AGRICULTURE TODAY
The National Agriculture Magazine






# AGRICULTURE YEAR BOOK | 2017

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# Editorial Note

Dear Readers,

With immense pleasure and pride, we introduce our most recent edition of the Agriculture Today Year Book. The 10th edition bears the fruit of the hard work and untiring efforts of a spectacular team, whose inspiration has always been our dedicated readers. Agriculture Today has emerged as a strong force in the Indian agricultural scene for close to two decades. Faring the test of time, the magazine has earned the trust of its readers over the years and has become the ideal platform to discuss and debate topics of agricultural relevance.

Agriculture Today Year Book of 2017 features articles penned down by some of the brightest minds in Indian agriculture. These articles evolved from years of experience are treasure trove for stakeholders in agriculture and address the most pressing needs of today's agriculture. Innovations, initiatives and plan of action to solve the trying challenges in agriculture are important takeaways from this repertoire of articles. The year book 2017, besides featuring some of the best articles written in agriculture realm strikes a right balance with data, analysis and information.

I would like to thank all the eminent writers for their valuable contributions for the Year Book 2017. Their timely and valuable contributions were critical 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. Our best efforts have gone into the creation of the Year Book. At the same time, we also believe that there is always room for improvement. 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 10th Global Agriculture Leadership Summit 2017 for their valuable guidance. I am thankful to Dr. MJ Khan for guiding us through out the entire process of compilation and bringing out the best in us. My colleagues specifically Fariha Ahmed, Dr. Sucheta Arora, Nehal Agarwal and Mr. Abdul Rehman deserve special mention whose untiring efforts in compiling the Agriculture Today Year Book 2017 were exemplary.

Anjana Nair

# CONTENTS

## AGRICULTURE YEAR BOOK 2017

# सफलता ही सफलता

# crops &

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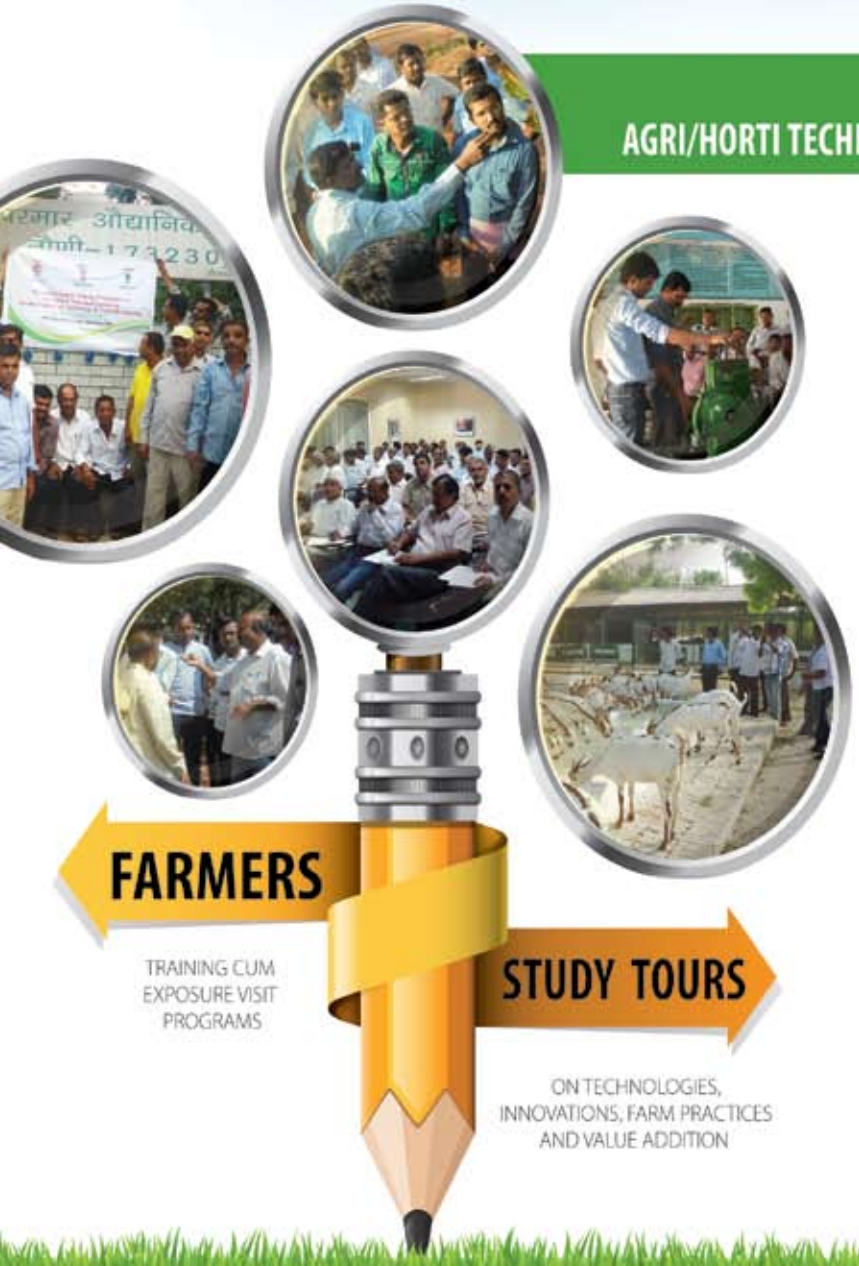
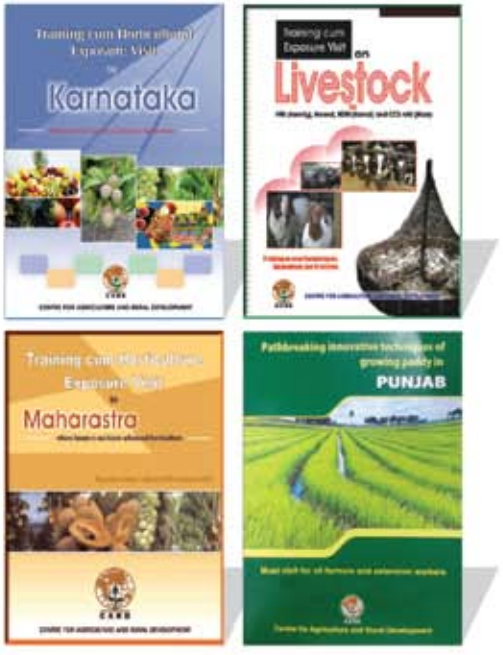



**EXPLORING PLACES & TRAINING ON AGRI/HORTI TECHNOLOGIES, INNOVATIONS AND PRACTICES**

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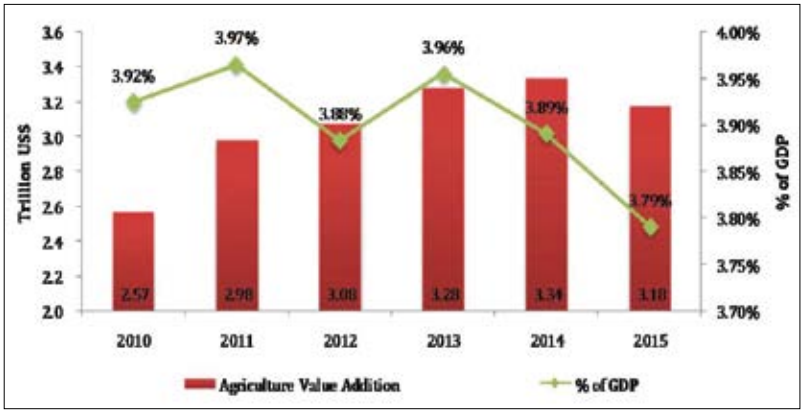
# AGRICULTURE - INTERNATIONAL SCENARIO

# International Agricultural Scenario

Agriculture is receiving increasing attention worldwide as government and non – government authorities recognize a need to accelerate productivity in order to ensure food security and improved nutrition to a growing population. Improved farming practices and solutions will not only address the need for increased productivity but also help farmers manage and protect the environment.

Agricultural productivity has been contributing to more optimized land use and consequently the conservation of natural habitats. In fact, millions of hectares of farm land become infertile globally each year as a result of soil erosion. Much of this soil is lost as a result of traditional tillage used for weed control.

**GLOBAL AGRICULTURAL VALUE ADDITION**




*Source: Company Presentation*

## GLOBAL AGRICULTURAL LAND

Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. During 2010-2014, the total agricultural land has marginally increased at a CAGR of 0.12%, with slight fluctuations during the period.The maximum agricultural land of the total land area of the country in 2014 was with Falkland Islands, Uruguay, Saudi Arabia, Kazakhstan, South Africa, Burundi, Nigeria, El Salvador, Syrian Arabia Republic and Eritrea.

However, the countries with the lowest share of agricultural land in the total land area of the country included French Guiana, Suriname, Greenland, Singapore, Turks and Caicos Islands, Bahamas, Faroe Islands, Papua New Guinea, Norway and Brunie Darussalam.

**GLOBAL AGRICULTURAL LAND**


*Source: FAO*

## GLOBAL AGRICULTURAL LAND BY SEGMENTS

The maximum share in the total agricultural land has been of permanent meadows & pastures, followed by arable land and permanent crop land. The total arable land has increased at a CAGR of 0.43% from 1.39 billion hectare in 2010 to 1.42 billion hectare in 2014. The top ten countries with largest share of agricultural land as arable land across the world include Bermuda, Saint Pierre and Miquelon, San Marino, Aruba, Turks and Caicos Islands, Faroe Islands, Finland, Japan, Denmark and Democratic People's republic of Korea.

The share of area under permanent crops constituted only about 3.3% of the total agricultural land during 2010-2015. The major countries with highest share of permanent crop land in the total agricultural land of the country included Nauru, Tokelau, Tuvalu, Seychelles, Kiribati, Malaysia and Walls and Futuna Islands.

## GLOBAL TOTAL AREA EQUIPPED FOR IRRIGATION

The total area equipped for irrigation can be defined as the area equipped with irrigation infrastructure to provide water to the crops. This includes areas equipped for full and partial control irrigation, spate irrigation areas, and equipped wetland or inland valley bottoms.Top 10 countries with maximum area equipped for irrigation across the globe in 2015 were Egypt, Suriname, Democratic People's Republic of Korea, Bangladesh, Japan, Pakistan, Bahrain, Republic of Korea, Cyprus and Vietnam.

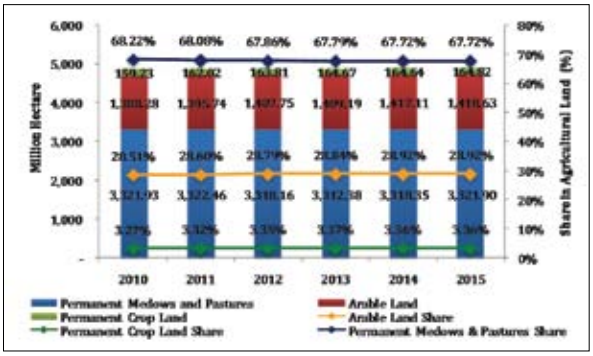
## GLOBAL FOOD GRAIN MARKET

Currently, the total consumption of food grains is averaged at 2.4 billion tonnes of grain per year for food, feed and fuel with three crops – maize (primarily for feed), and wheat and rice (primarily for food). Most grain is locally produced and consumed. Only a few countries, such as the United States, Brazil and Argentina, have sufficient industrial-scale grain production to contribute significantly to global trade.

## GLOBAL FOOD GRAIN PRODUCTION AND CONSUMPTION

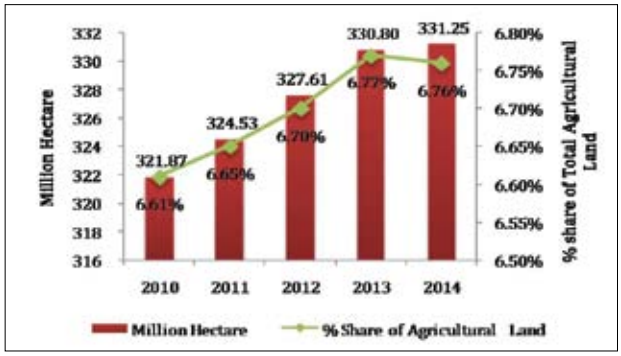
The total production and consumption of the food grains have increased at a CAGR of 1.72% and 1.76%, respectively, during 2010 – 2016. Maize is widely cultivated throughout the world, resulting in more tonnes pro-

**GLOBAL AGRICULTURAL LAND BY SEGMENTS**



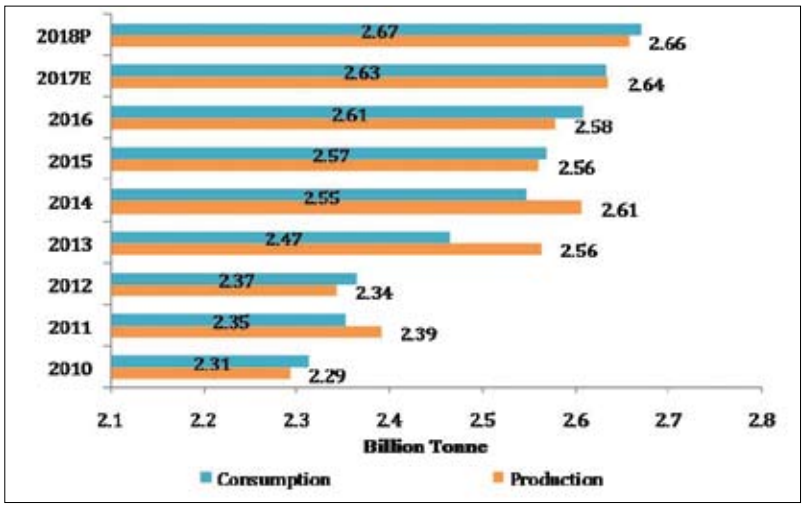

*Source: FAO*

**GLOBAL TOTAL AREA EQUIPPED FOR IRRIGATION**



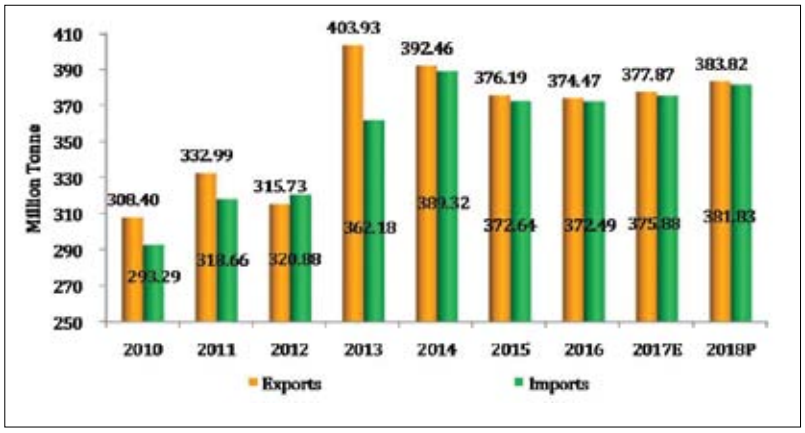

*Source: FAO Statistics*

**GLOBAL FOOD GRAIN PRODUCTION AND CONSUMPTION**



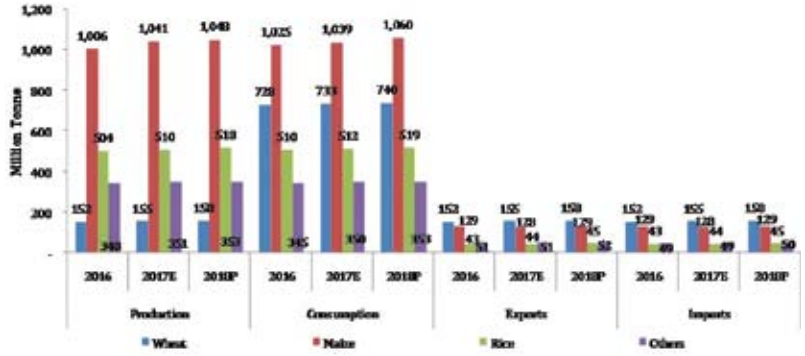

*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL FOOD GRAIN TRADE**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL FOOD GRAIN MARKET BY COMMODITIES**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

duced each year than any other grain. It is the most widely grown crop in the Americas, specifically the United States which produces around 35% of the world's harvest. Wheat is grown on more hectares worldwide than any other crop and likewise is distributed over a wider range of countries, China being the major individual producer. Rice is the most important staple food for a large part of the world's human population. The growth in demand for rice is correlated to population growth and is expected to be around 1% per annum.

The total food grain trade i.e., exports and imports have seen a fluctuating trend during 2010 – 2016. However, during the 2017 and 2018, trade is expected to increase due to overall increase in the production of food grains. The key exporters of maize are the USA, Brazil and Argentina, while, the major exporters of wheat are the CIS, United States, Canada and the European Union. Approximately 9% of the total production of the rice is traded world wide.

## GLOBAL FOOD GRAIN MARKET BY COMMODITIES

Historical yield growth for maize has been driven by a succession of technological innovations and intensification. The continuing advances in genetic modification (GM) and marker-assisted breeding are expected to accelerate this growth to meet future increases in demand. Given a record crop on the horizon, maize markets remain generally calm.

The global wheat market should remain adequately supplied during the forecast year as with around 80% of the crop being used for food, wheat consumption is driven primarily by population growth. Feed use at approximately 20% is the next largest outlet, and this has been growing recently as wheat has been competitive with alternative crops such as maize and sorghum.

A small increase in global production is expected to keep rice supplies ample, although reserves held by the major rice exporters may fall to a 10-year low. Moreover, rice market faces two major challenges, namely, labor scarcity due to which cost of labor in-

creases and excessive losses during & after harvest.

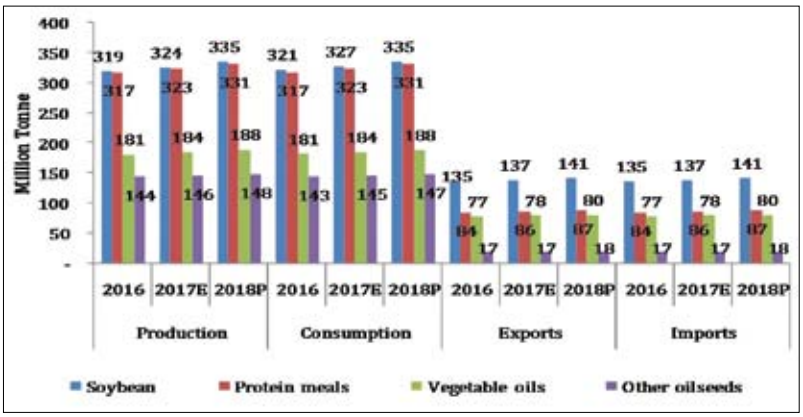
## GLOBAL OIL SEED MARKET

Prices and profitability for oilseeds have generally been stronger than for grain because soybeans, canola and other oil crops have not suffered burdensome global oversupply. The oversupply in 2010 melted away when sharply lower soybean yields in Brazil and the United States reduced production and lifted prices. By the end of 2011, the global stocks-to-use ratio was a tight 20.5%. Looking ahead to 2017, it is expected that with big production from South America and the U.S., there will be ample low cost supplies that will stimulate demand.That demand should help to trim the oversupply but not by a lot.

## GLOBAL OIL SEED PRODUCTION AND CONSUMPTION

The global soybean production for the 2015 continued to increase, whereas production of other oilseeds (rapeseed, sunflower seed and groundnuts) declined relative to 2014. Low crude oil and cereal prices put additional pressure on oilseed prices. The continuously growing demand for protein meals has been the main driver behind the expansion of oilseed production in recent years. This has increased the share of protein meals in the returns from the crushing of oilseeds, and more so for soybeans over other oilseeds due to its higher protein content.

**GLOBAL OIL SEED MARKET BY COMMODITIES**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

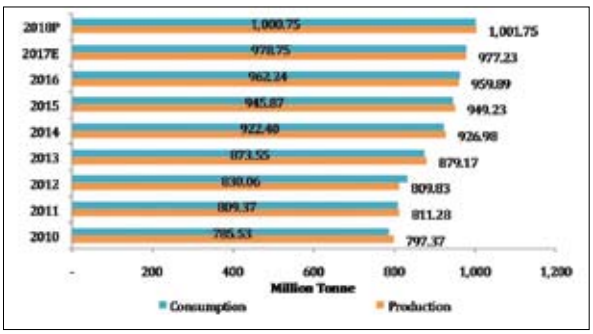
## GLOBAL OILSEEDS MARKET TRADE

The trade of oilseeds has been increasing during 2010 – 2016. However, soybean, other oilseeds and protein meal exports are dominated by the Americas, vegetable oil exports continue to be dominated by Indonesia and Malaysia. Vegetable oil, at 42%, is one of the agricultural commodities with the highest share of production that is traded. It is expected that this share remains stable during 2017 and 2018.

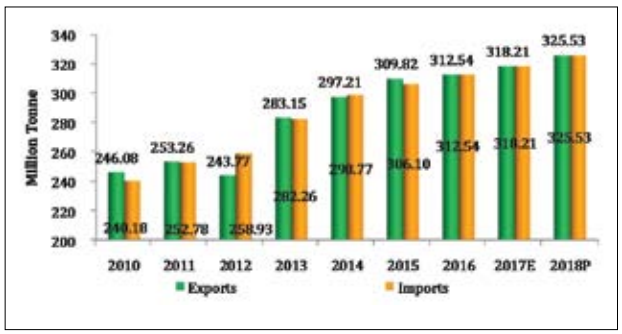
## GLOBAL OILSEED MARKET BY COMMODITIES

During the 2017 and 2018, the global soybean production is expected to continue its expansion, yet at 1.64% annually, below the annual growth rate of 4.2% experienced during the last

**GLOBAL OIL SEED PRODUCTION AND CONSUMPTION**

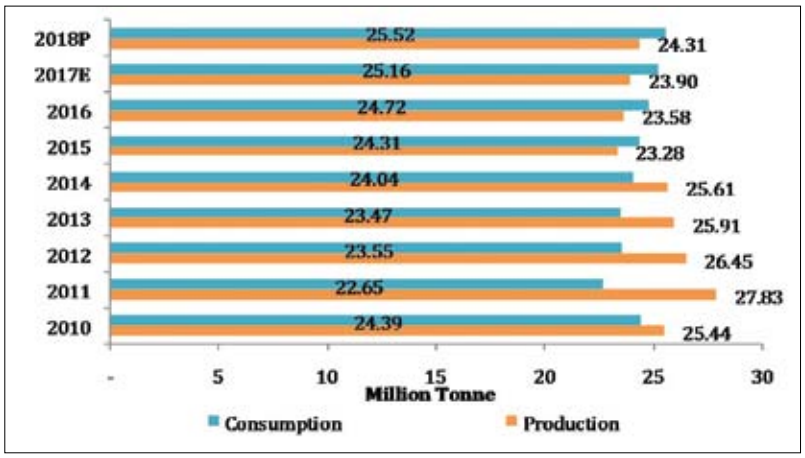



**GLOBAL OIL SEED TRADE**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL COTTON PRODUCTION AND CONSUMPTION**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

decade. Production of other oilseeds is expected to increase by 0.92% p.a., considerably below the growth rate of 3.6% p.a. in the previous decade.

Globally, crushing soybean and other oilseeds into meal (cake) and oil dominates total usage and it increases slightly faster than other uses, notably direct food consumption of soybeans, groundnuts and sunflower seed. Overall, 91% of world soybean production and 84% of world production of other oilseeds will be crushed in 2025.

## GLOBAL COTTON MARKET

While continuing increases in farm labor costs and competition for resources with other agricultural crops place significant constraints on growth in the global cotton production, higher productivity driven by technological progress, including greater adoption of bio-tech cotton, creates substantial potential for cotton production to expand in the next decade.

## GLOBAL COTTON PRODUCTION AND CONSUMPTION

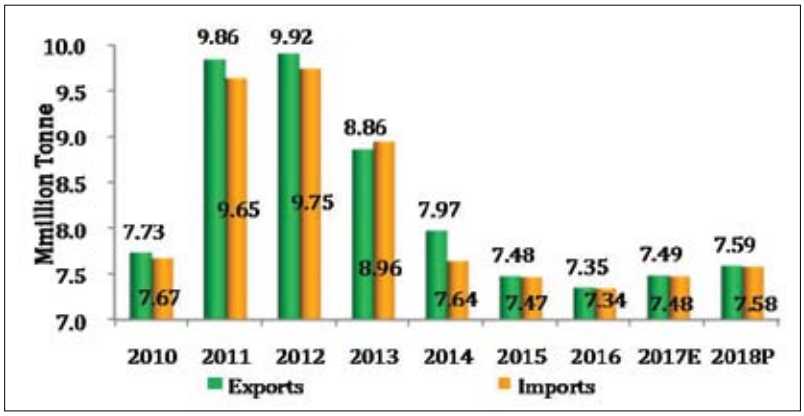
The world cotton market experienced dramatic developments in the first half of the 2015 caused by an acute drop in production – about 9% – in major producing countries. Production fell in almost all major cotton producing countries led by Pakistan, the United States, and China, which experienced declines of 5%, 19% and 17%, respectively.

Cotton mill consumption increased by 1% from 24.04 million tonnes in 2014 to 24.31 million tonnes in 2015. Mill consumption estimates in China and India remained stable at 7.7 Mt and 5.3 Mt respectively, Pakistan experienced over 2% and Bangladesh over 4% growth while, Vietnam picked up 6% as Chinese direct investment in mills of the latter two countries continues to increase. However, the consumption in China is expected to fall to 6.9 Mt following the downward trend that started in 2010, while India becomes the world's largest country for cotton mill consumption (8 Mt) in 2025.

## GLOBAL COTTON MARKET TRADE

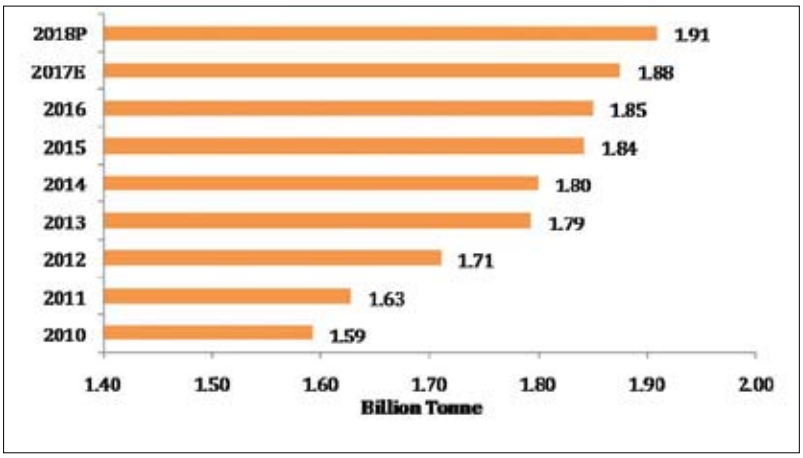
It is expected that the growth in global cotton trade will be slower compared to previous years, especially 2011-13, when growth was driven by surging Chinese imports. A shift to trading cotton yarn and fabrics rather than raw cotton has emerged over the past few years, which is expected to continue. The United States retains its position as the world's largest exporter, accounting for 28% of world trade. Exports from Brazil are expected to almost double from 0.7 Mt to 1.5 Mt, making it the world's second largest cotton exporter. On the import side, China is expected to import 1.6 Mt in 2025 and retains barely its position as the world's largest import market.

**GLOBAL COTTON PRODUCTION AND CONSUMPTION**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL SUGARCANE PRODUCTION**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

## GLOBAL SUGARCANE MARKET

Sugarcane is a highly productive perennial grass which is grown largely in tropical and subtropical regions with no water scarcity. Sugarcane requires around 250,000 m3 of water per hectare.

Sugarcane production is largely concentrated in six countries. Brazil is the world's largest sugarcane producer, producing over 40% of the world's sugarcane. Over the past 10 years, production has increased by over 100% and the upward trend is continuing at a comparable pace. Sugarcane demand is growing exponentially driven by both human sugar demand and biofuels. With sugarcane producing over 80% of the world's sugar, this creates a significant requirement to improve yields and efficiency.

## GLOBAL DAIRY PRODUCTS MARKET

The global dairy commodity market is prone to disturbances from weather variability, developments in the dairy market will stem from import demand in China and how quickly producers react to lower prices. The strengthening of demand from the developing countries is anticipated and while China does not resume importing whole milk powder and butter at 2014 levels, instead servicing much of its demand internally, SMP and cheese imports will increase in 2017 and 2018.

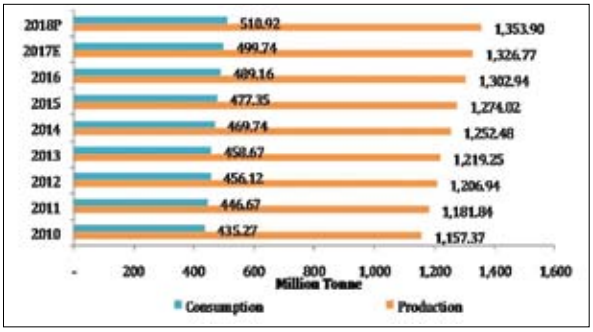
Production in Oceania is facing challenges, low dairy prices have caused a reduction in the total dairy herd, which dropped by 2.7% in 2015. Furthermore drought and adverse weather conditions related to a very strong El Niño have restricted production in Oceania's pasture-based systems in 2016; this is expected to reduce production in New Zealand by 6.8% and to stall growth in Australia.

## GLOBAL DAIRY PRODUCT MARKET TRADE

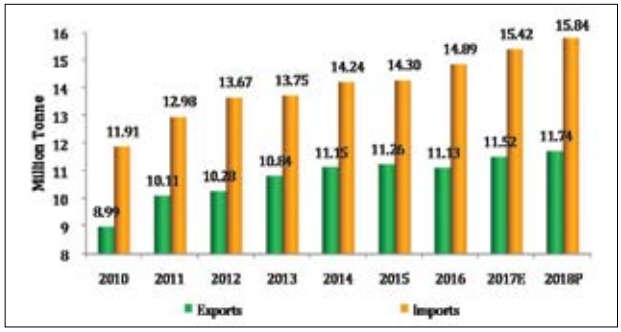
International prices of all dairy products continued to decline from their 2013 peak, in particular the skim milk powder (SMP) and whole milk powder (WMP). A key factor was the decline in Chinese import demand, with demand for WMP dropping by 34% from 2014 levels. This decrease in Chinese demand for dairy products was coupled with continued production growth between 2014 and 2015, in key export markets, with total output of milk increasing in Australia (4%), the European Union (2%), New Zealand (5%) and the United States (1%).

The Russian Federation's ban on imports continues to restrict dairy trade. Russian cheese imports dropped by 62% between 2013 and 2015, which mainly affected exports from

**GLOBAL DAIRY PRODUCTS PRODUCTION AND CONSUMPTION**



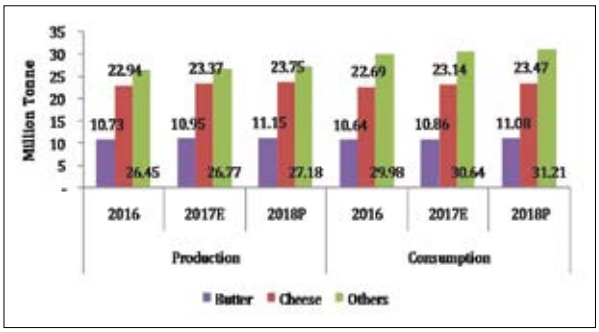

**GLOBAL DAIRY PRODUCTS TRADE**



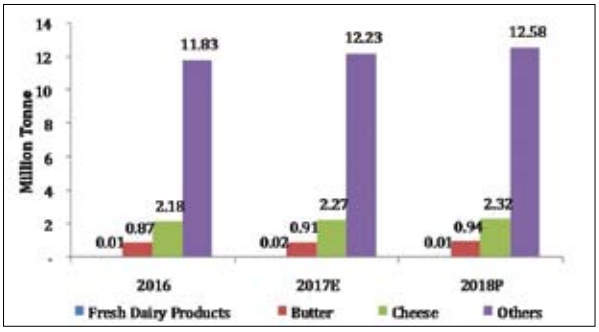

*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL FRESH DAIRY PRODUCT MARKET– PRODUCTION AND CONSUMPTION**

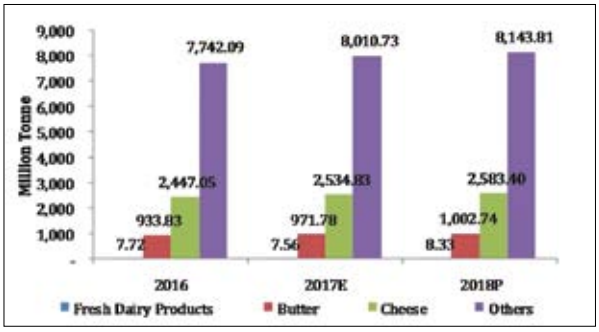

**GLOBAL DAIRY PRODUCT MARKET BY COMMODITIES – PRODUCTION & CONSUMPTION**




**GLOBAL DAIRY PRODUCT MARKET BY COMMODITIES – EXPORTS**




**GLOBAL DAIRY PRODUCT MARKET BY COMMODITIES – IMPORTS**




***Source: OECD statistics, Note: E = Estimated, P = Projected***

the European Union, the United States and Australia. Conversely, Belarus has greatly increased cheese exports to the Russian Federation, supplementing demand there. The ban is assumed to continue until the start of 2017; with imports of cheese expected to increase sharply as trading resumes, mostly supplied from the European Union and the United States, albeit at lower levels than prior to the ban.

Per capita demand for dairy products in developing countries is expected to grow consistently over the medium-term, supported by rising incomes and lower dairy prices relative to their 2013 peak. As seen in previous years there is a continued shift in dietary patterns away from staples and towards animal products, due to changes in diets. Strong consumption growth is expected across several markets in the Middle East and Asia, including Saudi Arabia, Egypt, Iran and Indonesia, with the per capita consumption of dairy products in developing countries growing between 0.8% and 1.7% p.a., the lowest growth being for cheese and the highest for fresh dairy products. In addition, per capita consumption in the developed world is expected to grow between 0.5% for fresh dairy products and 1.1% p.a. for SMP.

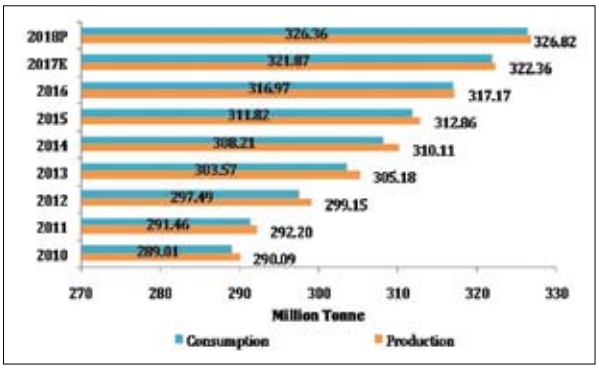
Continued export growth is expected over the coming decade following the slump in 2014-15. Butter, cheese, SMP and whey all average strong growth of over 2%. Growth for exports of WMP is more modest at 1.8% p.a. With low dairy prices serving as a barrier to market entry for non-traditional exporters, export growth will continue to be satisfied by a small concentration of key exporters. The European Union will be the principle exporter of SMP and cheese, and New Zealand the lead exporter of butter and WMP.

Asian countries consistently rank in the top twenty of the global importers of dairy products. Several trends emerge such as the rise of China as the largest global importer and the fall of Russia from the ranking (due to the import ban). Additionally, the importance of other Asian markets is evident which include Japan, Indonesia, Malaysia and the Philippines.

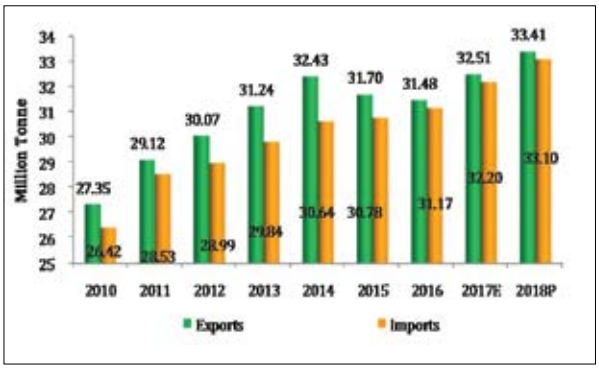
## GLOBAL MEAT MARKET

Globally, animal disease outbreaks and trade policies remain among the main factors driving the evolution and dynamics in world meat markets. The implementation of various trade agreements, such as the proposed Trans-Pacific Partnership, in the near future could increase and diversify meat trade. An announcement in 2015 by International Agency for Research on Cancer of the World Health Organization (IARC) classified processed meat as carcinogenic. This raised concerns among consumers worldwide

**GLOBAL MEAT PRODUCTION AND CONSUMPTION**




**GLOBAL MEAT MARKET TRADE**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

and may impact the projected consumption of countries with high per capita meat consumption.

## GLOBAL MEAT PRODUCTION AND CONSUMPTION

Global meat production is projected to be 16% higher in 2025 than in 2013 – 2015. This compares with an increase of almost 20% in the previous decade. Developing countries are projected to account for the vast majority of the total increase, through a more intensive use of protein meal in feed rations.

Global annual meat consumption per capita is expected to reach 35.3 kg retail weight equivalent (r.w.e.) by 2025, an increase of 1.3 kg r.w.e. compared to 2013 – 2015. This additional consumption will consist mainly of poultry. In absolute terms, total consumption growth in developed countries over the projection period is expected to remain small relative to developing regions, where rapid population growth and urbanization remains the core drivers. This is particularly true in Sub-Saharan Africa, where the rate of total consumption growth in the near future is faster than any other region. The composition of growth is also somewhat unique, with the absolute growth in beef almost matching poultry.

## GLOBAL MEAT MARKET TRADE

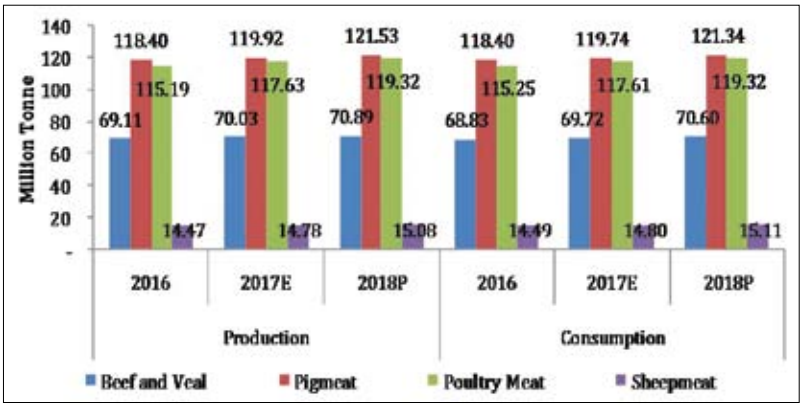
Globally 10% of meat output will be traded in 2025, up from 9% in 2015, with most of the increase coming from poultry meat. Import demand will be weak during the 2017 and 2018 arising out of lower imports due to the import ban of the Russian Federation and slower growth in China. The most significant growth in import demand originates from Vietnam, which captures a large share of additional imports for all meat types. Africa is another fast growing meat importing region albeit from a lower base.

Although developed countries are still expected to account for slightly more than half of global meat exports by 2025, their share is steadily decreasing relative to 2013 – 2015. On the other hand, Brazil's share of global exports is expected to increase to around 26%, contributing to nearly half of the expected increase in global meat exports by 2025.

## GLOBAL MEAT MARKET BY CATEGORY

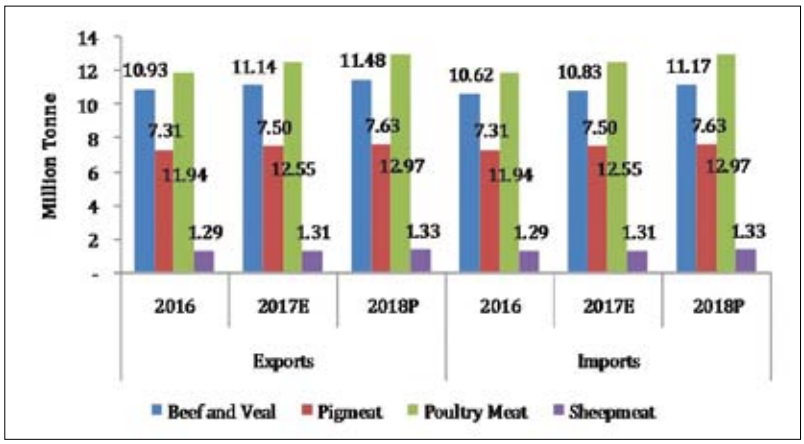
Poultry meat is the primary driver of the growth in total meat production in response to expanding global demand for this more affordable animal protein compared to red meats. However, production is expected to grow from 2016 onwards, with higher carcass weights more than offsetting the decline in cattle slaughter. Pigmeat production will also grow after 2016, driven by China, where herd size is expected to stabilise after years of substantial reductions (a drop of 25 million pigs between 2012

**GLOBAL MEAT MARKET BY CATEGORY – PRODUCTION AND CONSUMPTION**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL MEAT MARKET TRADE**




*Source: OECD statistics, Note: E = Estimated, P = Projected*

and 2015). Another factor contributing to China's output expansion in the coming years is further consolidation of the pork sector. Production is also expected to increase in the sheepmeat sector with an expected global growth of 2.1% p.a., a higher rate than the last decade, and led by China, Pakistan, Sudan and Australia.

Although by 2025, developed countries are still expected to account for slightly more than half of global meat exports, their share decreases steadily relative to 2013 – 2015. Meat exports from the United States will capture more than a quarter of total trade expansion, while exports from the European Union will grow only marginally. The European Union has improved its access to Asian markets, but market competition from North and South America will prevent it from taking full advantage of this opportunity.

Global import growth in volume terms is driven by poultry meat, the bulk of which is imported by developing countries. Developing countries will also trade between themselves the vast majority of all additional growth in bovine meat. However, developed countries will supply the bulk of additional trade on pigmeat, which is going almost entirely to the developing world.

## GLOBAL FISHERIES MARKET

The global fish production is expected to grow by 1.1% in 2017, driven by aquaculture, which continues to expand at some 4% - 5% per year. Supply rebounds for a number of important traded species is likely to dampen some price gains realized in 2016, while political uncertainty in multiple markets is suppressing growth in international seafood trade.

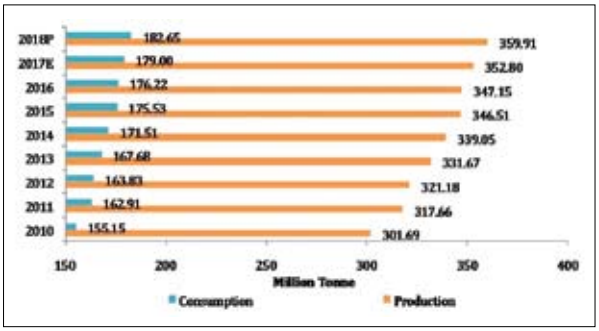
## GLOBAL FISHERIES MARKET PRODUCTION AND CONSUMPTION

World fish production is projected to grow at 1.5% p.a. during 2016 – 2025, a slowdown relative to the 2.5% p.a. of the previous decade. Production is expected to reach 196 Mt, with an overall increase of 29 Mt, or 17%, between 2013 – 2015 and 2025. Most of the production growth for fish will take place in developing countries and in particular in Asia. As capture fisheries production is expected to increase by only 1%, by 2025, the majority of growth will come from aquaculture, which will surpass total capture fisheries in 2021. Despite the increasing role of aquaculture in total fish supply, the capture sector is expected to remain dominant for a number of species and vital for domestic and international food security.

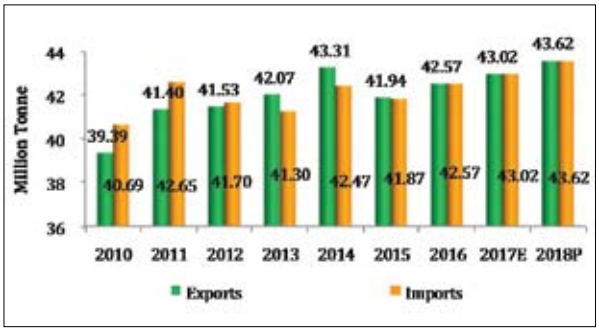
## GLOBAL FISHERIES TRADE

During 2015, the global fishery and aquaculture sector showed sustained growth in overall production and consumption. In 2014, aquaculture's contribution to total fish supplied for food overtook that of wild fish for the first time and this trend continued in

**GLOBAL FISHERIES MARKET PRODUCTION AND CONSUMPTION**

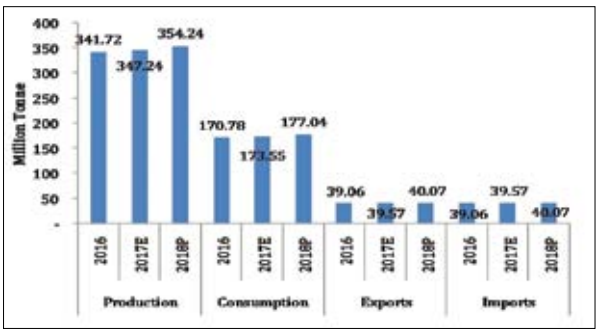



**GLOBAL FISHERIES TRADE**

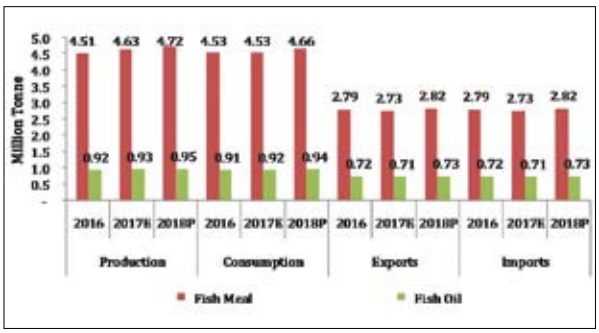



*Source: OECD statistics, Note: E = Estimated, P = Projected*

**GLOBAL FISH MARKET**




**GLOBAL FISH MEAT AND FISH OIL MARKET**




***Source: OECD statistics, Note: E = Estimated, P = Projected***

2015. In the same year, after a period of continuous expansion, trade of fish and fishery products declined in value terms. This slowdown was caused by economic contractions in key markets, exchange rate developments and lower fish prices.

