmers across the country to grow along with the company.

Today, Suguna Foods is India's largest poultry enterprise. Our operations span from broilers, breeders, hatcheries, farm integration, feed mills, soya oil, poultry equipments to meat processing, retail and QSR. We deliver the best across the entire value chain in the poultry industry.

We forge ahead with strong commitment to our vision and over 5000 dedicated employees, we continue our journey of energising rural India.

India's Largest integrator, livelihood for thousands of farmers

Supply DOC layer birds, bringing high breed for more sustainable farming

Feeds, Poultry equipments, Organic manure, helping productivity at farms

Procuring agricultural produce, creating market for farmers

Regd. Office: 5th floor, Jaya Enclave, 1057, Avinashi Road, Coimbatore, Tamil Nadu - 641 018
Phone: 0422 3073000 | Fax: 0422 3073333 | Email: corporate@sugunafoods.co.in

Customer Care: 1800 103 4343 | www.sugunafoods.co.in



MR. AMIT SHUKLA
(VP, Marketing) and
NIVEDITA SHARMA
(Manager, Marketing
and Communication)
Harvel Agua India
Pvt Ltd.

Automation in Plant Nurseries for progressive Horticulture and Floriculture

Nursery management is indispensable for progressive development of floriculture and horticulture in India. The success of a nursery depends upon the effective management of agro climatic inputs such as temperature, ventilation, light, watering and feeding. In India, most of the nurseries are still labour intensive. Although, some processes have been mechanized, others are not. But, for all seedlings to give similar results in terms of quality and quantity, it is imperative to control the above stated agro climatic factors through automation precisely.

While temperature, ventilation and light can be adjusted as per the crop requirement by growing the nursery under protected conditions in greenhouse or shade net, other factors like watering and feeding should be accurately managed based on the crop requirement by adopting automation.

When we talk about automation of

irrigation in Plant and flower nurseries, we need to first look at the drivers responsible for it. There are two prime reasons because of which horticulturists/ floriculturists should rapidly move towards automating the operations in the nurseries.

Automation in Micro Irrigation offers multiple advantages viz., Improved Water Use Efficiency as water is supplied directly to the root zone of the crops in the required quantity



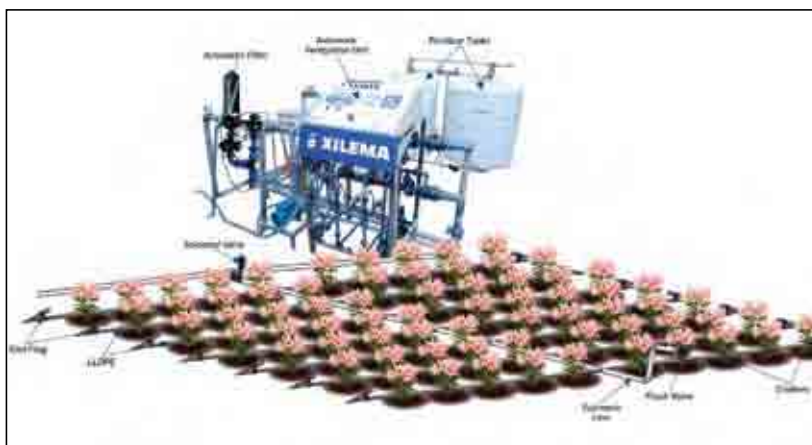
at the desired time; Uniformity of discharge results in better quality of the crop (better size and morphological characteristics of the raised seedlings); Improved Fertilizer Use Efficiency (as fertilizer is supplied along with the water to the root zone and not broadcasted) resulting in a healthier crop; Irrigation and Fertigation is also possible on land with elevation difference; Reduced Incidence of Weeds, Reduced incidence of diseases and Reduced dependency on labour.

An Automated Irrigation System consists of the following main components:

- a) Pump
- b) Sensors (Temperature, Moisture, pH, Ecetc)
- c) Irrigation Controllers
- d) Solenoid Valve
- e) Fertigation System
- f) Standard Components of a Drip Irrigation system (ARV, Pressure Gauge, Disc Filter, Main Line, Sub Main Line, Laterals (with inline Drippers)

Working of an Automated Irrigation System

Temperature and Moisture sensors detect and guide the controllers about the ambient Temperature and Moisture requirement. The irrigation and temperature sensors detect the ET (Evapo-Transpiration Level) and thus indicate when the ET falls so that irrigation can be planned based on that. So, the sensors raise an alarm for the controllers to signal the irrigation which in turn help to calibrate the entire irrigation schedule through the solenoid valves. Through solenoid valves, Main line, Sub main line and laterals water is then delivered to the individual plants by drippers in the appropriate quantities in which



it is needed by the plants. By way of this, water can also be delivered to the plants at night when it is not practically possible by manual means. In addition to this, these controllers followed by solenoid valves can also give us the liberty to automate the irrigation and Fertigation for longer periods of time like a week/ 10 days etc.

For the purpose of Fertigation (delivering the fertilizers to the plants along with water), controllers are also available which monitor and adjust EC and pH of water as per the crop requirement and help foriculturists deliver multiple fertilizers to crops at a given point of time.

Conclusion

Therefore, all of the above Automation means combined with a good planning can yield the desired results for foriculture and horticulture. Automation is a boon for remunerative nursery management and horticulture/ foriculture under protected conditions but it has to be managed well to yield good results. A few limitations of this technique are listed below:

- a) Requires high initial investment.
- b) Technical expertise of the technician who operates the system is the heart of the system. Even the best automation will not work if not handled by a person who has technical knowledge and skills on the subject.
- c) There is no incentive from the govt. to adopt this advanced technology. Till date, in India the subsidy is available only on basic Micro Irrigation components.

If all the above limitations are addressed well, by public- private partnerships in the country we can transform horticulture and foriculture into the most profitable venture for a country where agriculture contributes a majority share in the national economy. ■



R. G. AGARWAL
Group Chairman
Dhanuka Agritech
Limited

ACCELERATED TRANSFER OF AGRICULTURE TECHNOLOGY— SOME DHANUKA'S INITIATIVES

India has achieved commendable position in foodgrains production (from 50.8 million tonnes in 1950-51 to 264.5 million tonnes in 2014-15), thereby surmounting a difficult path of moving from 'Food Deficit to Self Sufficient Nation'. Today, we are the first in production of total pulses and total milk, second in rice, wheat, cotton, groundnut, sugarcane, tea, vegetables, potatoes, fruits and fisheries. Further, India has created a place for itself by attaining second place in agriculture GDP, and as per FAO information for 2013, our agriculture GDP at 325 million US dollars has surpassed that of USA. This became a reality because of the diversified system of our agriculture which encompasses Horticulture, Dairying and Fisheries. These are all laudable achievements, but in real terms the food grain availability per person has not much improved due to ever increasing population.

The Challenge of Producing More from Less for More

The food security, sustainability and nutritional security have assumed much significance today. However, the major challenge now is to produce more from otherwise dwindling arable area, which is only possible if we are able to

match the per hectare yield of some advanced countries. India's per hectare yield is less than half that of China and even less than the world average. As against India's average rice yield (2012) of 3721 kg/ha, China's yield is 1.8 times higher. Similarly, during 2012, the China's wheat and maize yield was 1.6 and 2.3 times respectively more than India (source: Agril. Stat at a Glance 2014, Ministry of Agriculture, Govt. of India).

Further, there is wide intra- state yield gaps, and among districts within a state. There are several challenges to bridge this gap, as there are several new generation issues, including technology fatigue, prolonged slow down of agricultural growth, degrading soil health, limited availability of good quality water for irrigation, newer pests and diseases due to climatic changes and crop intensification, non-availability of quality seeds and other critical inputs. It is well documented that farmer's knowledge of improved agriculture technology plays a critical role in his resource allocation decisions.

At present, the farmers' priorities are to connect with agri-business. It is well apparent that whenever the farmers are exposed to improved agriculture technology (both



by public and private extension services), they go in for good crop management practices along with rational allocation of land, capital, labour and knowledge, thereby their enhancing crop productivity and income is much more than to those who were less exposed. Therefore, knowledge empowerment is becoming more and more important for optimum returns.

State of Public Extension Services

As per the 2005 Report of All India study by the National Sample Survey Organization, only 40.4 per cent farmers are accessing different sources for obtaining information on various aspects of crop production. Out of those who accessed different sources, 5.7 per cent had received information from extension worker, while 13.1 per cent from Agri-input dealers (Table 1). Further, out of those who sought information, 59.6, 49.4, and 24.0 per cent wanted information on improved seed/variety, fertilizer application, and plant protection respectively. This very well demonstrates that the public transfer of technology system in the country is not able to fulfill the fast increasing information demands of the farmers. The major constraints pertain to the inability of the public extension to reach all the farmers, all the time; lack of educational and professional expertise to disseminate



Felicitation Function of Agri-Input Dealers organized in partnership between MANAGE & Dhanuka Group VIPS from L-R : Shri T.Nandaiah, Joint Director of Agriculture, Govt. of AP; Shri Abhishek Dhanuka, Director, DAL; Shri K.V. Satyanarayana, IAS, DG, MANAGE; Shri R.G. Agarwal, Group Chairman, DAL; Dr M. N. Reddy, Director, MANAGE; and Dr Satyanarayana Reddy, Principal Scientist, Dr N. G. Ranga Agricultural University

knowledge on all aspects of agriculture in a systems perspective; and no technology backstopping mechanism.

The Union Finance Minister in his speech in Parliament while presenting Union Budget 2007 said that 'Sadly, the extension system seems to have collapsed'. Therefore, Ministry of Agriculture is advocating multi-agency dispensation of agricultural extension services through greater public-private partnership for easy availability of improved technology at the door steps of the farmers. Reaching all the farmers in the country with technology, focusing on Good Crop Management practices, relevant to the location specificity and in line with the resource endowments, can only be achieved if farmer's capacity building is undertaken on a priority basis.

INDISPENSABLE ROLE OF AGRI-INPUT DEALERS

There is a large network of agri-input dealers in the country, estimated to be around 3 lakh, who are an important source of "Farm Information" to the farming community. The paradoxical situation however, is that an overwhelming majority of them do not have any formal agricultural education. They also don't have any exposure to the Acts governing storage, handling and sale of agri-inputs especially fertilizers, and pesticides. On the other-hand, being basically businessmen, they are well conversant with different market forces.

Dhanuka joins hands in Public-Private Partnership

The origin of a skill up-gradation of

Table 1: Farmers access to different sources for modern technology for farming

Major source of Information	Per cent of farmers accessed	Major source of Information	Per cent of farmers accessed
Other progressive farmers	16.7	Primary cooperative society	3.6
Input dealer	13.1	Out-put buyers/food processor	2.3
Radio	13.0	Participation in training	0.9
Television	9.3	KrishiVigyan Kendra	0.7
Newspaper	7.0	Para technician / private agency/NGO	0.6

(source: NSSO Report, 2005)

agri-input dealers through certificate course- Diploma in Agricultural Extension Services for Input Dealers (DAESI) can be traced to the National Institute of Agricultural Extension Management, commonly known as MANAGE, Hyderabad for launching an out-reach course, in 2001. On a request from MANAGE, Dhanuka Group was the first to join hands, and sponsored a batch of 40 Dealers of West Godavari District by paying 50 per cent of their fee, amounting to Rs. 4 lakhs in 2002. A joint function (MANAGE & Dhanuka Group) was organized on 21 December 2008 at Rajamundry (AP) to felicitate those Agri-input dealers who successfully completed the DAESI programme. Besides the awardees, about 800 dealers from all over the state, senior officers from the State Department of Agriculture, scientists from ANGRAU and representatives from Andhra Pradesh Pesticides Manufacturers Association also joined the programme. The feed-back of the pass outs was so encouraging that the Dhanuka Group undertook a lead for facilitating such a course at other Institutions as well.

Up scaling for Agri-input dealers training

Since it is a herculean task to impart training to such a large number of dealers, there needs to be many organizations for imparting this type of out-reach training. Moreover, the course curriculum required focus on location specific farming systems as well as the Institution within easy reach to facilitate participation in Contact Programmes, which is an essential requirement for imparting on-farm skills in soil and plant deficiency symptoms, pest identification etc. Dhanuka Group therefore, addressed letters to the Planning Commission, (Now

called as the Niti Aayog) Ministry of Agriculture, Govt. of India, Indian Council of Agricultural Research, State Agricultural Universities for launching such an out-reach course.

PPP with State Agricultural Universities in Gujarat

On Dhanuka Group's initiative, Anand Agricultural University (AAU), Gujarat came forward and one-year Diploma course as an out-reach programme was launched in partnership with Dhanuka Group after a formal MoU was signed in 2012. Dhanuka Group paid Rs 4 Lakh as fee for 40 dealers, and facilitated formulation of guidelines, training modules in Gujarati on major farming systems practiced in the area, practical exercises and case studies, and examination schedule as per University requirements.