China, the leading producer, processor and exporter, and the third largest importer of fish and fishery products entered a period of serious uncertainty, even reducing its fish exports due to a slowdown in its processing sector. Seafood consumption in the Russian Federation suffered from the effects of its continuing trade embargo on fish from certain countries. Norway had record total export values, while in Thailand and other large shrimp supplying countries lower shrimp prices pushed total export values down significantly. Catches of anchoveta (mainly used to produce fishmeal and fish oil) were better than expected, relieving some short-term pressure on fishmeal and fish oil prices.

The outlook for capture fisheries, fishmeal and fish oil depend on the natural productivity of fish stocks and ecosystems, which is uncertain, as well as on variable weather patterns. For aquaculture, relevant factors are the accessibility and availability of sites and water resources as well as to technology and finance; the sustainability, availability and cost of fish seeds (e.g. eggs, spawn, offspring, fry, larvae) and feeds; antibiotic use; assessment of environmental impacts (including pollution, fish diseases and escapees); and food safety and traceability issues. Furthermore, trade policies, trade agreements and market access remain important factors influencing the overall dynamics of world fish markets.

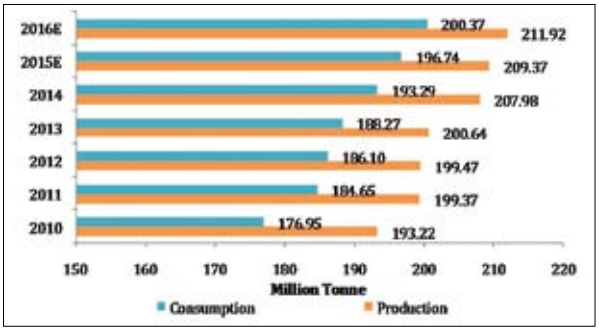
## GLOBAL FERTILIZER MARKET

The global total nutrient capacity was 285.15 million tonnes in 2015, out of which the total supply was 245.77 million tonnes. Over the following four years to 2020, the global capacity and production of fertilizers are expected to increase further. However, the total non – fertilizer nutrient use demand was estimated to be 44.93 million tonnes in 2015 and is forecast to reach 50.21 million tonnes by 2020.

## GLOBAL FERTILIZER MARKET PRODUCTION AND CONSUMPTION

Asia's share of global nitrogen consumption was 60%, in 2015 with China representing approximately half of that share. The highest growth rates going forward are expected to be seen in sub-regions with recovering agriculture such as Eastern Europe and Central Asia, and in regions with a large potential to increase agricultural production. Latin America falls into the latter category, and although it still

**GLOBAL FERTILIZER MARKET PRODUCTION AND CONSUMPTION**

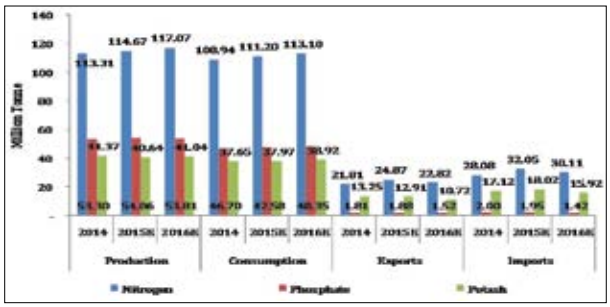



***Source: OECD statistics, Note: E = Estimated, P = Projected***

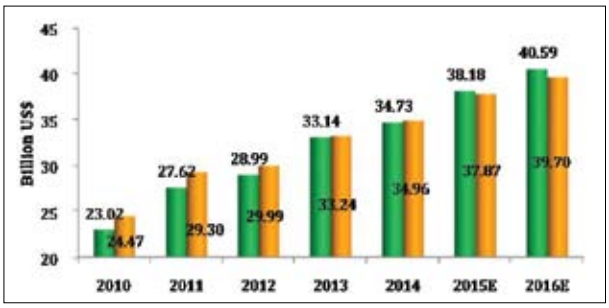
**GLOBAL FERTILIZER TRADE**


***Source: FAO statistics, Note: E = Estimated***

**GLOBAL FERTILIZER MARKET BY NUTRIENT**




**GLOBAL PESTICIDE MARKET TRADE**




*Source: FAO statistics, Note: E = Estimated*

accounts for a relatively small volume, the region is expected to keep its position as the region with the highest growth rate. Consumption in mature markets like North America and West Europe is forecast to grow at a slower pace while Chinese consumption is expected to be flat over the next years.

## GLOBAL FERTILIZER TRADE

The trade of fertilizers largely depends on the crops grown in the particular region and the fertilizer produced in there. Africa is a major phosphate exporter and increased nitrogen exports while importing all of its potash. The Asia region is expected to produce a rapidly increasing surplus of nitrogen, but will continue to import phosphate and potash. Europe will be the major nitrogen and potash exporting region in the world and will continue to produce surpluses of phosphate though decreasingly so. It is expected that deficits of all three nutrients will persist in Oceania.

## GLOBAL FERTILIZER MARKET BY NUTRIENT

Nitrogen fertilizers are produced in many countries, reflecting the wide availability of key raw materials (natural gas and air) needed for production. The global nitrogen market is therefore less consolidated, but some regions such as Europe and the US have seen significant restructuring and consolidation in the last decade.

There are fewer large suppliers of phosphate and potash fertilizers, as phosphate rock and potash mineral deposits are only available in certain regions of the world. The potash industry is the most consolidated fertilizer industry.

There are large variations in nitrogen fertilizer use in different regions and countries. Urea, the fastest growing nitrogen product, is popular in warmer climates. UAN is mainly used in North America, while nitrates are mainly used in Europe. In the US, ammonia is also used as a source of nitrogen in agriculture, especially for fall application. In China, urea is dominant. China is also the only country that uses ammonium bicarbonate (ABC). Although this product is gradually being phased out, it still has approximately 17% market share in China. Brazil consumes relatively more phosphate and potash compared with nitrogen, due to a large soybean production.

## GLOBAL PESTICIDES MARKET SCENARIO

The global pesticide industry is expected to reach an estimated US$81.1 billion by 2021, increasing at a CAGR of 4.4% during 2016-2021. The major drivers of growth for this market are increasing population, limited availability of arable land, and increasing awareness of using pesticides.Within the global pesticides industry, the herbicides segment is expected to remain as the largest market. Increasing demand for weed management and food security are expected to drive pesticides demand, which would spur growth for this segment.

North America is expected to remain the largest market and is expected to witness the highest growth due to limited availability of arable land, demand for healthy diet, and priority for food safety.Emerging trends, which have a direct impact on the dynamics of the industry, includes development of nano-pesticides to reduce environmental pollution and development of formulated technology for weed control system.

2014 witnessed a divergence in crop and livestock markets with decreasing crop prices and increasing livestock prices whereas prices for both crops and livestock fell in 2015. Production of most crops declined in 2015 compared to the exceptionally high output levels in 2014. However, this fall in output could not halt the decline in crop prices which was fuelled by lower demand and high inventories. Livestock prices came down from their historic highs in 2014 following weaker demand growth and lower feed grain prices. Dairy prices continued their decline that started during 2014 amid reduced import demand and higher output. An increased supply within certain fishery species combined with lower consumer demand in key markets led to generally declining fish prices. ■

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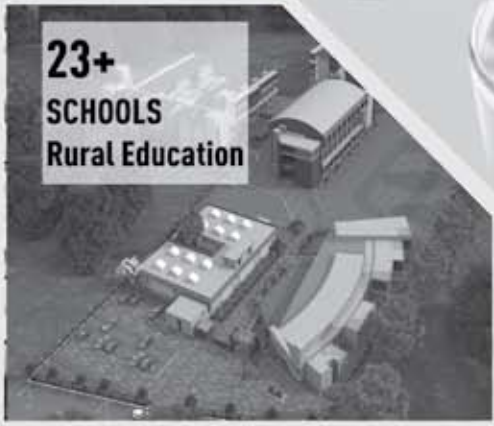



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# INTERNATIONAL AGRICULTURE CONSULTING GROUP

## 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.

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- Improved Neem Larvicidal Composition
- Slow or Controlled Release Mosquito Larvicidal Composition and Process of preparation thereof
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- Technology Package for Palm Oil Extraction
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# DOUBLING FARMERS' INCOMES

# DYNAMICS OF MANAGEMENT OF RICE FOR DOUBLING FARMERS' INCOME

Col (Dr) A. R. Pathak, Vice Chancellor, Junagadh Agricultural University, Junagadh and Dr. V. P. Patel, Associate Research Scientist, Navsari Agricultural University, Navari, Gujarat

Rice is one of the most widely cultivated (118 countries) crops in the world. Rice ranks second after wheat in terms of area harvested but in terms of importance as a food crop, rice provides more calories per hectare than any other cereal crop. It is a staple food for about 50% of the world's population. World paddy production is 741 million tonnes from 162.7 million hectares with productivity of 4.55 t/ha. Asia is considered as 'Rice bowl' of the world, occupying 90% of world's rice area (143.5 Mha) contributing 90% of the global production (667 MT) with a productivity of 4.6 t/ha. In India, the rice occupies one-quarter of the total cropped area, contributes about 40 to 43 percent of total food grain production and continues to play a vital role in the national food and livelihood security system. In India, rice is grown in 43.8 million hectare area with production of 157.2 million tonnes and productivity of 3.58 t/ha. India's rice productivity is less in comparison to Asia and World. The main reason for low productivity of rice is its cultivation under various production ecologies mainly grouped as irrigated (58%) and rainfed (42%) systems. While former is considered most favorable, rainfed system has again a wide range of subsystems like shallow, mid and deep water rainfed lowlands and rainfed uplands. Considering its importance in Indian Agriculture, doubling the income of Rice growing farmers will play a significant role in achieving the goal of "Doubling the Farmers' Income by 2022"

Some of the Major factors for low productivity of rice are

- Moisture stress due to erratic and inadequate rainfall
- Continuous use of traditional varieties due to the non-availability of new variety seeds in adequate quantities and lack of awareness of farmers about high yielding varieties (Upland, rainfed lowland and deep water areas),
- Low and imbalanced use of fertilizers,
- Heavy infestation of weeds and insects/ pests,
- Poor crop plant population in case of broadcast sowing method resulting in uneven germination (upland and direct seeded lowlands).

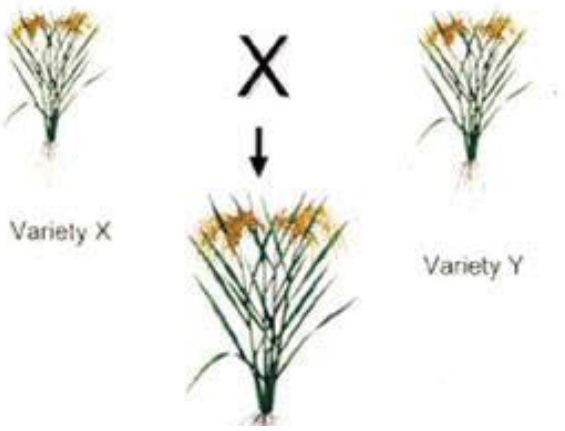
Delay in monsoon often results in delayed and prolonged transplanting and sub-optimum plant population. Moreover, rice production will come under additional pressure from intense competition for land, labour and water, a more difficult growing environment because of climate change, higher price of energy and fertilizers and problems related to soil health.

## TECHNOLOGICAL ASPECTS TO INCREASE FARMERS' INCOME

### RAISING THE YIELD CEILING

The yield level set by high yielding semi dwarf varieties of green revolution era needs to be increased particularly under high productive environment. These could be feasible by using the concepts of hybrid rice, new plant type, multiple resistant varieties, region specific variety and transgenic rice.

Hybrid rice is a practically feasible and readily adaptable genetic option to increase the rice production. By exploiting the phenomenon of hybrid vigor, hybrid rice varieties yield about 1-1.5 tonnes per hectare higher (15-20%) than the best semi dwarf inbred varieties. This technology has already demonstrated great potential to increase rice production in China, where 15 million hectares (50% of the total rice area) are planted with hybrid rice




varieties. More than 75 rice hybrids have been released in India and hybrid rice was cultivated in about 2 million hectares during 2015. This technology clearly helps rice farmers to increase their yields, productivity, and profitability by using less land and water and enables them to opt for crop diversification to increase their income. An associated seed production technology has also helped to develop a seed industry, which in turn has contributed to increased rural employment opportunities.

New Plant Type Rice (NPTs) will have a major part to play in breaking the yield barrier. The NPTs have many properties to support higher yields and high leaf nitrogen content for building higher grain yield. NPT lines have higher total biomass and the harvest index, with 20% more yield over the current modern varieties. NPT based hybrid will further improve rice yield. This kind of technologies help to improve rice productivity and profitability of rice farmers in general and farmers of high productivity environments in particular.

Recommendation of crop cultivars with wide adaptability is essential for countries with diverse environments or agroecological regions and seasons. Superior yielding varieties are available, which can take farmers' yield to 8.0 t/ha if grown properly. Therefore there is a need to identify and release stable yielding varieties even on a specific area basis, including rainfed ecologies.

Marker assisted selection is successfully implemented in resistance breeding in rice. Many rice varieties viz., PR 106, Improved Pusa basmati 1, Improved Sambha masuri, Pusa 1592, Punjab Basmati 3 etc. resistant to bacterial blight have been developed through MAS in India. Rice variety IR-64 Drt-1, DRR Dhan 42 resistant to drought and Samba Sub-1 tolerant to submergence have been developed. Pusa Basmati 1609, Pusa Basmati 1509, Pusa Basmati 1637 and Pusa Basmati 1728 have been developed by using new biotechnological tools. Efforts are on to improve complex traits like drought and yield using molecular breeding. Drought and yield Qtls are transferred from wild to cultivated species using MAS. Molecular breeding helps in

pyramiding genes for resistance in cultivated lines. Efforts are on to pyramid genes for gall midge, BPH, blast, BLB resistance in rice. It is easier to develop multiple resistant varieties through MAS. Varieties provide multiple resistance and climate resilience resulting in assurance of production motivating farmers to invest more.

Golden rice was developed to alleviate malnutrition and vitamin A deficiency by enriching rice with beta-carotene, which when consumed is converted to Vitamin-A. Golden rice will provide nutritional security and also provide better price for produce. Like this biofortified varieties rich in Fe, Zn developed recently e.g. GNR4 will get more price. Similarly efforts are on to develop C4 rice, drought tolerant rice, insect pest resistance. Success in these efforts will raise production potential.

Other than using genetic means of raising yield ceiling, avenues of agronomic manipulation need to be explored. Increase rice area under irrigation and/or increase summer/ boro rice cultivation can improve rice production and productivity.

## CROPPING SYSTEM APPROACH

Rice based cropping system is a major cropping system in India. Rotation of crops involving rice, pulses, oil seeds, sugarcane, vegetables etc. is followed depending on local needs. Various rice based cropping systems viz., rice-wheat, rice-rice, rice-pulses, rice-oilseeds, rice-vegetables, rice-fibre crops etc. can be adopted. Rice-vegetable is a profitable sequential cropping system followed under protective irrigation. Based on local market demand, vegetables like okra, cluster beans, chillies, brinjal, amaranthus, raddish, sweet potato, etc., needs to be cultivated for higher return. Early maturing rice hybrids/ varieties followed by Okra in rabi (off) season in Vyara and Dolvan talukas of Tapi district in Gujarat state provide very high price (more than three times) for okra produce. This type of cropping sequence can significantly improve livelihood of poor tribal farmers in this region.

## LAND LEVELING

Laser aided precision leveling; herbicide based minimum tillage; dry shallow tillage prior to puddling; shallow tillage soon after harvest to incorporate crop residues and improve soil N supply and better water management have resulted in good crop growth and yield, with decrease in water requirement.

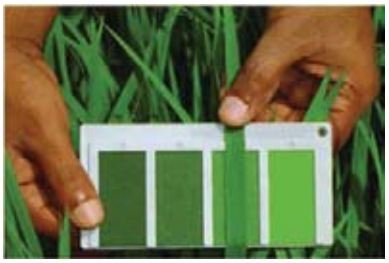
## CROP ESTABLISHMENT

Rice cultivation in India are classified in four broad ecosystems viz., irrigated, rainfed lowland, upland and flood prone. Depending upon the ecosystem, the crop undergoes different methods of establishment within each ecosystem. The irrigated ecosystem, the predominant ecosystem, cultivated in about 25 M ha is patronized with many methods of stand establishments.

Conventional transplanting, planting using rice transplanter are important ones. System of Rice Intensification (SRI) as precision farming, a different crop establishment methods used in our country can be more rewarding. Similarly Savant's Integrated Rice Agrotechnology (SIRA) for rainfed ecology showed promising results. Direct seeding and seed cum fertilizer drill are methods used in upland ecology. Cost saving technologies viz., aerobic rice and drum seeder are technologies to conserve resources, timely operation and reduce women drudgery involved in rice planting.

## INTEGRATED NUTRIENT MANAGEMENT

In addition to chemical fertilizers, using organic manure and biological nitrogen fixation, are needed to reduce cost of nutrients and improve soil health. Soil test based fertilizer application, field specific fertilizer recommendation are also good options. Nitrogen being the major nutrient and in demand, is applied in every crop season. Thus, efforts in improving the N use efficiency will save quantity and cost, and reduce the cost of rice production. Rice suffers from a mismatch of its N demand and N supplied as fertilizer, resulting in a 50 to 70 percent loss of applied N fertilizer. N is lost due to denitrification, ammonia volatilization, leaching and runoff.



Real time N management with chlorophyll meter and leaf color chart; deep placement of urea briquette; coated controlled release urea can reduce the cost of fertilizer and thereby reduce cost of cultivation.

Use of biofertilizer such as Blue-green algae, Azolla, Azosprillum and Azotobacter for supply of nitrogen to crop and Phosphorous solubilizing bacteria for solublizing non-available Phosphorous to available form for easy uptake by crop plants are cost reduction and biological means of nutrient application.

## IRRIGATION

Total irrigated area in the country, including that in rabi/boro season contributed 78% of production, whereas 42% of rainfed area contributes only 24%. So adequate water supply is one of the most important factors in rice production. For improving production and

productivity, more area should be under assured irrigation. Development of on farm water reservoirs for water harvesting, selection of drought tolerant varieties, land leveling, subsoil compaction, and need based irrigation scheduling may play a major role in increasing water use efficiency and improve production and productivity. Alternate wetting & irrigation as well as SRI reduces water requirements by about 25 - 50%.

## INTEGRATED WEED MANAGEMENT (IWM)

Weeds were reported to reduce rice yields by 12 to 98%, depending on method of rice establishment. Rice yield losses due to uncontrolled weed growth and weed competition were least (12%) in transplanted rice and highest in aerobic direct seeded rice on a furrow-irrigated raised-bed systems and in dry-seeded rice sown without tillage. The concept of IWM is not new. For example, the traditional practice of puddling soil to kill existing weeds and aid water retention, transplanting rice seedlings into standing water to achieve an optimum stand density

and maintaining standing water to suppress weeds, followed by one or several periods of manual weeding, is a well established example of integrated weed management. Effective IWM combines preventive, cultural, mechanical and biological weed control methods are an effective, economic and ecological manner. Interculturing by weeder in SRI is most useful for cost reduction and weed control.

## INTEGRATED PEST MANAGEMENT (IPM)

Promoting the integrated pest management approach for control of pest and diseases by emphasizing need based application of pesticides. Replacement of old pest susceptible/

low potential old varieties with improved high yielding pest tolerant varieties/hybrids are more useful. No early spraying against leaf folders and thrips; pheromone traps for yellow stem borer; active barrier system for rat control; silica application for blast control; timely and judicious use of bio and/or chemical pesticides not only reduces cost but increase yield too.

## MANAGEMENT ASPECTS

Efficient management of resources are key for doubling the income of Rice growing farmers. Rice cultivation in main field with high value tree plantation like teak wood on bunds or pulse crop like pigeon pea provide additional income. Animal husbandry in addition to rice cultivation consumes by products like paddy straw and provide income in the form of milk or selling of animals. It also provides by-products in the form of manure. Manure supply nutrient to improve fertility of soil and hence yield. Fish rearing in rice field also provide additional income.

## MINIMIZE POST HARVEST LOSSES

About 20 to 25 percent of the harvested rice is lost before it reaches the consumers' table. The postharvest losses in both quantity and quality lead to substantial profit gaps among farmers. Improved processing, storage, and direct marketing will help farmers to increase their profits. Effective farmer organizations such as cooperatives can assist farmers in postharvest processing and marketing. For better grain quality and higher head rice yield, production and

post-production practices have to be improved. Harvesting, threshing, cleaning, drying, and parboiling/ drying are labour intensive. These operations must be carried out at the right time to minimize losses and to ensure good grain quality resulting in higher price to farmers for their produce and better price for consumers.

## UTILIZATION OF BYPRODUCTS

Rice byproducts viz., rice straw, rice hull, and rice bran provide additional income to farmers and/ or traders. Utilization of rice hull in rice hull stove, rice hull briquette; rice hull ash and cement for hollow blocks; rice hull mulch for cut flower gardens and mushroom culture. Rice


straw for animal fodder with urea treatment. It can also be used for various industrial uses in packaging, mixing in soil for soil health. Rice bran for oil extraction is more rewarding.

## VALUE ADDED QUALITY PRODUCTS

Value addition also enhances the profitability of rice production. Value-added products from organic rice and therapeutic value medicinal rice, basmati varieties have good niche in domestic and export markets. A wide range of value added products like processed and canned, ready-to-eat products, vitamin, iron or calcium enriched flaked or puffed rice, flavoured rice, starch extraction from broken rice are nowadays getting popular.

## POLICY ASPECTS

The Government policies should be effected in terms of input output pricing, institutional support and to re-address the needs of rice farmers in order to complement the technological gains. The interventions like improving irrigation facilities, river linkage, subsidy to small and marginal farmers of rainfed ecology, decentralization of supply of fertilizers to village markets by cooperative societies at village level and ensuring the availability of certified seed etc. will provide the environment to benefit from research investment, improve productivity, alleviate poverty, ensure systems' sustainability, protect the environment and provide food security.

Innovative approaches for bridging knowledge gaps among researchers, extension workers and farmers need to be carried out at national level to solve farmers' problems and speedy extension of new technologies. Krushi Mahotsav which was introduced in the Gujarat State Government since 2005 as an innovative approach in which agricultural scientists and officers have provided technical knowledge as well as shared information about Government schemes. Transfer of technology through online portals, 'apps' and FAQs having information on latest technology, current weather conditions and prediction, government schemes, APMC market prices of agricultural commodities on etc. will help in speedy and fair implementation of government schemes. ■

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President & CEO
DuPont South Asia

# INDIAN AGRICULTURE - WHAT AILS AND FAILS THE FARMER? AND A LOOK AT POLICY IMPERATIVES FOR SUSTAINABILITY IN AGRICULTURE

Come June, the most anticipated news in India is the arrival of monsoons and the promise it holds for the country's 119 million farmers and 144 million agricultural laborers directly involved with agriculture. The impact of a good monsoon could be felt in the collective sigh of relief heard,when IMD improved their long range forecast for this year to 98% and ruled out El Nino possibilities altogether.

With the monsoon going well, we may have a bumper production year in 2017-18, on the heels of a good 2016-17.In 2016, India produced its largest ever cereal food grain estimated at 273 million tonnes. We also saw bumper production in pulses, sugarcane and cotton. Agricultural budgets have gone up from Rs 16,646 cr to Rs 41,855 crore in the last 3 years. And the government has introduced many agro-centric initiatives like Pradhan Mantri Fasal Bima Yojana, Soil health cards, Pradhan Mantri Krishi Sinchayee Yojana and National Agriculture Market (eNAM). Minimum Support Price (MSP) for different crops have also been enhanced regularly. Our Prime Minister has also pledged to double farmers' incomes by 2022 and this certainly makes for a rosy picture.

## UNDERSTANDING WHY INDIAN FARMERS DON'T REAP WHAT THEY SOW

Despite this positive outlook, we recently saw intensive agitations across states. While farmers may have genuine reasons to protest and demand government support, often these protests are perceived as lawlessness by general public. We must remember though, that farming is indeed a tough job with earnings that hardly measure up to the hard work and toil involved. Infact, annual earnings of a 3-acre farmer are much lower than an IT sector or corporate newbie. For Indian farmers, this boils down to survival each season.

Today food production is not the trigger for an agricultural crisis. Global and local market volatility is the current bane. Global explosion in foodgrain production has changed the market dynamics leading to pressure prices on our produce. While produce prices are constantly under pressure, costs are rising everyday thereby impacting farmer's incomes, debt repayment capacity and their overall wellbeing. Making matters worse, farmers bear the entire risk in the farm to market cycle. Be it outbreak of pests at production or losses in storage & transport or price uncertainty while marketing, the risk is not distributed evenly amongst other stakeholders like grain traders, aggregators or processors.

Being an agricultural nation, our farmers deserve considerably more. To create a more enabling environment addressing the following priorities will form the core of any transformative reform agenda for agriculture in India:

1) Minimizing the risk for farmers and distributing it equitably across the agro-value chain.

2) Ensuring a fair share of the value that is generated at the end consumer level reaches the farmer.

## WHAT AILS THE INDIAN FARMER

Indian farmers require long term sustainable solutions instead of short term rhetorical promises and reactive concessions. This process involves recognizing and acting on the macro challenges listed below:

• **Weak Producer:** Consumer Linkages: There is a disconnect amongst what the Indian farmer produces and what the consumer demands. The farmer is not connected to aggregators, food processors and retail chains to help shape the nature of his produce. As a result, produce remains the same annually, largely dependent on farmers and is often driven by the government's MSP program.

• **Weak Supplier Power:** The farmer is barely empowered as a supplier. He continues to be small & marginal, inadequately resourced, ill-informed on markets and marketing, ill-equipped to manage risk, burdened with credit & debts and is dependent on traders to reach the buyers.

• **Overdependence on Agriculture:** 60% of the Indian population depends on agriculture for livelihood, while contribution to the national GDP through agriculture is only 14-15%. Clearly this is a recipe for unsustainable development.

• **Technology Starved:** The farmer is not equipped with the latest technology nor trained to adopt it fast. Lack of new technology solutions keeps the farmer from gaining an equal footing globally. Also, they have little control over driving development and change due to the involvement of multiple pressure groups such as environmentalists.

• **Commercial Agriculture vs Subsistence Agriculture:** Policy frameworks across different crops remain the same and do not enable any significant impact. Whether they are basic food grains, pulses and oilseeds that meet staple dietary requirements and food security needs of the country or commercial crops like cotton, sugarcane, chilies that feed into industries that produce consumable goods or even vegetables and fruits for domestic consumption

or export crops – the same broad stroke policy measures are used across each segment.

• **Low investment in Research & Development:** Less than 1% of the Agricultural GDP in India is spent on research. That is abysmal considering this sector is critical to food security of the country and provides livelihood to 60% of our population.

• **Lack of enabling infrastructure along the value chain:** There is a staggering lack of infrastructure across the entire agricultural value chain. To make matters worse, a perspective on how this can be fixed also does not exist.

## BREAKING THE VICIOUS CYCLE – FUTURE POLICY IMPERATIVES:

A long term strategic vision which puts in place a holistic framework is the need of the hour. Key areas that need to be addressed include'Increasing Supplier Power', the 'Producer – Consumer Linkages' and 'Customized Approach to Different Crop Groups'. These areas enabled with quality infrastructure, education, R&D, technology, marketing and risk mitigation etc. will give us the agricultural empowerment we need. Some solutions that could be considered as part of this framework are listed below:

**A 20 Year Vision & Implementation Road Map to enable suppliers:** Essential to this would be consolidation of farmers and their land into large groups without them losing land title. This will help in gaining collective scale and can be implemented in two ways

• **Large Farmer Producer Organizations (FPOs)** While there are some successful FPOs currently running, sustainability of operations in FPOs is still a question. What can help is ensuring that FPOs are properly networked and federated, regionally as well as centrally.

• Encourage **Land Banks** wherever possible, especially hills and semi-arid areas where farming is difficult. This may be more feasible in areas where fruits are grown. Individual farmers can form large land banks by depositing their land into a large pool and then cultivate as one body in a professional manner on predetermined price and other terms. This could be a partnership model between producer-supplier bodies on one hand and aggregators, retail chains, food processors, another buyer on the other hand making them a stakeholder in the bank.

**A comprehensive vision document to promote and establish direct linkages between growers and consumers:** A policy framework that promotes structured,direct linkages between professional aggregators, food chain collaborators, food processors with large FPOs/Land Banks will reduce uncertainties drastically. This will ensure a fair share of the value created at the terminal end insuring the farmer from concentrated risk.

**Roadmap that establishes a distinctive and customized policy approach for different crop groups.** Each crop group comes with its own set of distinct challenges. For instance, increasing export crop production requires a different mindset and policy prerogatives compared to basic food crops or other commercial crops. As a nation, we need to move from an 'Export what is Grown' ideology to 'Grow per international quality standards & Export'. Measures such as establishing AgroExport Zones that have an independent APEDA equivalent as an enabler will be key. A customized approach and policy framework is needed for each crop segment such as food crops, commercial crops and vegetable growing regions.

**Advance technology adoption** throughout the agro-value chain. Rapid technology upgradation to global standards need to be viewed as a top priority. Keeping current realities in mind, a complete overhaul of education in Agri Universities and research in scientific institutions need to be considered. R&D investments and capabilities in the sector must be enhanced substantially while bringing in transparency and accountability.

**State of the art infrastructure** in areas like storage & transportation, knowledge & information, credit & insurance etc. needs to be established.

**And lastly, a clear plan to reduce dependence on agriculture from an untenable 60% to a more sustainable 30%.** Agricultural policies would do well to address the need to make agriculture more efficient and less burdened. Also, enabling supporting professions for people looking for alternate careers would go a long way.

A revolution of the Indian agricultural sector is what the country is calling out for today. Not short-term fixes, but a long-term, strategic, sustainable vision based on the realities of 2017. Agreed, it is easier said than done. But if we can send space probes to Mars at first go, this should not be such a big deal after all, right? ■

# रामबाण

सफल किसान की पहचान...

## भारत का पहला ऑटोमैटिक तकनीक से बना
## दानेदार एस.एस.पी. खाद


## फसलों के लिए वरदान

16% फॉस्फेट NCS
11% सल्फर


उपजाऊ ज़मीन

उत्तम फसल

अधिक पैदावार

जुबिलैंट ऐग्री एण्ड कंज्यूमर प्रोडक्टस लिमिटेड

प्लॉट नः १५, नॉलेज पार्क - II, ग्रेटर नोएडा, (उ.प्र.)-२०१३०६

JUBILANT
AGRI & CONSUMER PRODUCTS

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# Challenges and Technology Options for Raising Agricultural Productivity

Agriculture continues to play an important role in Indian economy by providing employment and livelihood to majority of rural people. As against 4 per cent growth target for agriculture and allied sectors, the foregone years met with immense pressures to achieve this vision consistently. Nevertheless, food grain production in the country rose five-fold in a span of 66 years i.e. from 51 million tonnes in 1950-51 to around 275 million tonnes. This increase was mainly due to enhancement of both area and productivity of crops. The food grain yield per hectare increased from 522 kg to 2101 kg. This phenomenal growth was achieved due to application of improved technologies besides implementation of various agrarian development policies and programs, boosting of private investments in agriculture and rural infrastructure including irrigation and technological changes.

## FORESEEN CHALLENGES

The productivity of most of the crops such as rice, wheat, cotton and oilseeds in India though has increased overtime, is still much lower than that of many countries. Though the yield plateau has set in many of the food growing countries, India still fortunately hasn't reached this stage. The vast rainfed area in the country, particularly drylands, where mostly coarse cereals, pulses and oilseeds are grown are still low yielding. Despite superior nutritional qualities and climate resilience, the area under cultivation of these crops is declining owing to low productivity, high labor intensity, drudgery and lack of attractive farm gate prices. Any positive development in these tracts could lead to better livelihood of farmers.

The marginal and small farmers in this

country currently constitute about 85 per cent of operational holdings cultivating about 45 per cent of the land. The trend in small holding character of Indian agriculture is much more prominent today than before. There is always more pressure to develop strategies which suit the developments taking place in the land holding pattern.

Alkalinity and salinity problems are other challenges affecting about 8 million hectares of land. Another 7 million ha of land in the country is losing its fertility due to water-logging. Besides, the organic matter content of soil is also dwindling in many of the states.

The next major challenge posed to agriculture sector is lack or scarcity of water. Water, the elixir of life is a precious gift of nature to the mankind and millions of other species living on the Earth. It is fast becoming a scarce commodity in most parts of the world. As per global norms, a region is classified as "water stressed" if the per capita availability is less than 1700 $m^3$ per year and "water scarce" if the availability is less than 1000 $m^3$. India, with its present per capita availability of around 1700 $m^3$ is already water stressed and with projected reduced availability of 1401 $m^3$ and 1191 $m^3$ by 2025 and 2050 respectively, is destined to become water scarce.

Agriculture is one of the major users of available water and the irrigation efficiency ranges from 20 to 50 per cent. The average irrigation efficiency, at present, in canal irrigation system is less than 40 per cent and ground water irrigation system 60 per cent. Further, certain adverse developments like inadequate water availability, inter-state disputes over sharing of available water, reduction in storage capacity of tanks due to poor maintenance and upkeep, declining ground water table, break down or defunct traditional and local irrigation management institutions like Water Users' Association and discharge of industrial pollutants are other challenges threatening the survival of cultivable lands.

Climate change is found to have a significant impact on agriculture. Although food security is unlikely to be threatened at the global level, some regions are likely to experience food shortages and hunger. Various studies warn extensive warming could cause significant reduction in crop yield. If temperature rose by 4.0°C, the grain yield would fall by 25-40 per cent. This could exacerbate the efforts in achieving higher productivity levels and thus limits the agricultural growth. The agricultural research system therefore needs to be much oriented towards monitoring and evaluation of the climate changes and develop technologies and practices to suit such changes.

The share of public sector investment for the development of agriculture and allied sectors has been declining. Thus, the lesser contribution towards capital formation through public funding than that of private capital formation in agricultural sector is cause for concern as the country is still in short of agricultural infrastructure.

Given the above scenario of various hurdles posed to agriculture, the following strategies based on the technologies that could maneuver the situations are suggested.

## INCREASING CROP YIELDS

A systematic approach in crop planning based on Soil Test Crop Response (STCR) and Integrated Plant Nutrient System (IPNS), price forecast based acreage decisions, weather based crop advisory for input application decision etc. could pave way for scientific way of crop production. Further, new and innovative technologies like precision farming, protected cultivation practices like shade net cultivation, poly house and green house cultivation are also being encouraged to increase crop yields. The recent advances in biotechnology, nanotechnology and agronomical practices like precision farming, System of Rice Intensification (SRI) and Sustainable Sugarcane Initiatives (SSI) are some of the renewed scientific efforts to break the yield barrier and increase productivity in agriculture. Besides, biotechnology offers greater scope for improving agricultural productivity, environmental quality, and the nutritional quality of staple foods. At the same time, some applications of biotechnology raise concerns of safety, access, and equity in benefits. Development of biotechnology as a component of our strategy to increase agricultural productivity and economic growth hence, needs to be further explored.

## PROMOTION OF MILLETS AND PULSE CROPS

Region specific and block specific technology identification, extension of whole village concept, increasing area under millets by bringing fallow lands under cultivation, incentivizing of small entrepreneurs, formation of millet clusters will address the issues in millets production and demand. Further, Millets Mission and Initiatives for Nutritional Security through Intensive Millets Promotion (INSIMP) was also implemented under NADP (RKVY) to increase the area and productivity of millets.

The productivity of pulses is considerably low due to poor crop management and lack of irrigation. Pulse production could be increased by adopting precision farming, intensification of transplantation by providing incentives and adoption of System of Pulses Intensification (SPI) technology package, distribution of certified seeds, increasing area under rice fallow pulses, bund cropping and promotion of varieties having synchronized maturity.

## ULTRA-HIGH DENSITY ORCHARDS

High density planting or meadow orchard system is the fastest way of reducing the gestation period and increasing the productivity of the orchards. Fruit cultivation in particular can be revolutionized by the adoption of Ultra High Density Planting or Meadow orcharding, a system that heralds a new era for production of quality fruit crops in short span of time. Scientific maintenance of orchard is achieved through proper canopy management and use of bio-regulators to restrict the size and shape of the plants/trees for getting continuous yield. This technology also bridges the research gap on the strategies for increasing the yield and improving the fruit quality.

## PROMOTING INTEGRATED FARMING (IFS)

In Tamil Nadu, the small and marginal farmers, constituting about 83 per cent of total farmers, are cultivating nearly 56 per cent of land area. This unique situation coupled with weather aberrations and inadequate capital investment is limiting the farmers to raise their income levels. Besides, the increasing demand on agricultural lands for urbanization and industrialization prompt the rural population to migrate to urban centers. In this context, advocating IFS to the farming community is the only solution to generate sustainable income and employment opportunity at farm level besides augmenting per unit land productivity.

In traditional farming, farmer cultivate crops in addition to allied enterprises. However, due to mono cropping and commercialization, the crop enterprises are subject to risk and uncertainty. This led to reinventing of the traditional practice but in a scientific way. In addition to cropping, other complementary enterprises are found to be included scientifically in the farming system to utilize the available resources in a better way and to enhance farm income in a sustained way. By integrating various enterprises suitable for different ecosystem and available farm resources including family labor, the income of the farmers can be doubled besides ensuring livelihood security.

The different enterprises that can be integrated with cropping under wetland ecosystem are dairy, fishery, poultry, pigeon, mushroom cultivation and vermicompost. Under irrigated dryland ecosystem along with cropping, dairy, goat rearing, poultry, horticulture, apiary, sericulture and vermicompost are found promising and can be integrated. In the dryland ecosystem, the enterprises viz., cropping, horticulture, agroforestry, rabbit and sheep rearing can be integrated.

## INCREASING WATER USE EFFICIENCY

Area under irrigation can be doubled in the country without requiring extra water if one could attain water use efficiency level of countries like China, USA, and Brazil. We need to adopt irrigation technologies such as micro irrigation and management of water resources through Water Users Associations and adopt new agronomic practices for realising the goal of "per drop more crop".

## FARM MECHANIZATION AND FARM IMPLEMENTS

To cultivate a crop, the power requirement includes human labor, draft animal and machine. Small and marginal farmers need machinery and farm implements for timely sowing, management of weeds and improved post-harvest technology.

The major focus in agricultural engineering is mechanization, harnessing solar energy, soil conservation in river valley project, increasing the conveyance efficiency of irrigation water and ground water recharge.

Women play a significant role in agricultural and allied activities including crop and livestock production, post-harvest operations, agro/ social forestry, fisheries, etc. Out of the total labor force engaged for these activities, women's contribution is around 55 - 66 per cent. Women-friendly equipments / tools to minimize drudgery of farm women in the areas of seed sowing / seedling transplanting, inter-cultural operations, plant protection, harvesting and post harvesting operations in agricultural and horticultural crop production are essential which can reduce drudgery, save time and enhance output.

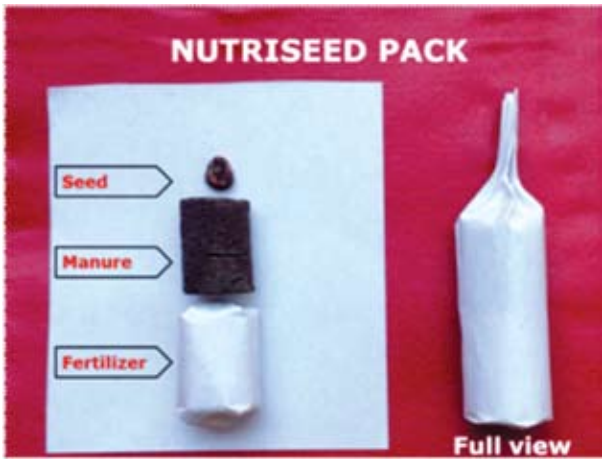
## ICT ENABLED AGRICULTURAL EXTENSION EDUCATION

There is wide gap between scientific know-how and its field level application through do-how. ICT is one of the innovative tools to reach the unreached in an efficient, effective and timely manner. ICT tools can be deployed for technology transfer, capacity building and market advisory. Various ICT tools are available to cater to the needs of small, medium and large farmers. The availability and affordability of mobile phones and internet connectivity gives scope for delivering quality services to the farming community for increasing the productivity of crops and allied activities. Government of Tamil Nadu leads the country in effective utilization of ICT tools in agriculture under AGRISNET platform. Tamil Nadu Agricultural University launched Agri Tech portal which disseminates all agricultural technologies to farming community and it further strengthens the Agriculture Extension delivery system. In order to implement farm level interventions through micro-level planning and execution, "Farm Crop Management System (FCMS)" software has been developed and launched in six districts of Tamil Nadu on pilot basis. It facilitates to narrow down the yield gap and easy access to information like weather, input availability, farm based interventions, market intelligence and scheme benefits besides farm plans and input requirement at farmer level. Such digital initiatives could solve most of the field oriented problems faced by the farmers.

## FRONTIER RESEARCH AND STATE OF ART TECHNOLOGIES

**Testing Plant – Microbe – Soil Interaction and breeding to Yield Sustainability**

Precise assessment of the plant-soil-microbe interactions in order to answer the key issues viz. phenome change of crop plants in response to microbial intrusions, effects of plants' small molecules and to understand the root metabolite and soil biochemical reactions as influenced by microbiome and the plant associated microbiome's influence on the availability of carbon, water and nutrients in the soil is very crucial. Rhizotron root-controlled with all probes and sensors for soil moisture will help to assess the interaction among the plant root – soil – microbiome of crop plants with anticipated benefits of isolating microbial inoculants for nutrient acquisition, drought mitigation, pest





and disease resistance. It will also help to assess the metabolites of roots inside the Rhizotron. Further research will help to reduce the use of synthetic fertilizer and thereby increase the profit as well as eco-friendly and a sustainable yield increase in crops.

## NUTRI-SEED

A Nutri-seed Pack contains seed at top, enriched manure in the middle and encapsulated fertilizer at the bottom. Nutri-seed Pack gives support for each plant in the root zone in terms of optimum nutrient supply, biological activity and consequently enables the fullest utilization of nutrients by plants. Nutri-seed Pack placement has been brought out as an alternative means of fertilization in crop production in the place of fertigation or surface broadcast. Yield improvement of 10 to 30 per cent for Nutri-seed Pack placement has been recorded in major cereal and vegetable crops over conventional method of fertilizer application. Nutri-seed Pack technique has been well tested in research trials and demonstration plots on crops like maize, rice, cotton, cauliflower, tomato, carnation and marigold and found to record more yield and profit over the conventional broadcast method of fertilizer application.

## DESIGNER SEED

The genetic improvements are continuously incorporated into crops and any achievements can be propagated and established in the field only through seeds. Usage of high quality seed is necessary as nothing will work upon a poor-quality seed, no matter how profusely other inputs are applied to such poor-quality seeds. Seed quality enhancement is application of physical, physiological, biological and chemical substances to the seed in order to enhance the potential of seed. Eventually, several seed quality enhancement treatments like seed priming, seed protection with insecticide and fungicide and bio-fertilizer biocontrol agent seed treatments specific to each crop seed have been developed. Designer seed is a seed enhancement treatment to integrate all the diversified treatments into a single entity so as to offer a comprehensive improvement in the seed germination, vigorous seedling growth and higher crop productivity. This concept is as an integration of seed priming treatment which increases speed of germination and germination percent, insecticide seed treatment to offer protection from insect pests, seed treatment with plant growth promoting substances of *Pseudomonas fluorescens* for growth improvement and biocontrol agent coating with *Trichoderma* so as to offer resistance against fungal pathogens and finally bio-fertilizer coating to provide efficient fixation of atmospheric nitrogen. The entire coating sequence is done by using seed coating polymers as an adhesive. Designer seed treatment has been developed for specific crops and it has been proven to improve the seed germination, seedling vigour, seedling health, crop growth and final crop yield.