Based on this experience a Bulletin entitled 'Today's Dealers will be Tomorrow's Credible Agriculture Technology Providers to the Farmers' was published jointly by AAU & Dhanuka Group in 2013 and was widely circulated to all the stakeholders- ICAR Institutes, State Agricultural Universities, Krishi Vigyan Kendra, Ministry of Agriculture, Govt. of India, Niti Aayog, etc.

Since the feed-back from Agri-

input dealers at Anand was so encouraging, the Navsari Agricultural University too launched such a course in 2013 in PPP with Dhanuka after MoU on pattern with Anand was signed. The Vice Chancellor of Navsari Agricultural University was also a witness at the launch and concluding function of DAESI programme at AAU.

The first batch at Anand and Navsari Agricultural Universities, which was started by our contribution of 50 per cent of the fees and our persuasion of dealers to join this course, was of such a success that it has become a regular feature at both the SAUs, and dealers themselves are coming forward to join the course by paying full fees. The numbers of applicants have also outnumbered the available seats, and therefore, the Universities are selecting the dealers to be enrolled.

Another University –Junagadh Agricultural University too on our persuasion has started a similar programme in partnership with Dhanuka Group which was launched on 9th July 2015 in which the Vice Chancellor of Kamdhenu University, Gandhinagar- Prof : M.C. Varshney released the 'Training Modules' in the presence of Guest of Honour, Invitees and Agri-input Dealers.



Release of Booklet of Training Modules by the VIPs – (L-R) : Dr.D. J. Koshiya, Advisor (R&D), DAL; Shri P. K. Kanodia, DAL; Shri Rahul Dhanuka, Director (Marketing), DAL; Dr.A. R. Pathak, V.C., JAU; Prof. M. C. Varshney, V.C. Kamdhenu University, Gujarat; Dr. T. Radhakrishnan, Director, ICAR- Directorate of Groundnut Research, Junagadh; Dr. H. B. Gardhariya, Director of Extension Education, JAU

Moving Forward

Such a course has an added value now. The new Pesticides Management Bill and the new Gazette Notification issued by the Ministry of Agriculture has an added requirement that all the existing Pesticides Dealers must go through some long-term training in agriculture or they should employ B.Sc.(Agri) person for renewal of license to sell pesticides. Therefore, we need to start training pesticides dealers, in particular and for all other agri-input dealers in general, at several places in the country.

Rather than limiting to only a few SAUs, the country needs to adopt a scaling-up approach. It is therefore, proposed that such courses be organized by the SAUs (at present 45-excluding Veterinary & Fisheries) and Krishi Vigyan Kendras

-KVK (at present 642) as they have the necessary infrastructure for agriculture training, by orienting to the locally prevailing farming systems, though maintaining the basic course format. If such a Diploma/Certificate course is launched, say in 75 per cent of these Institutions, with an intake of 40 Dealers per year, thereby annually around 20,000 dealers can be trained. By further extrapolating that 3 lakh dealers are to be trained, it will require around 15 years. Further, training in agriculture is not onetime activity and as agriculture technology advances, the dealers would also be required to have some refresher training as well.

One dealer, on an average, is in touch with 1,500 farmers. Upgrading the knowledge of agriculture technology of the existing dealers

is expected to bring qualitative change in their agriculture knowledge, communication skills and entrepreneurship development, etc. Therefore, 45 crore farmers could be effectively provided access to improved agriculture technology, if all the dealers are trained. However, agriculture technology being fast changing, even this one-time training may not be sufficient. Therefore, the dealers will have to be provided technology backstopping by assigning additional responsibility to the SAUs and KVKs for regular interactive meetings.

Let the policy makers initiate early launch of such a course to provide much needed fillip to transfer of agriculture technology with enhanced reach! ■

HARVEL AZUD
RESPONSIBLE WATER RESOURCE MANAGEMENT

World Best European Irrigation Technology in India

neither too much nor too little, each plant gets the amount of water it needs



Azud Helix Filters



Azud Pro



Azudrip



Azud Raintec



Modular 100 Filters



Rain Gun



Automatic Filter



Harvel Sprinkler

HARVEL AGUA INDIA PRIVATE LIMITED

An Indo-Spanish Joint Venture

301-304 Meghdoot, 94 Nehru Place, New Delhi - 110 019 (India); Phone: +91-11-46224444; Email: info@harvel.in; Website: www.harvelazud.in; Toll Free: 1800 11 6070

INTERNATIONAL AGRICULTURE CONSULTING GROUP

Indian initiative towards food and agriculture solutions

Vision

Our vision is to be a leading provider of Indian regional expertise in food and agriculture and to outstand as key advisory partners on food security concerns, policy planning and strategy framework for sustainable development through agriculture.

Mission

Our mission is to initiate and support micro and macro level changes in agriculture by providing Indian expertise and solutions for research, extension, education, training, institutional frame, policy planning, agribusiness and project consulting so as to address their major agricultural concerns relating to farm production, food security, environment sustainability, rural employment, economic growth and human resource development.

Objectives

1. Provide Indian expertise to deliver solutions to agricultural issues and concerns through formulation of agro and rural development projects, farming solutions, micro and macro level national agriculture planning, policy support, organized research, extension infrastructure and institutional set-ups, value addition and market linkage services.
2. Manage short terms management programs, training and entrepreneurship course for farmers, research & extension personnel, officials and professionals of various countries while recognizing and understanding ecological, technological, social and economic concerns related to their food and agriculture sector.
3. Facilitating students from different countries in enrolling in food and agricultural degree programs; management and entrepreneurship courses offered by various institutes and recognized universities of India, so as to help various countries in developing human resource for creative and productive change at ground level.
4. Organizing delegation level visits from India to various countries and of different countries to India for participation in agri and business summits, learning and exposure at technology institutions, agri universities, model farms etc., and discussing possibilities for joint ventures, collaborations and promoting better understanding in agriculture and agribusiness.
5. Facilitating Governments, Corporates or Institutions to venture globally and act as total solutions providers in implementation of foreign agriculture projects by providing research structure, technical assistance and investment planning in food, farming, agribusiness or agriculture development programs.



Technical Partner



Head Office:

306, Rohit House, Tolstoy Marg, New Delhi - 110001

Ph: 011-23731129, 46569160, Fax: 23731130

Email: president@iacg.in, Website: www.iacg.in

**LATEST AND MAJOR
AGRICULTURE R&D
BREAKTHROUGHS IN
THE WORLD**

Seed Treatment With Nano-Particles of Iron-Pyrites

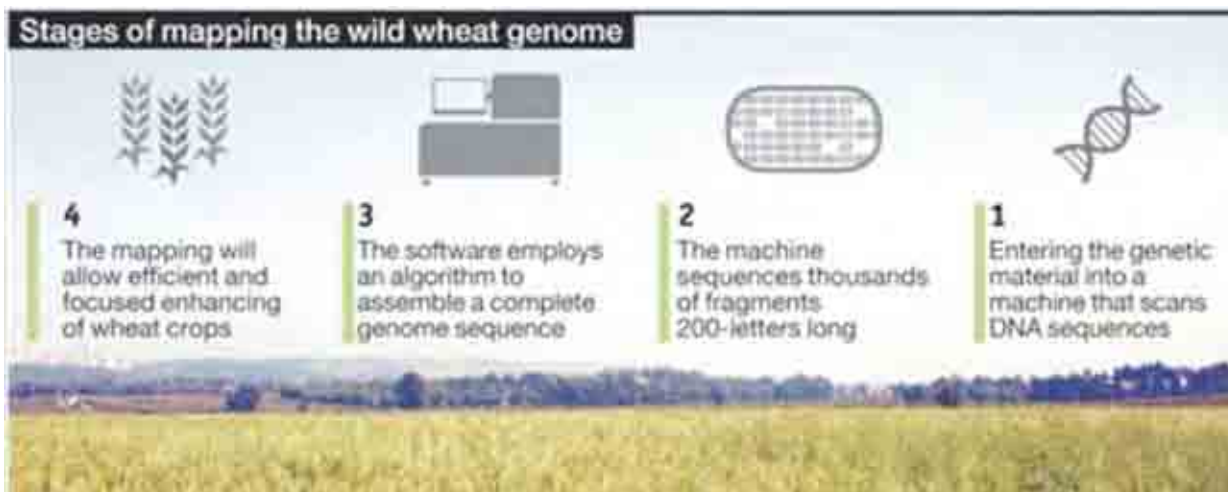
Team of scientists from India Mainak Das, Deepu Philip, Sushil Kumar Singh, Kalpana Bhargava and Niroj K Sethy have successfully demonstrated a novel innovation that enhances productivity without fertilizer or genetic engineering. They have successfully demonstrated a new way to treat seeds with nano-particles of iron-pyrites before sowing that enhances plant growth significantly. Mainak Das and Deepu Philip are respectively from IIT Kanpur and IIT Kharagpur, while the rest of the team are from Defense Research & Development Organization (DRDO). Encouraging results have been found so far with crops like spinach, carrot, fenugreek, sesame and beetroot where productivity has increased from 40 per cent to 100 per cent without disturbing the soil ecosystem unlike chemical fertilizers.



Mapping of wild Emmer Wheat Genome Makes it Possible in Future for Genetically Engineered Breeds of Wheat to Thrive in Hot, Dry Climates

Israeli biotech start-up NRGene has been able to map out the genome for wild Emmer wheat in a record three months' time whereas generally, genome mapping takes years. This is a major technological achievement in agricultural research and development and also from the point of view of preventing world hunger. Mapping of the wild Emmer wheat genome means that it will be much easier now for scientists to develop breeds of bread wheat that will thrive in drier, hotter climates. Mapping genomes for plants allows scientists to see what attributes they contain which allow them to thrive in specific environments. Deci-

phering the genetic code that make up maize and rice had taken scientists anything between five to ten years. Rice genome was mapped in 2002, and the maize genome mapping was completed in 2009. Mapping of the wheat by the Israeli company now makes it possible with the help of DNA data to point out a variety's specific characteristics that will enable farmers and scientists to breed variety of the crops that can stand up to arid surroundings, brackish water, and other harsh environmental conditions in as little as three years. Usually it takes 15 years or more to develop a strain that is more suited to specific conditions.





Newly-discovered molecule called Fluensulfone proves to be effective control for Nematode

Adama Agricultural Solutions (formerly Makhteshim-Agan Industries Ltd) has developed nematicide based on a newly-discovered molecule called fluensulfone. Nematodes destroys a number of crops like tomatoes, cucumbers, melons, okra plants, potatoes, and many more species. The product has been branded as Nimitz and is the culmination of a wide range of studies conducted over the past six years in 21 countries proving its efficacy. It is the first new nematicide introduced anywhere in the past 20 years, and is less hazardous to the environment than other solutions and has already got approval from countries like Israel, Australia, Europe, and many US states for marketing.



Big data teaches farmers means of better cropping

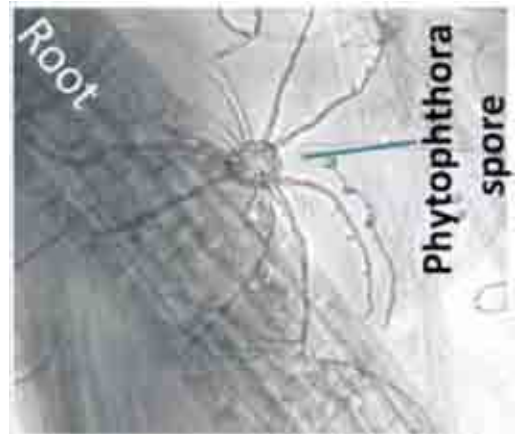
Big data is not just for cybersecurity or mobile app developers but farmers too who can use it to increase their productivity, as demonstrated by the Israeli ag-tech big data firm AKOL. The platform created by this tech firm enables users see exactly what to do to take care of crops, when to do it, and how much of it to do, in order to get the best results from their fields. Chinese agricultural authorities signed a deal last month with AKOL to use its “agricultural cloud” technology for fish farms. This will help fish farmers to access detailed information through sensors and analyzed on the system’s servers, and informing them when to clean pools, how much and when to feed fish, etc.

Sensors are placed on trees, vines, and fields, or attached to cows, milking systems, feed bins, and any other

appropriate host, where data is recorded about the environment, temperature and humidity, how much animals are eating, activity among animals, soil conditions for plants, the level of pests in an area, and much more. Captured data is then analyzed and compared to guidelines for ideal production under the circumstances, with specific instructions sent back to farmers. Beyond this raw data about growing and environmental conditions, AKOL’s systems take into account cultural issues as well, and analyze the way people in specific areas work. Based on this, it was discovered that for farmers in Serbia, there was a definite connection between drinking coffee and farm productivity and that farmers who did not drink coffee first thing in the morning were not as productive as those who did.