Thus, research and the technology dissemination thereof plays a major role in facing challenges with appropriate strategies. Moreover, adequate infrastructure for post-harvest management and value addition has to be created. The support from the State and Central Government has to be enhanced. Such steps would further motivate the farmers to be an effective partner to achieve the National Goal besides ensuring the farmers with the additional benefits that could emerge out of their participation. ■

योगी आदित्य नाथ
मा. मुख्यमंत्री, उत्तर प्रदेश
मा0 अध्यक्ष, मण्डी परिषद

पंडित दीनदयाल उपाध्याय
1916 2016
जन्म शताब्दी वर्ष

श्रीमती स्वाती सिंह
मा. राज्यमंत्री (स्वतंत्र प्रभार)
कृषि निर्यात, कृषि विपणन एवं कृषि विदेश भवापार, उत्तर प्रदेश

सबल किसान-प्रबल प्रदेश

# राज्य कृषि उत्पादन मण्डी परिषद, उत्तर प्रदेश

किसान मण्डी भवन, विभूति खण्ड, गोमती नगर, लखनऊ

## आम निर्यात

- मण्डी परिषद, उ0प्र0 द्वारा स्थापित मैंगो पैक हाउस की लखनऊ व सहारनपुर में स्थापना।
- आम की तुड़ाई से लेकर सार्टिंग, क्लीनिंग, वाशिंग, ग्रेडिंग तथा पैकिंग तक सम्पूर्ण कार्य तकनीकी विशेषज्ञों की देख रेख में सम्पादित।
- उत्तर प्रदेश मण्डी परिषद द्वारा निर्यातकों/व्यापारियों को हवाई/समुद्री/सड़क मार्ग से आम निर्यात हेतु निर्यात मात्रा के आधार पर नियमानुसार परिवहन भाड़ा/ब्राण्ड प्रमोशन अनुदान।

## देय अनुदान धनराशि

| क्र. सं. | आम सत्र में निर्यातित आम की मात्रा | गैर रूपये पर देय परिवहन भाड़ा अनुदान (रू0 प्रति किलोग्राम) हवाई/समुद्री मार्ग | सड़क परिवहन से | ब्राण्ड प्रमोशन अनुदान राशि |
|---|---|---|---|---|
| 1 | 25 टन तक | 13.00 | 6.50 | 13.00 |
| 2 | 25 टन से अधिक परन्तु 50 टन से कम | 14.00 | 7.00 | 14.00 |
| 3 | 50 टन से अधिक परन्तु 100 टन से कम | 15.00 | 7.50 | 15.00 |
| 4 | 100 टन से अधिक | 16.00 | 8.00 | 16.00 |

## आलू विपणन/निर्यात

- आलू निर्यात को प्रोत्साहित किये जाने हेतु मण्डी परिषद के तत्वावधान में ''उ0प्र0 पोटैटो एक्सपोर्ट फैसिलिटेशन सोसायटी'' का गठन।
- गठित सोसायटी के अन्तर्गत पंजीकृत आलू उत्पादकों/निर्यातकों को उ0प्र0 में उत्पादित होने वाले आलू को ''ताज ब्राण्ड'' के उपयोग पर हवाई/समुद्री/थल मार्ग से निर्यात किये जाने की दशा में मण्डी परिषद द्वारा निर्धारित शर्तो एवं प्रतिबन्धों के अधीन ब्राण्ड प्रमोशन अनुदान एवं भाड़ा सहायता।
- प्रदेश के कृषकों/व्यापारियों को प्रदेश के भीतर या प्रदेश के बाहर 300 कि0मी0 से अधिक दूरी पर परिवहन करने पर परिवहन भाड़े का 25 प्रतिशत अथवा रू0 50/– प्रति कुन्तल, जो भी कम हो, अनुदान मण्डी परिषद द्वारा दिया जायेगा।
- उक्त प्रकार के परिवहन अथवा निर्यात पर मण्डी शुल्क एवं विकास सेस से छूट होगी। उक्त योजना 31 दिसम्बर, 2017 तक लागू रहेगी।
- आलू निर्यात हेतु परिवहन भाड़ा सहायता रू0– 2.00 प्रति किलोग्राम तथा ब्राण्ड प्रमोशन हेतु रू0– 00.50 प्रति किलोग्राम।

- राज्य कृषि उत्पादन मण्डी परिषद, उत्तर प्रदेश से आलू एवं आम निर्यात हेतु सतत् प्रयासरत है। निर्यातकों का उत्तर प्रदेश से निर्यात करने हेतु स्वागत है। आपको प्रदेश से निर्यात हेतु पूर्ण सहयोग प्रदान किया जायेगा।

Nawab Mangoes

## सम्पर्क करें:

दूरभाष संख्या: 2720383, 2720384, 2720405
टोल फ्री/हेल्प लाइन नं0: 155241 (समय– प्रात: 8.00 बजे से रात्रि 10.00 बजे तक)
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Taj Premium Quality Products

Ajay Shriram
Chairman and Sr Managing Director, DCM Shriram Ltd

# DOUBLING FARMER INCOME; FOCUS ON AGRICULTURE MARKETING

When we talk about agriculture it means different things to different sections of the society. For the government it is often about food security, for consumers it is about availability of food items at reasonable prices, for industry it means a source of raw materials as well as a buyer of agricultural inputs, but for 600 million people in our country it is a source of livelihood. With about half of our country dependent on agricultural income, this aspect needs some serious attention. It is more so because over the last several decades, the terms of trade have become unfavorable, and a typical farmer's income is approximately one third of the non-farmer. Therefore the clarion call given by the Prime Minister to double farmer income is critical for the well being of our nation.

There are no simple answers and action is required on several fronts. It will entail productivity improvement, access to new technologies, increased irrigation, farm mechanization, focus on soil fertility and so on. However, with the emphasis on farmer's income, just higher output will not suffice. What is required is a concerted effort towards better price realization for farm produce as well as risk mitigation.

Is this doable without compromising consumer interests? There is a perception that it is zero sum game and better prices offered to farmers will be at the cost of consumers, particularly urban consumers. Conversely, when consumer prices fall, there are reports of farmers' distress and dumping of produce at abysmally low prices. I believe this pattern needs to be, and can be broken. My belief is reinforced by the many success stories around us, and we need to build and tweak the models for more widespread adoption. So my hypothesis is that better price realization, access to markets and risk reduction is the centre piece in doubling farmer income.

Lets us first look at a few success stories and then suggest some steps for the way forward. Middlemen are often seen as the villain, responsible for many ills. While this may or may not be true, we need alternative and financially viable supply chains before middlemen can be substituted. Let us look at four commodities where direct buying from farmers has had huge benefits.

**Milk:** The white revolution story is both well known and well documented. However that model has now been adopted and improved upon by private sector

as well as multinationals. With the rapid increase in demand for dairy products, processing companies have built supply chains to source milk directly from farmers. They have installed equipments and made arrangements at the village level to receive milk, which is weighed and checked for quality. This is recorded transparently in the presence of the farmer and his payment credited to the bank directly, within a week. This has resulted in a steady and reliable source of income, particularly to marginal dairy farmers.

**Sugarcane:** Let me share a story from

our own sugar mills at DCM Shriram Ltd. Smt. Puspa Devi's village falls in the catchment area of DSCL Sugar –Rupapur, and is actively involved in sugarcane farming. She takes pride in showing the healthy standing crop. According to her, lack of proper knowledge and unavailability of high yielding variety seeds and transparent buy back arrangements made her loose both money and interest. After motivation from our cane team, she agreed to adopt the technology of sugarcane production, high yielding varieties were arranged for her, trench method of planting adopted, and soil health improvement activities were undertaken. Sugarcane productivity increased from 360 qtls per hectare to 1000 qtls per hectare in two years and she is hopeful of achieving 1500 qtls per hectare in season 2017-18. With guaranteed buy back, her income increased three fold! She is very happy with the timely agronomic advisory given by the cane team at the Rupapur Sugar Factory.

**Poultry:** Poultry farmers, particularly those rearing broiler chicken were always a nervous lot. Price fluctuations were notorious and it was not unusual for prices to dip below production costs. Access to funds was limited and therefore the option to scale operations and derive efficiencies was not there. The international practice of integrating the supply chain took root in India about 15 years ago and has since helped the industry grow rapidly to global benchmarks. The integrators have taken on the responsibility for supplying all the inputs, such as day old chicks, feed, medicines, etc. The farmer is now just responsible for growing the birds as per norms, and is promised a pre agreed conversion

charge. With this step, the farmers' price risk and marketing risk was eliminated and is assured of a steady income stream.

**Vegetables:** This is a relatively difficult area because of variability of produce, but here also companies like Mother Dairy Fruits and Vegetables Ltd in Delhi have been able to safeguard the growers' income. This is achieved by tying up with farmer groups on a pre-agreed schedule for supply of vegetables. The company picks up the entire lot and arranges the logistics till the final consumer. Prices are declared as per an agreed formula that the farmer understands, and his bank account is credited based on volume and quality.

There are many more models, to name a few, grape farming in Maharashtra, seed production in the whole country, basmati cultivation

in north India and so on. I have deliberately mentioned sectors of agriculture that now represent the bulk of agricultural output in value terms, and not covered grains. Grain farmers are relatively less vulnerable due to government intervention through MSP etc. In all the above examples, farmer's income has gone up considerably through a combination of agricultural advisory, guaranteed buy back, transparent practices and risk mitigation measures. The question to ask is where do we go from here?

Many experts have studied the problem and the solutions are largely known. What is more encouraging is that the political environment or "mahaul" as they say in Hindi is also favorable. Let us break the steps required into four key interventions.

## MARKET INTEGRATION

Agri Markets are fragmented because of area restrictions imposed by APMC and this has had a negative impact on competitiveness. The creation of a futures commodity exchange gave the first framework of a national unified market. The Government of India's Economic survey encouraged the creation of a single market and this resulted in the concept of e-NAM, a pan India electronic market for farm produce. The true uniqueness is that it requires a single license per state and no physical location in market yard. The roll out has been rapid and impressive, and already 455 Mandis in 13 States out of a total of 580 Mandis are displaying the e-NAM sticker. This is just the starting point and transactions are still far and few, mostly within a Mandi, instead of across all India Mandis. The reason for low adoption is that the supporting infrastructure of grading, quality testing and certification is not in place. The government needs to actively encourage the private sector to provide this. Payment systems too need to be fine tuned so that it happens instantly as farmers are often used to cash transactions.

As things fall in place, competition amongst buyers will enhance farmer realization, ensure transparent price discovery and reduce transaction cost.

## CONTRACT FARMING

There was some reluctance to accept the idea of contract farming a few years back, but it is again gradually finding favour amongst policy makers. This see-saw is primarily because it was poorly understood and viewed through a legal lens. This idea has been successfully practiced in India since quite some time. In addition to examples given earlier, other instances include SAB Miller for Barley, McCain for potatoes and various specialized items such as medicinal plants, organic cotton and so on. Farmers adopted this arrangement as it lowered the market risk, with the contracting firm committing in advance to buy farmers' produce at a pre determined price and within a reasonable range of quality parameters. In addition farmers gained from technical advisory services. There has been some concern that contract farming terms are loaded in favour of the corporate, while others claim that farmers may not always comply with agreed terms. Our own experience and view is that these are minor teething troubles, compared to the overwhelming benefit. Eventually contract farming works because it is a commercially win-win for both parties and not because of fine print clauses written in the agreement. In fact the proposal to bring in a central contract farming law is probably not necessary; what is required is tacit encouragement by state governments. What the Governments need to appreciate is that the option

of treating a farmer, however small, unjustly, is not in the self interest of any corporate and therefore they should not worry on that account.

## FARMER PRODUCER ORGANIZATIONS

The underlying philosophy for promoting FPOs was to overcome disadvantages farmers face due to the small size of their operations, both while buying inputs as well as at the time of selling their output. In addition, the legal framework was designed to overcome the short coming of a traditional cooperative. In actual practice the success of FPOs has been below expectations because they often lacked a clear objective or strategy for product development or marketing. Without bringing value addition, there is little chance of financial sustainability. Government subsidies and schemes to keep FPOs afloat are neither doable nor desirable. However FPOs are too important an idea that can be allowed to fail. FPOs should be enabled to identify specific opportunities, set achievable business targets, and develop skills. They should be encouraged to do primary processing, packaging and other value additions. For this capacity building of the management team and the CEO is a key detriment for success. Government should therefore rope in private sector experts to take up capacity building programmes to impart technical expertise and managerial skills to FPOs. Private sector can then partner FPOs and link them with either food processing units or inputs suppliers.

## MARKET INFRASTRUCTURE

This covers a wide gamut of facilities some of which include, warehousing, cold chain, grading services, futures trading, and so on. What is however sometimes under-appreciated is the importance of all weather village roads and 24/7 electricity. Lack of these two basic needs results in high transport cost and value loss, particularly for perishable items like milk and horticulture produce. The negative impact is high transaction cost, which is all borne by the farmer. To draw an analogy, what GST has done to movement of goods across states in terms of reducing cost and transit time; reliable power and all weather roads can facilitate quick evacuation of output from the fields. This will result in produce reaching the consumer with lower logistic cost and in better condition.

Agricultural marketing is a complex task given the diverse nature of produce and dominance of small farm sizes. The answers are not simple, but directionally we are making progress. Some solutions have been listed above, but they are by no means exhaustive. Encouraging FDI in multi-brand retail by removing the restrictive clauses can help quickly establish supply chains that will further benefit farmers.

There is a need for collective effort by Government, private sector and universities. The changes in regulatory environment are positive and need to be pushed further for incentivizing investments. Banks will need to be more receptive in developing innovative products for the emerging financing needs. Finally, the day a single license suffices to market and trade agricultural products across the country, we can then truly say that the process of liberalization that commenced in 1991 has come a full circle. Farmers and consumers can both benefit by capturing value that currently vanishes into thin air. ■

# "DOUBLING THE FARMERS' INCOME" – THE ROAD AHEAD FOR FARMERS PROSPERITY

R. G. Agarwal
Group Chairman,
Dhanuka Agritech Limited

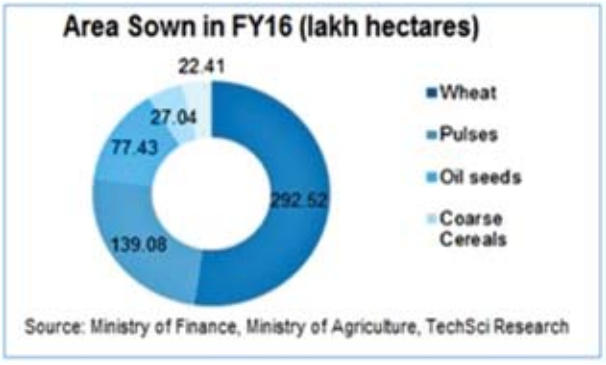
In early years of our independence, agriculture was practiced at subsistence level due to absence of technical know-how and low farmers resource endowments. The arable area under irrigation was approximately 18.1 %, and < 2 kg/ha N+P+K was used in 1950-51. Thus, the food grains production was merely 50.8 million tonnes to feed around 361.1 million population. In 1960s, we lived a ship-to-mouth existence and Ships from USA loaded with wheat would dock at our ports, and the grain was channelled straight to ration shops.

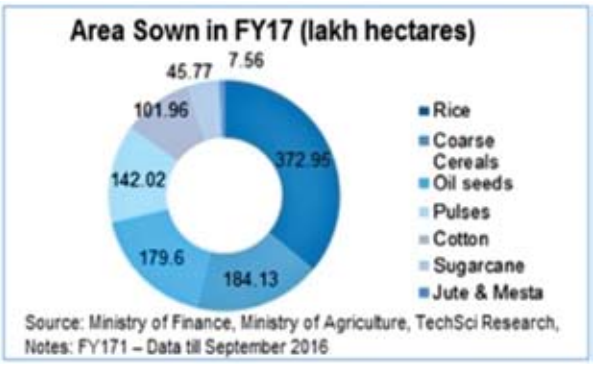
Due to impetus on producing more, the country introduced high-yielding varieties from 1965s onwards. The high production potential input responsive HYVs motivated farmers to adopt improved production technologies with the use of water, fertilizers and agrochemicals. Besides the public sector rural infrastructure, farmers developed their own 'on farm' resources. The extension support for production technology and the marketing support through procurement operations encouraged farmers to step up production. Therefore, the country moved to self-sufficiency by achieving crop productivity. This helped to come out of dependence on imports.

Of-late there had been technology fatigue as there was stagnation in food-grains yield, especially from 2001-02. However, due to focus on increased production, favourable policy, assured minimum support price (MSP), the country achieved over five-fold food-grains production in 2015-16 over 1950s. It is expected that India's GDP would be 7.1 per cent in FY 2016-17. Agriculture, Horticulture, Dairying, Poultry, and fisheries are one of the largest contributors to the Gross Domestic Product (GDP). As per the 2nd revised estimates by the Central Statistics Office, the share of agriculture and allied sectors (including agriculture, livestock, horticulture and fishery) is expected to be 17.3 per cent of the Gross Value Added (GVA) during 2016-17 at 2011-12 prices.

Doubling farmers' income by 2022, when the country will be celebrating 75 years of independence is the major agenda of the NDA led Government. However, the most difficult question is 'How', when the Indian agriculture is growing at present slowly, and facing the challenges to produce more from less for more to meet the needs of the growing human and animal population under fast diminishing arable area and water resources.

India has a capacity to achieve the target of doubling Farmers' Income by 2022 as envisaged by the Hon'ble Prime Minister by integrated implementation of several policy decisions. For the sake of proper appreciation, let's compare



some of the important aspects in India vis-à-vis China. During 2014, China GDP in Agriculture was 1036 billion dollars and of India 356 billion dollars; India's net sown area was 191 million ha as against 167 million ha of China. Fertilizers and chemical pesticides use in China was 2.1 and 21 times more respectively, than India. This very clearly shows a direct association between extent of agri inputs use and agriculture production. It is a matter of pride that India's GDP which was just 100 billion dollars in 2000, has reached to 356 billion dollars, and one-third contribution was from horticulture and vegetables, one-third from Dairying, Poultry and fishery sector, and the remaining from cereals. This amply shows that if farmers are provided improved location-specific technology, doubling the farmer's income can become a reality.

## INTEGRATED CROP MANAGEMENT FOR HIGHER YIELDS AND HIGHER INCOME

Everyday farmers face many challenges on field and with the in-depth knowledge and optimum resource utilization they try to fix it as well. Dhanuka Agritech Limited is advocating 'Dhanuka Kheti Ki Nai Takneek (DKKNT)', a holistic approach o f Integrated crop Management for higher yields and in turn income. DKKNT focuses on complete end to end farming solutions which help in boosting the production and increasing the farmer income.

Placing profound emphasis on soil testing, Dhanuka group runs one soil testing mobile van in Rajasthan in Public Private Partnership with Government which helps farmers to test their soil and apply fertilizers in accordance. We are also promoting

Pradhan Mantri Fasal Bima Yojana (PMFBY), the flagship scheme of government of India in various platforms for minimizing the risk of farmers.

Since the seed replacement rate in our country for most of the crops is low, the Govt. of India in 2008 launched 100% seed treatment campaign. Since then, the Dhanuka Group is providing machines for seed treatment at the farmer's door-step.

During the first green revolution era the chemical pesticides use was catalytic in bringing out appreciable growth in foodgrains production. At present, the arable area is fast decreasing, and there is emergence of new pests due to intensive agriculture and climate change. Therefore, the challenge is how to 'produce more- from less- for more'. It is estimated that around 20 to 30 % are avoidable crop losses due to pests, though the range was 8 to 90 % depending upon crop, season and severity of pest attack (IARI, 2008). The average cost: benefit ratio of chemical pesticide use is 1:5. In terms of money (at present MSP),

the loss would be about Rs 4 lakh crore per annum. Such a colossal loss can be minimized by judicious use of pesticides, and which is an economically viable option-every one rupee spent can give return of rupees five.

Our Group advocates safe and judicious use of pesticides, following the recommended dose and application methods. Trainings and demonstrations are regularly organized to upgrade skills in handling spray pumps, selection of appropriate nozzle, safe storage of pesticides, disposal of containers after use, precautions for the person handling pesticides. It is to be highlighted that there is very stringent procedure laid out by the Central Insecticides Board & Registration Committee (CIB&RC), Govt. of India, to be met before it allows registration of any pesticide in India.

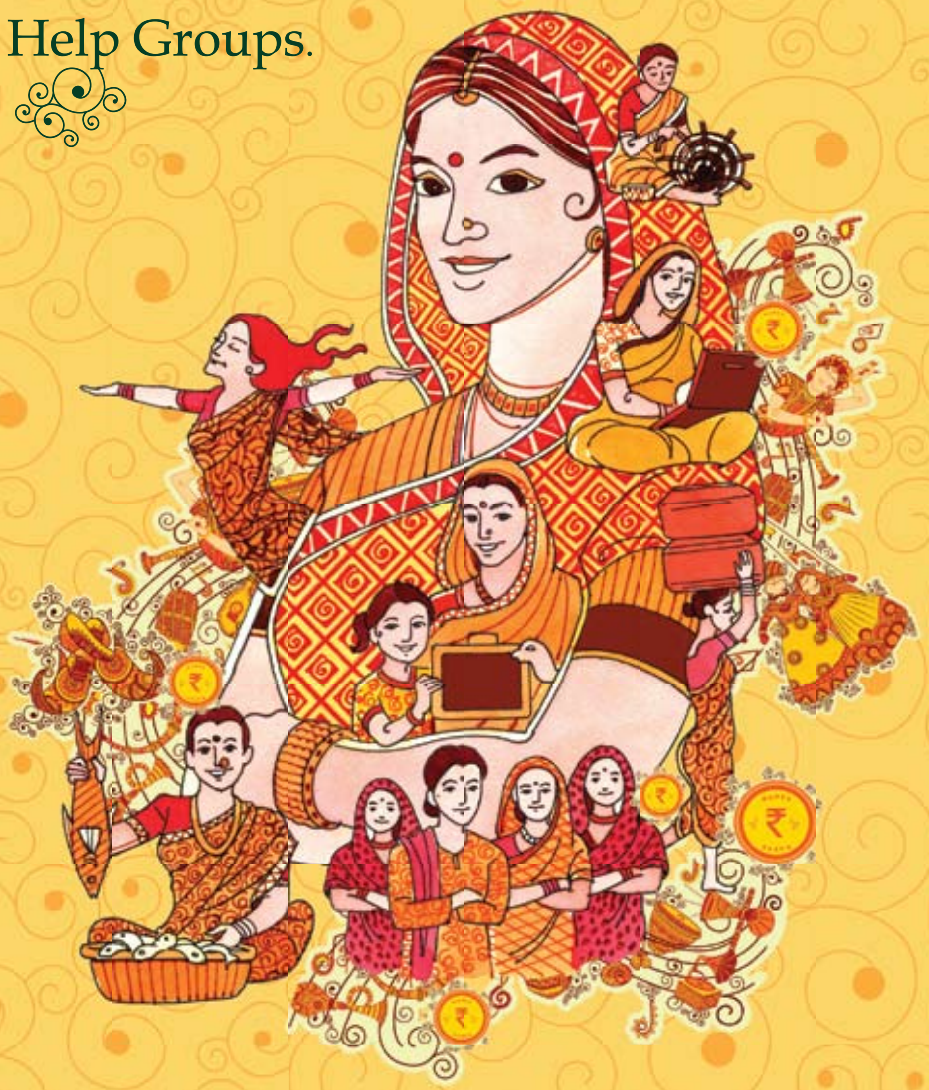
In order to save the environment, we are also educating our farmer community not to burn the crop stubbles in the field. Instead plough it in the field to enhance soil physical conditions and fertility. Crop stubbles burning is one of the major source of air pollution. Burning of farm waste causes severe pollution of land and water on local as well as regional scale. Burning of crop residue also contributes indirectly to the increased ozone pollution. It has adverse consequences on the quality of soil, as the existing micro flora, and minerals present in the soil get destroyed, adversely hampering the soil fertility. Again, Dhanuka Group is actively involved in creating awareness of the effect of residue burning and educating the farmers for adoption of zero tillage practices.

In additional we are promoting farmers to create Self – Help – Group for capturing the big market for their produce. They may create farmers produce organization and sell their produce directly to the end consumer. This has been seen many states especially in Punjab, Maharashtra and southern part of India.

## THE WAY FORWARD

The Central Insecticides Board & Registration Committee, Govt. of India has prescribed very stringent procedure for registration of any pesticide. However, the time involved in this process is very long, it is proposed that registration be expedited so that the new molecules are made available timely. Often there are press and media reports against pesticide use based on unscientific facts. The Govt. may launch an intensive campaign of educating the public at large by bringing scientific facts. Since input dealers remain primary source of information to the farmers, it is necessary to upgrade their capacity for providing credible information through DAESI course at all the SAUs. Intensive training for farmers for encouraging safe and judicious use of pesticides needs more impetus. It is expected that integrated policy frame-work implementation will lead to the country becoming food and nutritionally secured nation by 2022. ■

# Celebrating 25 Years
## of Women Empowerment through Self Help Groups.




Foundation Day Celebrations 2017

- Self-managed, door-step, savings-led largest microfinance programme in the world.
- Partnership with Banks, NGOs & NRLM.
- Focus now on digitizing the SHGs.

NABARD

CONCEPT


- राज्य में वर्ष 2022 तक कृषकों की आय दुगुनी करने का रोडमैप तैयार कर क्रियान्वयन की त्वरित कार्यवाही।
- स्वायल हेल्थ कार्ड योजना के प्रथम चरण में शत्-प्रतिशत लक्ष्य पूर्ति कर देश में अग्रणी स्थान।
- खरीफ 2016 में प्रधानमंत्री फसल बीमा योजना अंतर्गत 49 प्रतिशत क्षेत्र को बीमा की परिधि में लाया गया।
- नीति आयोग द्वारा राज्यों की उत्कृष्ट गतिविधियों के प्रकाशन **"State forward"** में राज्य की **"PPR Vaccination in Pulse Mode"** शामिल।
- राष्ट्रीय कृषि बाजार से संबद्ध प्रदेश की 14 मंडियों में क्रय-विक्रय प्रारंभ।
- छः मंडियों में किसान उपभोक्ता उपमंडी प्रांगण की स्थापना।
- प्रदेश के 5 जिलों एवं 22 विकासखंडों को शत-प्रतिशत जैविक किए जाने राज्य शासन दृढ़ संकल्पित।
- 2003-04 से 2016-17 तक उद्यानिकी फसलों के रकबे में 9 गुना वृद्धि।
- साग-सब्जी के गुणवत्ता युक्त पौध वितरण हेतु 4 प्लग टाईप तथा 19 मिनी प्लग वेजीटेबल सीडलिंग प्रोडक्शन युनिट की स्थापना।
- मत्स्य बीज उत्पादन तथा अंतर्देशीय मत्स्य उत्पादन के क्षेत्र में देश में पांचवा स्थान।
- इंदिरा गांधी कृषि विश्वविद्यालय को आदिवासी जिलों में सर्वश्रेष्ठ अनुसंधान कार्य के लिए वर्ष 2016 में ''फकरूद्दीन अली अहमद पुरस्कार'' सम्मान।
- सूचना एवं प्रौद्योगिकी मंत्रालय भारत सरकार द्वारा इंदिरा गांधी कृषि विश्वविद्यालय को सर्वश्रेष्ठ ''ई-गर्वनेंस मॉडल'' अवार्ड।

**छत्तीसगढ़ शासन**
**कृषि एवं जैव प्रौद्योगिकी विभाग**

# SEEDS

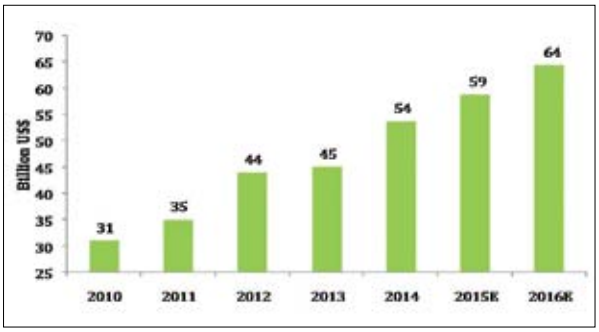
# Indian Seed Market

The seed industry has witnessed a substantial change in the past century, with farmers relying on purchasing seeds from market with better traits rather than relying on seeds from previous season's harvest. Developments in seed technology have increased the momentum of the industry's growth, and the introduction of genetically modified crops has further boosted the seed market. The value of global seed market has tripled since 2000 and reached US$ 54 billion in 2014.

## GLOBAL AND INDIAN SEED MARKET

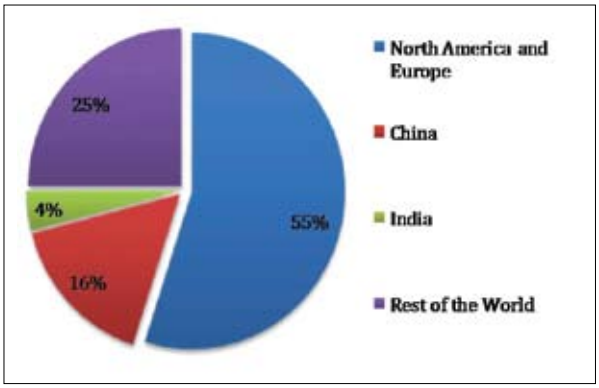
The global seed market is segmented into North America, Europe, Asia-Pacific, South America, and Africa by Geography. North America occupies the largest market share and together with Europe it constitutes 55% of the global seed market. Asia-Pacific is seen as the fastest growing segment with a CAGR of 7.9%, followed by South America during 2015-2020. China is the second biggest seed market in the world, right behind the United States. However, India also has a significant share of 4% in the global seed market.

**GLOBAL SEED MARKET**




*Source: NSAI, Company Reports and ICFA*

**GLOBAL SEED MARKET BY REGION; 2015**



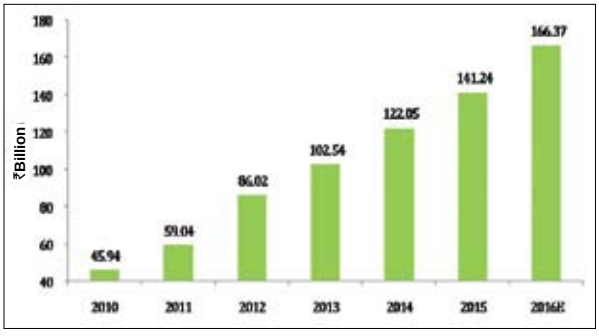

*Source: NSAI, Company Reports and ICFA*

## INDIAN SEED MARKET

The Indian seed industry, over the years, has evolved by adopting and innovating upon scientific advancements in variety development and quality seed production. The industry has grown at a rapid pace of 20.59% over the period 2010-2015 and reached Rs. 141.24 billion in 2015 on account of rapid adoption of Bt cotton hybrids, single cross corn hybrids and hybrid vegetables.

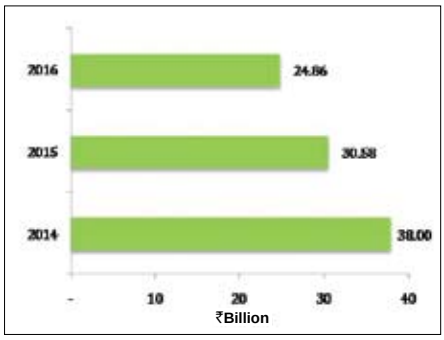
Rising awareness among the farmers related to the benefits of using certified/ quality seeds has led to an increase in the demand for seeds over the past few years. This has resulted in an increasing willingness among the farmers to pay higher price for quality seeds.

**INDIAN SEED MARKET**




*Source: NSAI and ICFA*

**INDIAN COTTON SEED MARKET**




*Source: NSAI and ICFA*

## INDIAN COTTON SEED MARKET

Cotton is one of the most cultivated crops in India, with great economic importance attached to it. The cotton seed market was valued at Rs.24.86 billion in India in 2016. India is also the second largest producer of Cotton worldwide. Since 2002, Bt Cotton has steadily prevailed over India's Cotton fields raising overall cotton production. Today, over 90% of Cotton grown in India is cultivated by using Bt Cotton seeds.

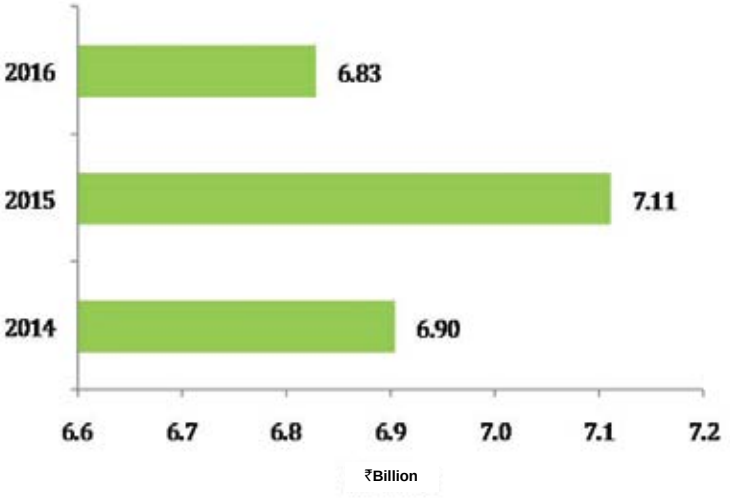
There are very few countries in Asia and Africa which allows commercial cultivation of GM crops and hence Cotton seed export has not been picked up in last decade. Now with more countries opening up for GM cultivation, there exists huge potential to export Cotton seeds from India.

## INDIAN MAIZE SEED MARKET

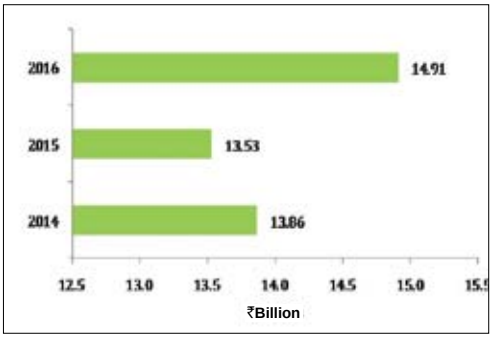
Maize is one of the largest consumed commercial seed, accounting for Rs.14.91 billion of revenue in 2016. The growth in maize is attributed to its increased use as livestock feed and in ethanol production.

Presently, approximately 25% of maize is used as food grain, while remaining 75% is used to meet non-food demand, viz. bio-fuels, poultry feed, animal feed, brewing alcohol, starch based wet milling industries and other industrial uses. However, the enhanced investment in maize by global seed companies would flow into India through technology transfer and Public-Private Partnerships in the next fifty years to develop maize.

**INDIAN MAIZE SEED MARKET**




**INDIAN MAIZE SEED MARKET REVENUE**



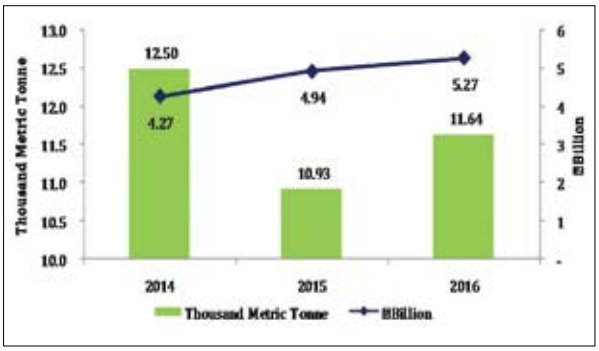

*Source: NSAI and ICFA*

## INDIAN HYBRID RICE SEED MARKET

Government of India has not fixed any target for increasing acreage of hybrid rice in the country. However, efforts are being made to promote cultivation of hybrid rice through various crop development programmes such as National Food Security Mission (NFSM), Bringing Green Revolution to Eastern India (BGREI) and Rashtriya Krishi Vikas Yojana (RKVY).

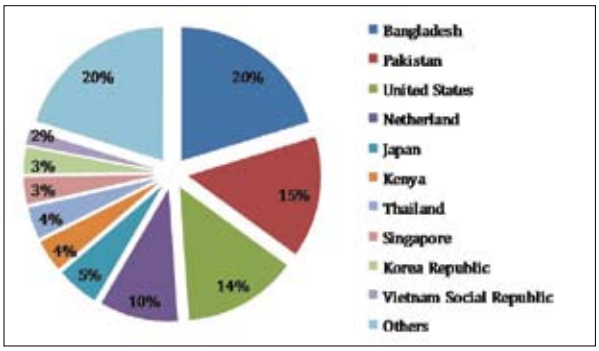
With private sector playing a major role in Hybridization of Rice, the hybrid rice seed market has touched more than 45 thousand metric tonnes volume sale in 2016. The growth in 2016 can be attributed to significant increase under Kharif acreage of rice due to abundant rainfall, after a consecutive two years of drought and growers shift from Inbred to Hybrid due to problems faced last year with OPV's.

**INDIAN FRUITS AND VEGETABLE SEED MARKET EXPORTS**

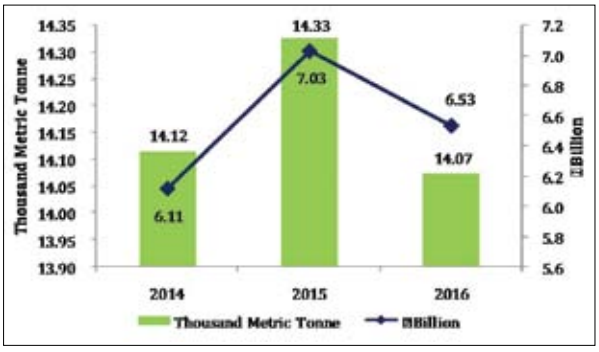



*Source: APEDA*

**INDIAN FRUITS AND VEGETABLE SEED MARKET EXPORTS BY COUNTRIES; 2016**

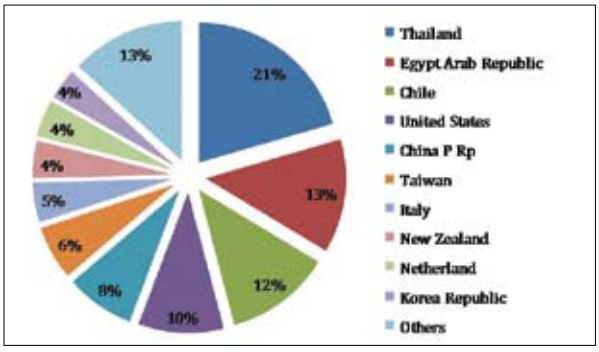



**FRUITS AND VEGETABLE SEED IMPORTS**




*Source: APEDA*

**FRUITS AND VEGETABLE SEED IMPORTS BY COUNTRIES; 2016**




## INDIAN SEED MARKET TRADE

Being agriculture based country; India is probably best placed to cater to not only domestic but also global seed requirements. Its importance is also reflected by its overall position in the global seed trade. In case of fruits and vegetables, India ranks at number 16 in the global fruits and vegetable seed exports with only 1.68% share of the global trade in 2014-15.

Although, there is a substantial increase in India's export of fruits and vegetable seeds in value, India has already started to lose a large share of such exports over the past few years.

Lack of appropriate policy reform in Indian seed sector can be one missing element, which are discouraging exporters and producers to engage more in export of fruits and vegetable seeds. It is also needed to see whether the bargaining positions of other countries have improved or they have taken any competitive advantage or market imperfections of India has increased in recent years. However, India's imports of the fruits and vegetable seeds have depicted a declining trend in 2016, when compared to 2015. This decline is reflected not only in quantity but also in value terms.

The major countries exporting fruits and vegetable seeds to India in 2016 included Thailand, Egypt, Chile, United States and China, accounting 64% of the total imports of fruits and vegetable seeds, amounting to Rs.4.16 billion in India.

The Indian seeds market is anticipated to grow at a considerable CAGR rate due to improvement of seed replacement rate, production and distribution of quality seeds appropriate to agro-climatic zone at affordable prices along with a determined effort to address region specific constraints. Moreover, several factors, including increased subsidies and renewed government thrust on the use of high yielding varieties, will lead to an increased productivity in the seed market. ■

Dr. G.L. Keshwa
Vice-Chancellor,
Agriculture University,
Kota, Rajasthan.

# QUALITY SEED FOR DOUBLING FARMERS' INCOME

The importance of quality & viable seeds has been realised by man kind long ago because seed in agriculture production is considered as the key component and basic input for enhancing agricultural production and productivity. The efficiency of all other agricultural inputs, such as nutrients, pesticides, irrigation etc. as well as the impact of agro climatic conditions, is largely determined by the quality of seed used. The estimated contribution of seeds in the productivity is considered to be 20-25 per cent depending on crops. Saving of some best portion of produce as seeds for next cropping season or year in various structures is a very common and age old practice of Indian farming community. Therefore, ensuring the availability of quality seeds to enable farmers to double agriculture income is a strategic requirement.

The green revolution that took place in 1965-66 in India has given new heights to agriculture production which was also mainly based on the use of qualitative seeds of high yielding varieties, which solved the problems of food grain deficiency in India.

Introduction of high yielding varieties during sixties was the result of long sighted vision and that has changed the fortune of agriculture in the country. The vision to make India self reliant was materialized by policies that exhorted and elevated India's domestic agriculture.

The Seed Act was formulated in 1963 to regulate the minimum, physical and genetic purity of seed and came into force in 1966. Simultaneously in 1963, National Seed Corporation (NSC) was created with the objective to undertake production of Foundation and Certified seeds of different crops and at present NSC is undertaking production of Certified seeds of nearly 600 varieties of 60 crops through its registered seed growers with the turnover of Rs. 890.03 Crores during financial year 2014-15. However, in India to meet out the demand of quality seeds of farmers, responsibility collectively lies with the both Central and State (governments) i.e. the ICAR, State Agricultural Universities, Public sector, Cooperative sector and Private sector institutions.

The seed industry in India has now emerged as one of the important sectors in Indian industry. Today Indian seed industry is ranked 5th in the world with the share of 4.7 per cent in the global seed production next only to US (28.1 %), China (21.2 %), France (8.4 %) and Brazil (6.2 %). In recent years, the private sectors have started to play a significant role in the production and distribution of seeds. The organised sectors, both private and public, contribute about 30-35 per cent of the total seeds.

The Indian seed industry grew at a compound growth rate of 8.04 per cent in terms of volume from 2009 to 2015 to reach 3.5 million tonnes in consumption.

In terms of overall demand and supply scenario,

**SEED PRODUCTION OF MAJOR CROPS IN INDIA** (metric tons)

| Year | Breeder Seed | Foundation seed | Certified seed |
|---|---|---|---|
| 2005-06 | 6823 | 74800 | 1405000 |
| 2010-11 | 11921 | 180640 | 3213592 |
| 2011-12 | 12338 | 222681 | 3536200 |
| 2012-13 | 11020 | 161700 | 3285800 |
| 2013-14 | 8229 | 174307 | 3473130 |
| 2014-15 | 9849 | 157616 | 3517664 |
| 2015-16 | 8621 | 149542 | 3435248 |

**REQUIREMENT AND AVAILABILITY OF CERTIFIED / QUALITY SEED OF HYBRIDS**

(in '000 tones)

| S. No. | Crop | 2011-12 | | 2012-13 | | 2013-14 | | 2014-15 | | 2015-16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Req. | Av. | Req. | Av. | Req. | Av. | Req. | Av. | Req. | Av. |
| 1. | Paddy | 9.9 | 9.2 | 31.6 | 31.4 | 42.8 | 34.2 | 15.1 | 19.5 | 38.5 | 61.4 |
| 2. | Maize | 101.7 | 122.0 | 97.0 | 103.5 | 94.0 | 9.6 | 93.5 | 106.9 | 101.6 | 120.5 |
| 3. | Jowar | 13.1 | 13.9 | 13.3 | 14.0 | 7.9 | 10.2 | 15.6 | 19.0 | 17.7 | 20.0 |
| 4. | Bajra | 24.6 | 28.4 | 24.0 | 27.1 | 23.6 | 33.2 | 21.0 | 24.8 | 24.1 | 26.6 |
| 5. | Sunflower | 6.9 | 9.6 | 6.4 | 6.6 | 4.9 | 5.4 | 2.9 | 3.0 | 4.4 | 4.6 |
| 6. | Castor | 3.4 | 4.5 | 4.0 | 4.3 | 3.4 | 4.3 | 7.1 | 8.4 | 6.0 | 6.1 |
| 7. | Cotton | 19.5 | 22.5 | 29.4 | 25.4 | 15.9 | 17.9 | 17.9 | 21.7 | 18.7 | 19.8 |

*Req.= Requirement, Av.= Available*

the Indian seed industry appears to be self sufficient in number of crops.

The country has a liberal seed export policy which is being linked with the long term plan for export of seeds. At present India's share of global seed market is less than 2 per cent. However, the national seed policy envisages a 10 per cent share of global market in the decade to come.

The establishment and maintenance of the seed bank programme has been re-structured as the national seed reserve for implementation during the remaining period of 12th plan with effect from 2014-15 to 2016-17. The basic objectives of the scheme are to meet the requirement of seeds of short and medium duration crops during natural calamities and unforeseen conditions. The national seed reserve programme is implemented by 22 implementing agencies in the country including NSC, SSC and Agricultural Universities.

**SEED PRODUCTION OF AGRICULTURE UNIVERSITY, KOTA FROM 2013-14 TO 2016-17**

| Year | BS | TL | FS & CS | Total |
|---|---|---|---|---|
| 2013-14 | 4214.4 | 4726.43 | 1570.25 | 10511.08 |
| 2014-15 | 3982.95 | 4613.09 | 1706.21 | 10302.25 |
| 2015-16 | 4925.83 | 2592.97 | 1846.24 | 9365.04 |
| 2016-17 | 7971.95 | 5325.20 | 774.09 | 14071.24 |

The seed forms a crucial and unavoidable component of agriculture. It convert the resources and labour into fruitful harvest. In fact, the response of all other inputs depends on the seed and seed is the centre of food security. Seed, the starting point of agriculture has become a potential tool that decides the direction and condition of agriculture. It has become the carrier of not only the rudimentary plant itself but also the technologies that decide the output. The years of intensive technologies up-dation has perfectly upgraded the seed potential to feed the fast growing population of the country.

Hence it is needed to raise the seed replacement rate from currently 15% to at least 25% to meet the doubling of farmer income from agriculture and to check the spread of spurious seed. Government of India had framed and brought out different legislations including seed Act to protect the quality of seed and planting materials. ■

*Agriculture University, Kota*

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# Adani Agri Logistics Limited

Food grains play an essential role in nourishing the nation's populace. Therefore it needs special care like proper storage and transportation. For taking care of these special needs, Adani Group, one of India's fastest growing business houses has set up seven base and field depots spread across the length and breadth of the country, coupled with specially designed top loading and bottom discharge rail wagons. The sole objective of this project is to provide comprehensive supply chain management solutions to FCI- Food Corporation of India. These depots are fully mechanized using state of the art technology for storing food grains. Fully integrated and IT enabled operations make sure that there are no lapses in quantity and quality of grains, and transparent transactions are carried out at all stages.

## Salient Features:

- AALL handles 5,55,000 MT of food grain for FCI in the states of Punjab, Haryana, Tamilnadu, Karnataka, Maharashtra and West Bengal. Another 3,00,000 MT of food grain is handled for Govt. of Madhya Pradesh.
- AALL is expanding its footprints across India by setting up more projects in Punjab, Haryana, Bihar & Uttar Pradesh.
- Wheat is stored in GI Sheet (Steel) silos. The silos are fully covered and have an elaborate system for preservation of wheat.
- High-end monitoring equipment's for checking critical quality parameters like moisture content, foreign matter, live infestation etc.
- Central Control System using state of the art PLC systems, for automatic operations of the facility.
- Modern cleaning and drying operations, through sieves, magnetic separators etc. to remove dust, tailings and other foreign matter.