'Silver bullet' kills phytophthora

Plant pathologist G. Shad Ali and a team of researchers of the University of Florida has developed "silver bullet" to control Phytophthora fungus that attacks the leaves and roots of more than 400 plants and tree varieties. They have successfully demonstrated how silver nanoparticles are proving to be extremely effective in eliminating the fungus in all stages of its life cycle. Wormwood is a herb naturally found in the foothills of Himalayas in the Indian subcontinent and is known to have strong antioxidant properties. Ali and his team have used silver-wormwood nanoparticles measuring 5 to 100 nanometers which are sprayed onto a plant, which then shield the plant from the fungus. This is proving to be economical and eco-friendly alternative to chemical pesticides. Moreover, the chances of pathogens developing resistance are minimized as the silver nanoparticles display multiple ways of inhibiting fungus growth.



Secrets of bamboo mosaic virus finally revealed

Bamboo mosaic virus are far too small to be seen with a traditional light microscope and so flexible that the efforts to create high-quality models of them via crystallography was a failure. This virus is responsible for billions in crop loss they cause every year and efforts to describe its form since before World War II yielded no results until Edward H. Egelman, PhD, of the University of Virginia School of Medicine successfully decoded the secrets of

this virus using Titan Krios electron microscope. UVA's Titan Krios electron microscope is so sensitive that it is buried underground, encased within tons of concrete, to prevent even the smallest of vibrations from disrupting its work. With this novel finding about the virus and its description, researchers can examine its structure to determine how best to stop it and others like it and even be able to harness the virus to stop other diseases.



**STATUS OF
COMMERCIAL GM
CROPS WORLD
AND INDIA**

Overview

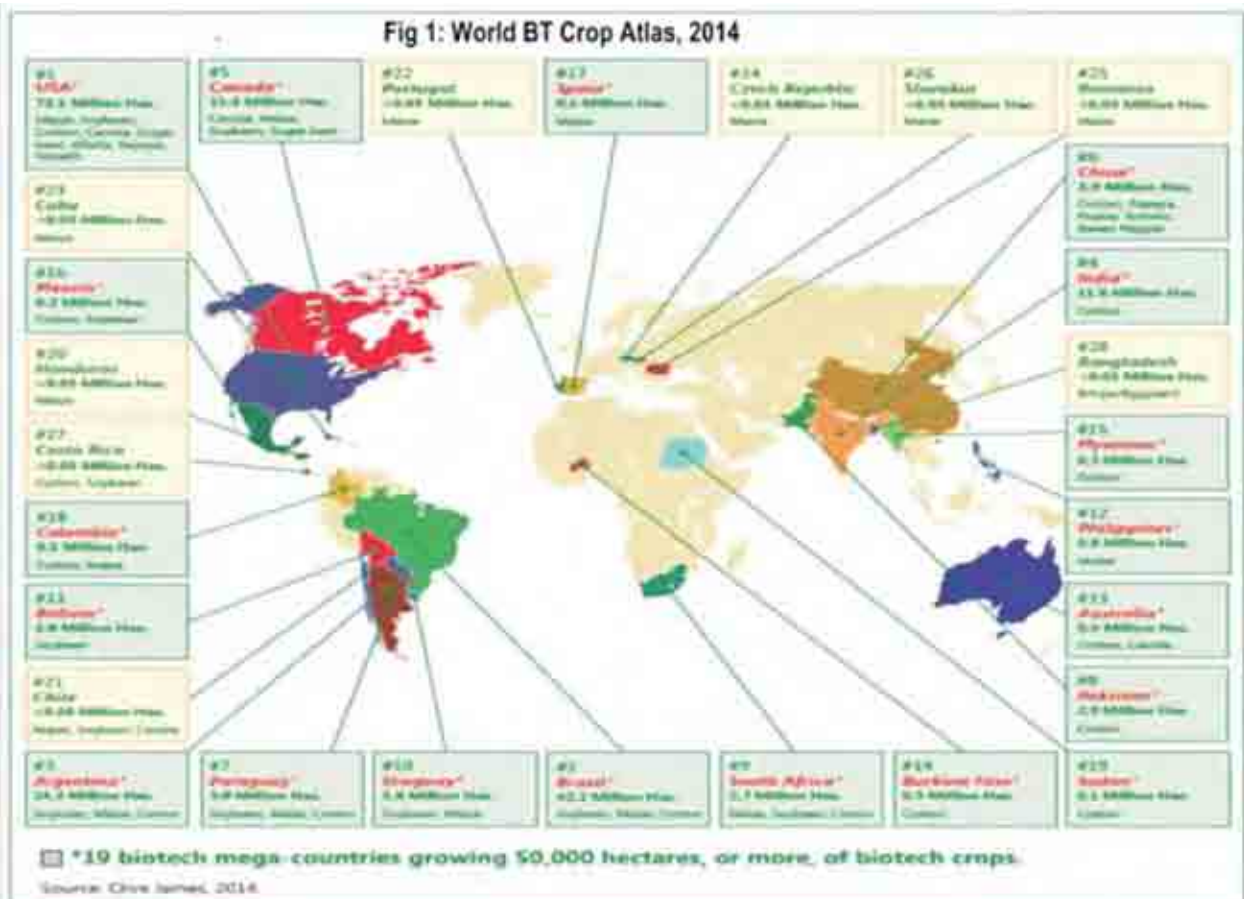
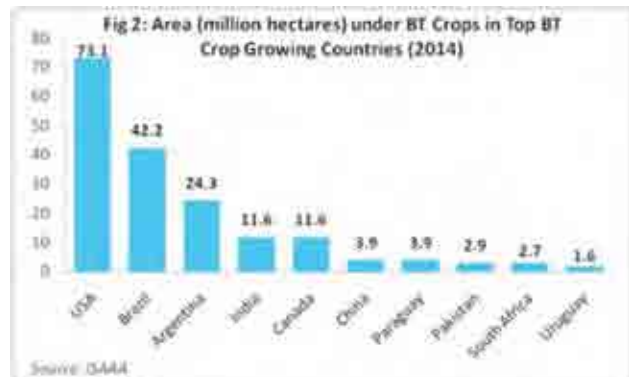
2015 marks the 20th year of the introduction of genetically modified crops in the global agriculture sector. All these years, GM crops have drawn significant attention worldwide with schools of thought clearly getting demarcated into those who consider it as an important technological breakthrough towards solving the ever increasing challenge of feeding the global population, with another group of people outrightly rejecting the use of GM crop technology arguing against its safety to humans and ecology while a third school of thought accepting GM crops with cautious optimism.

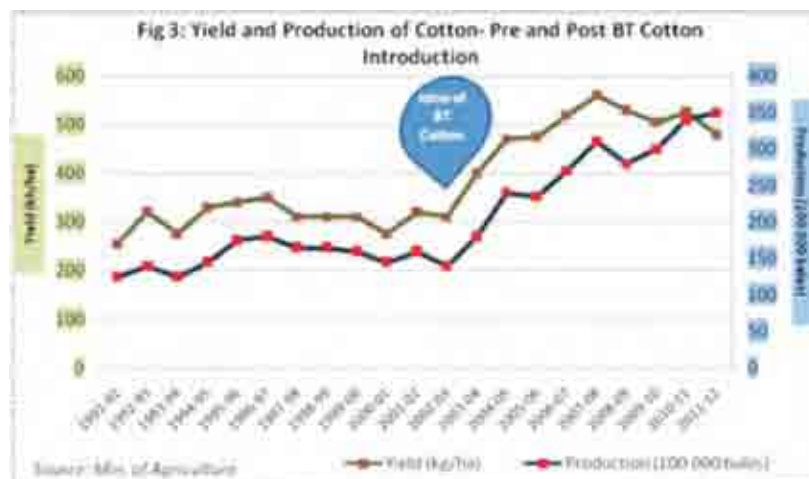
However, what has remained consistent during these two decades of GM crops introduction amidst various schools of thoughts putting forward their views all in the interest of mankind is the adoption of GM crops

globally by farmers and continuous increase in area of its production. In 2014, 18 million farmers in 28 countries had planted more than 181 million hectares. In 1996, global GM crop acreage was just 1.7 million hectares and in 2004, it was 81 million hectares. Fig 1 below provides the latest scenario related to GM crop adoption globally.

Fig 2 shows the status of area under Bt crops in the leading Bt crops growing countries in the world. USA with 73.1 million hectares of land under Bt crops is the leader in the world in terms of total area under Bt crops

followed by Brazil (42.2 million hectares), Argentina (24.3 million hectares), India and Canada (11.6 million hectares each), China and Paraguay (3.9 million hectares each), Pakistan (2.9 million ha), South Africa (2.7 million ha) and Uruguay (1.6 million ha). Together, the top Bt crop growing countries constitute 98% of the total global area under Bt crops. Bangladesh was the latest country to join this





group with its approval of Bt brinjal for the first time in October 2013, and following which in record time of less than 100 days, small farmers in Bangladesh commercialized Bt brinjal in January 2014. GM potato (lower levels of acrylamide) was the other major food crop to get approval in the US in November 2014. GM potato offers decreased wastage, promising to contribute to higher productivity and global food security.

Bt Crop Scenario in India

India's emergence as one of the leading Bt crop growing countries in the world comes solely through Bt cotton, which is a non-edible commercial crop and till date, no edible GM crop has been approved to be cultivated commercially in the country. It's been over a decade now that India had been growing Bt cotton and since its approval of Bt cotton in 2002-03, the area under its cultivation has grown by leaps and bounds.

The scenario of Bt crops in India can be distinctively separated into pre Bt cotton and post Bt cotton eras, with yield and production of cotton in the country being significantly influenced in the positive direction after Indian farmers adopted Bt cotton in 2002-03 (Fig 3). Yield and production of cotton in the country significantly increased after the adoption of Bt cotton. Be-

Table 1: Major Cotton Growing States in India and adoption of BT Cotton

	Area (100,000 ha)	Production (million bales)	No. Of Cotton Farmers (million)	% Adoption of BT cotton
Punjab	5.3	1.6	0.2	96
Rajasthan	3.34	0.9	0.3	82
Gujarat	26.3	10.2	1.5	81
Maharashtra	39.7	8.2	2.7	91
Karnataka	5.34	1	0.3	74
Haryana	4.95	1.4	0.3	95
Madhya Pradesh	6.51	1.7	0.5	92
Andhra Pradesh	17.8	5.3	1.2	98
Tamil Nadu	1.3	0.5	0.3	77

tween 2003-04 and 2011-12, the average yearly yield of cotton increased to 496 kg/ha, while the average yearly production during this period was almost 28 million bales. Bt cotton



seeds are sold in the country across the leading cotton producing states under a tight regulatory framework of the government. Price and quality of seeds are strictly monitored by government regulatory agencies. Certain states, Maharashtra and Andhra Pradesh have a separate state Act to control all aspects of Bt cotton seeds in the respective states including controlling seed prices.

Since its introduction in the country, cultivation of Bt crops has been significantly increasing and currently, more than 90% of the total cotton area is under Bt cotton as can be seen in Fig

4. This is an important trend considering the fact that the total area under cotton has also increased during this period. In its initial years of introduction, till 2005-06, Bt cotton was grown in 500,000 hectares of land out of the total 88,00,000 hectares of land under cotton cultivation in the country. The trend picked up and growth of area under Bt cotton consistently increased in the subsequent years. In 2012-13, out of 11.6 million ha of land under cotton, 10.8 million ha was under Bt cotton cultivation.

In India, states like Punjab, Rajasthan, Gujarat, Maharashtra, Karnataka, Haryana, Madhya Pradesh, Andhra Pradesh and Tamil Nadu figure prominently in the cotton growing scenario and all of these states have embraced

Bt cotton on a large scale. Table 1 below provides an overview of cotton growing statistics in these states along with adoption rate of Bt cotton by farmers.

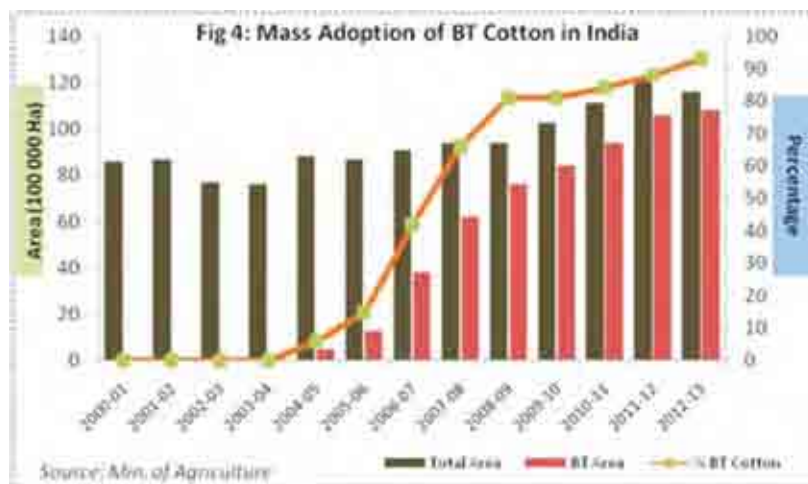
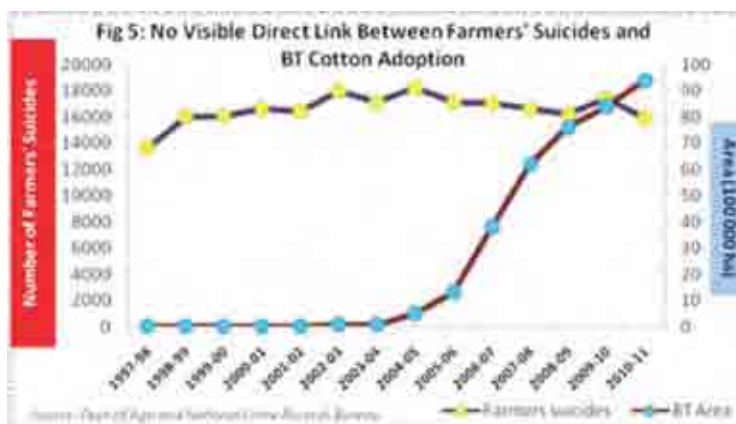
Adoption of Bt cotton has also positively influenced the income of the cotton farmers in India. While on one side, the cost of production of Bt cotton has decreased due to savings on various input costs, on the other hand the income has increased due to increased production from Bt cotton as compared to non BT cotton. Table 2 below shows that production cost of Bt cotton is almost 42% lower than normal cotton and the net income is more than three times the income from non Bt cotton.