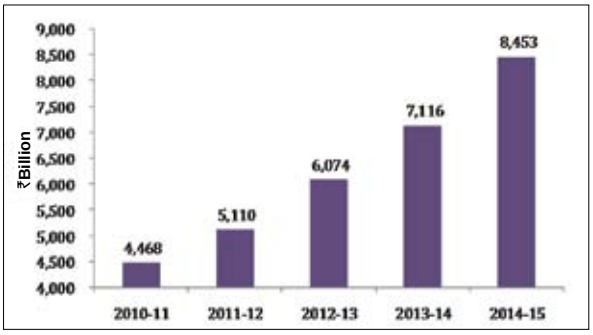
**Adani Agri Logistics Limited**
Adani House, Plot No. 83, Institutional Area,
Sector-32, Gurugram. 122001 Haryana
Phone: +91-124-2555555 Fax: +91-124-2555113

# AGRICULTURE CREDIT

# Agriculture Credit in India

Since Green revolution, the investment requirements for cultivation has continuously increased, as almost all inputs like seeds, pesticides, fertilizers, motor pump sets, tractors, pipe lines, etc., are to be purchased and several other services such as tractors, sprayers, rotors, harvesters etc.,are to be hired from the market. The agricultural credit in India increased at a CAGR of 13.6% from Rs. 4468 billion in 2010-11 to Rs. 8453 billion in 2014-15.

**Total Agriculture Credit in India**




*Source: Department of Agriculture, Cooperation & Farmers Welfare*

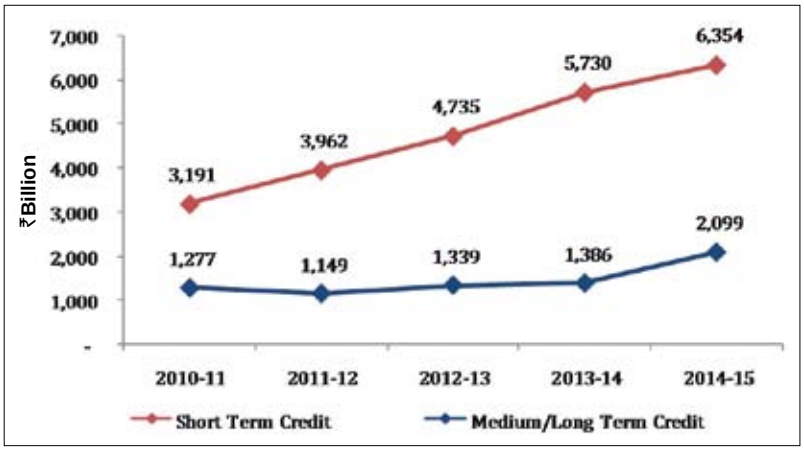
## AGRICULTURE CREDIT TYPES

Considering the period and purpose of the credit requirement of the farmers of the country, agricultural credit in India can be classified into three major types, namely, short term, medium term and long term credit.

The Indian farmers require credit to meet their short term needs viz., purchasing seeds, fertilizers, paying wages to hired workers etc. for a period of less than 15 months. Such loans are generally repaid after harvest and are called short term credit. In fact, the proportion of such loans has been quite high as compared to the medium term/long term credits. The increase in the short term credit loans was at a CAGR of 14.77% during 2010-2014.

Medium term credit includes credit requirement of farmers for medium period ranging between 15 months and 5 years and it is required for purchasing cattle, pumping sets, other agricultural implements. Medium term credits are normally larger in size than short term credit.Farmers also require finance for a long period of more than 5 years for purposes such as buying additional land or for making any permanent improvement on land like sinking of wells,

**Total Agriculture Credit in India by Type**




*Source: Department of Agriculture, Cooperation & Farmers Welfare*

reclamation of land, horticulture etc. This type of loan is called long term credit.There has been significant increase in medium/long term credit to Rs. 2,099 billion in 2014-15 from Rs. 1,277 billion in 2010-11, at a CAGR of 10.45%.

## SOURCES OF AGRICULTURE CREDIT

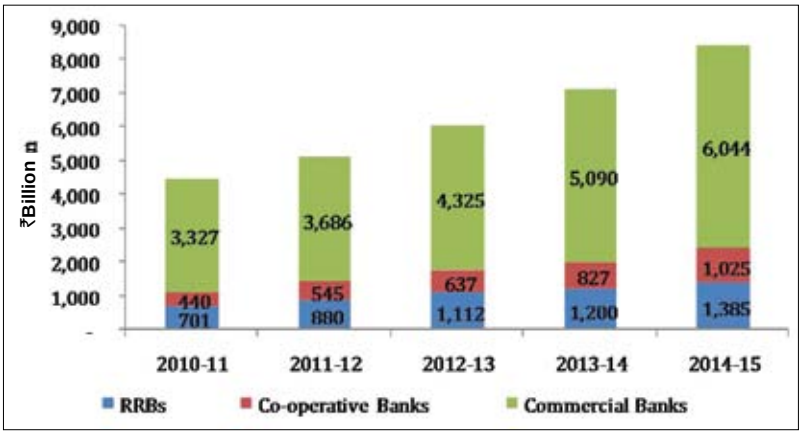
The major institutional credit agencies in India are Commercial Banks (CBs), Regional Rural Banks (RRBs) which are mainly sponsored by the Scheduled Commercial Banks and state governments. There are also the Cooperative Banks which are further divided into rural cooperatives and urban cooperatives. Rural cooperative banks further differ based on the time periods of loan. The short term structures of loans are provided by the State Cooperative Banks, District Central Cooperative Bank (DCCB) and Primary Agricultural Credit Societies (PACS). The long term structures of loans are provided by State Cooperative Agricultural and Rural Banks (SCARDBs) and Primary Agricultural and Rural Development Banks (PARDBs).

There have been changes in relative share of sources of institutional credit. It is observed that after the nationalization of commercial banks of India in 1969, the commercial banks as a whole have increased consistently its share in institutional credit to agriculture sector from 38.4% in 1980-81 to 71% in 2014-15. Resultantly, the relative share of co-operative societies declined from 61.6% in 1980-81 to 12% in 2014-15.

## STATE – WISE AGRICULTURE CREDIT

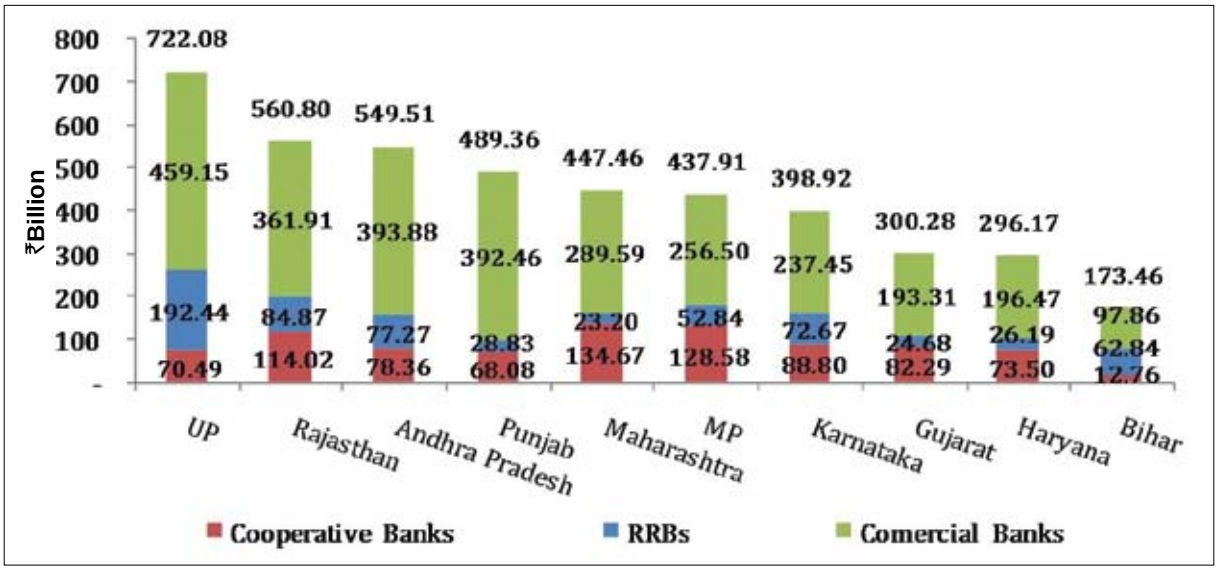
In recent years, the disbursement of agricultural credit has reached a new

**Total Agriculture Credit in India by Source**




*Source: Department of Agriculture, Cooperation & Farmers Welfare*

**Top 10 States with Maximum Amount Outstanding as on 31st March 2015**




*Source: Department of Agriculture, Cooperation & Farmers Welfare*

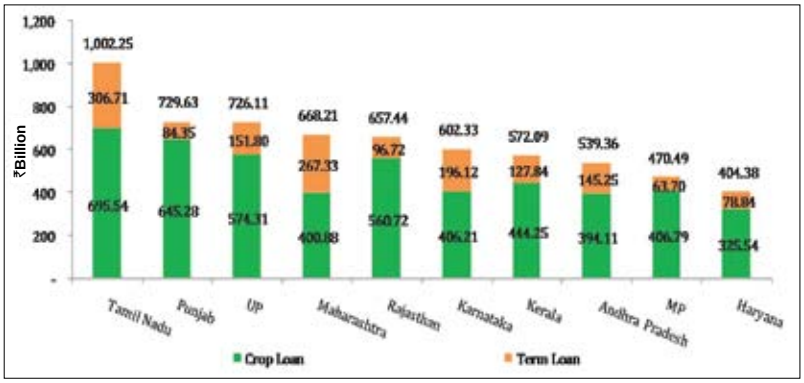
dimension. Co-operatives, commercial banks and Regional Rural Banks (RRBs) are advancing both short-term, medium term and long term credit to Indian farmers to help them adopt modern technology and improved agricultural practices for raising crop productivity and production.

The government provides short-term crop loans up to Rs.3 lakh at subsidized interest rate of 7% per annum. An additional incentive of 3% is provided to farmers for prompt repayment of loans within due date, making an effective interest rate for them at 4%. The states with maximum loan disbursements in 2014-15 were Tamil Nadu, Punjab, Uttar Pradesh, Maharashtra and Rajasthan.

The total agricultural loan outstanding as on 31st March 2015 stood at Rs.5,203.07 billion. The agricultural loan outstanding stood at Rs.758.93 billion with regional rural banks, Rs.1,096.87 billion at cooperative banks and Rs.3347.27 billion at commercial banks.

Access to finance, especially by small holders, is crucial for improved agricultural performance. Credit flow doubled in the Eleventh Plan but mainly by credit deepening, with little increase in farmer coverage and still leaving 60% of farmers without institutional credit. There are several ways in which credit access can be widened. Primary Agricultural Co-operative Societies (PACS) still have the widest coverage and must be made more members driven and less dependent on higher tiers. Joint Liability Groups (JLGs) are still the most appropriate mechanisms for farmers and livestock owners who have productive assets but cannot access credit because they have no land records, are located too far from banks or have last mile problems. The SHGs Bank Linkage programme is still the most appropriate financial mechanism to extend credit to marginal and dry land farmers as this allows better income smoothing since SHGs provide space for diversity in loan purposes and sizes, enabling financing for a variety of activities that such families select as part of livelihood strategies when income from agriculture is low. ■

**Top 10 States with Maximum Agriculture Loan Disbursement in 2014-15**




*Source: Department of Agriculture, Cooperation & Farmers Welfare*

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**Features**

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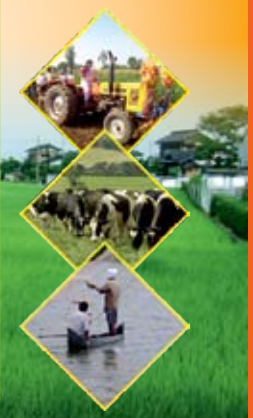
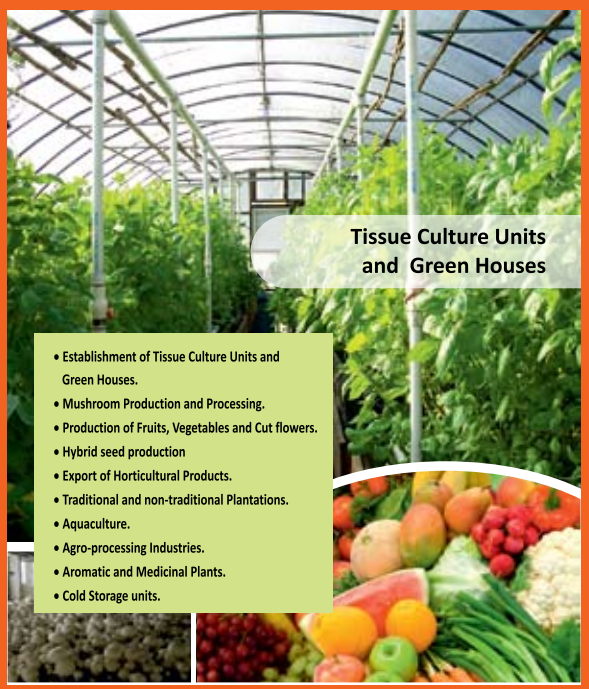
- SKCC is in the nature of revolving cash credit facility
- Rupay Kisan card will be issued to SKCC farmers
- Limit is valid for 5 years with annual review
- Repayable within 12 months for short duration crops,18 months for long duration crops.
- Interest subvention of 2% is available from GOI up to Rs. 3.00 lakh
- Personal accident insurance cover is available up to Rs.50,000/-
- Additional Personal Accident Insurance Cover for Rs.1 lakh for Rupay card holders



## Schemes for Hi-Tech Agriculture



**Tissue Culture Units and Green Houses**

- Establishment of Tissue Culture Units and Green Houses.
- Mushroom Production and Processing.
- Production of Fruits, Vegetables and Cut flowers.
- Hybrid seed production
- Export of Horticultural Products.
- Traditional and non-traditional Plantations.
- Aquaculture.
- Agro-processing Industries.
- Aromatic and Medicinal Plants.
- Cold Storage units.

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# Crop Insurance in India

Crop insurance in general has not been so successful across the globe in different countries. Policy makers have unrolled various avatars of crop insurance in different times. Considering the unique nature of Indian agriculture and inequitable socio-economic status of Indian farmers, crop insurance has remained a failed attempt in general. Even after repeated revision of the schemes and huge support in the form of premium subsidies for the farmers, crop insurance has failed to produce the desired results. Even after more than decades of existence of crop insurance in some form or the other, it has only reached just a small percentage of the farmers.

## NATIONAL AGRICULTURAL INSURANCE SCHEME (NAIS)

The Scheme was introduced during Rabi 1999-2000 season replacing Comprehensive Crop Insurance Scheme (CCIS). The Scheme was implemented by Agriculture Insurance Company of India limited, on behalf of Ministry of Agriculture. The main objective of the Scheme was to protect the farmers against the losses suffered by them due to crop failure on account of natural calamities, such as drought, flood, hailstorm, cyclone, fire, pest/ diseases, etc., so as to indemnify the losses and restore their credit worthiness for the ensuing season. The Scheme was available to all the farmers both, loanee and non loanee irrespective of the size of their holding. The Scheme envisages coverage of all crops including cereals, millets, pulses, oilseeds and annual commercial and horticultural crops in respect of which past yield data is available.

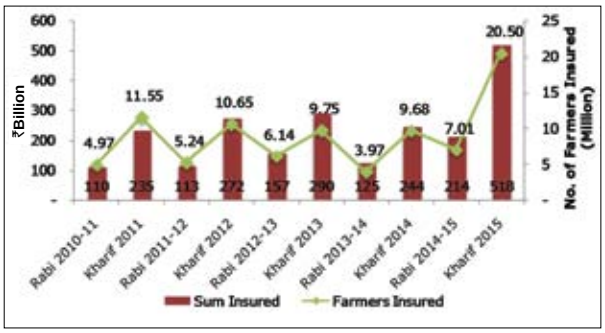
Under National Agri Insurance Scheme, except for

**CROP INSURANCE INITIATIVES/SCHEMES**

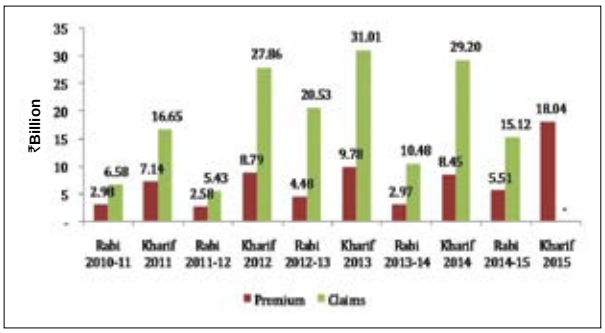
| S.No | Time Frame | Initiative/Scheme |
|---|---|---|
| 1 | 1971-1978 | First individual Approach Scheme |
| 2 | 1979-1984 | Pilot Crop Insurance Scheme (PCIS) |
| 3 | 1985-1999 | Comprehensive Crop Insurance Scheme (CCIS) |
| 4 | Rabi 1999-2000 to Rabi 2013-14 | National Agricultural Insurance Scheme (NAIS) |
| 5 | Rabi 2010-11 season | Modified National Agricultural Insurance Scheme (MNAIS) |
| 6 | 2007-08 | Weather Based Crop Insurance Scheme (WBCIS) |
| 7 | 2009-10 | Coconut Palm Insurance Scheme (CPIS) |
| 8 | 2016 | Pradhan Mantri Fasal Bima Yojana (PMFBY) |

*Source: Department of Agriculture, Cooperation & Farmers Welfare*

**Sum Insured and Farmers Insured under NAIS**




**Premium and Claims under NAIS**



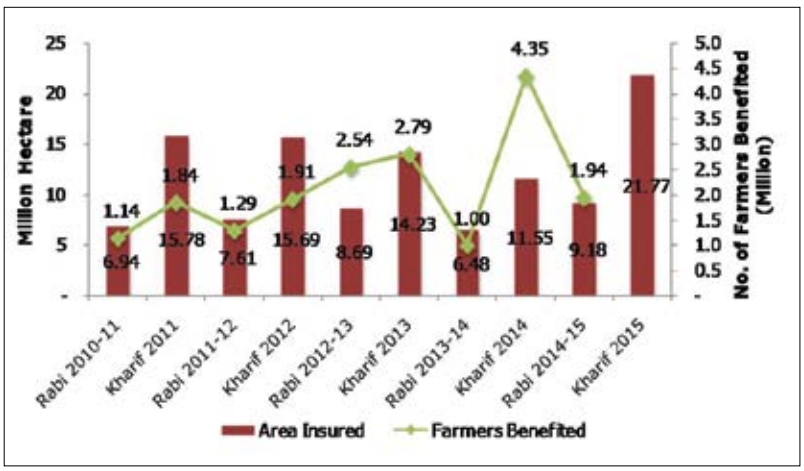

*Source: IRDA Journal*

Rabi season of 2013-14, the number of farmers covered by the scheme witnessed consistent growth, and during Rabi 2014-15, a total of 7 million farmers were brought under the crop insurance scheme and the total sum insured during this season was Rs. 213.80 billion. The coverage of Kharif crops exhibited rapid growth as during Kharif season of 2012, about 10.6 million farmers were covered with a total sum insured of Rs.271.99 billion. The number of farmers covered almost doubled to 2 million during Kharif 2015 with Rs.518.48 billion as the total sum insured. As per administrative approval from GOI, 10% subsidy is to be provided to small & marginal farmers in premium amount in Rabi-Summer, 2015-16 season shared equally by State and Central Government.

Every year since its launch, huge amount of claims were made as losses caused to agricultural production by farmers. Premium collected for Rabi 2014-15 season was Rs.5.51 billion and the total claims during the same season was a staggering Rs.15.12 billion.

When premium collected and total claims are compared to the number of farmers being covered and the area covered, it reveals quite an interesting trend. The area covered under the scheme decreased from 15.69 million hectare in Kharif 2012 to 11.55 million hectare in Kharif 2014,while the claims increased from a total of Rs.27.86 billion in Kharif 2012 to Rs.29.20 billion in corresponding Kharif season of 2014. This indicates at several possibilities like severe weather failure during 2014 in general, severe weather failure in some pockets and can also include possibilities of corruption and fraud where there have been illegitimate claims.

**Area Insured and Farmers Benefited under NAIS**



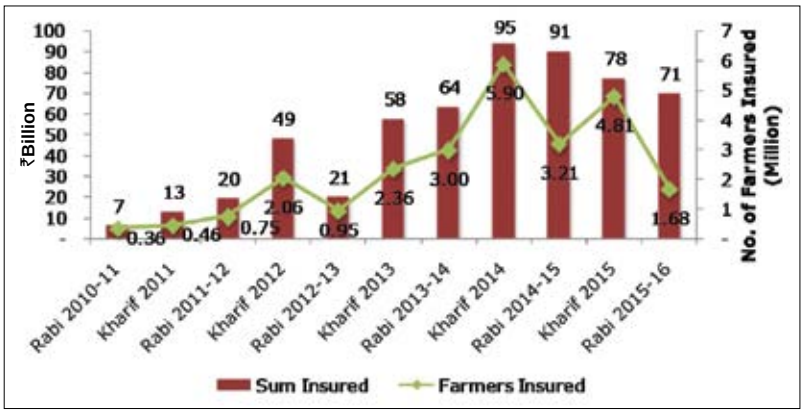

*Source: IRDA Journal*

## MODIFIED NATIONAL AGRICULTURE INSURANCE SCHEME (MNAIS)

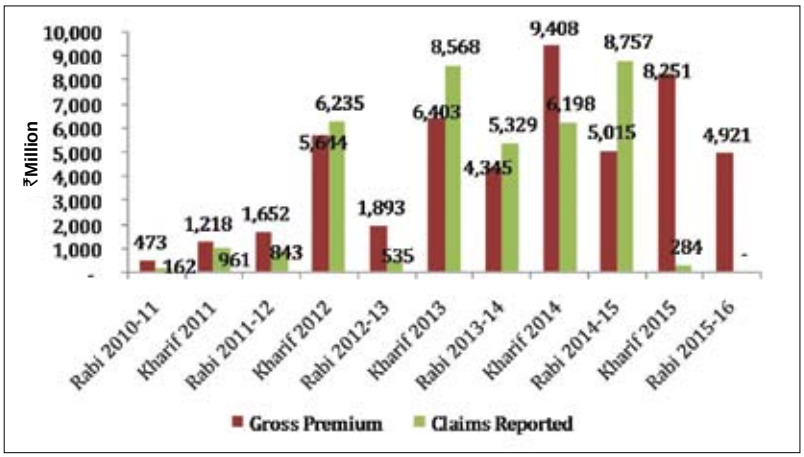
The Scheme before incorporation in NCIP was piloted from Rabi 2010- 11 to Kharif 2013. The modified version has many improvements viz., Insurance Unit for major crops are village Panchayat or other equivalent unit; in case of prevented / failed sowing claims up to 25% of the sum insured is payable, post-harvest losses caused by cyclonic rains are assessed at farm level for the crop harvested and left in 'cut & spread' condition up to a period of 2 weeks in coastal areas; individual farm level assessment of losses in case of localized calamities, like hailstorm and landslide; on-account payment up to 25% of likely claim as advance, for providing immediate relief to farmers in case of severe calamities; threshold yield based on average yield of past seven years, excluding up to two years of declared natural calamities; minimum indemnity level of 80% is available (instead of 60% in NAIS); and premium rates are actuarial supported by up-front subsidy in premium, which ranges from 40% to 75%, equally shared by Centre and States.

The study of figures about number

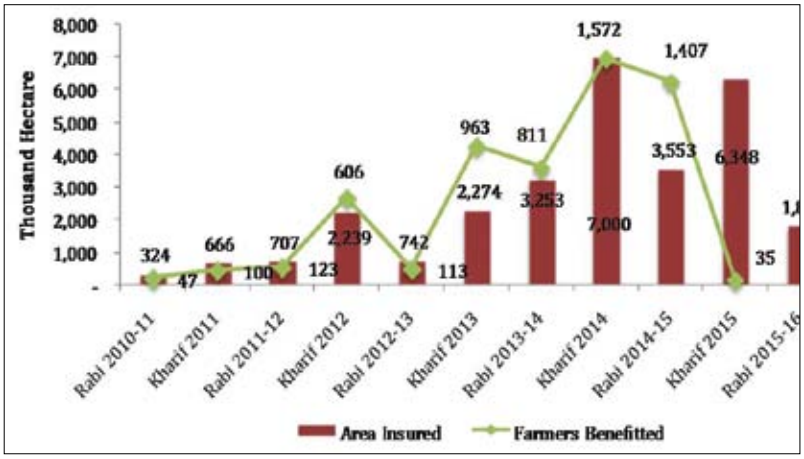
**Sum Insured and Farmers Insured under MNAIS**




**Gross Premium and Claims Reported under MNAIS**




**Area Insured and Farmers Benefited under MNAIS**




***Source: IRDA Journal***

of farmers covered and sum insured under the Modified National Insurance Scheme reveals that the highest increase was witnessed in Rabi 2014-15 when the number of farmers opting for the insurance scheme was 3.21 million and sum insured was Rs.91.08 billion. The figures for Kharif farmers showed a similar trend. However, the figures fell down to 4.81 million farmers and Rs.78 billion as sum assured during the Kharif season of 2015.

A study in terms of premium v/s claims reported reveals that farmers are perhaps realizing the benefit of agriculture insurance schemes and perhaps getting used to insurance, even if it means later that no crop loss or damage occurred due to any natural or biological disasters.

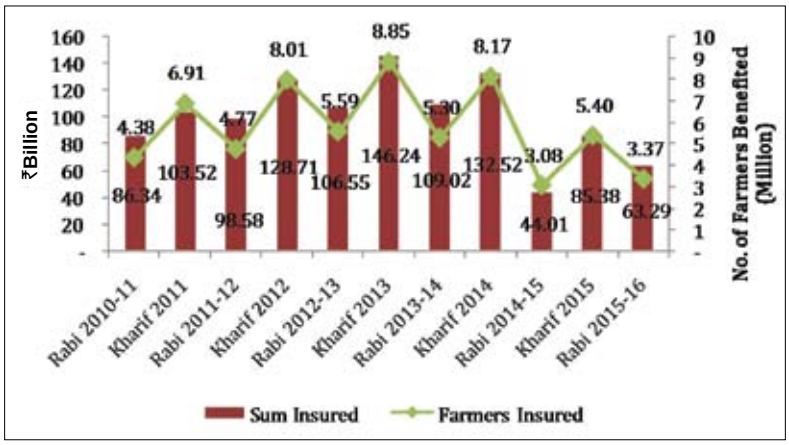
While number of Kharif farmers have benefitted from the scheme have always been higher when compared to the Rabi season. However, 2014-15 was an exceptional one when perhaps due to extreme weather calamity, the number of claims were more from the Rabi season farmers than the Kharif season ones.

## WEATHER BASED CROP INSURANCE (WBCI)

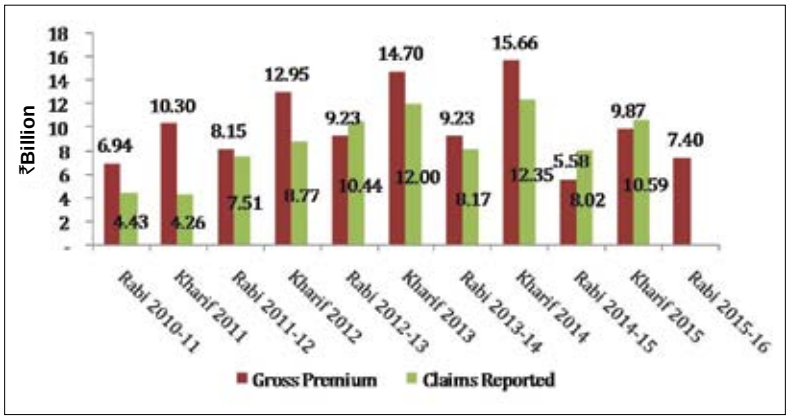
Weather Based Crop Insurance that was introduced in 2011-12 on a pilot basis with an aim to make it more convenient for the farmers to avail crop insurance appeared to have received good response from the farmers.

The following graph depicts the number of farmers insured along with the sum insured during each cropping season.

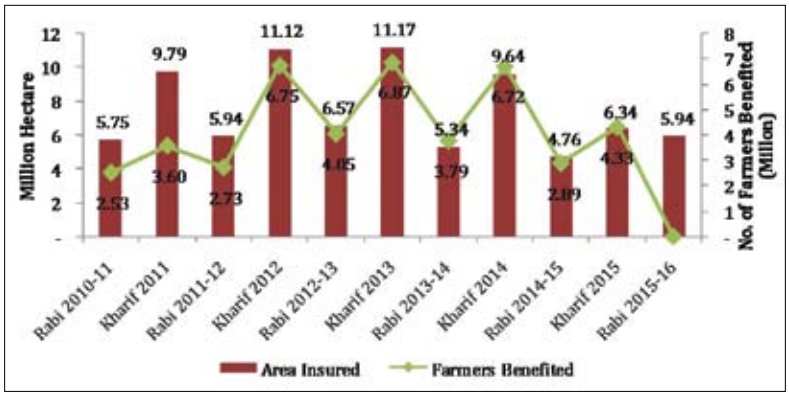
**Sum Insured and Farmers Insured under WBCI**




**Gross Premium and Claims Reported under WBCI**




**Gross Premium and Claims Reported under WBCI**




***Source: IRDA Journal***

Gross premium and claims reported continued to increase till Kharif 2014 when the gross premium and the total claims reported for this season was Rs.15.66 billion and Rs.12.35 billion respectively. However, Rabi 2014-15 and Kharif 2015 witnessed a drastic decline in terms of both gross premium collected and claims reported.

During 2012-13 including both Kharif and the Rabi seasons, total area covered by this pilot scheme was 17.69 million hectare and total number of farmers benefited was 10.81 million. The area increased to 14.39 million hectare benefitting 9.61 million farmers during 2014-15 seasons of Rabi and Kharif.

## PRADHAN MANTRI FASAL BIMA YOJANA (PMFBY)

Pradhan Mantri Fasal Bima Yojana (PMFBY)-2016 has been the most recent version of crop insurance in the country. Pooling in the important learning from all the earlier schemes and taking into consideration of access to technology in the recent days, Pradhan Mantri Fasal Bima Yojana promises to take care of the loopholes of earlier schemes.

The Nodal Banks intermediaries may collect the list of individual insured farmers (both loanee and non-loanee) with requisite details like name, fathers' name, Bank Account number, village, categories - Small and Marginal group, Women, insured holding, insured crops, sum insured, premium collected, Government subsidy etc., from concerned branch in soft copy for further reconciliation. This will be done online once the E platform is put in the place.

Like other agriculture related schemes ranging from fertilizer subsidies to subsidised loans and loan waiver for farmers, crop insurance schemes were also observed to be highly skewed in favour of just few states and only the large and wealthy farmers. Number of farmers covered by crop insurance is more in states like Maharashtra, Madhya Pradesh and Andhra Pradesh. Within these states too, it was mostly the large farmers who reaped the benefits of the insurance schemes. Interestingly Uttar Pradesh which has the highest farming population, has the least numbers of farmers covered by crop insurance. ■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AGRICULTURE TODAY

# FARM INFRASTRUCTURE

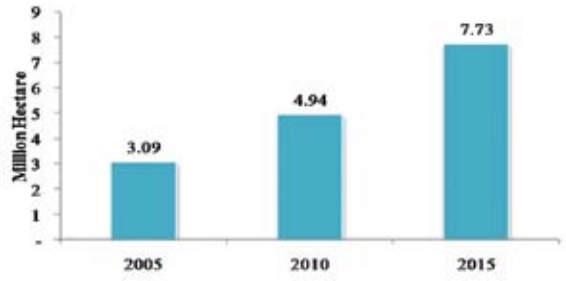
# Indian Micro Irrigation Market Overview

Micro irrigation has seen a steady growth over the years. Since 2005, area covered under micro irrigation systems has grown at a CAGR of 9.6% and reached 7.73 million hectares. However, the potential area which can be covered under micro – irrigation was totaled to 69.5 million hectares in 2015.

Although, adoption of micro irrigation techniques by farmers is growing at a fast pace, the market penetration is still very low. With half the cultivable land in the country still being rain-fed, there is mammoth potential for promoting micro irrigation.

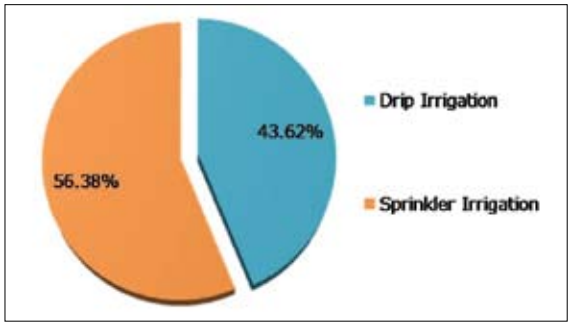
Majority of the area covered under micro irrigation systems comes under sprinkler irrigation with 4.36 million hectares while 3.37 million hectares comes under drip irrigation. Area under drip irrigation has shown stronger growth in recent years, growing at a CAGR of 9.85% during 2012-2015, while sprinkler irrigation has grown at a pace of 6.60% during the aforementioned period.

**ALL INDIA AREA COVERED UNDER MICRO IRRIGATION**




*Source: Strategic Paper by IAI and FICCI*

**ALL INDIA AREA COVERED UNDER MICRO IRRIGATION BY SEGMENTS; 2015**




*Source: Mission for integrated development for horticulture Website*

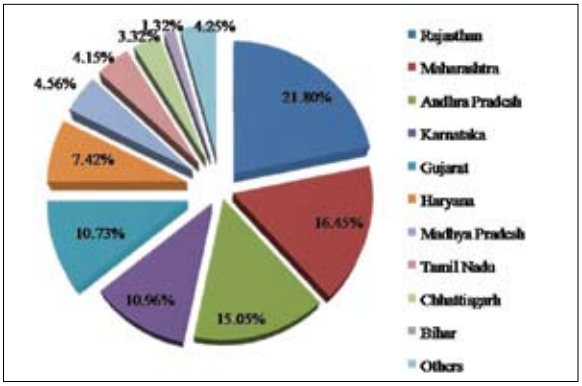
The drip and sprinkler irrigation methods differ in terms of flow rate, pressure requirement, wetted area and mobility. India has enormous potential for both the irrigation methods. Among the crops, maximum adoption of drip irrigation system was in fruit crops, followed by plantation crops, in terms of area coverage.

The Indian micro irrigation market is highly competitive with the presence of large and small scale drip and sprinkler irrigation equipment producers and marketers across numerous states in India. Presently, there are nearly 200 micro irrigation companies in the country.

## TOP 10 STATES

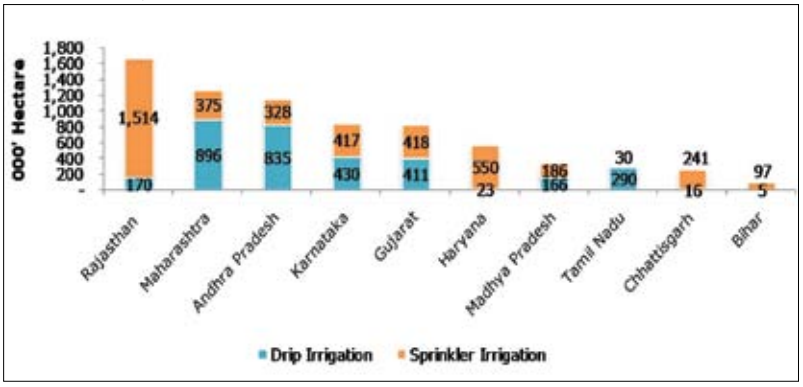
The states with the largest area under micro-irrigation include: Rajasthan (1.68 mh), Maharashtra (1.27 mh), Andhra Pradesh (1.16 mh), Karnataka (0.85 mh), Gujarat (0.83 mh) and Haryana (0.57 mh).

**TOP 10 STATES WITH MICRO IRRIGATION AREA COVERED; 2015**

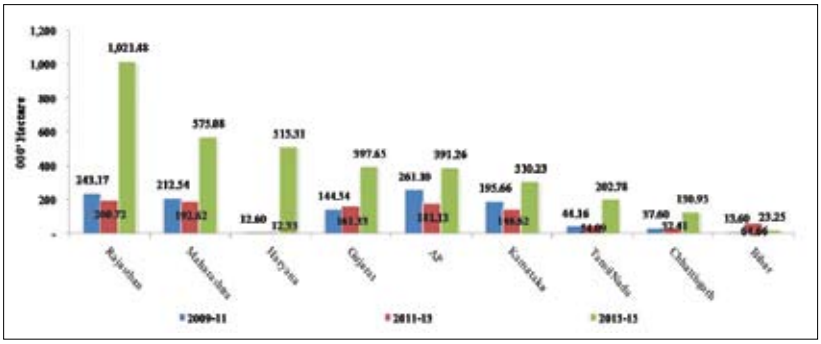



*Source: Mission for integrated development for horticulture Website*

**MAJOR STATES AREA COVERED UNDER MICRO IRRIGATION BY SEGMENTS; 2015**




**MAJOR STATES AREA COVERED UNDER MICRO IRRIGATION**



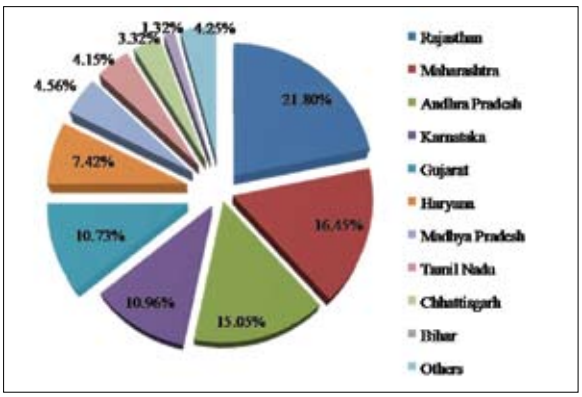

*Source: Mission for integrated development for horticulture Website*

Rajasthan had the maximum area under micro irrigation, whereas Haryana had the highest penetration rate of 16.3% in 2015. Sprinkler irrigation is popular among Rajasthan, Gujarat, Haryana, Madhya Pradesh, Chhattisgarh and Bihar. However, drip irrigation is popular in Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

## GOVERNMENT INITIATIVES

Recognizing the importance of micro irrigation, the government has taken various initiatives since 1992. The first real thrust however came in 2006, when the government launched a Centrally Sponsored Scheme (CSS) for micro irrigation with the objective to enhance water use efficiency in the agriculture sector by promoting appropriate technological interventions like drip & sprinkler irrigation technologies and encourage the farmers to use water saving and conservation technologies. In June, 2010, it was upscaled to National Mission on Micro Irrigation (NMMI), which continued till the year 2013-14. From 1st April, 2014, NMMI was subsumed under National Mission on Sustainable Agriculture (NMSA) and implemented as "On Farm Water Management" (OFWM) during the financial year 2014-15.

**TOTAL AREA COVERED UNDER MICRO IRRIGATION BY STATE; 2015**




*Source: Strategic Paper by IAI and FICCI*

The Pradhan Mantri Krishi Sinchayee Yojna (PMKSY) was launched in July, 2015. The objective of the scheme is "to achieve convergence of investment in irrigation at the field level, expand cultivable area under assured irrigation."

## INDIA'S POSITIONING IN THE GLOBAL MARKET

India now has close to 8 mh under micro irrigation. This is attributed to the large cultivable area and area under irrigation. However, penetration of micro irrigation systems is still very low in India. Penetration of micro irrigation in states of India is variant. The average penetration at the all India level is 5.5%, which is much lesser compared to countries like Israel, US and even China.

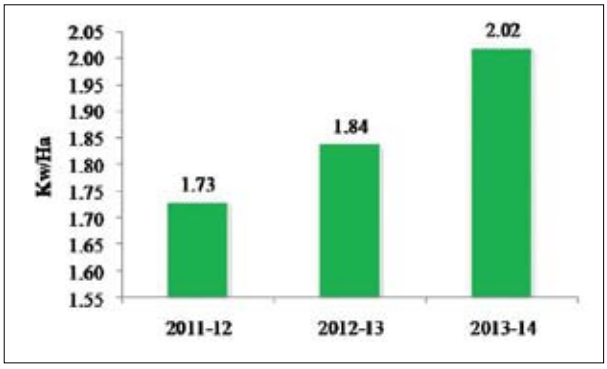
Till date, farmers have adopted micro-irrigation mainly for fruits, vegetables and other high-value crops that can provide a good return on the investment.The most dramatic gains in this sector have occurred in China and India, the world's top two irrigators, where the area under micro-irrigation expanded 88-fold and 111-fold, respectively, over the last two decades. India now leads the world, with nearly 2 million hectares (about 5 million acres) under micro-irrigation. Some of the impediments with our efforts to promote micro irrigation are lack of focus on micro irrigation as currently there is no dedicated programme for micro irrigation. Further, we also lack IT-backed operations like geo-tagging and referencing for tracking the progress.In order to have sustainability in agriculture with shrinking natural resource base, especially water, micro irrigation is of extreme importance. ■

# Indian Farm Mechanization Market Overview

The agriculture sector in India has witnessed considerable decline in the use of animal and human power in agriculture related activities. The trend has paved the way for introduction of agricultural machinery mostly driven by fossil fuels such as tractors, diesel engines resulting in a shift from the traditional agriculture to a more mechanized version.

Though, farm mechanization in India stands at about 40%-45%, it is still low when compared to countries such as the U.S. (95%), Brazil (75%) and China (57%). While the level of mechanization lags behind other developed countries, it has seen strong growth through the last decade. The farm power availability on Indian farms has grown from 1.47 kW/ha in 2005-06 to 2.02 kW/ha in 2013-14.

**FARM POWER AVAILABLE ON INDIAN FARMS**

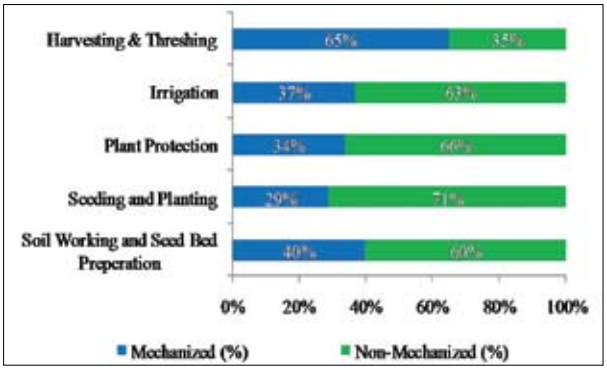



*Source: Country presentation paper, Agricultural Machinery Manufacturers Association (AMMA) India, October 2014*

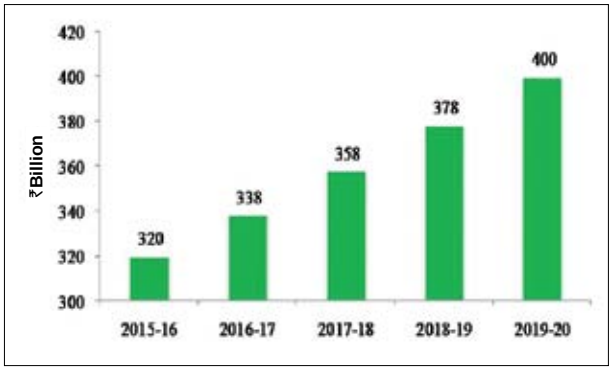
## INDIAN FARM MECHANIZATION MARKET

The Indian farm mechanization market, which was valued at Rs.320 billion in 2015-16, is expected to grow at a CAGR of 5.74% to reach Rs.400 billion by 2019-20. Shortage of farm labour and the need to enhance farm productivity are among the main reasons for increasing farm mechanization in India.

**EXTENT OF FARM MECHANIZATION AT DIFFERENT LEVELS OF VALUE CHAIN PROCESS**




**INDIAN FARM MECHANIZATION MARKET**




*Source: UNESCAP CSAM*

However, farm mechanization provides different streams of employment related to handling of farm machines thus resulting in increased rural employment. Increased farm mechanization is a key step towards doubling farmer's income and better rural prosperity.

The availability of abundant and cheap labor in India has largely confined farm mechanization to tractors and power tillers. While tractors and power tillers still outsell other farm equipment like paddy transplanters and combine harvesters, the gap has narrowed in recent years. With rural youth migrating to cities in search of better jobs, a big market for specialized machineries, such as threshers, rotavator, transplanters, reapers, zero till drills, laser levellers and power weeders is being created.

## INDIAN TRACTOR MARKET

Tractor is the largest segment in the equipment category with an annual sale of 600,000-700,000 units. The market has grown at a CAGR of 8.62% till 2014-15. However, there is a sharp downturn since 2015-16. This has been attributed to a reduction in farm incomes due to the decline in production of major crops as well as softening commodity prices with lower procurements by the government on account of adequate buffer reserves. Penetration of tractors in India is higher in northern India, mainly Punjab, UP and Haryana.

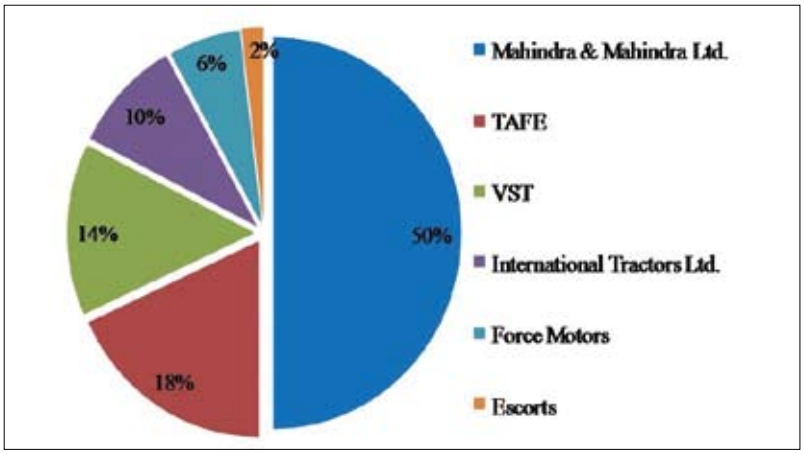
Within the tractor market, the 41-50 HP segment is the largest selling unit, followed by the 31-40 HP segment, which has been sourced mainly from the > 50 HP segment.

While the country produces a large volume of tractors, it also exports tractor units to other countries across the world. On an average, the country exports 60,000 tractors annually. India's tractor export markets primarily include African countries and ASEAN countries where soil and agro-climatic conditions are similar to India.

**INDIAN FARM MECHANIZATION MARKET**


*Source: Department of Agriculture and Cooperation, State of Indian Agriculture 2013-14, ICRA, A report on 'Farm Mechanization in India', TechSci Research*

**INDIAN TRACTOR MARKET PLAYERS**




*Source: Company Reports*

The major players in the market include, Mahindra & Mahindra, TAFE, VST, International Tractors, Force Motors and Escorts.

## INDIAN POWER TILLER MARKET

A larger portion of the farming population of the country falls into the small and marginal segment. Hence, affordability of farming equipment and the size of the yield are some of the factors that come into play. Hence, the power tiller category has not seen much growth in the past several years.

However, if compared, then utility wise, power tillers can perform a lot of functions just like tractors in the fields. Tractors cannot till the land, cultivate crops, and are especially difficult to use in smaller fields.

Power tillers are particularly useful in rice fields.China is the largest rice producing country in the world, and Sifang and Dongfeng Motors as the main suppliers in the country. Next in line is India, with companies like Crompton Greaves, Shrachi, VST and KOEL, Indonesia (Quick Tractors, Yanmar), Vietnam (VEAM), Thailand (Siam Kubota), and Japan (Kubota, Yanmar, Mitsubishi).

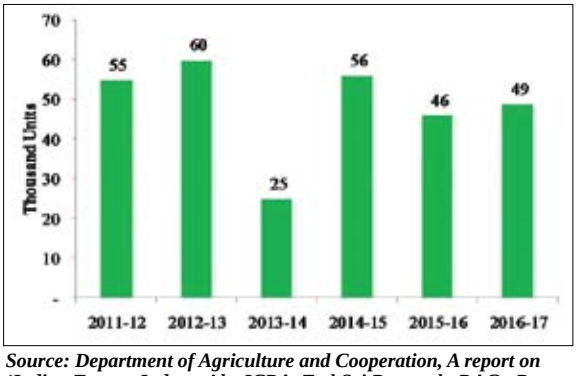
The Indian power tiller market, in terms of the volume has been fluctuating during 2011-17. Domestic power tiller industry is government subsidy-driven and the subsidy can range from Rs. 40,000-Rs. 90,000 per power tiller and can even extend beyond Rs.1,00,000 for farmers belonging to economically backward class.

The penetration of power tillers in India is higher in southern and eastern India as compared to the others parts of the country on account of the small size of land holdings per farmer in these respective regions.

In fact, small land sizes and high cost of labor, coupled with rising income levels in rural areas, provide a huge untapped opportunity.

The average farm power availability in the country is still at a low level as compared to other developing countries. Unlike other agricultural sectors, farm mechanization sector in India has a far more complex structural composition. It is facing various challenges related to farm machinery and equipment, technology, markets, operations, legislations, policy framework and other related areas. Land size, cropping pattern, market price of crops including Minimum Support Price (MSP), availability and costs of labor are the major factors deciding the growth of agricultural mechanization. The production and productivity in Indian agriculture cannot be enhanced by primitive and traditional practices of farming. However, the tractors, power tillers, combine harvesters, rotavators, threshers and rice transplanters are some of the equipments for which a surge in demand has been witnessed over the past few years. ■

**INDIAN POWER TILLER MARKET**




*Source: Department of Agriculture and Cooperation, A report on 'Indian Tractor Industry' by ICRA, TechSci Research, DAC - Dept. of Agriculture and Cooperation*

*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.*

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# Agricultural Logistics and Warehousing in India

The issue of food wastage is central to India's efforts in combating hunger and improving food security. While focus has been on improving production, reducing food supply chain, losses remain a relatively unaddressed problem till very recently. It is hard to put a figure on how much food is lost and wasted in India today due to lack of adequate infrastructure, however, a 2011 report by a UN body, FAO, puts wastage in fruits and vegetables as high as 45% of produce (post-harvest to distribution) for developing Asian countries like India.

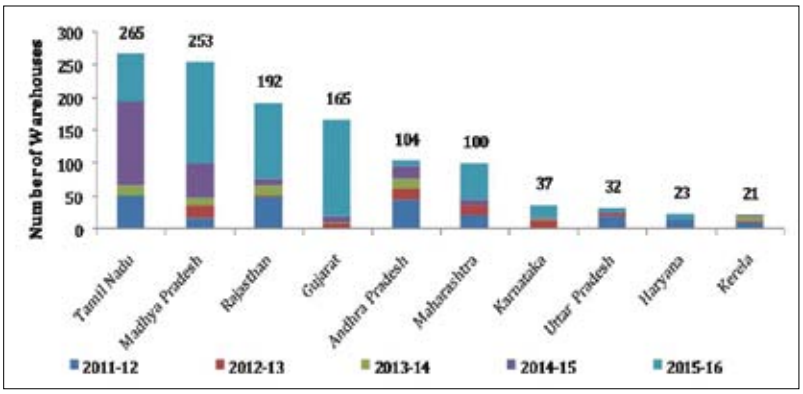
Agriculture is a 'state subject', and a large part of investment as well as regulatory progress is happening at the state level. Till very recently, regulatory barriers had constrained the development of storage and processing infrastructure but measures like inclusion of agri-warehousing under priority sector lending by RBI, subsidy schemes, tax incentives and the Warehousing Act (which will promote negotiability of warehousing receipts) have helped private players take an active interest in the same. The Private Entrepreneur Guarantee Scheme is one such initiative to incentivize private investment for construction of warehouses by private entrepreneurs, with an FCI guarantee to hire them for 10 years, assuring a fair return on investment by the entrepreneur.

## SUPPLY CHAIN MANAGEMENT

Supply chain management plays an integral role in keeping business costs minimum and profitability as high as possible. Though India has lot many positives in the fruit and vegetable production and marketing sector, it has several disadvantages too. The country lacks an efficient supply chain for the distribution of the fruits and vegetables. It has been found that 30%–40% of fruits and vegetables (approx. 25% of total worth) are wasted due to post harvest losses, leading to low availability of fruits and vegetables for consumers and the need for import; in spite of India being second largest producer. There is lack of basic as well as specialized infrastructure such as cold storages, reefer vans, cool chains, ripening chambers etc.Also there is a missing link between production and research system and consumers. The system lacks in capacity building, market information, research and intelligence. India is short by 10 million tonnes of cold storage capacity due to which over 30% of agricultural produce goes waste every year, more than 20% of produce from fields is lost to poor post harvesting facilities and lack of cold chain infrastructure.

Some of the problems that are to be mentioned in Indian food supply chain are the presence of numerous stakeholders who are working in isolation and the

**Number of Registered Warehouses in India**




***Source: Warehousing Development and Regulatory Authority***

infrastructure connecting these partners is very weak. There is lack of demand estimation and technology applications such as cold chain logistic supply chains and product tracking and tracing. Lack of system integration along with the presence of large number of unorganized retailers may result in making unorganized supply chain practices further inefficient.

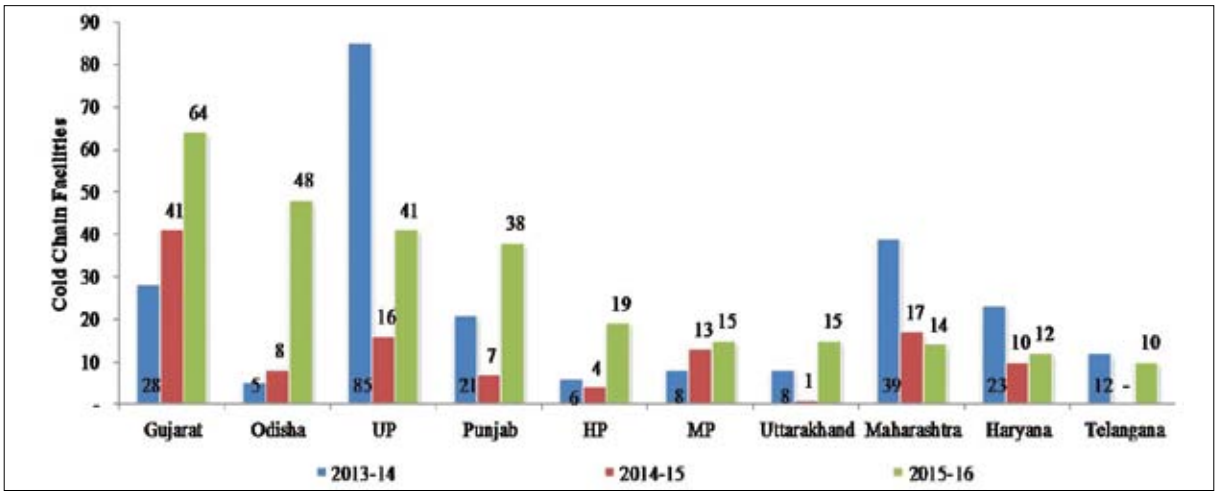
## WAREHOUSING

The warehousing and logistics have played a very important role in maintaining the supply chain of agricultural and other essential commodities in the country as well as promoting the agricultural marketing, rural banking, financing and ensuring food security in the country. Although, the warehousing segment constitutes only 15%-35% of the total logistics costs, its importance cannot be ignored with respect to the role it plays in the smooth functioning of a supply chain network.

In the complete logistics value chain, warehousing forms a very import link. Warehousing, which forms 20% of the total logistics market, was traditionally used as godowns to store goods from the time of production till the time of consumption. Due to the rapid growth in retail sector, increased flow of FDI in warehousing and cold chains, the traditional warehouses have transported into collection and storage points, where raw materials, intermediate and manufactured goods are collected, stored and distributed to the point of consumption/sale.

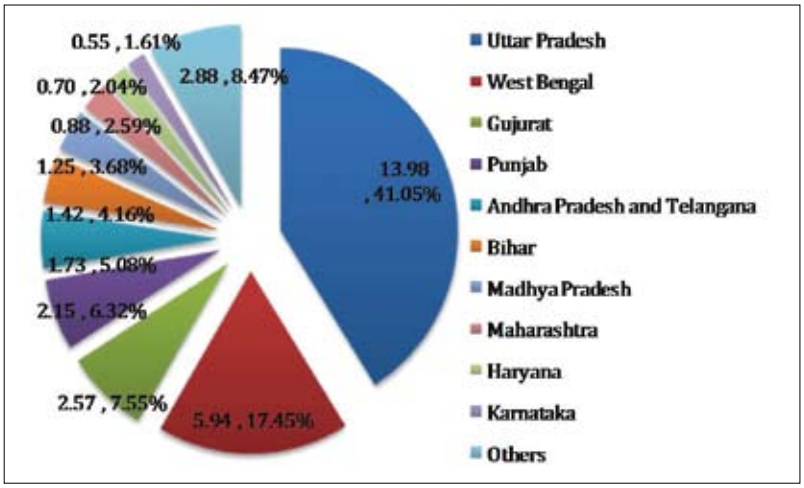
Currently, almost three-fourth of the organized warehousing sector is being controlled by government PSUs such as Food Corporation of India (FCI), Central Warehousing Corporation (CWC) and state Warehousing Corporations (SWCs). The current capacity of the organized warehouses, controlled by PSUs, cooperatives and private sector is 126.97 million tonnes, of which the private sector has only 18.97 million tonnes.

**State-Wise Number of Cold Storages Facilities/ Cold Chain Projects Approved for Financial Assistance in the Country; 2013-2016**




*Source: Ministry of Agriculture*

**State Wise Cold Storage Capacity in India as of 31 March 2016**




*Source: Ministry of Agriculture*

## COLD STORAGE

Scientific warehousing which also includes cold storages minimizes the storage losses in agricultural and horticultural commodities. Warehousing and cold storage facilities for farm produce prevent the distress sale of these commodities by the farmers during peak harvesting season and ensure uninterrupted supply of essential commodities viz., food grains, oil seeds, fruits, vegetables, etc., to the consumers during off season.

Due to diverse agro climatic conditions and better availability of package of practices, the agricultural production is gradually rising. Although, there is a vast scope for further increase in the production, the lack of cold storage and cold chain facilities are becoming major bottlenecks in tapping the potential. The cold storage facilities are mostly for a single commodity like potato, orange, apple, grapes, pomegranates, flowers, etc. which results in poor capacity utilization. The following figure depicts the total capacity of cold storages as of march 2016.

However, government is taking initiatives for developing an infrastructure for cold storage facilities by providing financial assistance to states according to their requirements.

It is reported that only 10%-11% of the fruits and vegetables produced in India use cold storage. Storage capacity needs to be increased by 40% to avoid wastage. There is more wastage of fruits and vegetables in the southern and western regions of India due to the tropical and humid climate.

Today, consumers expect protection from hazards occurring along the entire food chain. Providing adequate protection to the consumer by merely sampling and analyzing the final product is not possible, hence the emphasis is on introduction of preventive measures at all stages of the food production and distribution chain. This calls for a determined, innovative, inclusive and participative approach from all stakeholders that are involved in food chain, from farm-to-fork. Not only is the responsibility of providing safe food to consumers of critical importance, the responsibility itself needs to be shared equally at every stage of the value chain, starting from the first steps of food production. ■

# CROPS IN FOCUS

# Indian Food Grain Market

India accounts for only about 2.4% of the world's geographical area and 4% of its water resources, but has to support about 17% of the world's human population and 15% of the livestock. India holds the second-largest agricultural land (179.9 million hectares) in the world. Food grain production covers dominant part of the cropped area (65%) in Indian agriculture. According to the FAO world agriculture statistics (2010), India is the world's largest producer of millets (Coarse grains) and second-largest producer of wheat and rice.

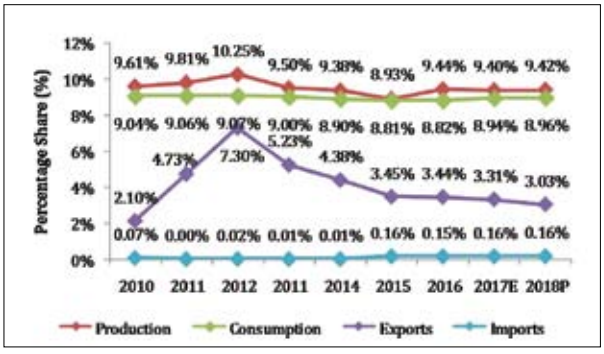
## INDIAN FOOD GRAIN MARKET – PRODUCTION AND CONSUMPTION ANALYSIS

India is continuously facing pressure on the demand side due to steady population growth, limited land availability, and several other production deterrents, which might also appear as obstacles for the supply of food grains. Indian government policies and planning have always given considerable importance to production of food grains due to which India has been achieving continued growth despite many constraints. The highest food grain production of 244.73 million tonnes was recorded in 2014, while consumption for the aforementioned year was 226.73 million tonnes.

Rice production in India has been showing a steady upward trend, but it is subjected to wide year-to-year fluctuations compared to wheat, as a significant portion of the crop is not irrigated. Indian Basmati rice is traditionally grown in Punjab, Haryana, and western Uttar Pradesh. With the introduction of high-yielding PUSA 1121 variety, India's long-grain basmati rice production has been improving, and its cultivation has spread to other parts of Uttar Pradesh and Madhya Pradesh. Among food grains, wheat in India stands next to rice both in area and production.

Out of the total food grains production, wheat production stood at 91.14 million tonnes in 2016, which was an increase

**INDIA'S SHARE IN THE GLOBAL FOOD GRAIN MARKET**




*Source: ICFA Analysis* *Note: E = Estimated, P = Projected*

at a CAGR of 1.74% during 2010-2016. The major wheat-producing states are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Maharashtra, Gujarat, Karnataka, West Bengal, Uttaranchal, Himachal Pradesh, and Jammu and Kashmir. These states contribute about 99.5% of the total wheat production in the country. The remaining states, namely Jharkhand, Assam, Chhattisgarh, Delhi, and other northeastern states, contribute only about 0.5% of the total wheat production in the country.

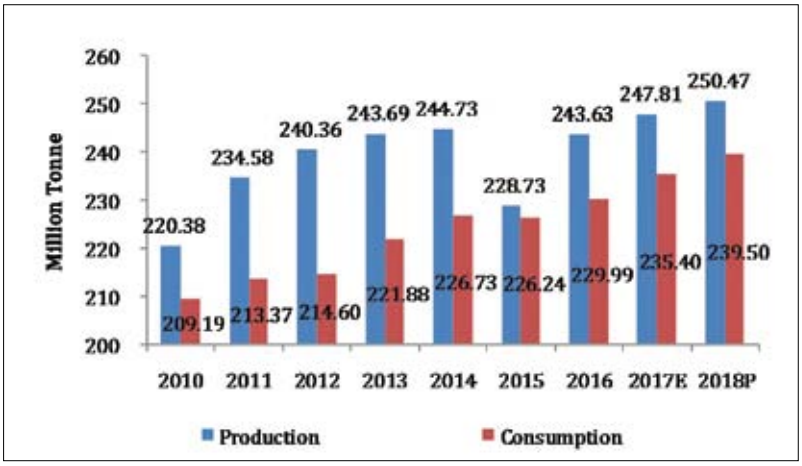
After rice and wheat, maize is emerging as the third-most important crop in India. However, despite the production strength, Indian corn yields are significantly below the yields in major corn producing countries. There is immense scope for an increment in India's corn production by increasing the area under hybrids, adoption of better genetics, and improved agronomic practices. In India 85% of maize production and 80% of the area under cultivation comes from nine states viz., Karnataka, Andhra Pradesh, Tamil Nadu, Rajasthan, Maharashtra, Bihar, Uttar Pradesh, Madhya Pradesh, and Gujarat.

Crops like sorghum, millets, ragi, and other small millets (kudo, kutiki, sanwa, and foxtail) termed as coarse grains have been the primary components of the food basket of rural India. Rain-fed regions of India like Karnataka, Maharashtra, Tamil Nadu, Madhya Pradesh, Rajasthan, and Gujarat are best suited for coarse grains and are therefore cultivated predominantly in these areas. Production of coarse grains in 2010 was 21.87 million tonnes, which decreased to 18.91 million tonnes in 2016 mainly because of a shift in the area of cultivation to other competing crops.

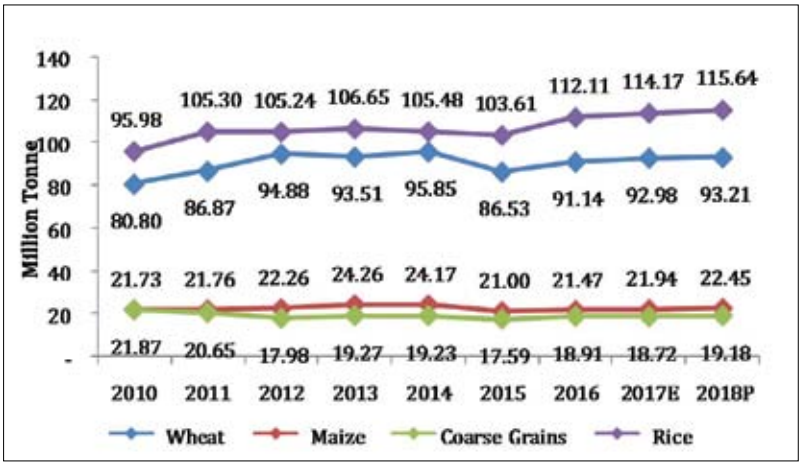
Wheat is the principal choice of food grains in the North followed by rice. Wheat comprises half of the total grain consumed in the West followed equally by rice and other coarse cereals together. Rice is consumed as the main food grain in the South and the East followed by wheat in the East and coarse cereals in the South.

The consumption of food grains per person in the rural areas is projected to decline from 15.3 kg per month in 2000 to 13.8 kg per month by 2050 and from 11.8 to 11.6

**INDIAN FOOD GRAIN MARKET – PRODUCTION & CONSUMPTION**

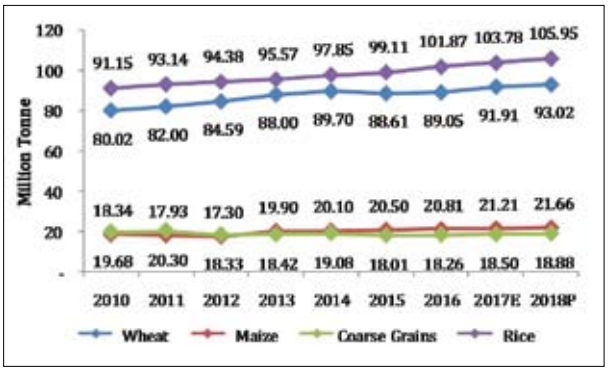



**INDIAN FOOD GRAIN MARKET PRODUCTION BY SEGMENTS**

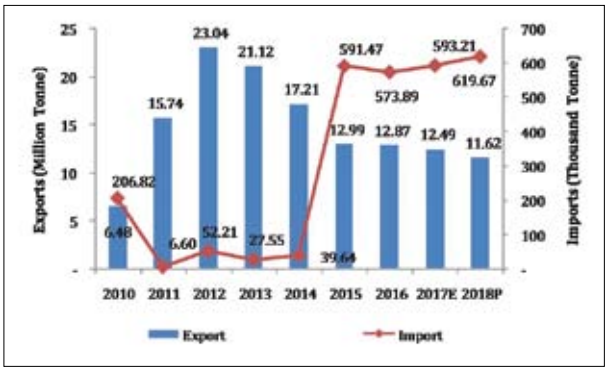



*Source: OECD Statistics* *Note: E = Estimated, P = Projected*

**INDIAN FOOD GRAIN MARKET CONSUMPTION BY SEGMENTS**




**INDIAN FOOD GRAIN MARKET TRADE**




*Source: ICFA Analysis* *Note: E = Estimated, P = Projected*

kg per month in the urban areas. It has been estimated that due to rapid urbanization, per capita consumption of food grain in India will decrease from 14.4 to 12.7 kg per month over the next 50 years. However, total food grain demand is projected to increase from 16.7 to 19.9 kg per month over the next 50 years due to increment in the demand of feed grain. The total grain demand will increase from 201 million tonnes in 2000 to about 291 and 377 million tonnes by 2025 and 2050, respectively.

## INDIAN FOOD GRAIN MARKET – TRADE ANALYSIS

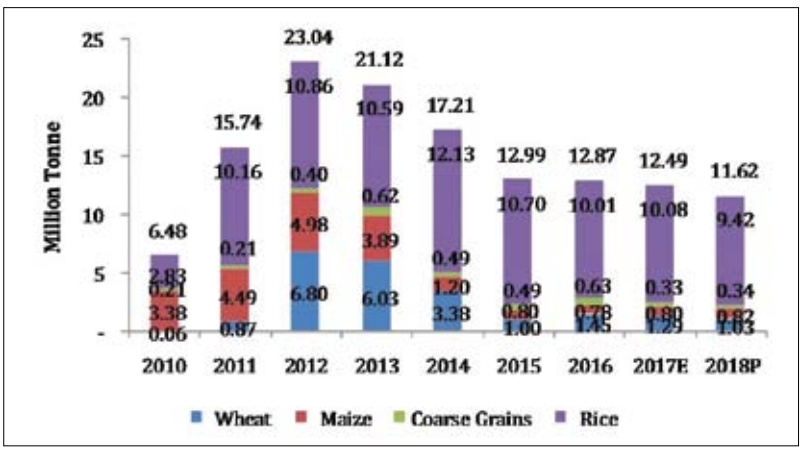
India, with a large and diverse agriculture, is among the world's leading producers of rice, wheat and millet. Therefore, changes in the balance sheets for these commodities will have a potentially large impact on world markets. Over the years, India has developed export competitiveness in certain specialized agriculture products viz., basmati rice.

India's share in global exports was around 0.40% in the year 2015-16.India's wheat export in 2015-16 declined by 79% over the corresponding period of the previous year in view of surplus global stocks and higher domestic prices. In 2015-16, India's major export destinations were Bangladesh, Nepal, UAE and Taiwan.

India exported substantial quantity of both Basmati as well as non-basmati rice to the world. In 2016, Saudi Arabia was the leading importing country for Basmati rice from India followed by Iran and UAE. However, Benin, Senegal, and Nepal were amongst India's top three importing countries for non-basmati. The poultry industry alone consumes 47% of the country's total maize output. The livestock sector accounts for around 13%, while 12% goes to starch millers and 8% is used by the food industry. So 80% of the total maize produced is consumed locally. Some quantum of the remaining 20% goes to exports and the rest is for carryover stocks. However, Indian maize exports have declined due to uncompetitive prices in the international market.

India's production of foodgrains and oilseeds is expected to hit record levels in 2016-17 on the back of a normal southwest monsoon and a decent winter. Indian farmers are seen to harvest record crops of rice, wheat, coarse cereals led by maize. Anticipating good monsoon in 2017-18 too, the ministry had set a target of food grain production at 273 million tonnes and has expressed confidence of maintaining farm sector growth rate of over 4% during the period. The target for next crop year (2017-18) was made after the recent prediction of normal and well distributed monsoon rainfall (during June-September period) by the India Meteorological Department. ■

**INDIAN FOOD GRAIN MARKET EXPORTS BY SEGMENTS**




*Source: ICFA Analysis* *Note: E = Estimated, P = Projected*

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# Indian Cotton Market

Cotton plays an important role in the Indian economy as the country's textile industry is predominantly cotton based. India is one of the largest producers as well as exporters of cotton yarn. There are four major cotton species of cultivated cotton, of which two are diploid *(Gossypium arboreum* and *G herbaceum)* and the other two tetraploid *(G hirsutum* and *G barbadense)*. India is the only country to grow all four species of cultivated cotton. In addition, hybrid cotton, which is produced from crossing tetraploid species *G hirsutum* are also cultivated in the central and southern zones. The diploid species referred to as the 'Desi' cotton, having low productivity and low quality cotton, contributes 25 - 30% of the country's production. The tetraploids variety contributes to the remaining 70% of the cotton production in India. These varieties have fine quality fibre, and are normally used by the textile industry.

## GLOBAL AND INDIAN COTTON MARKET

Almost 75% of the world cotton consumption happens in Asia, of which three Asian countries namely China, India and Pakistan amount to about 63% to 65% (five years average) of the world cotton consumption, of which the average consumption in India during the same period has been about 20% of the world consumption.

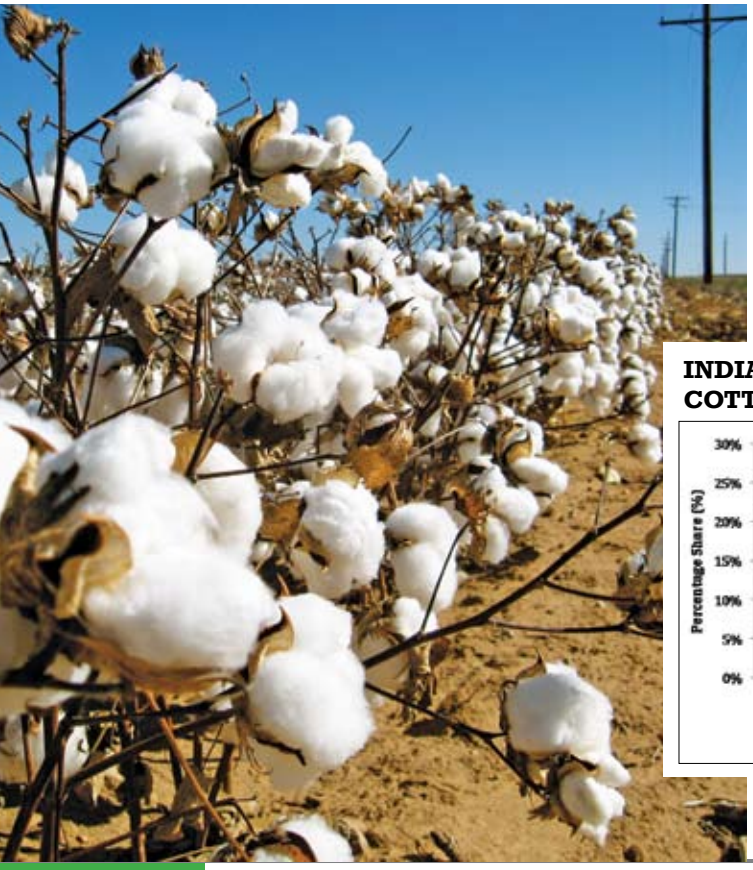
Presently, India has about 38 % of the world area under cotton cultivation. This is the largest area under cotton cultivation in the world. India's share in world cotton production is about 25%. As per the production estimates of the International Cotton Advisory Committee (ICAC), India has become the largest raw cotton producer in the year 2014-15 leaving China behind.

## INDIAN COTTON MARKET

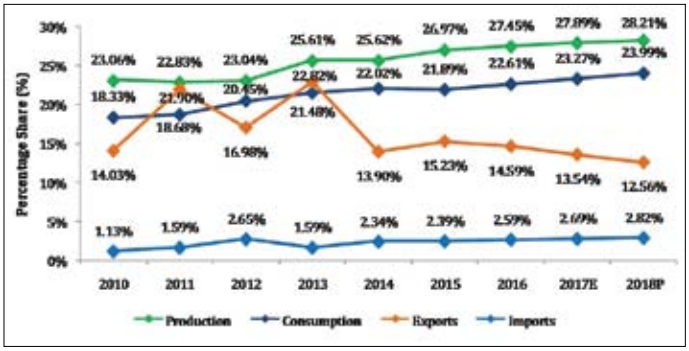
Despite having such abundant area under cotton cultivation, India's raw cotton production is below expectations. As per ICAC's estimates, India's area under cotton cultivation in the year 2014-15 was about three times of the total area under cotton cultivation in China, but there is no significant difference in the total cotton production in both countries. India has three times of the area under cotton cultivation as compared to USA, but its cotton production is about twice the USA's cotton production. Comparatively lower yield per acre is the reason for India's lower cotton production.

If India could achieve a yield level equivalent to the present world average yield of 784 kg/ hectare then the country would produce about 9.6 million tonnes of cotton fibre at its present cotton acreage of about 12.25 million hectares. This volume of cotton production will be equivalent to about 40% of the present world cotton consumption of 24.22 million tonnes.

While the world moves away from cotton towards man-made fibers, Indian cotton consumption has been growing at a higher rate. During the same 2007-2014 timeframe, Indian consumption of raw cotton has increased at a CAGR



**INDIAN COTTON MARKET SHARE IN THE GLOBAL COTTON MARKET**

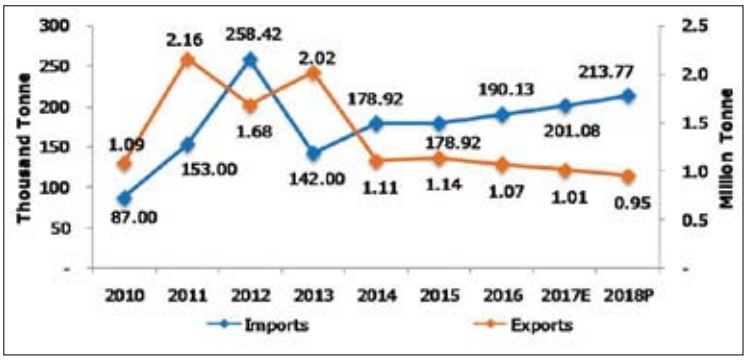



*Source: OECD Statistics and ICFA Analysis*

**INDIAN COTTON PRODUCTION & CONSUMPTION**


*Source: Ministry of Agriculture and ICFAAnalysis*

**INDIAN COTTON MARKET TRADE**




*Source: APEDA*

of 4.04% against the growth rate of 2.45% for man-made fibers and filaments together. The current Indian ratio of cotton consumption vs. man-made fibers is about 65:35, which is the opposite of what is prevailing in the international market (25:75). In China, this ratio is about 15:85.

India's raw cotton consumption has grown at a CAGR of 4.2% during the last five years. With this growth rate, the Indian cotton consumption will be between 6.5 million tonnes to 7.0 million tonnes by the year 2020. At the same growth rate, this level may go beyond 8 million tonnes by 2025 and India may also surpass China in the raw cotton consumption and may become the largest consumer of raw cotton globally.

The states of Gujarat, Maharashtra, Telangana, Andhra Pradesh, Karnataka, Madhya Pradesh, Haryana, Rajasthan, and Punjab are the major cotton producers in India. State Governments of the cotton producing states in India are also coming up with textiles policies to encourage installation of textiles and apparels machinery by way of giving various capital and interest subsidies. Other schemes like concessional power tariff, tax concession and skill development, etc. will encourage the production of value addition products for the entire textile value chain.

## INDIAN COTTON MARKET TRADE

The total value of textiles and clothing exports from India stood at Rs.2,410.22 billion in 2015. The value of cotton yarn exported from India in 2015 stood at Rs.235.78 billion, while export of cotton fabrics, cotton made ups and raw cotton stood at Rs.137.54 billion, Rs.340.57 billion, and Rs.124.44 billion respectively.

India has overtaken Italy and Bangladesh, and is now the second largest textile & clothing exporter in the world, contributing around 5% to the global textile and clothing trade. USA is the biggest importer of cotton textiles from India with a share of 22.7 per cent, followed by China (13.9%), Bangladesh (9.0%), UAE (5.7%) and Germany (3.1%), among others. However, China's restrictive import policy and its accumulated stock have adversely impacted India's export to that country in 2015.

Countries such as Bangladesh, Vietnam, Pakistan and Taiwan are scaling up their cotton imports from India to meet the requirements of their export-focused garment industries.

Various reputed foreign retailers and brands such as Carrefour, Gap, H&M, JC Penney, Levi Strauss, Macy's, Marks & Spencer, Metro Group, Nike, Reebok, Tommy Hilfiger and WaI-Mart import Indian textile products.

The Cotton Textile Export Promotion Council (TEXPROCIL) takes part in national and international events to enhance the visibility of Indian products, advertises and promotes Indian products in various media vehicles such as fashion magazines, event-related pull-outs, India reports and leading trade magazines, and organizes buyer-seller meets (BSM) and trade delegation visits.

Cotton is one of the principal crops of India, and plays a vital role in the country's economic growth by providing substantial employment and making significant contributions to export earnings.

The Indian cotton cultivation sector has not only been increasing its productivity, but also has been undergoing a drastic improvement in terms of quality of cotton. Cultivation of hybrids, Bt cotton varieties, latest production technology and plant protection technologies, adoption of scientific and agronomic practices by farmers, increase in area under irrigation, seed, Government policies such as giving greater force to research and development in cotton, encouraging use of quality seeds and pesticides and price support, are all responsible for the present drastic change in Indian cotton scenario. ■

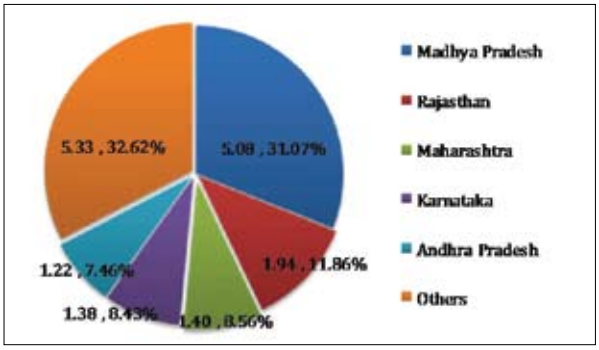
# Indian Pulses Market

India is the largest producer, importer and consumer of pulses, accounting for 25% of global production from 35% of global area under pulses. However, the productivity of pulses in India is 755 kg/ha, whereas in the USA and Canada it is as high as 1,900 kg/ha. The pulses in India are grown in semi-arid areas which face high rainfall variability adding to high instability and low productivity. Best parcel of lands with irrigation facility is usually reserved for other crops by farmers.

## INDIAN PULSES MARKET – PRODUCTION ANALYSIS

Although, being one of the largest pulses crop cultivating country in the World, pulses' share to total food grain production in India is only about 6%-7% in the country. The total share of pulses to total food grains basket in the country in terms of area, production and productivity was 19.62%, 16.55% and 84.48%, respectively during 1950-51.

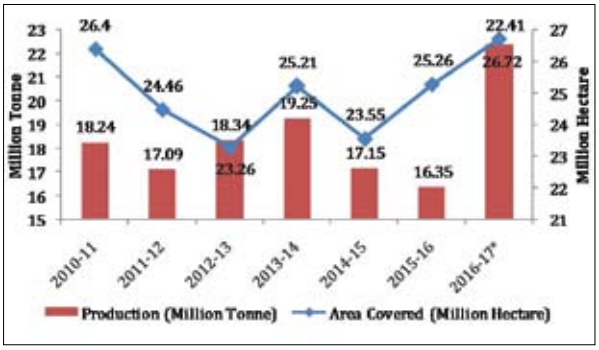
**PRODUCTION OF PULSES IN INDIA BY STATES; 2015-16**




*Source: Ministry of Agriculture and ICFA Analysis*

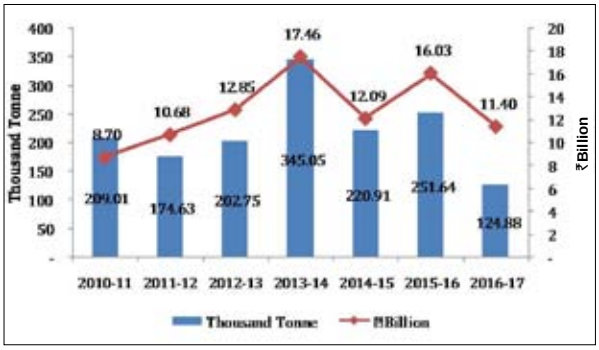
This trend continued till 1960-61 and started declining from 1970-71(after green revolution) due to no breakthrough in production technology of pulses in comparison to other commodities of foodgrains. Deceleration of contribution of pulses to total food grains prompted the Ministry of Agri-

**AREA COVERED AND PRODUCTION OF PULSES IN INDIA**




*Source: MOSPI*

**PRODUCTION OF PULSES IN INDIA BY 2015-16**




*Source: Ministry of Agriculture and ICFA Analysis*

culture & Farmer's Welfare to vigorously pursue the NFSM-Pulses during the Eleventh plan (2007-08 to 2011-12) and was continued during Twelfth Plan (i.e. 2012-13 to 2016-17).

There has not been any significant increase in area and production during 1950-51 to 2009-10, however, significant growth in area and production has been recorded since 2010-2011. With the increase in infrastructural and irrigation facilities/resources, the pulses get marginalized treatment pushing them to another poor and marginal land piece. The major states producing pulses in India are Madhya Pradesh, Rajasthan, Maharashtra, Karnataka and Andhra Pradesh.

## INDIAN PULSES MARKET – EXPORTS ANALYSIS

Pulses export has increased from approximately 34 thousand tonnes in 1992 to 124.88 thousand tonnes in 2016-17. However, the trend in the exports from India during 2010-11 to 2016-17 has been fluctuating, in terms of both value and volume. This may be attributed to various reasons such as unstable production pattern in India during the period and fluctuations in the foreign exchange market.

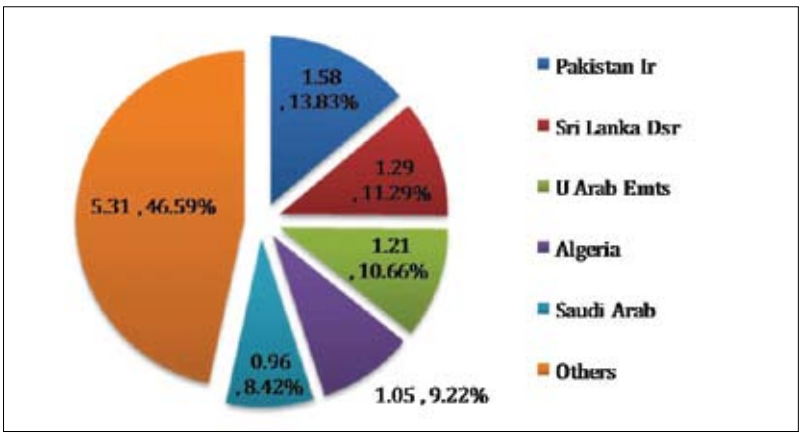
Moreover, India is the largest pulses processor, as pulses exporting nations such as Myanmar, Canada and Australia, do not have adequate pulses processing facility. The reason is that these countries do not have much domestic consumption of pulses and therefore, they have never attempted to develop domestic processing industry. Due to this India re-exports a considerable amount of pulses.

## IMPORT ANALYSIS

The increasing mismatch between production and consumption of pulses has resulted in larger imports of pulses in recent years. The country was importing merely 0.17 million tonnes of pulses during 1980–81, which has increased fast to 5.91 million tonnes in the year 2016–17. The import of pulses has grown at compound annual rate of 10.07% per annum since 1980–81, while the production has merely increased at 2.04% per annum during the corresponding period. Total pulses imports were just 1.6% of total pulses production in India during 1980–81, which has presently rose to about 26.37%.

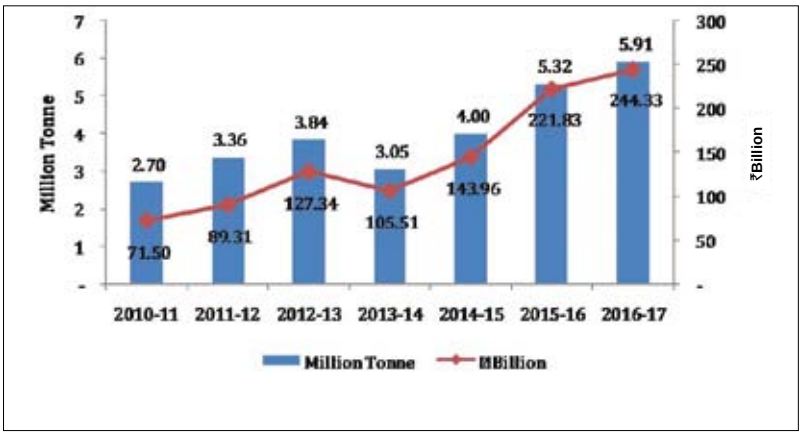
To augment the supply of pulses to poor masses under the current scenario, supply through public distribution system will not only distribute pulses to poor at affordable prices and enhance nutritional security, but will also lead to stabilize prices and boost the farmers through assured procurement. The dependence on imports needs to be reduced gradually over time by stepping up the domestic production of pulses supported with appropriate long-term strategies. The major countries exporting pulses to India include Canada, Australia, Myanmar, United States and Russia.

**INDIAN PULSES EXPORTS BY COUNTRIES; 2016-17**




*Source: APEDA*

**PULSES IMPORTS BY INDIA**

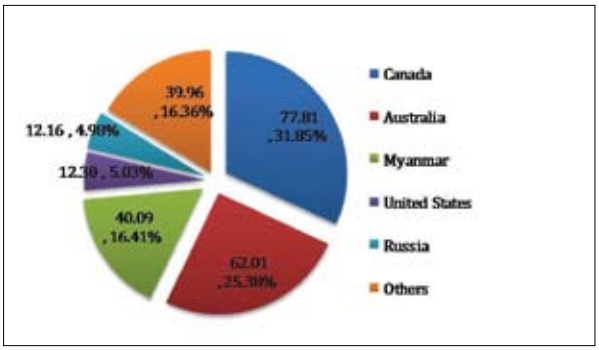



*Source: Indian Institute of Pulses Research and APEDA*

## INDIAN PULSES MARKET BY TYPES

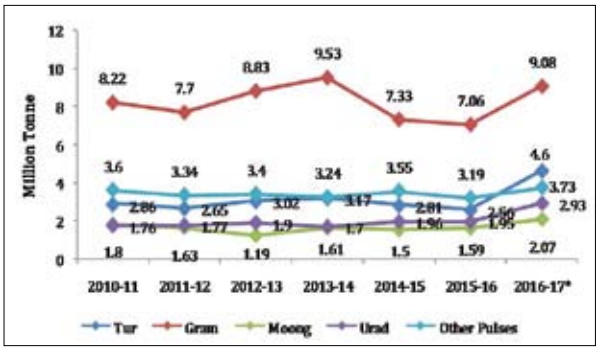
The area under pulses has declined in north India, while it has expanded in central and south India. The regional area shift is more conspicuous in case of Gram. Tur and Gram are the major pulses cultivated in India, together accounting for about 53% of total area under pulses and contributing to 63% of the total pulses production.

**PULSES IMPORTS BY COUNTRIES; 2016-17**




*Source: APEDA*

**PRODUCTION OF PULSES BY TYPES IN INDIA**




*Source: Ministry of Agriculture*

Production of Gram was 4.94 million tonnes during 1972–73, which has increased to 9.08 million tonnes during 2016–17, an increase of 1.36% per annum, mainly on account of about 50% increase in yield. The area under Gram has declined during 1980s and 1990s and witnessed negative growth rate in area, with the impressive growth. The decline in area under chickpea was mainly due to substitution with high-yielding varieties of cereals particularly in Punjab, Haryana, Rajasthan, Uttar Pradesh, Bihar and West Bengal. However, area under Gram started increasing only from 2006–07, mainly on account of higher adoption of improved short-duration and wilt-resistant varieties in central and South India, particularly in Andhra Pradesh and Karnataka.

Instability in area, production and yield has increased over the time in case of gram, Tur and total pulses. This implies that yields continued to remain unstable and volatile, as these crops have been grown under rain-fed conditions and on marginal lands. Further, pulse crops are highly susceptible to pests and disease infestation.

Chickpeas contribute the single largest share in India's export basket of pulses registering 62.16% share in the total pulses export during 2016-17. The major export destinations of Chickpea include Pakistan, Algeria, Turkey, Sri Lanka and United Arab Emirates. However, India imports chickpea from Australia, Russia, Tanzania, Myanmar and USA.

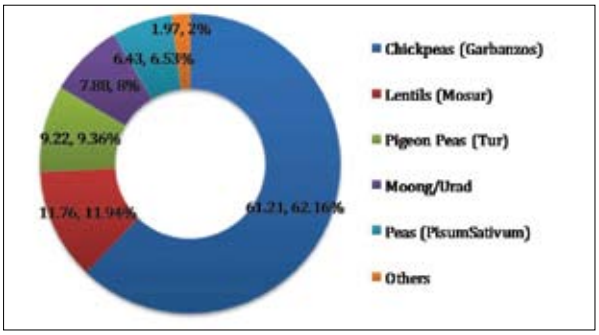
Peas form a major share in the total import of pulses. The major countries from where India imports peas include Canada, Russia, USA, France and Lithuania. Though, Shri Lanka DSR, Nepal, Ukrain, USA and Bangladesh are the major export destinations.