One of the vociferous campaigns against Bt cotton is the linking of farmers' suicides at various cotton growing parts of the country to the adoption of Bt cotton by those farm families. However, there has been no direct statistical linkage in terms of farmers' suicides and adoption of Bt cotton. An analysis of time series data related to farmers' suicides in India between 1997 and 2010 shows a range of 13622 (minimum in 1997) and 18241 (maximum in 2004). It has been observed states like Maharashtra, Andhra Pradesh, Karnataka and Madhya Pradesh (including Chhattisgarh) accounted for more than 60 per cent of all farm suicides in the country and incidentally,

Table 2: Cotton Economics in India- Before and After Bt Cotton Adoption (all figures in INR)

Cost Item	Before adoption (non-Bt, 2004 – 2005 growing season)	After adoption (Bt)
Hired laborers	1476	1535
Labor with buffalo and oxen	855	806
Mechanical labor	587	788
Seed	598	798
Organic fertilizers	406	338
Fertilizers	1603	1532
Insecticides	3267	1422
Irrigation	54	49
Miscellaneous (repair and transport)	84	78
Total production cost	9057	7405
Yield (in quintals)	721	1027
Production cost per quintal	1256	721
Gross income	12338	17540
Net income	3281	10134

Source: Economic & Political Weekly



these states are also the major Bt growing areas in the country. According to Fig 5, the farmers' suicides in India increased from 13622 in 1997 to 17971 in 2002-03, the year when Bt cotton was first introduced and a meagre 77 thousand hectares of land was cultivated with this crop. However, since then, the area under Bt as seen in the figure has increased exponentially while the farmers' suicides started declining (barring the year 2004-05 when the suicides were highest at 18241), with lowest suicides numbers in 2010 at 15964. ■



सिंडिकेटबैंक
SyndicateBank

भारत सरकार का उपक्रम A Govt. of India Undertaking

Schemes for Hi-Tech Agriculture Medium & Long Term Loans



Minor Irrigation Schemes Medium & Long Term Loans



For greater and sustained production

Syndicate Kisan Credit Card (S.K.C.C)



Renewable Sources of Energy Schemes

Synd Solar Jyothi



Solar Water Heaters



Bio-fuel plants



Solar Pumpsets



Wind Mills



Bio-gas & Gobar Gas plants



For more details please contact our nearest Branch

www.syndicatebank.in

Toll Free Voice Mail No: 1800 425 66 55

*Conditions apply.



“Kisan is the sentinel of our food security. Annadaata Sukhibhava has been one of our fundamental civilizational values. My Government attaches enormous importance to the well being of farmers. This will need value-added agriculture, market reform, use of technology and improving productivity in areas with untapped potential.”

Pranab Mukherjee, President, India



“If we are to eradicate hunger and poverty, we need to level the playing field by economically empowering women farmers,”

Dr. William Dar, former Director-General, ICRISAT



“Today, the country has to import pulses. Let’s resolve that by 2022 we will no longer have to import pulses. Our agricultural universities should take up each variety of pulses, how to do research on it, how to do genetic engineering, how to increase productivity, how to increase protein content so that farmers get good prices”

Narendra Modi, Prime Minister, India



“In some states on certain occasions we have had debt waivers. How effective these debt waivers have been? In fact the studies that we have typically show that they have been ineffective. In fact they have constrained the credit flow post waiver to the farmers.”

Raghuram Rajan, RBI Governor



“Today, the sons of farmers are willing to work even as watchmen, or take up any odd job in the city, but are not interested in working as farmers. (To solve this) We can promote small scale industry and set up units here for industries such as food processing so that not only farmers get the right price for their produce but local youth also get employment”

Rajnath Singh, Union Home Minister



“Agriculture and all that it encompasses is not only critical for our food supply, it also remains a main source of livelihoods across the planet. While it is a sector at risk, agriculture also can be the foundation upon which we build societies that are more resilient and better equipped to deal with disasters”

José Graziano da Silva, Director General, FAO



“A double digit growth is impossible if we ignore this sector. Agri-growth has multiplier effect on poverty reduction and rural prosperity. It has a high potential for creating ‘Near Farm’ jobs”

M. Venkaiah Naidu, Union Minister of Urban Development, Govt of India



“We keep on emphasising empowerment of women and smallholder farmers and we need to provide them with social and financial entitlements so as to enable them to absorb shocks,”

Kanayo F Nwanze, President, International Fund for Agricultural Development (IFAD)



“While acquiring land, three factors—food security, security of farmers and purpose for which land is to be acquired—should be kept in mind. Preserving land is a must as 90 percent of food for humanity comes from the soil and only 10 percent comes from other resources such as the ocean”

Dr MS Swaminathan, Renowned Agriculture Scientist



“The Indian Government should focus on producing basic food and other food grains should be imported. Instead of producing routine food crops, farmers should be persuaded to grow high value crops with a potential to export”

Juergen Voegelé, Senior Director, Agriculture Global Practice, World Bank



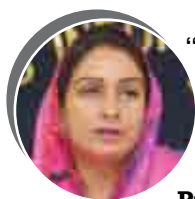
“All economists agree on the importance of rural sector in the economy... Our government is seriously working towards developing rural areas and agriculture. The country can never progress if the villages are not developed”

Akhilesh Yadav, Chief Minister, UP



“Apart from increased productivity to produce more from less water and land, the losses that occur due to droughts, floods, biotic and other abiotic stresses also need to be eliminated decisively through adoption of appropriate technologies. In this context, genetic engineering holds great promise”

Radha Mohan Singh, Agriculture Minister, Govt of India



“Currently, there is Rs 44,000 crore of wastage and unless we work towards removing that, our growth story cannot be completed,”

Harsimrat Kaur Badal, Food Processing Minister, Govt of India



“Food security is a humanitarian concern, especially in these times of uncertainty and volatility, and the issue of food security is critical to a vast swathe of humanity and cannot be sacrificed to mercantilist considerations.”