Australia and Russia are the major suppliers of chickpeas to India. Large share of pulses, including urd bean, mung bean, pigeon peas is imported from Myanmar. Importers favor Myanmar because it offers varied pulses with qualities similar to those domestically produced, low freight rates, and relatively fast delivery.

India has the world's largest pulses sector, producing and consuming diverse pulses. Since majority of the consumers in India have low incomes, their reliance on pulses as a key source of protein is high. Slow growth in production of pulses in India compared to population growth has resulted in increasing demand-supply gap and in turn rising prices and declining per capita consumption in spite of growing pulse imports. Pulse production remains unattractive to Indian farmers because of the relatively low productivity of pulses coupled with preference and policy support to cereals particularly to wheat and rice.

Moreover, the lack of an assured market is one of the major issues in the poor performance of pulses. Government procurement for supply through public distribution system and as part of mid-day meal schemes and welfare programmes would provide adequate marketing support to growers. An improvement in production technology of pulses aiming towards yield improvement and resource conservation can certainly reduce the cost of production and in turn prices may lead to balancing nutritional intake by reducing disproportionate use of cereals in the consumption basket. ■

**INDIAN PULSES EXPORTS BY TYPES; 2016-17***




*Source: Commodity Report on Pulses, March 2017*
*Note: * means April 2016 to December 2016*

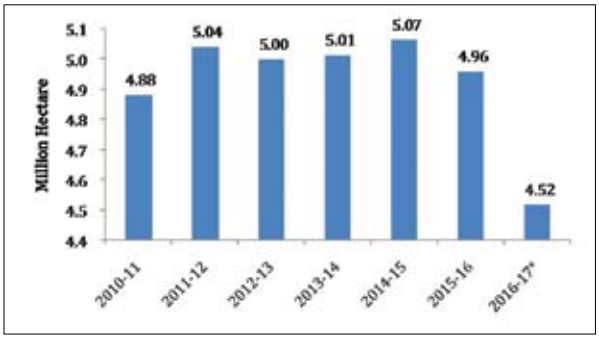
# Indian Sugarcane Market

Agriculture is the backbone of India which has approximately 70% of the rural population engaged in agriculture. The agro-based industries like sugar and cotton play an important role in the national economy and socio-economic development of the country. Sugar industry, the second most important among the agro-based industries with an annual turnover of approximately Rs. 800-850 billion per annum, has a significant contribution to the national GDP. Sugarcane is being grown in about 126 million ha in the world with a total cane production of approximately 1850 million tonnes. Three-fourth of the total sugar produced comes from sugarcane and the rest from sugar beet. More than 115 countries cultivate sugarcane with a total sugar production of approximately 177 million tonnes. Brazil is the largest producer of sugar followed by India.

## INDIAN SUGARCANE AND SUGAR PRODUCTION ANALYSIS

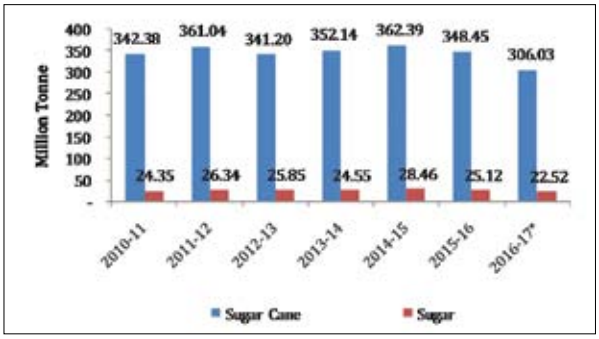
Sugarcane is a source of alternate products like feed, fibre and energy, esp., bio-fuel and co-generation, apart from sugar. The crop being one of the most efficient converters of biomass to energy and thereby an excellent source of bio-fuel production, has resulted in a heightened focus on its cultivation, sugar trade and that of other related

### AREA COVERED UNDER SUGARCANE CULTIVATION IN INDIA




*Source: Ministry of Agriculture*

### PRODUCTION OF SUGARCANE AND SUGAR IN INDIA




*Source: Ministry of Agriculture*

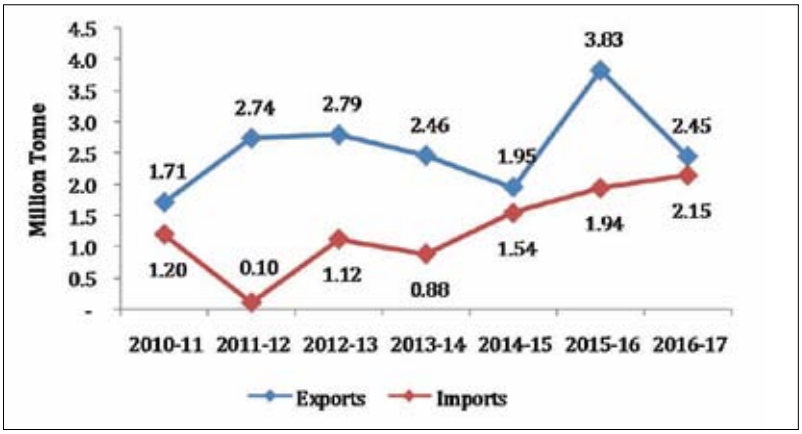
products at national as well as international level. Out of the total global sugar output, developing countries contribute approximately 70% of the total production. In most of the developing countries, the production is mostly consumer centric except in Brazil, where the annual growth rates have enabled the country to turn its attention towards global sugar export market.

There are two distinct sugarcane growing zones in India- the tropical zone comprising of the southern region below the Tropic of Cancer and the sub-tropical zone comprising of the northern states. The tropical zone contributes 45% of the total area under sugarcane and the sub-tropical zone around 55% of the area. But the average cane productivity in the sub-tropical zone is lower than that of the tropical zone. The lower cane productivity in subtropical north zone is primarily due to availability of shorter period of favorable environmental conditions for crop growth and shorter crop cycle as compared to the tropics.

However, India is a major producer as well as consumer of sugar in the world and its annual sugar production comes to 25-26 million tonnes. The contribution of Indian sugar was nearly 14% of the total sugar production of the world. Due to its potential as a feedstock for renewable energy, sugarcane is becoming the preferred crop not only for sugar production but also for bio-fuel, green energy and other by-products like bio-plastics, bio-polymers etc.

Indian sugar industry is very vibrant, supporting approximately 6 million people through sugarcane cultivation and other related industries. The crop is grown in about 5 million hectares i.e., in around 3% of the total cultivated area, which produces approximately 350 million tonnes of sugarcane annually. The production of sugar is spread across the country.

**INDIA'S SUGAR TRADE**




*Source: Ministry of Agriculture*

Maharashtra, Uttar Pradesh, Karnataka, Tamil Nadu, Gujarat and Andhra Pradesh are the major sugar producing states in India. These six states together accounted for almost 94% of the total sugar produced in India.

## INDIAN SUGAR TRADE ANALYSIS

India is the fourth largest exporter of sugar in the world. The export of sugar from India increased tremendously over the past two decades. The reasons for increase in the sugar export were increase in domestic production. The major export destinations for India in 2015-16 were Myanmar, Somalia, Sudan, Sri Lanka and UAE. The highest growth in India's sugar export was for Myanmar in 2015-16 compared to the preceding year.

India is surrounded by sugar deficit countries in the Middle East, East Africa, Bangladesh, Pakistan and Sri Lanka. India enjoys freight advantage in exporting sugar to these countries in the post EU sugar sector reform scenario. The Indian sugar sector should make the necessary investments to capture these markets on a long term basis. Export of large quantities of sugar requires handling infrastructure in the ports.

However, India also imports sugar from across the globe. Substantial part of India's sugar imports (around 99.6%) came from Brazil in 2015-16. India imported negligible amount of sugar during the same year from Germany, USA, UK and China.

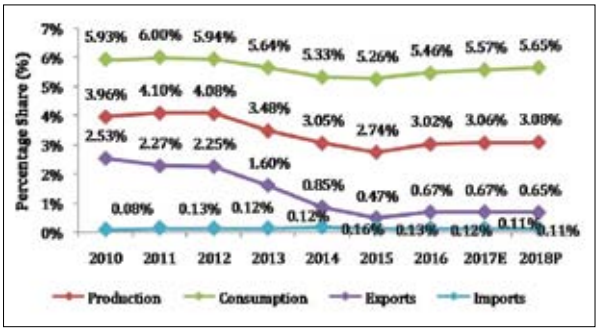
Sugarcane is the main source of sugar in India and the crop has a significant contribution towards the national economy. Being an important agro-based industry, it has a substantial role in the socioeconomic development of the rural population in the country. This is apart from the large proportion of workers who are employed in the ancillary units/industries like jaggery, paper, alcohol etc. Besides providing direct employment to approximately 7.5% of the rural population of the country, the sugar industry undertakes various developmental schemes to create infrastructure and socio-economic overhead, thereby playing a vital role in employment generation. The sugar sector as a whole contributes significantly to export earnings, excise revenue etc. , besides supplementing energy generation, reducing pollution through facilitating use of clean/green energy, carbon sequestration etc. The sector also serves as a major source of food, nutritional as well as economic security. The Indian sugar industry through its vast network of sugarcane growers, sugar mills and other infrastructure has been self-sufficient in meeting the huge demand of sugar arising within the country.

# Indian Oil Seed Market

On the oilseeds map of the world, India occupies a prominent position, both with regard to acreage and production. India is the 4th largest oil seed producing economy in the world after USA, China and Brazil, which contributes about 10% of the world oilseeds production, 6-7% of the global production of vegetable oil, and nearly 7% of protein meal.

Although India has 20.8% of the world's area under oilseed crops, it accounts for about 10% of global production. This is because of low productivity of oilseed crops and year to year fluctuations in production in India.

### INDIA'S POSITION IN THE GLOBAL OIL SEED MARKET




*Source: NSAI, Company Reports and ICFA*

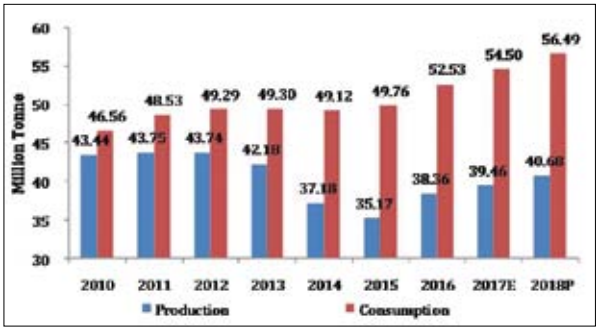
## INDIAN OIL SEED MARKET

A wide range of oilseed crops are produced in different agro-climatic regions of the country. Three main oilseeds namely, groundnut, soybean, and rapeseed-mustard accounted for over 88% of total oilseeds output. Soybean is the most important crop grown mainly in Madhya Pradesh, Maharashtra, and Rajasthan accounting for more than 95% of total production. The second most important oilseed crop is rapeseed-mustard mainly grown in Rajasthan, Madhya Pradesh, Haryana, Uttar Pradesh, West Bengal and Gujarat with an estimated share of about 93% in total production in the country. Groundnut, which was the largest oilseed crop in the 1990s, lost its share and is now third important oilseed and grown in Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka and Maharashtra with a combined share of about 91% in total groundnut production in the country.

## INDIAN OILSEED MARKET – PRODUCTION AND CONSUMPTION ANALYSIS

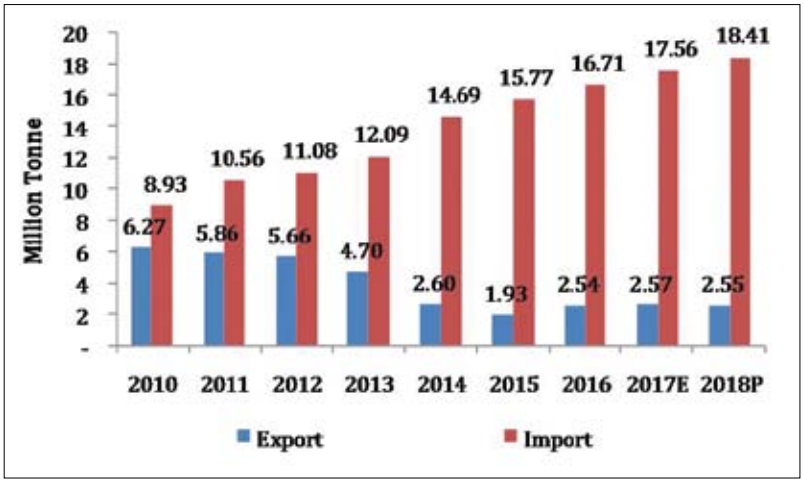
Oilseeds are not high yielding crops in comparison with cereals and other competing crops. Moreover, compared with traditional cereals, these crops are generally more risky because oilseeds are mostly grown under rainfed conditions, and market price support is also not very effective. However, India's oilseed production in 2017 is forecasted to rise by approximately 3% to 39.46 million tonnes, pushing total oilseed supplies to an all-time high of 57 million tonnes. Though, over the last three years, an estimated two million hectares of traditional oilseed area was lost to dry weather

### INDIAN OIL SEED – PRODUCTION AND CONSUMPTION




*Source: OECD Statistics*
*Note: E = Estimated, P = Projected*

**INDIAN OIL SEED EXPORT AND IMPORT**




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

conditions or to competing crops.

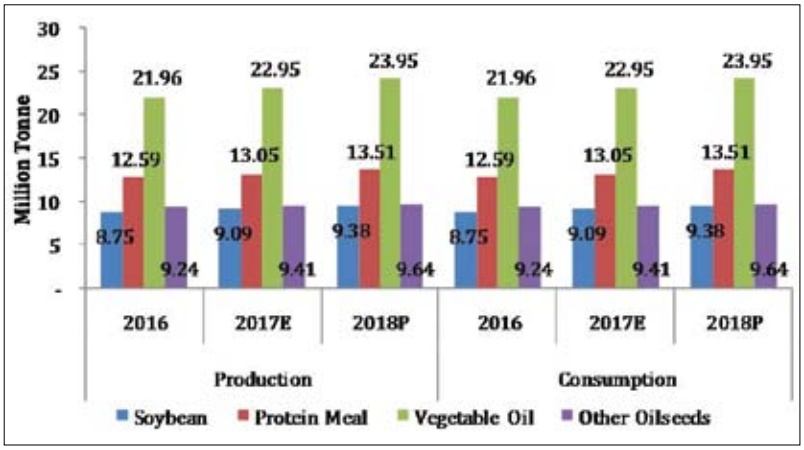
However, the consumption levels of oil seeds have surged since 2010 from 46.56 million tonnes to 52.53 million tonnes in 2016, at a CAGR of 1.74%. The expansion is partly reflecting national policy measures in support of domestic crushing and refining industries along with the increasing demand for edible oils in the country.

## INDIAN OIL SEED MARKET – TRADE ANALYSIS

India is the largest producer of oilseeds in the world but domestic production of edible oils has not kept pace with the rising demand for edible oils in the country, leading to a substantial increase in the imports of edible oils over time. India was nearly self-sufficient in edible oils and a net exporter of oilseeds complex till the mid-sixties. However, with stagnating production and yield as well as rise in demand for edible oils due to increase in population, oilseed production fell far short of its demand in the 1970s.

However, in 2012, government started promoting National Mission on Oilseeds and Oil Palm (NMOOP) for the period of 2012-2017 to achieve objectives such as increasing Seed Replacement Ratio (SRR) in oil crops with focus on Varietal Replacement, increasing irrigation coverage under oilseeds from 26% to 36%, diversification of area from low yielding cereals crops to oilseeds crops, inter-cropping of oilseeds with cereals/ pulses/ sugarcane, use of fallow land after paddy/ potato cultivation, expansion of cultivation of Oil Palm and tree borne oilseeds in watersheds and wastelands, increasing availability of quality planting material enhancing procurement of oilseeds and collection, and processing of tree borne oilseeds.

**INDIAN OIL SEED MARKET – PRODUCTION AND CONSUMPTION BY CATEGORIES**




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

## INDIAN OIL SEED MARKET BY SEGMENTS

Of all, vegetable oil production and consumption is highest. They are obtained from crushing local oilseeds, mustard in northern and eastern India; groundnut in Gujarat, Maharashtra, Karnataka and Andhra Pradesh; sesame and groundnut in Tamil Nadu; and coconut in Kerala, in kachchi ghanis.

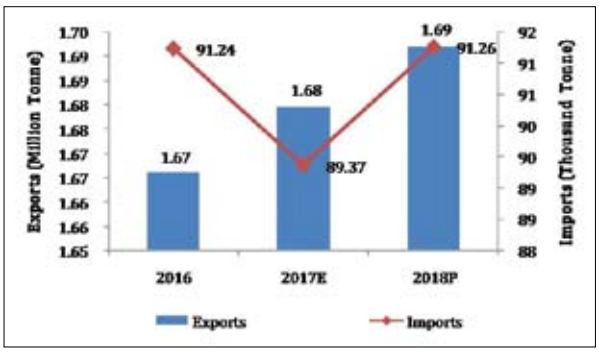
India is one of the largest exporters of oil meals, particularly of soybean meal. Soybean accounts for more than 70% of the total exports of oil meals, followed by rapeseed, castor seed and rice bran. Soybean oil is primarily imported from Argentina, Brazil and the USA, with an estimated share of about 73%, 16% and 9%, respectively during the last five years.

India exports oil meals to a large number of countries but bulk of exports are to South and South East Asian countries with a share of over 77% followed by Middle-East and Africa region (about 15%). Japan is the largest importer of oil meals from India, followed by Vietnam, South Korea, Iran and Thailand.

Indian vegetable oil economy is world's fourth largest, which accounts for 7% of world's oilseeds output, 7% of world's oil mill production, 6% of world's oil mill exports, 6% of world

**INDIAN SOYBEAN MARKET TRADE**


**INDIAN PROTEIN MEAL MARKET TRADE**




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

vegoil production, 14% of world's imports and 10% of world edible oil consumption. Palm oil has been accounting the largest share of India's total vegetable oil imports followed by soybean and sunflower. About 80% of the palm oil is imported as crude palm oil and the remaining as refined oil because of high import duty on crude oil compared to refined. India imports palm oil mainly from Indonesia and Malaysia and the share isabout 71% and 28%, respectively. During the last decade, Indonesia has lost its share while Malaysia has increased its share.

Indian agriculture has made considerable progress, particularly in respect of food crops such as wheat and rice in irrigated areas; however, performance has not been so good in case of other crops particularly oilseeds, pulses, and coarse cereals. Therefore, after achieving self-sufficiency in food grains the government is focusing attention on these agricultural commodities. The oilseeds scenario in the country had undergone a sea change in the last fifteen years while India changed from net importer in the 1980s to a net exporter status during the early 1990s. Again, it has come back to net importer status importing more than 40 percent of its annual edible oil needs.

However, India is bestowed with a number of oil yielding species including annuals, perennials, minor oil bearing species of forest and tree origin and as a component in by-products of some non-traditional sources such as rice bran, cotton seed and maize. India has also diverse agro-ecological areas for their growth. The cultivation of oil crops, in general, is not labor-intensive and thus these crops can be managed in labor scarce areas. Their cultivation is very economical and remunerative, and thus, helps in improving the socio-economic status of the farmers. Thus, Oil crops are an ideal component in the sustainable production system in Indian agriculture. ■

# CHALLENGES IN SUGARCANE AGRICULTURE AND SUGAR INDUSTRY IN INDIA

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ICAR-Sugarcane
Breeding Institute
Coimbatore, Tamil Nadu

The sugar industry sustains the livelihood of 6.2 million agricultural families and nearly 0.5 million skilled and semi-skilled industrial worker families including highly qualified and trained technologists engaged in the manufacturing of sugar. Sugar manufacturing is the second largest agro-based processing industry. The turnover of the sugarcane and sugar related economic activities were approximately of Rs. 80-85 thousand crores per annum, out of which, nearly Rs. 55-60 thousand crores is paid to the sugarcane farmers by the sugar mill as prices for its supply. In India, there are more than 556 sugar factories in operation. Prevailing sugarcane production scenario in India needs immediate attention to adopt measures for sustaining sugar production and productivity at higher level to meet the escalating demands of sweeteners in coming years. Sugarcane is also emerging as a multi-faceted crop contributing to the production of sugar, ethanol, electricity, paper and other allied products. Consequently the overall demand for sugarcane for its varied uses will increase significantly. However, the area under the crop is not likely to increase and the increased demand for sugar is to be met only through the vertical growth in sugarcane productivity and sugar recovery.

The contribution of sugarcane to the national GDP during 2014-15 is 0.68% which is significant considering that the crop is grown only in 2.56% of the net cropped area. The contribution of sugarcane to the agricultural GDP was 4.96%, which is higher than the cotton crop grown over 11.96 m ha (5.95% of net cropped area). The growth in cane area and sugar production in the country during the last eight decades had been spectacular. From 1.17 m ha in 1930-31, the cane area increased to 4.93 million ha by 2015-16; almost a fourfold increase. During this period the productivity went up by from 31 t/ha to 70.7 t/ha, sugarcane production increased from 37 million tonnes to 348.44 million tonnes and sugar production had gone up from 0.12 million tonnes to 25.13 million tonnes. Sugar recovery also showed an improvement from 9.05% to 10.61%. The number of sugar factories in operation went up from 29 to over 526 during 2015-16. During the past two decades, the average annual growth of sugarcane agriculture sector was about 2.6% as against the overall growth of 3% in agriculture sector in the country. Sugar industry contributes an estimated Rs. 4,100 crores annually to the national exchequer and treasuries of various state governments by way of excise duty and purchase tax on sugarcane and sugar.

Sugarcane productivity, however is affected

by certain limiting factors - biotic and abiotic stresses, declining soil fertility due to continued mono cropping of sugarcane for several decades, depletion of natural resources, the high cost of production and climate change. The current average productivity in the country is hardly 25% of the theoretical yield potential of the crop. The challenges in improving productivity include unfavourable climatic conditions under which the crop is grown in subtropical India.

## SUGAR AS SOURCE OF ENERGY

Sugar is one of the most significant contributors to dietary energy supply. Sugar is 3rd most important source of per capita dietary energy supply after cereal products in the rural India and is relatively inexpensive food. The cost of calorie from sugar is about 15% lesser than that from cereals. At the global level, sugar currently contributes more than 8% of the total calorie intake, after cereals (52%) and oils (10%).

## IS SUGARCANE A WATER INTENSIVE CROP?

In recent years, sugarcane crop was blamed as a water guzzler crop. Sugarcane,being a long duration crop (9 – 18 months),is a water intensive crop and requires6 to 40 irrigations in different states. The water requirement for sugarcane in different states is varied from 150 to 250 cm, which is on par with paddy and lower than paddy + wheat. Further, the total annual water requirement for sugarcane crop is much lower than paddy, wheat, paddy + wheat and even cotton.Therefore, it is not wise to blame sugarcane for water crisis in the country. However, efforts are on to popularize micro irrigation and

challenge is to develop water use efficient genotypes.

## SUGARCANE VS RURAL POVERTY

Sugar factories located in various parts of the country work as nuclei for development of rural areas by utilizing rural resources and generating employment, developing infrastructure (roads) and communication facilities. The industry caters to over 7.5% of our rural population. Financial assistance (loan) at discounted rates, loans for purchasing new machinery, seeds, creating irrigation facilities etc. are provided by the cooperative sugar mills to the farmers thereby paving the way for sugarcane farmers to become agri-entrepreneur in the rural economy.

Indian jaggery industry is the largest unorganized sector which has been one of the most ancient and important rural-based cottage industries in the country. About 25% of the sugarcane growers are manufacturing jaggery utilizing about 21.5% of cane produced, engaging over 2 million people. It provides jobs to the unemployed rural people in their vicinity with minimum capital investment.

Most of the sugar factories provide education facilities (schools) in rural areas which help in improving their living standard. These schools have transformed village education in rural areas. Extension activities by the sugar mills helps in understanding globalization, transferring knowledge on new technologies, government policies, inputs requirements and availability, importance of water and water management practices, participation in environment related activities, ability to work in better and systematic way etc.

All above mentioned factors help in reducing the poverty of rural poor population of India. The national average poverty in rural population is 28.37%. Out of total 452 sugarcane growing districts in India, in 152 districts spread index (percentage of sugarcane area to net sown area in a district) of sugarcane is more than one with average poverty of 20.79%. The poverty in rural population was further reduced to 17.77% in 43 districts with high sugarcane spread index (> 10%), which contribute nearly 75% cane area & cane production of the country. In 21 districts with either high cane spread or high cane

production, average rural poverty level was reduced to 15 %. Therefore, it is inferred that economic condition of sugarcane farmers are better than those of other farmers.

## IMPACT OF VARIETIES

Crop varieties play an important role in improving the productivity. Co 86032 was introduced in Maharashtra state during 1996-97 along with CoC 671. The average sugar recovery of the state was 11.18% during 1996-97. The area of these varieties, in subsequent years, increased to 41.29% and 37.79% of Co 86032 and CoC 671, respectively during the year 2002-03. The average sugar recovery of the state increased to 11.64% within 6 years with the increase in area of these varieties. Similarly, sugar recovery of M/s Ugar Sugar Works Ltd. increased by 1.86% due to adoption of CoC 671 (with 54.5% area) within 6 years of its adoption.

The average sugar recovery of the Punjab state was 8.53% during 1975-76 when the variety CoJ 64 was introduced. Within 5 years of its release sugar recovery of Punjab state increased to 10.14% during 1979-80.

## POLICY ISSUES

Diversification of sugar industries by-products is needed to keep the industry vibrant and viable. In Brazil, 27% ethanol is blended with gasoline. In Thailand, 10% ethanol blending was targeted during 2015-16. Govt. of India has targeted 10% doping of ethanol with Petrol for running motor vehicle during 2015-16. For 5% ethanol blending, India needs 115 crore litre ethanol. Presently, 152 ethanol plants are attached to sugar mills, with the capacity to produce 7,306 Kilo Lit alcohol /day. The Oil marketing companies (OMC) have sought expression of Interest (EOI) from sugar mills for the supply of

266 crore litres ethanol during 2015-16. The actual production of ethanol during the year was 290 crore litres. Molasses is the cheapest feedstock for the distilleries.

Unlike other crops, there is surplus sugar production in the country.To deal with this excess production of sugar, there is a need to divert a part of sugarcane juice for purposes other than sugar. The most feasible diversion of sugarcane juice is towards production of ethanol, spirit and potable liquor. I see a great potential in ethanol production directly from sugarcane juice as well as bagasse. Depending upon the sugar requirement in the country, the quota for sugar production may be fixed for each mill as per the capacity of the mill and distillery. The rest of the juice can be diverted for ethanol production. This will help in - increase in availability of renewable energy in the form of ethanol, lesser emission of carbon gases by vehicles and hence reduction in air pollution, saving in foreign exchange for the exchequer, and better economic health of sugar industry. For producing ethanol directly from sugarcane juice, essential changes in the law have to be made.

Cogeneration using bagasse is viewed as another way for sustaining the viability of sugar industry. The installed capacity of co-generation plants in India is 3200 MW/day, but the potential worked out to be around 5,000 MW/day. Bagasse could be utilized either for co-generation or for production of second generation ethanol. There is a need to have a state level policy in this regard. The Institute has developed high bio-mass producing energy canes, which can be grown on marginal/barren lands and the same could be utilized for co-generation or for ethanol production.

Sugarcane bagasse has comparable fibre properties as that of wood pulp. About 10% of the bagasse pulp has been used as substitute for wood pulp in paper industry in China, South America, Thailand and also in India but increased R&D efforts are needed in this direction.

A large number of intercrops can be grown with sugarcane. Intercrops give mid-season income to the farmers, help in managing weeds and improve soil fertility. If intercrops are taken in autumn planted sugarcane replacing the summer planting of sugarcane, then it will also result in increased cane yield (>50%) and better sugar recovery in Western UP, Haryana and Central UP. However, in spite of these well-known advantages, the area under autumn planting of sugarcane with intercrops never crossed 10% in major sugarcane growing states. The reason is lack of assured marketing for the produce of intercrops. If sugar factories come forward for further diversification in the form of packed products, particularly pulses, vegetables and oil seeds, the area under autumn planting of sugarcane is bound to increase. It will also diversify the activities of the sugar factories.Since sugar industry is rural based, another possibility of diversification in the activities of sugar factories in the country is in the field of dairy technology. Sugar factories can process the milk and if desired may go for other dairy products. ■

# HORTICULTURE

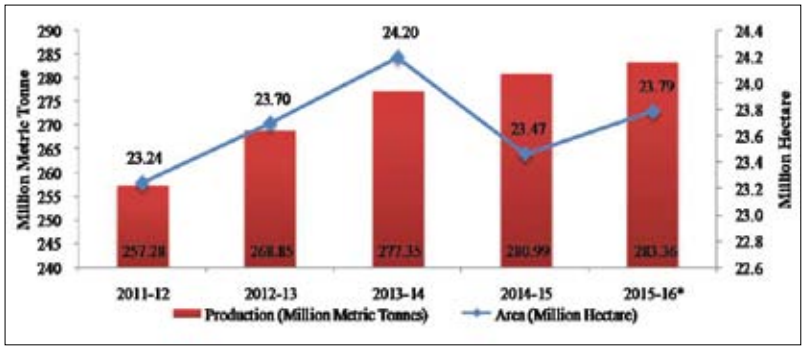
# Indian Horticulture Market Overview

Horticulture crops have a significant contribution in the gross domestic production of the agricultural sector. Due to the increasing demand and important contribution in agricultural sector, horticultural crops are becoming an area of priority. For the commercialization of horticultural crops and diversification of agriculture, various programmes are being implemented within the states by state governments like expansion of area, rejuvenation of old mango, guava and aonla orchards, production of quality planting materials and post harvest management etc.

Looking at the spatial distribution of horticultural crops in India, Karnataka along with Maharashtra, Uttar Pradesh, Gujarat and West Bengal occupy fore front positions. Out of 23.79 million hectares of total area under horticultural crops, Karnataka occupied 2.08 million hectares that was around 9% of the total area under horticultural crops. Uttar Pradesh was second with 1.87 million hectares (8% of the total area) while West Bengal and Maharashtra occupied third and fourth place with around 7.7% and 7.2%, respectively, under these crops. Gujarat was fifth in area with approximately 6.5% share of all India area cropped.

The production of horticultural crops was found highest in Uttar Pradesh with 36.05 million tonnes, accounting for 13% share in the all India horticulture crops production. West Bengal with 27.25 million metric tonnes was placed second in terms of production and had 9% share in production. Madhya Pradesh and Gujarat with above 22 million metric tonnes of production were placed third and fourth in all India.To accelerate the growth, the government of India

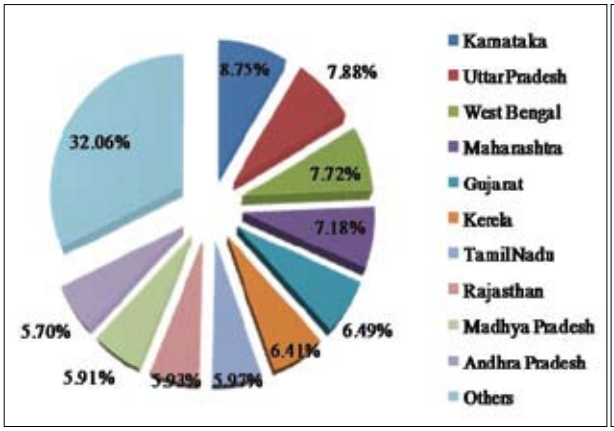
**INDIAN HORTICULTURE CROPS AREA AND PRODUCTION**



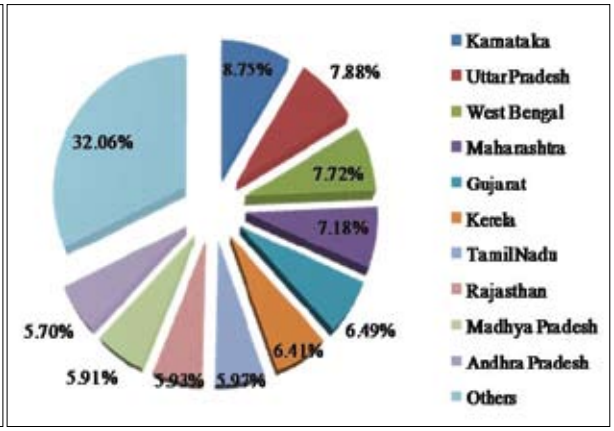

*Source: ICFA Analysis* *Note: E = Estimated, P = Projected*

**INDIAN HORTICULTURE CROPS BY STATES**

**ON THE BASIS OF AREA CROPPED**




**ON THE BASIS OF PRODUCTION**




***Source: NHB, Note: * @ 3rd advance estimates***

introduced "Mission for Integrated Development of Horticulture". All states, including, Uttarakhand and UTs, have been covered under the Mission.

## AREA AND PRODUCTION

Indian horticulture crops witnessed an increasing trend over the past five years, on the basis of production, growing at a CAGR of 1.95% during 2011-2016. However, in terms of area cropped, there was a decline in 2014-15, which may be attributed to the Consecutive droughts and freak weather in 2014 and 2015.

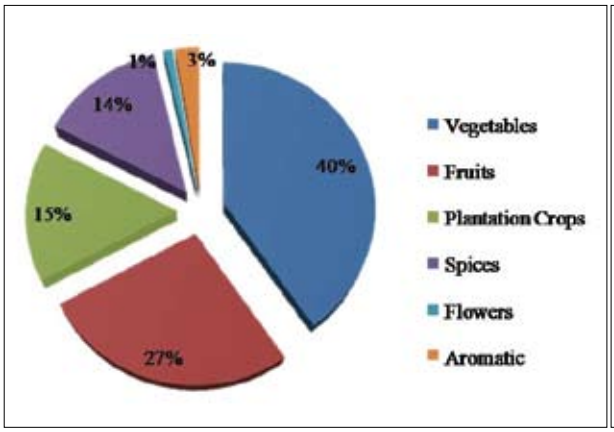
The year 2015-16 marked the fourth straight year that India's horticulture production will outstrip food grain output, underlining a structural change underway in Indian agriculture. In 2015-16, horticulture production exceeded food grain output by more than 31 million tonnes. In 2012-13, the difference was 11.3 million tonnes.

The fact that horticulture crops are grown in about 10% of India's gross cropped area, compared to over 50% of the area used to grow food grain, also signals the success of small and marginal farmers in growing more fruits and vegetables, driven by higher demand.

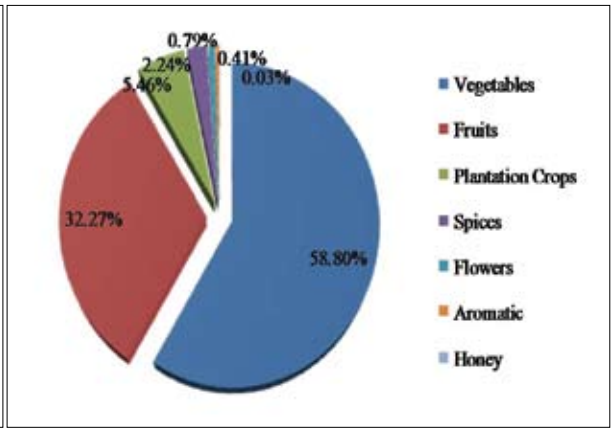
Although, the horticulture sector is one of the fastest growing segments of agriculture in India, it also faces numerous emerging challenges. The most prominent ones are pressures emanating from climate change, post-harvest losses, bio-security concerns, absence of market linkages and resultant price fluctuations, changing quality consciousness and global competition.

**INDIAN HORTICULTURE CROPS BY SEGMENTS**

**ON THE BASIS OF AREA CROPPED**




**ON THE BASIS OF PRODUCTION**




***Source: NHB, Note: * @ 3rd advance estimates***

These concerns need to be addressed in order to sustain the growth momentum in horticulture. The focus of growth strategy, therefore, needs to be on raising productivity by supporting high density plantations, protected cultivation, micro irrigation, quality planting material, rejuvenation of senile orchards and a thrust on post-harvest management to ensure that the farmers do not lose their produce in the transit from the farm gate to the consumer's plate.

## CROPS BY STATES

The top four states producing horticulture crops with maximum cropped area are West Bengal, Karnataka, Uttar Pradesh and Gujarat. Among theses, Karnataka has the largest cropped area as Karnataka is predominantly an Agriculture State. 24% of the total GDP comes from agriculture and 65% of the work force is dependent on agriculture with 70% of the population still in rural areas, depending on agriculture for their livelihood. In fact, total gross annual income from horticulture was Rs.7,152 crore, which was 40% of the gross annual income from combined agriculture sector.

On the basis of production, Uttar Pradesh is expected to have produced the largest amount of horticulture crops in 2015-16 with 36.05 million metric tonnes production. This may be attributable to the diverse climate of Uttar Pradesh, which is suitable for producing all kinds of horticultural crops. In fact, for more than 90% of small holding farmers, horticultural crops are the main source of higher income, employment and nutrition per unit area.

Also, in the year 2015-16 in Bundelkhand and Vidhya region, beneficiary farmers are being given Rs.3,000 per hectare for three years per month as an incentive for establishing orchards in 0.2 hectare to 1 hectare with fencing to be done by the beneficiary to establish new orchard in field of beneficiary farmers and also to address the mortality in established orchard. Besides this, under Bundelkh and Special Package various programs are also being implemented.

## HORTICULTURE CROPS SEGMENTS

India's horticulture production is expected to be around 287.32 million metric tonnes, which will continue to outstrip food grain production by a good margin in 2016-17 also, even as vegetables might see just a marginal decline.

Over the years, vegetables and fruits have occupied the position of foremost importance and thus, constituted more than 90% of the total production of horticulture crops and approximately 70% share of the area cropped in 2015-16.

Under horticulture, fruit production in 2016-17 is expected to be 91.72 million metric tonnes, against 91.44 million metric tonnes last year. Vegetables production in the aforementioned year, according to the first advanced estimates, is expected to touch 168.59 million metric tonnes, against 166.61 million metric tonnes in 2015-16.

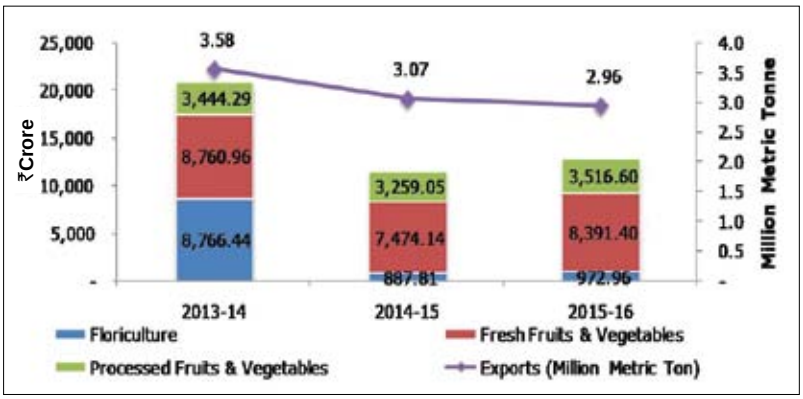
## INDIAN HORTICULTURE MARKET TRADE

It is widely believed that India is going to become a net importer of agricultural products. However, there are areas where India could show good export performances. Horticulture sector is one such sector.

## INDIAN HORTICULTURE MARKET EXPORTS

Besides meeting the increasing demand of the domestic population, which continues to grow, India exports some portion of its horticulture produce. During 2015-16, total exports of horticulture produce by India were 2.96 million metric tonnes, which amounted to about Rs. 128.81 billion. Even though the quantum of

**INDIAN HORTICULTURE CROPS EXPORTS**




*Source: APEDA*

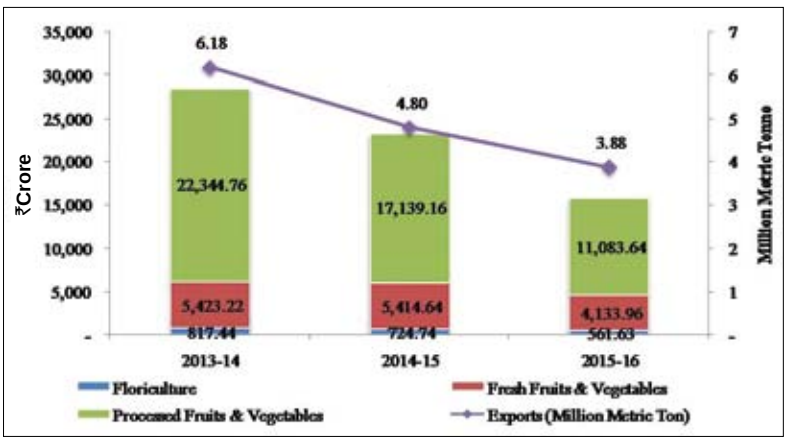
export decreased in comparison to the preceding year i.e. 2014-15, when it was 3.07 million metric tonnes, the value of export of horticulture produce increased by 10.84% from Rs116.21 billion in 2014-15. The untimely rains that caused the damage, may have affected the volume of exports during 2015-16.

The consecutive drought and freak weather along with the impact of the currency depreciation of Black Sea and South American countries, and the falling crude prices in 2014 compelled Indian agricultural exports, including horticulture crops to become a trickle.

The decline in the volume of the exports of horticulture crops also signifies the increasing per capita availability of crops, along with increase in the domestic demand of the crops.

Horticulture crops can be segmented into three categories, namely, Floriculture, Fresh Fruits & Vegetables and Processed Fruits & Vegetables. Of all, in 2015-16, Fresh Fruits & Vegetables accounted for largest share, constituting 65.15%, followed by Processed Fruits & Vegetables with 27.3% share. Although, in 2013-14, floriculture exports share was 41.8%, which drastically declined to 7.64% during 2014-15 and further to 7.55% during 2015-16. The major reasons for the same may be attributed to the several production level challenges faced by the industry, such as, small size of land holding unavailability of basic inputs and skilled manpower for harvesting and post harvesting techniques.

**INDIAN HORTICULTURE CROPS IMPORTS (2013-16)**




*Source: APEDA*

Also, with increasing involvement of supermarkets in flower trade, organizing logistic is also becoming a critical factor for the flower exporters.

## INDIAN HORTICULTURE MARKET IMPORTS

The imports of the horticulture crops have declined in terms of both value and volume over the years. The import volume decreased to 3.88 million metric tonnes in 2015-16 from 6.18 million metric tonnes in 2013-14, while imports in terms of value, declined to Rs15,779 crore from Rs. 28,585 crore. The imports were largely affected by the high import duties and increasing self sufficiency of horticulture products in the country.

There was a decline in the imports of processed fruits and vegetables at a negative CAGR of 20.84% during 2013-16. This may be attributed to the rise in the number of food processing units in India, during the period. However, there was a significant decline in the imports of fresh fruits & vegetables and floriculture of 8.65% and 11.76%, respectively, during the aforementioned period.

The productivity of horticultural crops has increased by about 34% over the span of past 10 years. The special attention given to the sector, especially after the introduction of the Horticulture Mission for North East and Himalayan States (HMNEH) and the National Horticulture Mission (NHM) in the 11th Plan, has borne good results. Given the increasing pressure on land, growth strategies have been focusing on raising productivity through high density plantations, protected cultivation, micro irrigation, quality planting material, rejuvenation of senile orchards and an emphasis on post harvest management and marketing of produce for better price realization. ■

Dr. R. A. Sherasiya
Director of Horticulture,
Gujarat State

# BLOSSOMING EPOCH OF HORTICULTURE IN GUJARAT

Horticulture contributes 13-14 % in area (1.47 Million Ha.) and nearly 50% (21.32 Million Tones) in the overall agriculture production of the state. The area under horticultural crops increased by 15% in the last five years, whereas the production had increased by 40%. Horticultural sector contributes about 25% in the overall farm income (including dairy and Animal husbandry) of Gujarat state. Contribution of the state is about 9.58 % in production of fruit crops, 7 % in production of vegetable crops and 16.70 % production in spices crops of the country. The average productivity of fruits is 21.21 Mt/ha and Vegetables 20.25 Mt/ha which is higher than the national average of 13.97 Mt/ha in fruits and 17.64 Mt/ha in vegetables.

The total vegetable production is 126.8 Lakh MT from 6.26 lakh hectares and the total fruit production is 85.05 Lakh MT from 4.01 lakh hectare area. The total flower production is 1.84 Lakh MT from the 0.19 lakh hectare area with productivity of 9.45 MT/Ha in Gujarat.

The state produces 90% of Fennel, 99% of fresh Dates, 51% of Cumin, 14% of Banana, 21% of Papaya, 12% of Onion and 5% of Pomegranate of the country. Gujarat stands first in the productivity of Onion and potato, whereas second in the productivity of Banana.

The state has given more emphasis on the horticultural development programs.

## MAJOR HORTICULTURAL CROPS OF THE GUJARAT

| Fruits | Vegetables | Spices-Medicinal | Flowers |
|---|---|---|---|
| Mango | Potato | Cumin | Rose |
| Banana | Onion | Garlic | Jasmin |
| Pomegranate | Brinjal | Isabgul | Marigold |
| Dates | Tomato | Fennel | lily |
| Sapota | Okra | Turmeric | Gaillardia |
| Lime | cabbage cauliflower cucurbits | Ginger | |
| Guava | | Chillies | |
| Aonla | | Senna | |
| Papaya | | Gerbera | |

The ultimate strategy is development of crop clusters and adoption of end-to–end approach. More emphasis have been made on the availability of genuine planting materials, capacity building, post-harvest management, protected cultivation and strengthening of marketing system.

The state had laid enough emphasis on ensuring availability of good planting materials to the farmers. Tissue cultures laboratories, model nurseries, modern vegetable nurseries

## AREA AND PRODUCTION TREND OF HORTICULTURAL CROPS IN GUJARAT

| Year | Fruit Crops | | Vegetable Crops | | Spices & flower Crops | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Area | Prod. | Area | Prod. | Area | Prod. | Area | Prod. |
| 2011-12 | 3.82 | 77.63 | 5.18 | 100.50 | 5.71 | 11.68 | 14.87 | 191.17 |
| 2012-13 | 3.98 | 85.30 | 5.37 | 105.20 | 5.66 | 14.03 | 15.02 | 204.05 |
| 2013-14 | 3.79 | 80.28 | 5.82 | 118.80 | 6.32 | 11.80 | 15.93 | 210.88 |
| 2014-15 | 3.92 | 83.28 | 6.04 | 120.49 | 4.69 | 9.45 | 14.66 | 213.22 |
| 2015-16 | 4.00 | 85.00 | 6.26 | 126.82 | 4.99 | 10.14 | 15.25 | 221.96 |

*(Area- Lakh Ha., Production- Lakh MT)*

*Smt. Anandiben Patel (Then Chief Minister of Gujarat) with H.E. Daniel Carmon (Ambassador of Israel to India)*

## INDO-ISRAEL AGRICULTURE WORK PLAN BLOSSOMING IN GUJARAT

The Centers of Excellence provide a suitable platform for rapid transfer of technology to the farmers. This include demonstration of knowhow and new agricultural technologies such as protected cultivation, drip irrigation and fertigation which will be later adopted by the farmers to increase their yields and income taking into consideration sustainable use of water, fertilizers and pesticides. The Center of Excellence target both small and large farm holders, thus offering a wide range of agricultural practices in order to enable all to benefit from the new technologies.

Applied Research provides solutions to the farmers, mapping the challenges and adjusts the challenges and adjusts the technology to local conditions.

Field Extension Officers (SMS) are the elements between the applied research and the famers. This function is carried out by the government extension officers.

Progressive Farmers are implementing the technologies demonstrated at the Centers and act as role models to other farmers.

Sustainability: IIAP is a self-sufficient platform in the aspect of HR, accumulated knowledge & operating capabilities.

have been established with the active support of the government in the state. Cultivation of high value crops like Banana, pomegranate, Papaya, processable potato and onion have also been promoted. Crops like, Dutch Roses, Gerbera, Capsicum, Chives, and Capsicum and off season vegetables are also being cultivated under protected cultivation. Farmers have adopted technologies like mulching, fertigation and micro irrigation.

Value addition and post-harvest handling are the important aspects to prevent post-harvest losses and increasing farm income. Establishment of Post-Harvest infrastructure facilities like On-farm pack houses, Grading Sorting lines, integrated pack houses, cold storages, ripening chambers for fruits like Mango and Banana, cold chain are the key elements of the Horticulture Development Program of the Government. Establishment of such infrastructures has a great potential to enhance internal and overseas trade of horticulture commodities. Government programs are supporting entrepreneurs to invest in this sector.

As horticultural crops generate higher income, the area and production under horticulture crops are increasing day by day. Three Centers of Excellence under Indo-Israel Agriculture Work Plan have been established to demonstrate latest technologies of vegetable cultivation, mango cultivation and post-harvest management of date palms. These centers are demonstrating technologies like hi-tech seedling production, screening of varieties, precision farming, irrigation management, IPM, INM and Post-harvest handling of horticultural crops. Looking at the benefits generated by these Centers of Excellence, the state government has decided to establish further more centers across the state.

**Under this phenomenon, Department of Horticulture, Government of Gujarat has got three Centers of Excellence, each for Vegetables, Mango and Datepalm.**

- COE- Vegetables- At. Vadrad, TA. Prantij, Sabarkantha
- COE- Mango-At. Talala, GirSomnath
- COE- Datepalm-At. Kukma, Ta. Bhuj, Kutch

*Center of Excellence for Vegetables*

**Center of Excellence for Vegetables** is located in Vadrad village of Prantijtaluka of Sabarkantha district which covers area under protected cultivation and demonstrating technologies like hi-tech seedling production, screening of varieties, low tunnel, mulching, precision farming, irrigation management, Integrated Pest Management, Integrated Nutrient Management, post-harvest handling of vegetables, vegetable grafting, Good Agricultural Practices, etc. More than 19 officers from horticulture department has received training from MASHAV, Israel. More than 50,000 people have visited the center in the last four years and more than 4,500 have been trained in these years. This center has also distributed more than 50 lakh high quality vegetable seedlings among farmers; on no profit no loss basis.

*Center of Excellence for Vegetables*

**Center of Excellence-Mango** is located in Talala of Gir-Somnath district which is the hub of Mango. It was inaugurated on 15th June 2017 by Honorable Union Minister for Agriculture (State) Shri Purusottam Rupala. It demonstrates technologies like, hi-tech nursery management, root-stock for high density and salinity tolerance, irrigation-fertigation management, rejuvenation, high density planting, IPM, pruning & canopy management, etc. CoE-Mango has distributed good quality mango sapling among farmers and trained more than 1000 farmers last year.

**Center of Excellence-Datepalm** is located in Kukama village in Kutch district of Gujarat which is major Date palm growing area of the country. CoE-Dates will mainly be concentrating on activities of selection of good varieties, pollination technology, post-harvest handling of dates for long distant and short distant market, etc. Israeli experts have visited this center. Various interaction seminars, field visits, etc. were also organized with experts and farmers. This center is to be inaugurated. ■

# DAIRY, POULTRY AND AQUACULTURE

# Indian Dairy Product Market

India is the world's largest producer of dairy products by volume, accounting for more than 13% of world's total milk production, and it also has the world's largest dairy herd. This is because India has 75 million dairy farms, about half of all dairy farms in the world.

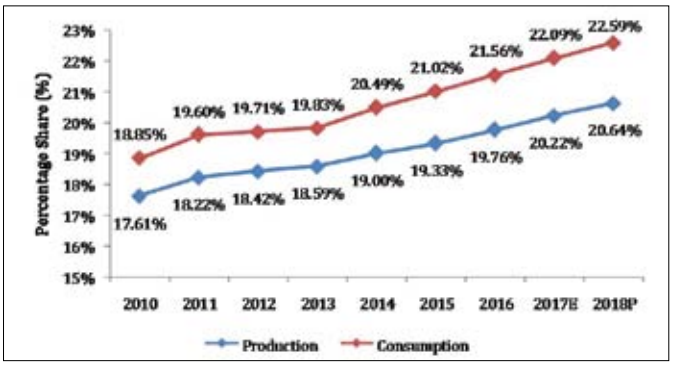
India has an edge over many developed countries also because its cost of production is lowest in the world and hence it enjoys a comparative advantage in the production of milk. The only problem with India is high cost of conversion to dairy products. It might be due to lack of scale at both production and processing level.

However, India has merely managed to capture only 1% of global dairy trade despite being the largest milk producer. However, India is a net exporter of all the dairy products except Lactose and Lactose syrups. Good potential for Indian casein and milk powders. whey cheeses also exist.

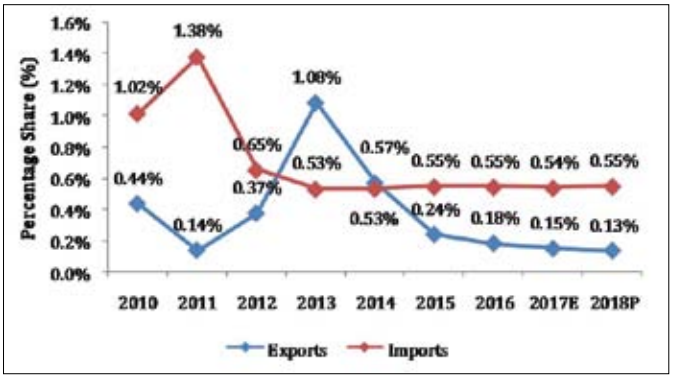
## INDIAN DAIRY PRODUCTS MARKET

The country has experienced noteworthy improvement in the per capita availability of milk over the last five years. The unorganized sector comprising of small farmers and cooperatives contribute primarily to the dairy market. Over the

### INDIA'S SHARE IN THE GLOBAL PRODUCTION AND CONSUMPTION OF DAIRY PRODUCTS




### INDIA'S SHARE IN THE GLOBAL TRADE OF DAIRY PRODUCTS




*Source: ICFA Analysis* *Note: E = Estimated, P = Projected*

last few years, the organized sector has been catching up rapidly by offering customized products to the end consumers, thereby causing a rise in the organized market share.

But dairy products industry continues to face challenges from lack of quality and low productivity as a result of large part of the market being unorganized. The Indian dairy market is now witnessing the entry of a large number of foreign players. This can be observed with the increasing presence of companies in emerging yogurt segment such as Red Mango, Cocoberry, Kiwi Kiss and Yogurberry, etc. Among dairy products, Amul and Mother Dairy are the two largest companies in the Indian dairy market.

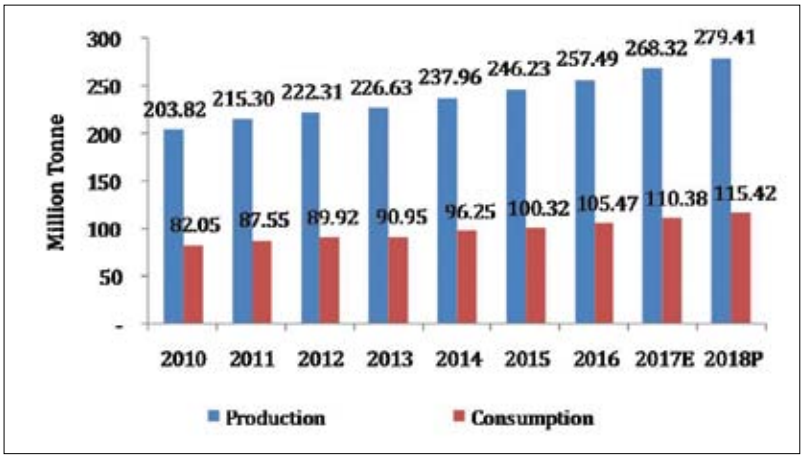
## INDIAN DAIRY PRODUCTS – PRODUCTION AND CONSUMPTION ANALYSIS

Indian dairy market is amongst the largest and fastest growing market in the world. India has been able to maintain its position in milk production during the past 18 years and milk production during 2015 stands at 155.5 million tonnes. Milk production recorded about 4% CAGR during the last five years. Strong farm gate prices and rising domestic demand for value-added dairy products are the major factors providing impetus to a steady increase in milk production.

Though India is the largest milk producing country, milk yield in the country is still very less as compared to other top milk producing countries like USA, Germany, France and New Zealand. High milk production in India is attributed to large population of cattle rather than good milk yields.

Moreover, milk processing capacity in the country has increased over the years due to increase in demand of good quality, hygienic and packaged milk and milk products. Of the total milk processed in the country, 65% to 70% is sold as liquid milk. The rest is processed into dairy products like cheese, butter, ghee, ice cream, curd etc.

**INDIA'S PRODUCTION AND CONSUMPTION OF DAIRY PRODUCTS**




*Source: OECD Statistics*

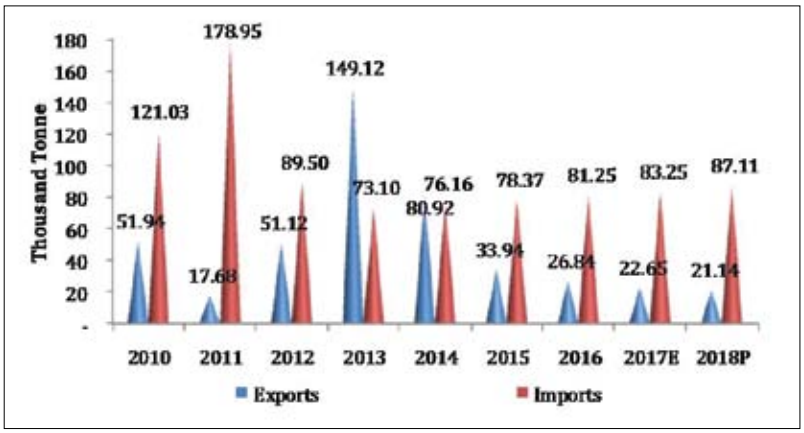
*Note: E = Estimated, P = Projected*

The consumption pattern of dairy products in India is quite unique as compared to some of the western countries. Consumption is primarily skewed towards traditional products; however, westernized products are gradually gaining momentum in the urban areas. Interestingly, buffalo milk accounts for the largest share of the total milk produced in the country. Since the pricing of milk is based on the fat content, buffalo milk offers higher profit margins as compared to cow milk as it contains higher fat.

Despite having the world's largest milk production, India is a very minor player in the international market. This is due to the direct consumption of liquid milk by the producer households as well as the demand for processed dairy products that has increased with the growth of income levels, which have left little dairy surpluses for export. Nevertheless, India consistently exports specialty products such as casein for food processing or pharmaceuticals.

The major export destinations for the Indian dairy products are Bangladesh, Middle East, US and Egypt.

**INDIAN DAIRY PRODUCTS – TRADE ANALYSIS**




*Source: OECD Statistics* *Note: E = Estimated, P = Projected*

## INDIAN DAIRY MARKET BY COMMODITIES

In terms of products, skim milk powder, Casein and ghee are the most important product exported from India followed by butter and whole milk powder. Most of these exports go to regional milk deficient nations including Pakistan, Bangladesh, Afghanistan, Nepal, Bhutan, and the United Arab Emirates. India also exports small volumes of casein to the United States, Europe, and other countries.

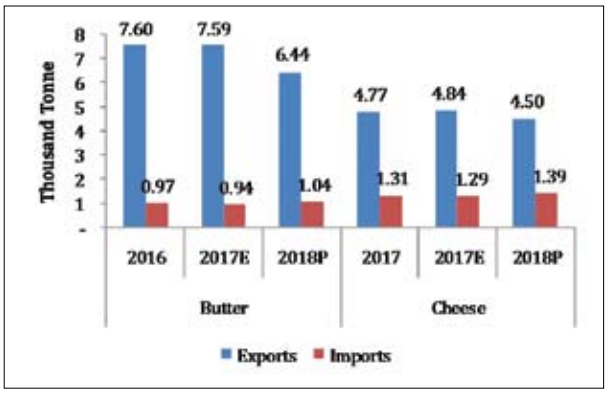
However, India's dairy imports can be irregular. In addition to skim milk powder, butterfat (including ghee and butter oil), and lactose, India also imports small volumes of whey products, cheese, and ice cream. The country applies tariff rate quotas to skim milk powder and butter oil. In addition, the county has restrictive import regulations, including import permits, that eliminate US exports from entering the country, and it placed a ban on Chinese milk and dairy product imports until June 23, 2017.

The government is taking several initiatives and introducing yearly plans in order to boost the dairy market. However, the dairy sector is still encountering problems such as non-availability of fodder and low yield of cattle.

Since agriculture and dairy sector share a relationship because of the mutually linked inputs and outputs, it is important to promote the two in tandem to move towards holistic growth. It is important to introduce efficient feeding methods and feeds, encourage commercialization and mechanization of dairy farms, develop networks to promote processed food and beverages based on milk, have well managed cold chain facilities to minimize wastage and organize the sector.

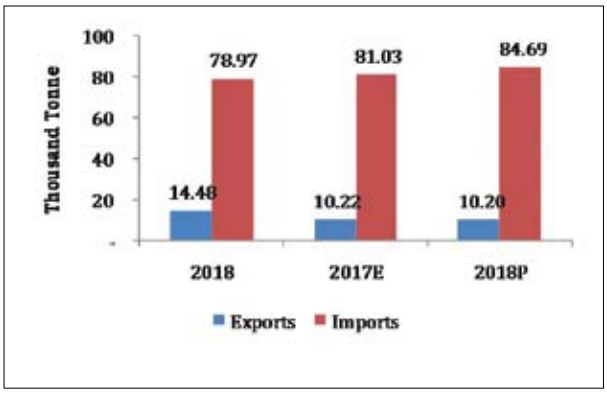
One emerging trend in Indian dairying is the growing number of the commercial dairy farms in the urban and peri-urban areas of the metros and big cities. These dairies mainly cater to the needs of the urban consumers. Their average herd size ranges from having 10 to 20 milch animals (small size dairy farms), 21 to 50 milch animals (medium size dairy farms) to more than 50 milch animals (large size dairy farms). Realizing the growing importance of commercialization, the livestock sector needs to meet the challenges of globalization, in terms of organized production and marketing. Many States' Dairy Development Departments, cooperatives like Amul and private sector dairy players are giving an impetus to setting up Hi-tech commercial dairy farms leading to clean milk production. ■

**INDIAN BUTTER AND CHEESE – TRADE ANALYSIS**




*Source: OECD Statistics*

**INDIAN MILK POWDER MARKET – TRADE ANALYSIS**



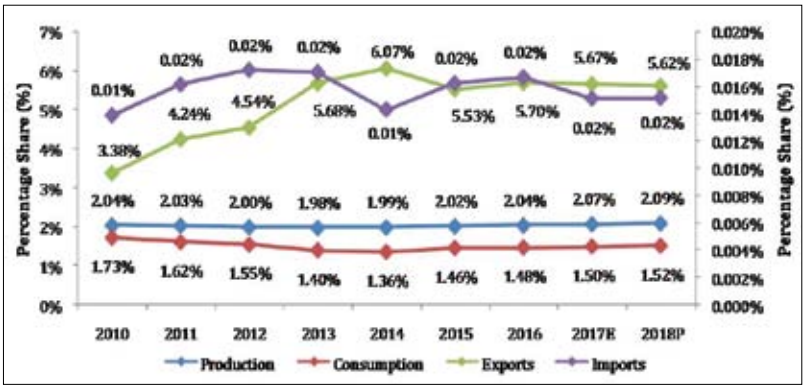

*Note: E = Estimated, P = Projected*


Every morning 36 lac women
across 18,600 villages bringing
in milk worth ₹70 crores,
are now celebrating
their economic independence.
Thanks to the co-operative
movement called Amul.
Amul
The Taste of India
10824406

# Indian Meat Market

Livestock sector is an important sub-sector of the agriculture of Indian economy. It forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, contributing to the health and nutrition of the household, supplementing incomes, offering employment opportunities, and finally being a dependable "bank on hooves" in times of need. It acts as a supplementary and complementary enterprise. India has vast resource of livestock and poultry, which plays a vital role in improving the socio-economic conditions of rural masses. There are about 300.00 million bovines, 65.07 million sheep, 135.2 million goats and about 10.3 million pigs as per 19th Livestock Census in the country.

**INDIA'S SHARE IN THE GLOBAL MEAT MARKET**



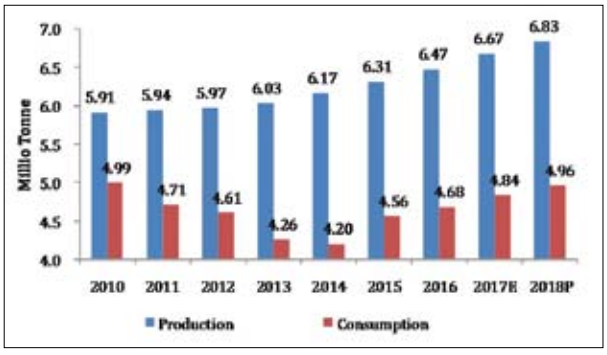

*Source: ICFA Analysis, Note: E = Estimated, P = Projected*

Globally, India is the second fastest growing processed meat and poultry market with a CAGR of 22%. However, Indonesia stands first in this category with 26.7% CAGR between 2011 and 2015 followed by Vietnam at 15.5%, China at 13.9% and Brazil at 10.9%.Global innovation within the processed meat category has increased over the years and many markets with the highest growth potential are from the Asia Pacific region, especially India.

## INDIAN MEAT MARKET

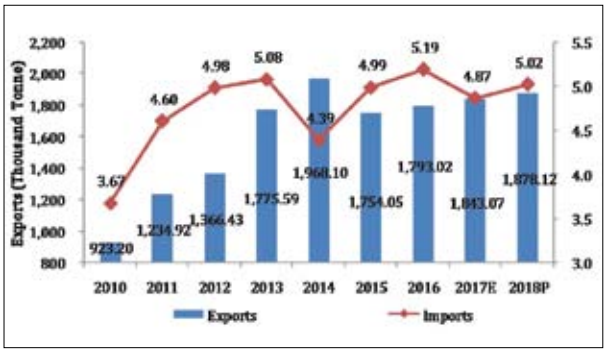
India is one of the countries with the lowest per capita meat consumption in the world, with 5.6 kg in 2013 as compared to the global average of 33.2 kg. With the population of about 1.3 billion, even a tiny per capita consumption increase has the potential to translate into a significant rise in the fresh meat volumes. Moreover, the erosion of traditional culinary habits and the acceleration of consumer lifestyles, underpinned by ongoing urbanization, are leading to a decrease in the time spent cooking at home in India, particularly amongst younger consumers. As a result, there is a growing demand for convenient, packaged processed meat products.

**INDIAN MEAT MARKET – PRODUCTION AND CONSUMPTION**




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

**INDIAN MEAT MARKET TRADE**




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

## INDIAN MEAT MARKET – PRODUCTION AND CONSUMPTION ANALYSIS

The meat production has registered a healthy growth. However, there is very little processing. Hardly 1% of the total meat produced in the country is used for processing and remaining meat is sold in fresh or frozen form. Pork and Poultry meat are used for production of ham, sausages, patties etc., for the elite market.

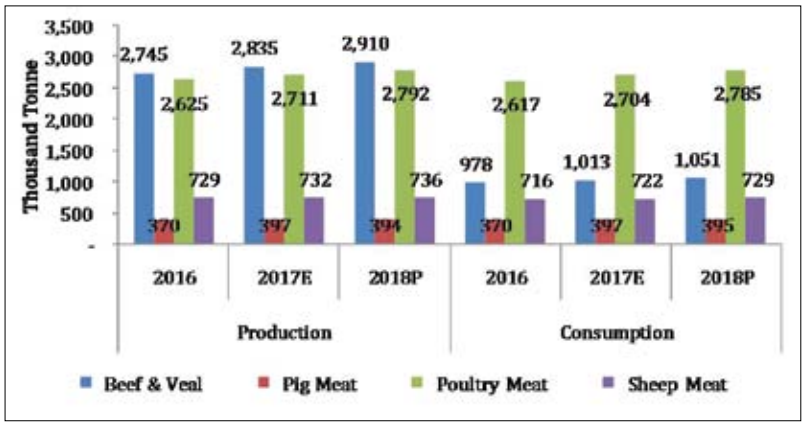
Although, with vegetarian diets supported by strong cultural and religious traditions, India has the lowest level of meat consumption in the world. Only 70% of the Indian population aged over 15 consumed non-vegetarian diets in 2014, according to a survey released by the Registrar General of India in 2016. Moreover, this represented a four percentage point fall since 2004, as consumers were increasingly attracted to the purported health benefits of a vegetarian diet. This process is expected to continue over 2016-2021, with the easy availability of vegetarian food bolstering the health-orientated drift towards vegetarianism.

## INDIAN MEAT MARKET – TRADE ANALYSIS

Meat industry, which has shown a tremendous development in the last decade, has a greater scope of improvement with support of the industrialists and government. India's international trade in livestock and livestock products is mainly in live animals (17%), meat and meat products (82%), dairy products and eggs (1%). At the global level, India's exports and imports account for only 0.17% of each. Meat and meat products have dominated the exports from livestock.

Driven by the structural changes in agriculture and food consumption patterns, the importance of meat sector has been undergoing a steady transformation. In recent years the meat industry for export has attracted heavy investment as major meat exporters are expanding their processing capacities to meet demand in new worldwide markets. The Government of India is also taking steps to provide thrust to the buffalo meat sector by introducing schemes on salvaging and rearing of buffalo male calves and modernization of abattoirs.

**INDIA'S SHARE IN THE GLOBAL MEAT MARKET**




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

India exports both frozen and fresh chilled meat to more than 60 countries of the world. The major items of export include deboned and deglanded frozen buffalo meat, which accounts for approximately 97% of the total meat export. Major market for Indian buffalo meat is Malaysia and Egypt and for sheep and goat meat are UAE, Iran and Jordan. India also exports small quantity of processed meat to Thailand, Yemen, and Japan and poultry products to Saudi Arabia, Oman, Kuwait and Qatar.

With a high proportion of Muslims and vegetarians in the population, pork consumption per person in India is negligible. However, demand from the hotel, restaurant and institutional

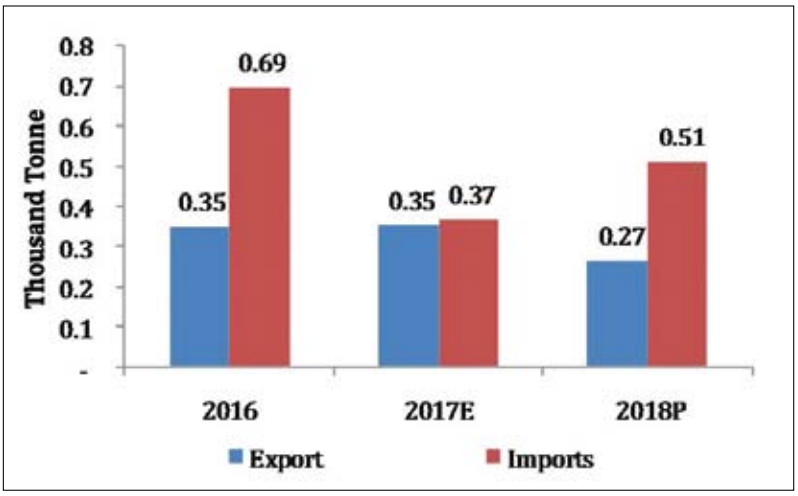
## INDIAN MEAT MARKET BY SEGMENTS

Major portion of meat from sheep, goat, pig and poultry is primarily used for domestic consumption in the form of hot meat. Certain portion of meat from buffaloes, cattle and sheep is exported.

**INDIA'S SHARE IN THE GLOBAL MEAT MARKET**


*Source: OECD Statistics, Note: E = Estimated, P = Projected*

## INDIAN PIG MEAT MARKET TRADE




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

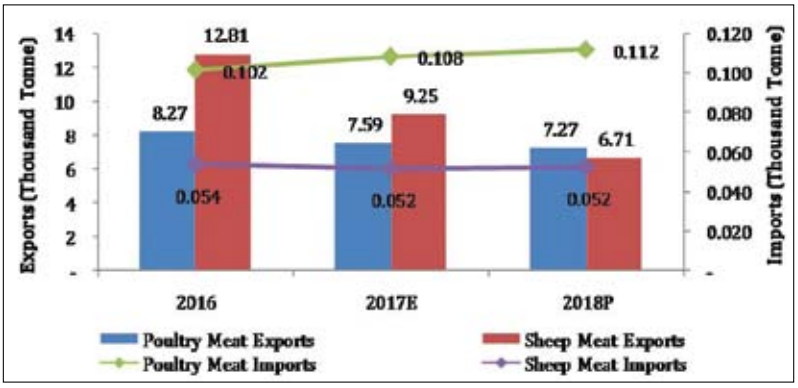
sector as well in high-end retailers helped to push up imports to 0.69 thousand tonnes in 2016. Imported products include pork belly, chops, loin, tenderloin, neck, shoulder, spare ribs, bacon, ham, salami and sausages.

While demand from high-end hotels, restaurants and retailers is driving imports of pork products to India, there is a largely separate but significant market for locally produced pig meat in north-eastern states - which include Assam, Nagaland, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim and Tripura - as well as in Bihar, Jharkhand, West Bengal, Goa and Kerala.

India's per capita consumption of poultry meat is estimated at around 3.1 kg per year, which is low compared to the world average of around 17kg per year. However, the consumption is expected to grow in the near future. India is the ninth largest producer of poultry meat in the world. Indian poultry meat products have good markets in Japan, Malaysia, Indonesia and Singapore.

Meat sector plays an important role in India as it not only provides meat and by-products for human consumption but also contribute towards sustainable livestock development and livelihood security for millions of men and women from weaker sections. Meat production and supply of meat for local consumption is the most neglected sector in the country. Meat is sold in open premises leading to contamination from dirt, dust, flies and other pollutants. The traditional production systems and the unhygienic practices have ruined and flawed the image of the Indian meat industry. Indian meat industry on scientific and modern lines is needed for benefiting livestock producers, processors and finally consumers. Indian meat contains less fat and the present international trend is favorable for low fat meat. Average fat content of Indian meat (buffalo/ poultry) is around 4% compared to 15-20% in most of the developed countries. Moreover, meat is free from growth promoters of other therapeutic residues and mad cow disease, which favors Indian meat in the international market. ■

## INDIAN POULTRY AND SHEEP MEAT MARKET TRADE




*Source: OECD Statistics, Note: E = Estimated, P = Projected*

# Indian Poultry Market Overview

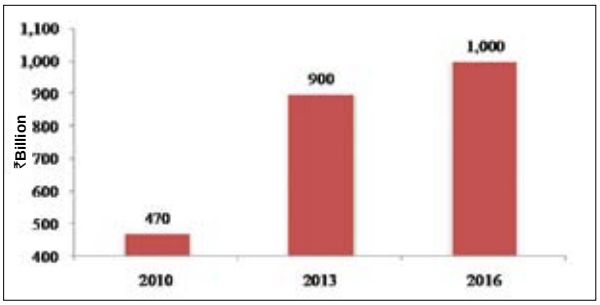
Poultry is one of the fastest growing sectors in the Indian agricultural industry. The poultry sector in India has experienced significant change in structure and operation in the recent two decades changing from a mere courtyard activity to a significant viable activity with presence of big players with effective execution of poultry cultivating on a vast scale. Poultry processing, though still in nascent stage, continues to record double digit growth driven by promising socio economic factors and increasing penetration of QSR chains. India is the second largest egg and third largest broiler-chicken producer in the world. However, India remains pre dominantly a live bird market with more than 90% of broiler sales being done at customary retail channels given consumer inclination for freshly cut broiler.

## INDIAN POULTRY MARKET BY VALUE

The Indian poultry market witnessed an increasing trend over the past five years, growing at a CAGR of 11.39% during 2010-2016. At present, urban markets account for about 80% of demand, but according to the recent estimates, rural demand will rise significantly, due to lower chicken prices, improving prosperity and changing lifestyles, helping the sector post at least 8-10% expansion annually.

The current fiscal year 2016 started strongly for the poultry market with high realizations during Q1FY2016,

**INDIAN POULTRY MARKET BY VALUE**




*Source: Company Reports*

though realizations moderated in Q2 and Q3, while feed prices continued to remain high.

The Indian poultry market is largely concentrated in Andhra Pradesh, Tamil Nadu and Telangana.

The major challenges faced by the market, other than high feed costs, include transportation infrastructure and inadequate cold chain along with high vulnerability to disease outbreaks and highly volatile realizations affecting cash flows.

India continued to report erratic instances of 'bird flu' epidemics in 2015 including in certain parts of Kerala, UP, Manipur, Chandigarh and Telangana, which had peripheral impact on poultry prices and supply for short duration in and around the affected areas. Given better consumer awareness and fast action by authorities to control the spread of infection, overall impact of such regional outbreaks has been

limited to the poultry market, though any large scale out break can have much varied effects.

Poultry integrators have partial control over feed prices and broiler realizations; and they continue to focus on improving production through better Feed Conversion Ratio (FCR) by testing with feed mixes, lower mortality rates through superior farm management, and constant efforts to improve other parameters like hatchability, average daily weight gain, reducing selection gap, etc.

While the industry had conventionally focused primarily on productivity advancement, it is currently also moving towards enhancing circulation infrastructure, swelling value additions and exercising better control over its supply network. Long-term solution to reduce volatility in realizations and enable better distribution across the country, along with developing exports markets, lies in moving towards processed chicken market from existing wet market orientation of consumers.

The trade analysis of the poultry products of India depicts that the country has very negligible presence in the international trade. Although, exports have been increasing over the years, imports were not stable during 2013-2015.

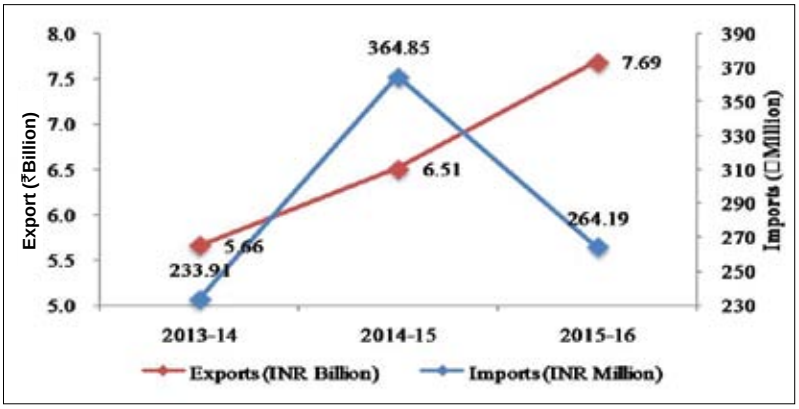
With reduced risk from imports flooding the markets and improving demand for poultry products is encouraging the domestic players to expand their production and provide with more variety of products.

## INDIAN EGG PRODUCTION MARKET ANALYSIS

In 2017 egg production is forecasted at 84 billion eggs, up 5% from estimations of 2016. The layer birds are mainly concentrated in the states of Andhra Pradesh, Tamil Nadu, Maharashtra, and Punjab. Egg production is also expanding in the states of West Bengal, Uttar Pradesh, Bihar, and Chhattisgarh. Most of the layer bird farming is in southern India due to less variation in seasonal climates. The Babcock is the preferred layer breed and constitutes about 80% of the market share.

Other layer breeds include Lohman, Bovans, and Hyline. The eggs are sold in bulk quantities without branding in most cases.

**INDIAN POULTRY MARKET EXPORT AND IMPORT**



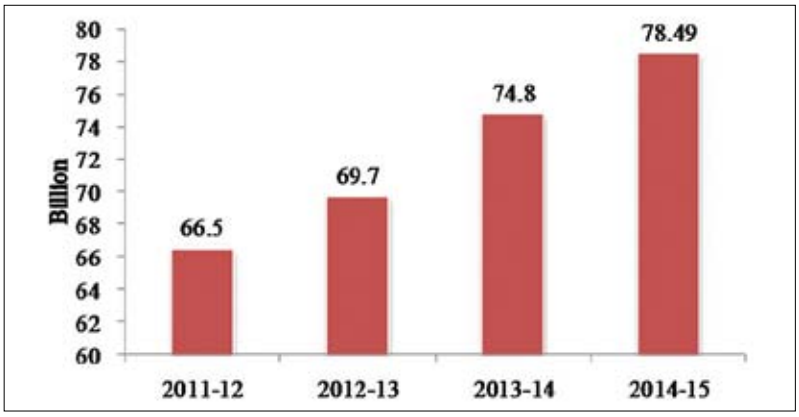

*Source: APEDA Statistics*

## INDIAN EGG PRODUCTION BY VOLUME

The egg production in India increased to 78.49 billion in 2014 from 66.50 billion in 2011, increasing at a CAGR of 5.68%. The domestic demand for the eggs is expected to drive the market in the long term as 4%-5% increase in demand, annually for eggs is expected.

The market value of egg market in

**INDIAN POULTRY EGG PRODUCTION**




*Source: Pocket Book of Agriculture Statistics 2015*

2015 was estimated to be INR255 billion. The low cost of egg production, high productivity, rise in egg consumption in the north owing to growing per capita income of a young and increasingly urban population and emerging export markets are certain key growth drivers of egg production in India. Some of the key challenges faced by the egg market in India include, High tariff, hygiene, price range of animal feed and outbreak of diseases.

However, the government should support the egg industry as it is environmentally viable and has a very low carbon footprint and eggs have the added benefit of being a more affordable and nutritional food option for consumers.

## INDIAN EGG PRODUCTION BY STATES / UNION TERRITORIES

The egg production in India is largely dominated by Tamil Nadu, Andhra Pradesh, Telengana, Maharashtra and West Bengal. Tamil Nadu had the highest share with 20.3%, producing 15.93 billion eggs in 2014 followed by Andhra Pradesh producing 13.1 billion eggs in the aforementioned year. Telangana also had a significant share in the production of eggs with 10.62 billion eggs. Maharashtra, West Bengal, Karnataka and Punjab are also leading egg-producing states with less than 10% share in the total eggs produced.

## INDIAN POULTRY MEAT PRODUCTION AND CONSUMPTION ANALYSIS

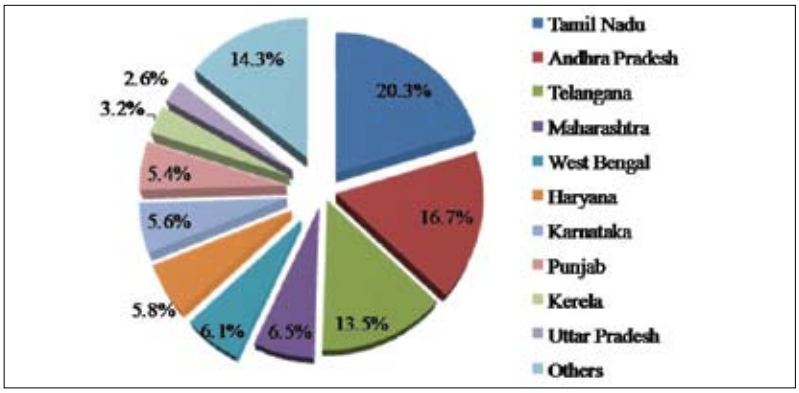
In India, the production and consumption of broiler meat have been almost equal over the years. India's per capita consumption of poultry meat is estimated at around 3.1 kg per year, which is low compared to the world average of around 17 kg per year. Chicken is the preferred meat in India due to its lower price than other meat sources, and is not subjected to the same religious restrictions as other meats. The demand can fluctuate due to religious and cultural practices though, as chicken and eggs may be eaten less at different times of the year.

Processed chicken meat constitutes about 5%-10% of total chicken meat production, but according to the estimates demand for processed chicken meat is growing between 15% - 20% per year, as the middle class grows. However, Chicken prices have slowly risen in the last few years due to increased feed prices and other costs.

Although, poultry meat exports are small due to limited slaughtering and processing facilities and an underdeveloped cold chain.

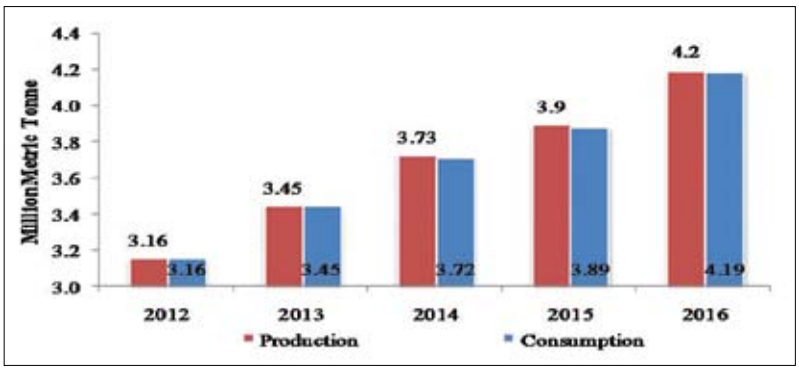
Thus, robust growth in the poultry output, coupled with future growth potential and favorable socio-economic factors over the last decade makes India one of the fastest growing world markets in this segment. India's transition from a predominantly live bird market to a chilled/frozen market is expected to be crucial for the increased presence in international trade, where India currently has minimal presence. The need for developing efficient distribution system with large investments in cold chain infrastructure, and increasing the market acceptability of frozen chicken are going to be the key industry drivers in the long-term. Other factors such as the increased requirement for upgraded infrastructure will also play a key role in determining India's continued presence in the global poultry market. The industry has traditionally focused primarily on productivity improvement, but current market needs suggest increased importance of enhancing distribution infrastructure, value additions and exercising better control over its supply chain. ■

**INDIAN EGG PRODUCTION BY STATES/UT**




*Source: MOSPI*

**INDIAN POTATO MARKER EXPORTS**




*Source: USDA Livestock and Poultry: World Markets and Trade 2016*

Dr R S Gandhi
Assistant Director General
(Animal Production &
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ICAR, New Delhi

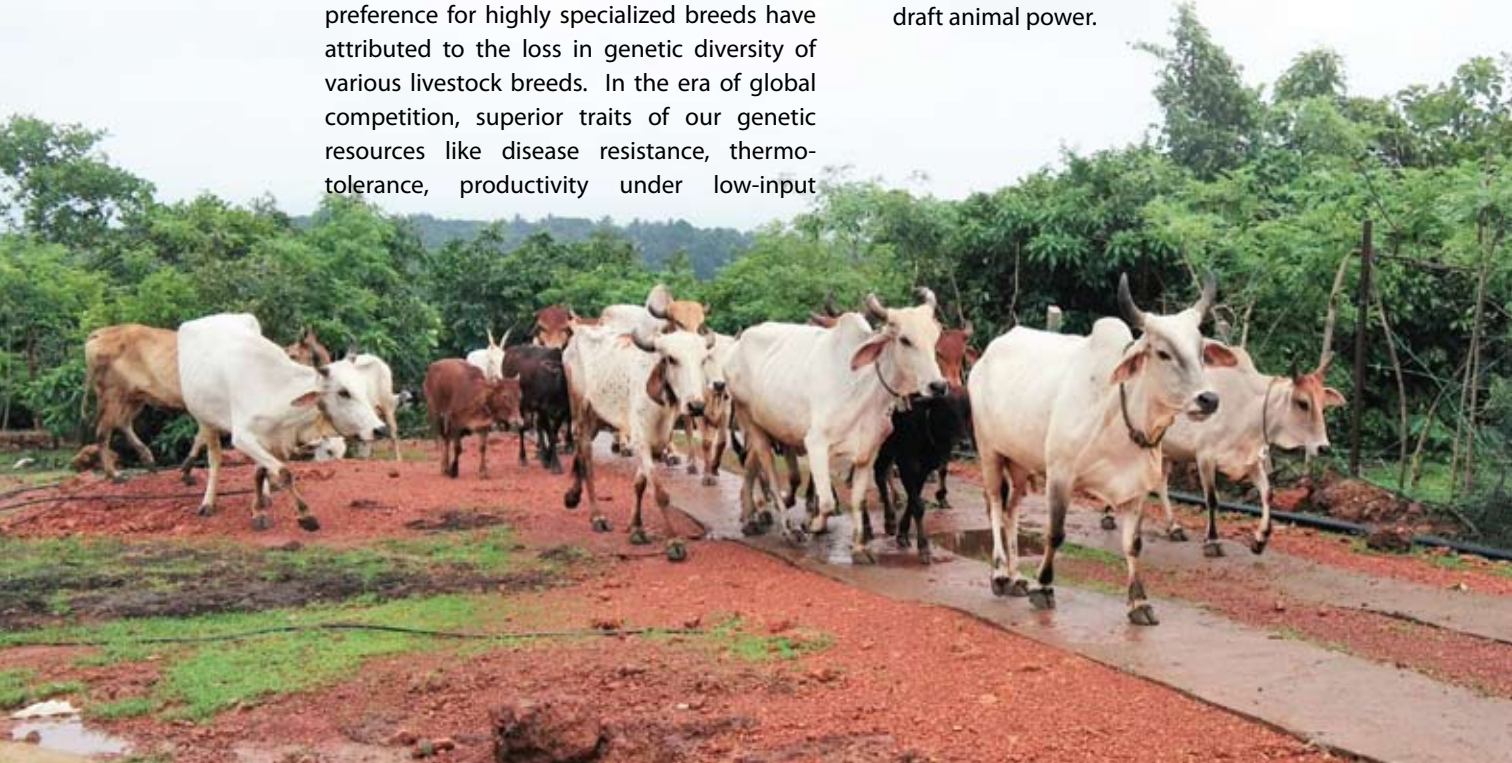
# Conservation of indigenous livestock – Futuristic Approach from Sustainability to Profitability

India is one of the mega biodiversity centers and rearing of livestock has been the backbone of our agriculture since time immemorial. Animal husbandry has been an integral part of Indian agriculture providing livelihood and nutritional security to about 66% of rural population. The country has 512 million livestock population and 729 million poultry birds. Presently, India has 160 registered breeds of livestock and poultry including 40 breeds of cattle, 13 of buffaloes, 42 of sheep, 26 of goat, 6 of horse and ponies, 9 of camel, 6 of pig, 1 of donkey and 17 of poultry besides populations/breeds of other species like mules, yaks, mithun, ducks, quails, etc. are yet to be classified. Various livestock breeds in our country have been evolved over centuries considered to be endowed with many desirable attributes like disease resistance, thermo-tolerance, adaptability to environmental fluxes, ability to utilize coarse fibres and crop residues. The biomolecules produced by Indian livestock are considered of paramount importance in terms of therapeutic and nutriceutical value.

The changing production scenario and preference for highly specialized breeds have attributed to the loss in genetic diversity of various livestock breeds. In the era of global competition, superior traits of our genetic resources like disease resistance, thermo-tolerance, productivity under low-input system, production of unique products/by-products need to be explored and exploited. Further, with the change in consumer demand, challenges posed by climate change and emerging diseases, the need seems to rely back on the adaptability and potential of indigenous animal genetic resources. Therefore, an immediate action for systematic conservation, genetic improvement and sustainable utilization of indigenous livestock genetic resources is required. Further, India being a signatory to the Convention on Biological Diversity (CBD) and adopting the Global Plan of Action (GPA) for animal genetic resources is committed to provide protection and enhance the sustainable use of its livestock and poultry genetic resources.

## THREATS TO LIVESTOCK DIVERSITY

- Genetic dilution due to crossbreeding especially with exotic breeds.
- Loss of superior germplasm attributed to uncontrolled breeding and migration.
- Mechanization lowering the demand for draft animal power.



- Trans-border illegal export of animal genetic resources.
- Continuous declining population of some breeds.
- Changing production system leading to intensive monoculture.
- Gap between demand and supply of fodder and grasses for livestock under prevailing production system.
- Higher human population pressure on land and other natural resources.
- Shrinking grazing areas in forests or revenue lands.
- Increased pollution and degradation of environment due to higher degree of urbanization.

## CONSTRAINTS FOR CONSERVING BIODIVERSITY

- Insufficient multiplication and production of germplasm of breeds from established nucleus farms.
- Lack of mechanism in place for coordination and monitoring different state programs on conservation of native breeds.
- Inadequate breeding programs for conservation of indigenous breeds.
- Criteria for assessing breed endangerment status are still absent and needs to be developed.
- Scarce capital resource and financial support for development of native breeds.
- Scanty availability of Breed Societies/Associations and lack of patronage for farmers' participation in conservation and development of breeds.
- Habitat erosion e.g. squeezing grazing lands.
- Lesser participation of livestock keepers.