Nirmala Sitharaman, Commerce and Industry Minister, Govt of India



“It is high time that farmers from Punjab and Haryana shun wheat, paddy and sugarcane crop pattern as traditional farming will continue to worsen their economic situation”

Nitin Gadkari, Minister of Road Transport and Highways of India, Govt of India



“The issue of water use efficiency is recognised as being very important for water security in the coming years. Irrigation sector accounts for about 80 per cent of total water use and therefore, it is imperative that water use efficiency is much more important in case of irrigation projects.”

Uma Bharti, Minister of Water Resources, River Development and Ganga Rejuvenation, Govt of India



“Agriculture is no longer a profitable venture as its input cost have increased manifold whereas the farmers are not getting remunerative prices of their harvest,”

Prakash Singh Badal, Chief Minister, Punjab



“Climate change is no longer a matter of debate. While our contribution to global warming is not much, there is no other country which is more affected by climate change. It is something that we have to be proactive on and not reactive to”

Jairam Ramesh, MP and former Minister for Environment, India



“In longer run, you do need that (farm) workers come out of agriculture into manufacturing and services jobs. If you don't want to leave this population in that (poor) state”

Arvind Panagariya, Vice Chairman, NITI Aayog



“Without making agriculture exciting for the youth, we cannot involve them in the farm sector. Once they are involved, we can surely achieve our target”

Dr. RS Paroda, former Director-General, ICAR



“We are not listening enough to science as it should determine our policies. We are not becoming a knowledge society. We are becoming a knowledge proof society”

Dr. Sunita Narain, Director General of Centre for Science and Environment



“Time is now fit for shifting focus from field crops to other frontiers of agriculture such as horticulture, livestock, dairy farming, fisheries – towards integrated and sustainable agriculture. This will help reduce the pressure on our scant resources such as land and water and improve the quality of life and general prosperity of the people”

Ashish Bahuguna, Chairman, FSSAI



“Any technology the country is trying to adopt should be evaluated from the lens of the small farmer, or you will polarize farming communities even further. GM technology is expensive. Rain-fed farmers have suffered. Almost 80% of our farmers are very resource poor”.

Suman Sahai, Winner of Norman Borlaug Award, Head, Gene Campaign.



“It is unfortunate that though India is the world's largest cotton producer, it has only a 4.5% market share in the world's textile market while Bangladesh and Vietnam that do not produce a single bale of cotton are way ahead of us. The government needs to focus on a fibre policy”

J Thulasidharan, President, Indian Cotton Federation (ICF).



CARD

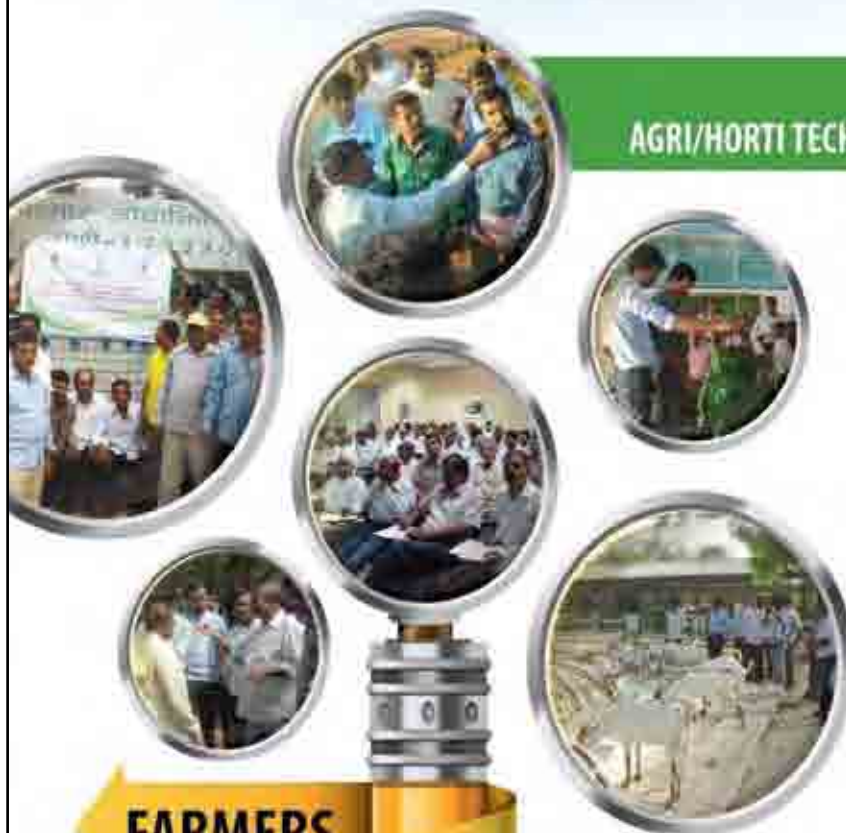
Centre for Agriculture and Rural Development

Farmers' Training cum Inter State Exposure Visit Programs

Under ATMA and MIDH, Government of India

Exposure and Training on Technologies, Innovations, Farm Practices and Value Addition

EXPLORING PLACES & TRAINING ON
AGRI/HORTI TECHNOLOGIES, INNOVATIONS AND PRACTICES

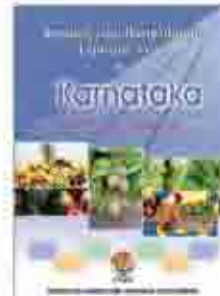


FARMERS

TRAINING CUM
EXPOSURE VISIT
PROGRAMS

STUDY TOURS

ON TECHNOLOGIES,
INNOVATIONS, FARM PRACTICES
AND VALUE ADDITION



FOR MORE DETAILS, PLEASE CONTACT

THE TECHNICAL MANAGER

CENTRE FOR AGRICULTURE AND RURAL DEVELOPMENT

306, Rohit House, 3 Tolstoy Road, New Delhi - 110001

Ph: 011-23731129, 23353406 (M) 9311469845

Email: agritours@card.org.in, director@card.org.in

www.card.org.in