## CONSERVATION OF LIVESTOCK BIODIVERSITY

Various methods have been used for conservation of livestock genetic resources. These include in situ conservation of the breeds/ populations, cryopreservation of semen, ova, embryos, skin, blood, DNA fragments, etc. These methods are relevant when the breed is rare or near extinction. However, in India, the situation is not so acute as to call for large-scale ex situ conservation efforts. It is necessary to evaluate and perfect these technologies at selected institutions which can be used whenever and wherever required.

It is suggested that research institutions of ICAR, agricultural/ veterinary universities and other research laboratories start programs to study and identify valuable adaptive traits at all levels (phenotypic, genotypic, DNA/RNA levels) and locate structural genes/ QTLs responsible for these traits. Higher emphasis should be given to explore inherent traits of indigenous genetic resources like resistance to various diseases, resistance to harmful endo- and ecto-parasites, tolerance to large fluctuations in quantity and quality of feed, tolerance to non-availability of adequate quantity and quality of drinking water, tolerance to extreme temperature, humidity and other adverse climatic factors, adaptation to low capacity management conditions, ability to survive, regularly reproduce and produce for long periods of time. The viability of a livestock genetic resource program is enhanced when it focuses on traits that increase the economic value of the breed to the communities involved.

The maintenance of a breed in its tract also satisfies the requirements of Article 8 of the Convention of Biological Diversity, which gives first priority to in situ conservation. It is suggested that 'wise use' should form the basis for drafting conservation policies. Cryo-conservation as a mean of maintaining breeds, should also be considered where specific livestock genetic resources are at risk of loss because farmers have not been getting any profit from their use under the prevailing circumstances. One of the most useful aspects of cryo-conservation is its supportive role in genetic up-gradation of breeds. Realizing

that no clear-cut guidelines are available within the present system of governance and management of resources in India, the strategy should be to combine genetic improvement and conservation of resources. It is necessary that identification, characterization, evaluation and documentation of the livestock genetic resources are completed in the next five years. Information on demographic distribution of breeds, their population trends and utilization patterns should also be generated. National and state livestock census needs to be conducted on breeds and information on ecologies in which they perform. A complete database should be generated on population of different breeds within each livestock species of the country. The database should also identify factors threatening the extinction of breeds.

The National Bureau of Animal Genetic Resources, Karnal has a significant role to play as a nodal agency for different aspects of breed characterization and conservation. A National Action Plan has been proposed by NBAGR, Karnal with strategies like characterization and inventory of farm AnGR; sustainable use and development of farm AnGR; conservation of farm AnGR; and policies, legislation, institutions and capacity building for conservation of animal genetic resources. Differences in number of breeds of a species listed in literature published by different authors from India as well as from other countries, including FAO has led to a confusion about the exact number of accredited breeds within each species. A panel of experts should be made in the Department of Animal Husbandry and Dairying of Government of India to list all descript breeds of

different livestock species and to evaluate the entire data before granting accreditation. An estimate of economic value of each breed in its own native environment needs to be done so that proper assessment of its sustainable management can be chalked out.

The basic strategy will be conservation through sustainable improvement and management. This will involve selection for important economic traits. A district-level improvement plan, with village as a unit will have to be devised. A village-level committee needs to be established which functions as Breeders' Association Unit, and is responsible for bull selection. This association/society/unit should maintain: (i) listing of all animals of each farmer, (ii) birth and death register, (iii) health cover register, (iv) breeding register and (v) monthly milk record register. All adult males not used in breeding needs to be castrated and for each castration the farmer should receive a reasonable compensation. A district-level monitoring committee, which will provide technical guidance and will involve district animal husbandry officer and all veterinarians in the district should be established. This would meet the WTO requirement for import and export of livestock and its products. A well-defined breeding plan should be developed to avoid problems of future degeneration.

Sincere efforts should be made to ensure that the livestock farmers move from subsistence-farming to a financially viable livestock enterprise. They should get access to credit on low interest rate from financial institutions and arrangements should be made by the Breeders' Association to provide services and goods as required as well as a

sustainable market for the product. If a breed is identified as rare or in danger of extinction, the farmers who maintain the animals of such a breed should get compensation at the rate of profit earned through crossbreds. The village group/association/ society should also arrange to take up marketing of animal products. The management and conservation of domestic animal diversity is very costly and people's participation in the conservation strategies is must.

## FUTURISTIC APPROACH:

- Developing species wise breeding policies by different states and chalking out effective plans for breed conservation and improvement.
- An atlas of performance of indigenous breeds and the appropriate breeding plans based on the information thus collected needs to be drawn up to facilitate sustainable utilization of animal genetic resources.
- Evolving suitable criteria for assessing breed endangerment status. The periodic review of the status of the breed needs to be taken.
- Enlisting breeds/populations at risk, and those requiring conservation.
- Initiating conservation programs for breeds at risk and collecting germplasm for preservation and dissemination in the native habitats.
- Adopting participatory approach by involving breeders, communities, gaushalas, NGOs and other relevant stakeholders in conservation programs.
- Strategies for community based conservation of local breeds involving traditional livestock keeping communities/ pastoralists should be evolved and their interest should be protected through proper legislation in place.
- It is proposed to formulate National Consortium of Partners for conservation of animal genetic resources.
- Declaring all the livestock farms of state/center govt. as *in situ* conservation centers for indigenous breeds. Each farm should maintain animals of native breed(s).
- Strengthening National Animal Germplasm Repository to face the future challenges of AnGR diversity *vis-à-vis* productivity enhancement through networking of institutions.
- Zebu breeds are bestowed with highly desirable characters like adaptability to harsh climatic conditions and resistance to tropical diseases. A more reliable and objective assess¬ment of performance of indigenous breeds with special emphasis on disease resist¬ance and adaptability to harsh environments is required under changing climatic scenario.
- It is highly desirable to generate adequate information on draft ability of indigenous livestock breeds which is scarcely available.
- Some native breeds are in danger of losing genes for high production because high-performing animals are taken away from breeding populations for use in units of high production and/or subsequent slaughter. Such animals should be identified and kept in the nucleus herd in the breeding tract. ■

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# CHALLENGES AND POTENTIAL OF INLAND OPEN WATER FISHERIES RESOURCES OF INDIA

Among the various fisheries resources, inland sector contributes the major chunk to total fish production of the country. In 2000-01, inland fisheries overtook marine fisheries in terms of production and the trend has been continued since then. The present fish production from inland sources is around 67% of total national production, among which inland aquaculture has the major share. However, the inland aquaculture sector has some inherent problems like intensive use of inputs, infestation of disease-pest, non-equitable distribution of income, ecosystem pollution etc. The surging demand for fish as food and protein supplement has created a quest among different stakeholders to augment the fish production from inland open water fisheries resources. Despite huge potential, inland water resources are over exploited and are being neglected. Among different open water resources, rivers are the important sources of germplasm and favorable breeding and nursery ground for commercially important species. However, capture fisheries from rivers are either stagnant or declining which might be attributed to different drivers such as water abstraction, low or no water flow, siltation, pollution, industrialization, anthropogenic interferences etc. The other inland water resources such as reservoirs and wetlands have huge untapped potential which can be harnessed with scientific fisheries management and policy frame work.

Government has put emphasis for a "Blue Revolution" in fisheries sector through scientific management practices, and open water fisheries resources have a great role to play in this direction. Fishermen would be greatly benefitted though 'doubling farmers' income' mission of the government. However, there is need to overcome the constraints and issues related to inland fisheries resources promptly to harness their untapped potential in sustainable and productive manner.

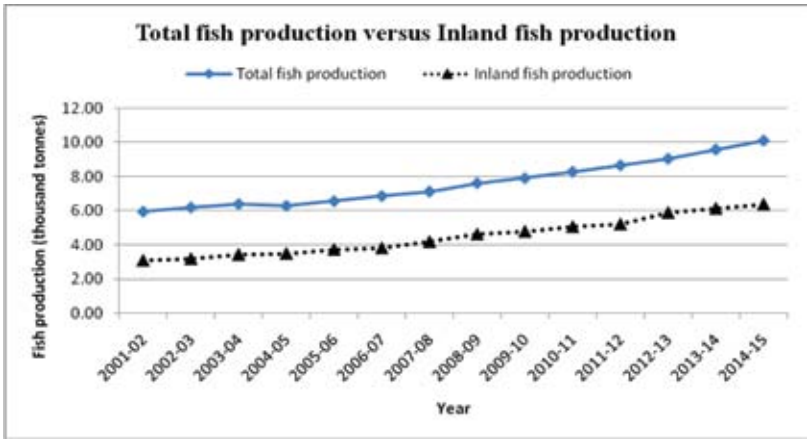
India is bestowed with a variety of inland water resources such as rivers, estuaries, reservoirs, wetland and other associated water resources. During the last decade, the inland fisheries stands at a great position in contributing to the total fish production of the country. At present, riverine fishery is below subsistence level with average yield of 0.3 tonne per km, which is only about 15% of their actual potential (Planning Commission, 2012). The average yield of major carps in river Ganga has declined from 26.62 to 2.55 kg/ha/year during last four decades. Based on studies made by CIFRI in some stretches of the Ganga, Brahmaputra, Godavari, Krishna and others, it has been estimated that the yield varies from 0.51-1.32 t / km with an average of under one tonne yield per km river stretch. The biologically and economically desirable fish species have started giving way to the low value species, exhibiting an alarming swing in the population structure.

The estuarine systems are identified as important source of fish and prawn seed. The average production varies between 45 and 75 kg/ha. The Hooghly-Matlah is the largest

**INLAND OPEN WATER FISHERIES RESOURCES AND THEIR FISHERIES POTENTIAL**

| Resource | Unit | Area/length |
|---|---|---|
| Rivers | km | 29,000 |
| Reservoirs | Million ha | 3.42 |
| Estuaries | Million ha | 2.7 |
| Lagoons | Million ha | 0.19 |
| Floodplain wetlands | Million ha | 0.58 |

*Source: ICAR-CIFRI Bulletin No. 187.*




estuary with an area of 2.34 lakh ha followed by Narmada estuary with 30 thousand ha, Godavari estuary with 18 thousand ha. Among different estuaries the largest fish production was recorded from Hooghly-Matlah system contributing 20,000 to 26,000 t/yr some years ago, while the production in others estuaries ranged between 4000-550 t/y. Floodplain wetlands are producing fishes @ 400-800 kg/ha, against the production potential of 1500-2500 kg/ha. Further, reservoirs are still considered as sleeping giant due to their untapped potential. The present fish yield from reservoirs is low, to the tune of about 110 kg/ha, in spite of their high production potential (500 kg/ha, 250 kg/ha and 100 kg/ha in small, medium and large reservoirs, respectively).


## CHALLENGES TO SUSTAINABILITY

Despite this wealth, inland open water fish production in the country has gone down in recent decades and going to be unsustainable if suitable measures are not taken. There are several reasons behind declining production. The major challenges for inland open water fisheries are cross linking of resources, multitasking nature of resources, pollution, siltation, lack of institutional arrangement, and governance, over-exploitation and encroachment, invasion of exotics.

## OPPORTUNITIES

The inland open water fisheries resources have immense potential and can contribute significantly to the country's fish basket. Sustainable management of natural resources has assumed significant importance

due to increased demand on these resources brought on mostly by population pressure. In addition, fisheries resources are shrinking both in quantitative and qualitative terms due to over-exploitation and encroachment. It has thus become an urgent priority to develop and implement steps and policies for effective and sustainable management of these resources. The floodplain wetlands can be harnessed as sustainable fish production systems without altering their ecological functions. Specific approaches for integrated fishery development, conservation for the native high value species and eco-tourism promotion are suggested to bring significant direct and indirect benefit to all stakeholders. The issues for sustainable fish production in these wetlands are: appropriate stocking material, adequate rearing space (on/off site) for good size seed, restoration through desilting, dyke construction & removal of aquatic weeds, integrating fisheries with agriculture and animal husbandry, and pen and cage culture. Culture Based Fisheries in reservoirs, lakes and floodplain wetlands are the focus for fish production as capture fisheries has its own limitations and risks. Further, the congenial institutional environment and community-based fisheries management are the necessary condition for better results. Moreover, river resources can be utilized as bowl of fish stock and diverse species for conservation as sanctuaries, primarily for maintaining brood stock populations and genetic biodiversity. Replenishment of depleted stocks in the rivers may be a suitable option through river ranching in selected stretches. Further, ecosystem based fisheries management could be an effective management strategy for enhanced fisheries and livelihood in inland open water fisheries resources.

## ROLE OF INLAND FISHERIES FOR DOUBLING FISHERS' INCOME BY 2022

Government of India has taken initiative for doubling farmers' income by 2022. The inland open water fisheries may play a great role in doubling the fishers' income in the coming years. In Inland open water fisheries, Culture Based Fisheries and stock enhancement techniques are feasible strategies to augment the fish production. ICAR-CIFRI has also disseminated stock enhancement techniques for increasing fish yield in wetlands of West Bengal, Bihar, Assam, Uttar Pradesh etc. The overall impact in the 2300 reservoirs was enhancement of average fish production from 20 kg/ha/year to 110 kg/ha/year, benefiting livelihoods and income of thousands of poor fishers. Small irrigation reservoirs (anicuts, barrages, ahars etc.) are also suitable for culture based fishery owing to smaller size, lesser depth and ease of recapture of the stocked fishes.

## STOCK ENHANCEMENT

Stock enhancement is done for augmenting the productivity of reservoirs or wetlands through stocking the fish seed of suitable species based on the pattern of the available natural food and the productivity of the waters bodies. Based on the fish potential and the ecological conditions, the stocking rate should be decided for the sustainable enhancement of fish production from reservoirs and wetlands. For floodplain wetlands, the stocking rate of 1500-2000 advanced fingerlings per hectare (>100 mm) is required. Similarly, an advanced fingerling of 1000-1500, 500-1000 and 300-500 are required for small, medium and large reservoirs, respectively.

## CAGE CULTURE

Cage culture of fishes involves holding fishes as captive stock in cages under controlled management. The technology is suitable for implementation in reservoirs and in oxbow lakes with depth of more than 5 meters. Cage culture of fish in open water bodies offers a good scope for increasing fish production preventing the need for more land-based fish farms. Utilization of a tiny fraction of the surface area of large and medium reservoirs can contribute a considerable amount of fish to the total inland fish production. Poor stocking of fish seed is the major reason of low productivity in reservoirs and other inland open waters. Seed raising and rearing of fish to table size through cage farming in reservoirs and other inland waters is one of the most preferred options for the enhancement of fish production from inland open waters of India. More than one million tonnes of fishes can be easily produced by utilizing a tiny fraction (0.1%) of the total area of medium and large reservoir with a moderate productivity of 15-25 kg/$m^3$. At present, there are more than 6000 floating cages of different dimensions in inland open water resources of India. States like Jharkhand and Chhattisgarh could successfully produce 40-70 kg/$m^3$ by adopting *P. hypophthalmus* as a candidate species (DoF, Chhattisgarh and Jharkhand). The Institute has also been successful in producing fingerlings in floating

*Cage culture in reservoirs*

## POTENTIAL OF CAGE CULTURE IN INDIAN RESERVOIRS

| Resource | Total area (lakh ha) | 0.1% of total area | Available volume lakh $m^3$ (3 m depth) | Per unit production ($kg/m^3$) | Expected fish productivity (Tonnes/$m^3$/ year) |
|---|---|---|---|---|---|
| | | | | | |
| Medium reservoir | 5.16 | 500 | 150 | 15-25 | 225 -375 |
| Large reservoir | 12.93 | 1,300 | 390 | 15-25 | 585-975 |
| **Total** | | | | | **1350** |

cages installed in different reservoirs across the country through scientific interventions.

CIFRI has successfully demonstrated production of stocking materials of IMC and exotic carps in low cost floating cages in reservoirs. In recent years, enclosure fish farming in reservoirs either for stocking materials or for the production of table size fish has attracted the attention of researchers, developmental agencies, entrepreneurs and policy makers across the nation. Growth of cage fish farming in reservoirs has gained further momentum during 2010-12 with the support from National Fisheries Development Board (NFDB), Government of India, NMPS etc. This paved way for the adoption and popularization of this technology in a number of reservoirs belonging to more than 15 States in 'Mission Mode' through NMPS scheme. Jharkhand, Chhattisgarh, Madhya Pradesh, Maharashtra have widely adopted this technology and scaling up is in progress in these states. *Pangasianodon hypophthalmus* has achieved great importance as a candidate species for farming in cages in reservoirs of above states in both GI and HDPE modular cages. Jharkhand and Chhattisgarh could successfully produce 40-70 $kg/m^3$ by adopting *P. hypophthalmus* as a candidate species (DoF, Chhattisgarh and Jharkhand).

The inland open water resources such as reservoirs, wetlands and associated water bodies may be used for enclosure culture and culture based fisheries as per the suitability of the culture system in these resources. River systems should be restored through scientific methods and their natural germplasm to be protected for biodiversity conservation. In addition, if necessary, the ranching programme with genetically pure seed must be encouraged to establish a natural stock of the important species including Indian major carps (IMCs). In this direction the ICAR-CIFRI is carrying out the fish diversity related research under the mission "National Mission on Clean Ganga" (NMCG). Under this mission institute is planning to release the seeds of Ganga IMC brooders into Ganga River for stock enhancement. This would facilitate both increasing fish production as well as conservation of fish diversity with genetically pure seed of IMCs. However, society at large and all the other stake holders including State departments, University, entrepreneurs, research institutes, fishers and NGOs have great role to play to protect the inland fisheries resources.

**** Arun Pandit, Principal Scientist; D. K. Meena, Scientist and P. K. Parida, Scientist, ICAR Central Inland Fisheries Research Institute Barrackpore, Kolkata***

Mr Manjit Singh Brar,
Managing Director
MILKFED

# ROLE OF COOPERATIVES IN SHAPING PUNJAB'S DAIRY INDUSTRY

Punjab has always been known as the food bowl of India but the state is also one of the leading producers of milk in the country. The White Revolution was given a big push when Punjab State Cooperative Milk Producers Federation popularly known as MILKFED was established in the year 1973 to boost dairy farming in the state.

Milk is quintessential food for any Indian, and milk products are savored in every day meals by families irrespective of their caste and creed. It is 'nature's perfect food' for all ages. It has almost all the vital nutrients needed for growth and well being of the human body.

Despite milk being a very important part of the Indian diet, India was milk deficit country post independence. This situation pushed the government to launch "Operation Flood", one the most successful government-led programs on inclusive growth and livelihood generation. Operation Flood was implemented in three phases and with three main objectives – increase in milk production, augmentation of rural incomes and fair prices for consumers. It revolutionized dairy farming in India. It popularized the practice of cooperative dairy farming and forming marketing unions for distribution.

Punjab has always been known as the food bowl of India but the state is also one of the leading producers of milk in the country. The White Revolution was given a big push when Punjab State Cooperative Milk Producers Federation popularly known as MILKFED was established in the year 1973 to boost dairy farming in the state.In the year 1983, the all the milk plants of the Punjab Dairy Development Corporation Limited were handed over to Cooperative sector under Operation Flood, to give the farmers a better deal and customers better products

Following the cooperative dairy model, the Punjab State Cooperative Milk Producers

Federation (MILKFED) was established as a three tier system, with Milk Producers Cooperative Societies at the village level, Milk Unions at District level and Federation as an Apex Body at State level. Currently MILKFED Punjab has around 6,850 functional village milk producers' cooperative societies, with over 3,60,000 members. These village level cooperatives work under 11 district milk producers' unions with 9 milk plants having a consolidated milk handling capacity of around 19,75,000 liters per day. It is envisaged to achieve an average milk procurement of 23,00,000 liters per day by the end of 2021-22

Fresh milk is procured from the milk producers twice a day through village level societies directly without the assistance of any middleman. For preserving the milk during transportation, the milk is chilled before transportation. Automotive Milk Collection Stations are deployed in the societies for efficiency and transparency in milk procurement. The federation is mandated for the milk procurement aligned with quality processing of milk and its products as well as marketing them under the brand name 'Verka'.

During the second stage of white revolution, the federation worked towards up gradation, automation and mechanization of the milk plants. Adopting new methods of technology has been key to successful procurement, processing and distribution of a time-sensitive item like milk. From feeding milk to final packaging at all the Verka Plants involves no human-touch. This automation ensures zero adulteration and quality standard. All nine milk plants are ISO/HACCP certified and all the products are in adherence to FSSAI standard. Constant efforts are made to sensitize people towards quality assurance in order to deliver the best.

Apart from cooperative societies, there are about 4 joint sector and around 40 private sector dairy plants in Punjab. These plants are not associated with the cooperative society and hence buy milk directly from local producers. The sector provides direct and indirect employment to many.

Dairy farming cannot be

imagined without healthy and good breed cattle and milch animals. To work towards improving the breed of the cattle, team of experts work relentlessly in the frozen semen station of MILKFED. This Station has modern semen processing facilities and has been awarded ISO 2000 Certification by BIS and `A' grade by the Central Evaluation Committee of Govt. of India. The technical input services are provided to the farmers at their doorsteps, enabling them to produce more milk at low cost.It is observed that animals do not get all the required nutrition for efficient milk production, body maintenance and better reproduction from the traditional feeding practices. Therefore, milk producers are suggested to feed their animals with balanced cattle feed which increases the productivity of animals by providing balanced nutrition with necessary proteins, carbohydrates, fat, fiber, vitamins and minerals etc. in required proportion as suggested by animal nutritionists.MILKFED has two Cattle Feed Plants to cater to the needs of Milk Producers, with a capacity of 300 MT per day and 200 MT per day. With a view to provide balanced feed to livestock for enhancing milk production, MILKFED is producing various types of Cattle Feed at both the Cattle Feed Plants to meet the varied requirements of the Milk Producers.

The objective was very clear from the starting to ensure financial gains to the farmers giving them a steady source of income beyond agriculture. MILKFED has come a long way in empowering the farmers making them feel that they are real owners of the operation rather than being just participants. Over the year Verka has witnessed growth in terms of profits and turnovers. The turnover for year 2016-17 was Rs.3000 crores. Eighty percent of the profits go to the soul behind the cooperative: The farmers.

For a state like Punjab where almost every rural household owns cattle, Dairy farming is practiced as a passion. In the true sense of a Cooperative, MILKFED, is operating as an independent association of farmers united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise. It is operating in line with a number of other cooperatives in the country which have emerged as one of the largest and most important parts of the Indian food processing industry. ■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# NER OF INDIA

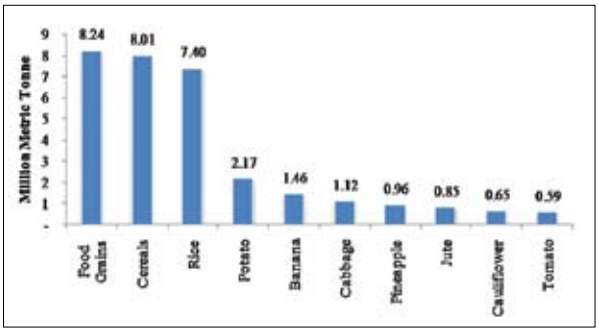
# Indian North East Region Overview

The seven states of Northeastern India along with Sikkim, namely Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland and Tripura cover 255.79 lakh hectares, constituting 7.92% of total land area of the country. The region has diverse hill ecosystems covering more than two-third of total geographical area. Agriculture is the dominant economic activity, followed by animal husbandry. The region has 3.73% of the total population of the country and contributes 2.6% to the Net Domestic Product. It has a forest cover of more than 66.1% against the national average of 21.1%.

## AGRICULTURE SECTOR SCENARIO

The major agricultural produce of the region includes food grains, cereals and rice.

**TOP 10 CROPS PRODUCED IN THE NORTH EAST REGION OF INDIA; 2014-15**




***Source: NEDFi Databank***

The region's comparative advantages in producing fruits, vegetables and other horticulture products can be tapped by setting up small-scale processing units for the local market, which will also boost rural employment. The region produces a large amount of spices such as chillies, ginger, mustard seeds, turmeric etc.Also, rubber and bamboo are among the important agricultural produces, offering investment opportunities in the region. Tripura is the chief production hub, while other rubber producing states in the region are Mizoram and Assam. Considering that globally India ranks third in the production and fourth in the consumption of rubber, it creates a huge market for investors. The NE states also produce a substantial percentage of bamboo, accounting for 65% of India's production value and 20% of the global production value.

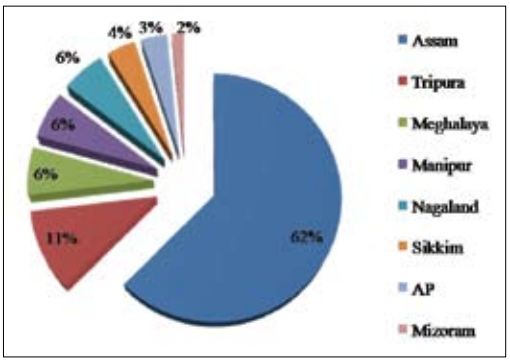
## ANIMAL HUSBANDRY SECTOR SCENARIO

Livestock production in the North East is pre-dominantly the endeavor of small holders. Almost 90% of the rural households keep livestock of one species or the other. Though there is vast potential for growth in this sector, yet production of meat, milk and eggs has not achieved self-sufficiency level in this region.

### Milk Production

Milk production is secondary to agricultural operations in the region. There are hardly any commercial livestock farms in the rural areas although in the periphery of cities and towns, a few commercial dairy farms exist. However,

**TOP 10 CROPS PRODUCED IN THE NORTH EAST REGION OF INDIA; 2014-15**




*Source: Department of Animal Husbandry, Dairying and Fisheries*

due to the favorable climatic conditions for setting up of dairy farms and processing units, many cooperatives and private players want to widen their presence in the region. As a step towards this, they are looking to forge alliances with local players for procuring milk and selling their branded products.

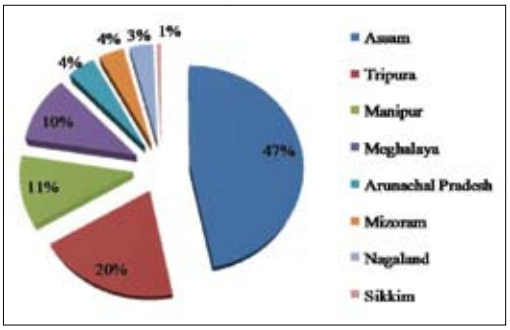
## Egg Production

Egg production in the North East Region is largely governed by the backyard poultry farming, which usually comprises of rearing indigenous birds with low production performances. The production potential of indigenous bird in terms of egg production is only 70-80 per year. Backyard poultry is advantageous as it provides supplementary income in shortest possible time with little minimum capital investment, simple operation and ensuring availability of eggs even in remote areas. Moreover, with this practice the egg production can be increased so the import of eggs from other states can be reduced and increased in the economy of the region.

## Meat Production

The main agricultural activity of farmers in Northeast India is the mixed crop-livestock system with livestock as an important component due to preference of meat in the diets of people in the region. The area is known as meat consuming zone of India. There are no social taboos in taking any type of meat but the most preferred meat is pork, followed by beef, chicken and others. Assam, Nagaland and Meghalaya are the major pig rearing states of NE region. Approximately, 28% of the total pig population of India is found in the region. Pig rearing is very promising in the region due to high demand for pig meat within the tribal people of the NE region. Thus, the pig sector is of major importance for rural livelihoods and poverty alleviation.

**MEAT PRODUCTION IN THE NORTH EAST REGION OF INDIA; 2014-15**




*Source: Department of Animal Husbandry, Dairying and Fisheries*

## STATE-WISE AGRICULTURAL SCENARIO

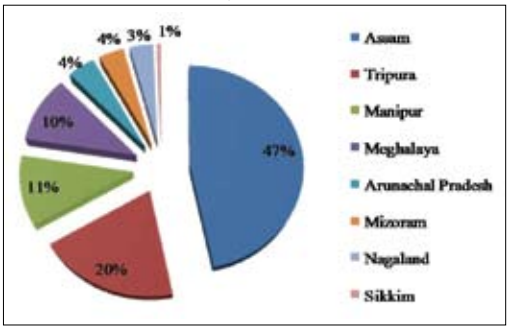
## ARUNACHAL PRADESH

The state's economy is largely agrarian, based on the terraced farming of rice and the cultivation of crops such as maize, millet, wheat, pulses, sugarcane, ginger, oilseeds, cereals, potato, and pineapple. Due to its topography, the state has varied agro-climatic conditions suitable for horticulture. It is home to 601 species of orchids, i.e., 52% of the species of orchids known in India, indicating a huge potential for attracting tourists, especially foreigners.

## ASSAM

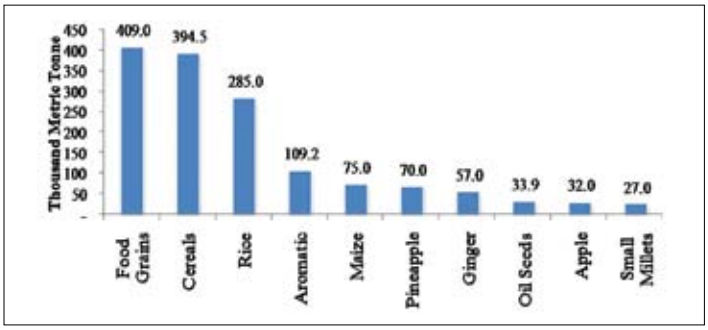
According to the survey of 2012-13, about 53 % of the population is dependent on agriculture in Assam. Major agricultural products of the state are rice, tea, jute, mustard,

**EGG PRODUCTION IN THE NORTH EAST REGION OF INDIA; 2014-15**




*Source: Department of Animal Husbandry, Dairying and Fisheries*

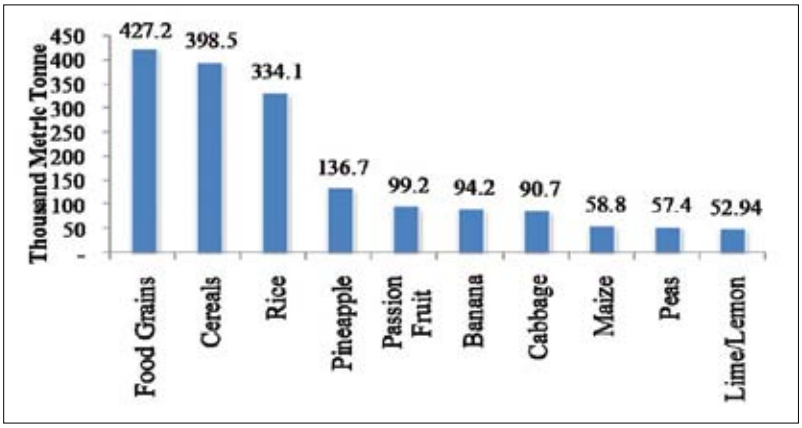
**TOP 10 CROPS PRODUCED IN ARUNACHAL PRADESH; 2014-15**




*Source: NEDFi Databank*

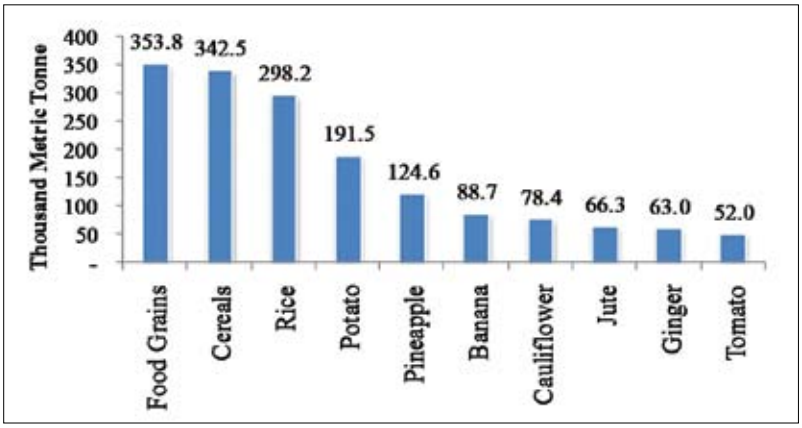
pulses, sugarcane, potatoes, oranges, pineapples, coconut, betel, black pepper, citrus fruits and bananas besides many types of vegetables. The total annual production of rice in the state was 5.22 million metric tonnes during 2014-15. Assam excels as number one tea producing state in the country contributing to over half of the total annual production of the country and the state earns about 11% of its revenue from the tea production.

**TOP 10 CROPS PRODUCED IN ASSAM; 2014-15**



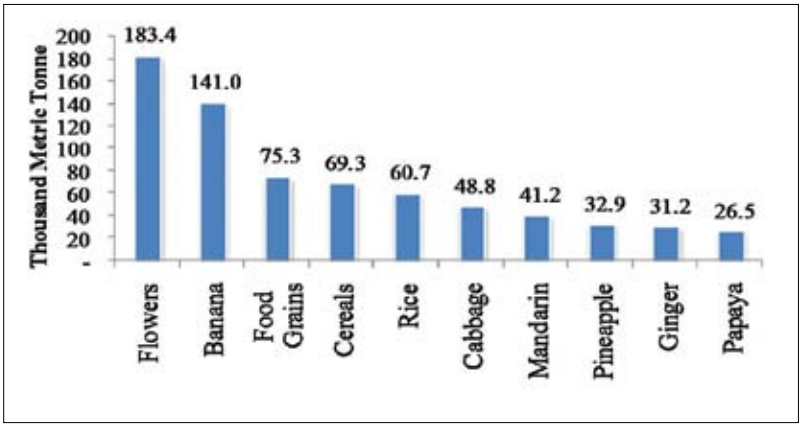

*Source: NEDFi Databank*

**TOP 10 CROPS PRODUCED IN MEGHALAYA; 2014-15**




*Source: NEDFi Databank*

**TOP 10 CROPS PRODUCED IN MIZORAM; 2014-15**




*Source: NEDFi Databank*

## MANIPUR

Manipur is situated in the eastern-most corner of Northeast India. The state shares borders with the neighboring country of Myanmar.Manipur has the advantage of acting as India's 'Gateway to the East' through Moreh town, which is the only feasible land route for trade between India and Myanmar and other Southeast Asian countries. With about 3,268 square km of area covered by bamboo forests, Manipur is one of India's largest bamboo producing states and a major contributor to the country's bamboo industry. In 2015, the state accounted for 9,303 square km of bamboo bearing area.

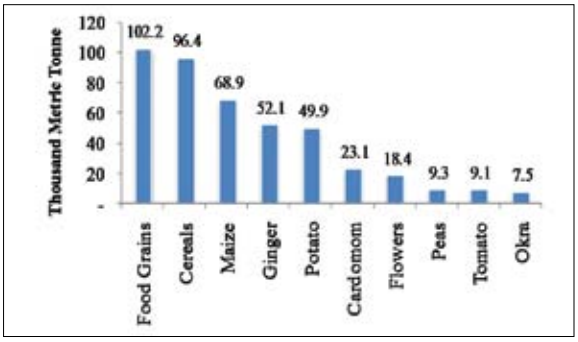
## MEGHALAYA

Meghalaya has diverse range of soil types, including red-loamy and laterite, which supports various agricultural crops like rice, maize, pulses, oilseeds, cotton, jute and mesta. The state has a strong floriculture sector and is one of the leading states in the region in terms of production and supply of cut flowers to mainland consumer markets. Of the 6,000 medicinal plants in India, 834 plants, including the famous Himalayan Yew, are in Meghalaya. Moreover, the state has 8 of the top 20 medicinal plants that are traded in the country and are in high demand. Also, about 14% of Meghalaya is covered by bamboo forests, and is one of the leading bamboo producers in the country.

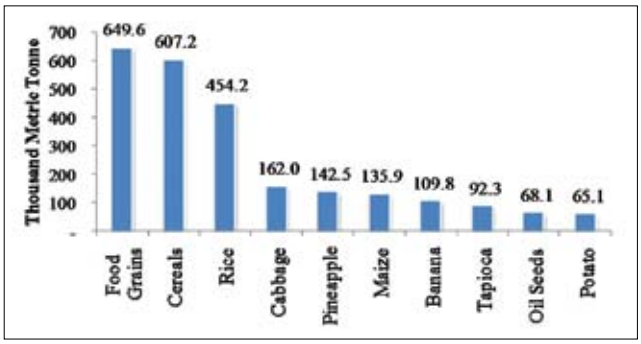
## MIZORAM

The climatic conditions in the Mizoram are quite suitable for the production of fruits. Thus, accounts for approximately 13% of the total fruits produced in the North East Region. Also, paddy is the principal food crop and is the staple food of the state. With the implementation of the National Food Security Mission – Rice, the productivity of rice under wet rice cul-

**TOP 10 CROPS PRODUCED IN SIKKIM; 2014-15**




**TOP 10 CROPS PRODUCED IN NAGALAND; 2014-15**




*Source: NEDFi Databank*

tivation increased tremendously. Horticulture, agro-processed and bamboo products have high export potential with bamboo cultivation being an area highly commercialized.

## NAGALAND

The gross state domestic product (GSDP) of Nagaland was about US$ 3.47 billion in 2015-16, of which agriculture and allied sector contribution to the economic output stood at 20% and expected to reach 28% by 2025. Approximately, 71% of the state's population is engaged in farming.

The agro-climatic conditions in Nagaland provide commercial opportunities for floriculture and horticulture. The state has 650 indigenous species of medicinal and aromatic plants. The state is estimated to have the potential to produce 15,000 metric tonnes of honey and 100 metric tonnes of wax. Moreover, the production of honey during 2014-15 was recorded to be 0.25 thousand tonnes.

## SIKKIM

The state is abundantly endowed with rare and exotic flora and fauna, which includes 4,500 different flowering plants, 550 types of orchids, 36 varieties of rhododendrons, 28 bamboo species, over 144 mammals, 552 species of birds and 600 different butterflies. This makes it one of the leading states in the North East Region in terms of production and supply of cut flowers to mainland consumer markets.

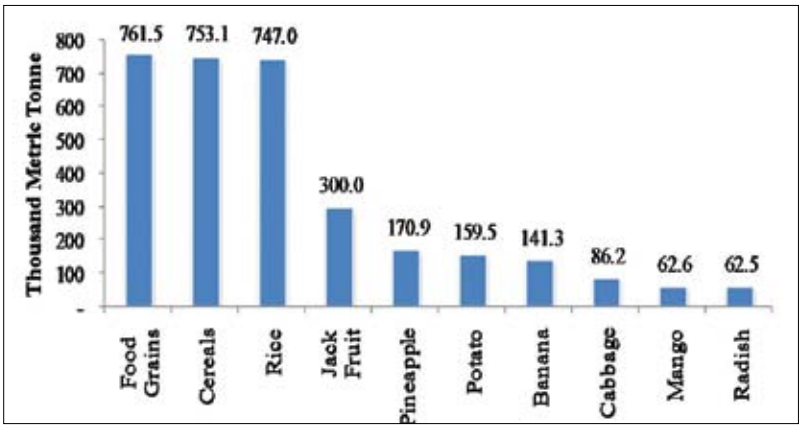
Sikkim has a suitable climate for agricultural and horticultural products. It supports multiple crops; viz., rice, wheat, maize, millet, barley, urad, pea, soya bean, mustard and large cardamom. In fact, Sikkim is the top producer of large cardamom, contributing over 80% to India's total production.

## TRIPURA

The state has favorable climatic conditions for cultivation of various fruits and horticultural crops. Tripura is endowed with rich and diverse bamboo resources. Tripura accounts for about 6% of bamboo sticks, used for making incense sticks in India. Around 21 of the 130 bamboo species known in India are grown in the state. It is also the second largest natural rubber producer in the country after Kerala. Moreover, Tripura holds a strong tea plantation base, with cultivation area of over 6,400 hectares as of 2014-15.

North East Region of India has lot of investment opportunities.The food and meat processing sector provides immense potential for investment, with huge scope for dairy processing and poultry, fishery processing in the region. There exists demand for dried fish in the region, though processing is not capital intensive. Private entrepreneurs have tremendous opportunities to set up storage, distribution and marketing infrastructure, such as a cold storage chain along major arterial highways. Besides, across border trade from these states can be a major source of income as the region shares 4,500 kilometers of international border with four other countries. ■

**TOP 10 CROPS PRODUCED IN MIZORAM; 2014-15**




*Source: NEDFi Databank*

Dr. Dilip Kumar Sarma
Director
ICAR – National Research Centre on Pig
Rani. Guwahati

# SCIENTIFIC PIG FARMING FOR LIVELIHOOD AND NUTRITIONAL SECURITY FOR NORTH EASTERN STATES

Piggery plays a significant role to the livelihood of small holder farmers and offers substantial scope for poverty reduction in rural communities owing to the unique attributes of pigs such as high fecundity, shorter generation interval, early sexual maturity, higher dressing percentage and low cost of production. Pigs convert inedible feeds, forages, certain grain byproducts obtained from mills, meat by products, damaged feeds and kitchen waste into valuable nutritious meat. Pig is considered as multipurpose animal as it provide meat, cooking fats, bristle and manure for field. Pig farming serves as an insurance against natural calamities while supporting food security and nutrient recycling. Due to huge preference for pork in North Eastern Region, development of piggery needs to be given special emphasis in the region as compared to other livestock species.

## PIGGERY IN NORTH EASTERN REGION (NER)

NER which constitutes 8 % of the Country's land and 4 % of the human population and possesses 38.38 % of the pig population of the country as per the 19th livestock census, Govt. of India. Approximately 80% of tribal population of North Eastern (NE) India is involved in raising pigs on a small scale semi-intensive basis, and pork is the most preferred meat in the NE hill states. As compared to national average of 39 pigs per 1000 households, seven NE states viz., Assam, Arunachal Pradesh, Nagaland, Mizoram, Tripura, Meghalaya and Sikkim have 253, 2188, 917, 1035, 374, 1047 and 260 pigs per 1000 households respectively. The average gross state domestic product (GSDP) growth of eight NE states during 11th plan stood at 9.95% against 7.9% at the national level (Developmental data, Ministry of DONER, Govt. of India). Increase in overall income is expected

to create huge demand for processed food products especially processed meat products as consumers of the region are predominantly non vegetarian. Paradoxically, 19th livestock census (2012) indicated reduction in population of pigs to an extent of 11.37 % as compared to 18th livestock census held in 2007.

The trend of change in pig population is also observed in the other pig producing states of India. Some of the causes for decline in pig population are: (a) Increased slaughter of pigs due to high consumption of pork (b) more fattener farmers than breeder farmers (c) high incidence of diseases (d) lack of availability of quality breeding animals (e) lack of coordinated breeding programs (f) absence of efficient post harvest infrastructure (g) poor awareness about scientific pig farming and (g) lack of structured marketing channels.

Crossbred pig variety HDK-75 developed by the AICRP on Pig centre, Assam Agricultural University, Khanapara

## ROAD MAP FOR TRANSFORMING PIGGERY SECTOR IN NER

In view of the issues mentioned above, there is an urgent need to undertake a coordinated and systematic programme covering all the states of NER for comprehensive development of piggery sector. Some of the initiatives, which need to be taken up urgently for promoting piggery in NER are given here as initial thought.

**CHANGE IN PIG POPULATION IN DIFFERENT NE STATES BETWEEN 2007 AND 2012**

| Sl No | Name of the NE states | Population of pigs in 2007 (18th livestock census) in thousand | Population of pigs in 2012 (19th livestock census) in thousand | Percent change in pig population. |
|---|---|---|---|---|
| 1. | Assam | 2000 | 1636 | -18.22 |
| 2. | Arunachal Pradesh | 356 | 356 | + 0.21 |
| 3. | Nagaland | 698 | 503 | 27.82 |
| 4. | Mizoram | 267 | 245 | |
| 5. | Meghalaya | 524 | 543 | + 3.63 |
| 6. | Sikkim | 35 | 29 | -17.14 |
| 7. | Tripura | 264 | 362 | + 37.48 |
| 8. | Manipur | 314 | 277 | -11.68 |
| | Total - NE states | 4458 | 3951 | -11.37 |
| | Total – All India | 11134 | 10293 | -7.55 |
| Share of NE states in total pig population of the country. | | 40.04 % | 38.38 % | |

**Promoting scientific and organized pig farming:** Throughout the world, about 50 % of the pigs rearing activities is backyard or improved family farming and the remaining is produced by commercial way. But in India, most of the10.29 million pigs are reared under backyard system and unorganized way. Prevailing pig farming using free range is apparently very resilient although economic studies have shown that these traditional production systems are wasteful and unprofitable due to poor feed conversion efficiency, high rate of mortality, low reproductive rates and poor final products. Consequently, contribution of India in total pig production in Asia is only 1 % as compared to 80 % share of China. In order to enhance the pork production in NER from present quantum of 0.15 million tonnes to 0.27 million tonnes, there is a need to promote scientific pig farming amongst the households and commercial pig farming. Apart from the possibility of introducing

scientific interventions, this will also help in availability of breeding stock and piglets in the region. For this purpose, a program specially focused on medium scale farms (capacity: 20 sows) should be initiated. Almost 70 % of the pig production cost goes to feed, therefore developing economic feeding rations using locally available pig feed resources, and particularly the alternative protein sources will give quality to pork and increase profit.

**Enhancing infrastructure for clean pork production:** One of the biggest challenges facing piggery sector in India, especially in NER, is ensuring 'safe pork production'. Pigs are slaughtered, processed and marketed under unscientific conditions. In the wake of enactment of Food Safety & Standards Act, 2006, producing pork hygienically is mandatory. Creating infrastructure for promoting clean pork production is the need of the hour. A scheme for promoting small scale abattoirs and rural abattoirs must be launched to address this need. Scheme can be implemented via subsidy to entrepreneurs and grant to local bodies to ensure that there is at least one quality abattoir in each district of the region.

**Control and prevention of important infectious diseases:** Different endemic diseases like classical swine fever (CSF) and foot and mouth disease (FMD) are responsible for huge mortality and morbidity, which often acts as a barrier in pig farming. Although, vaccines are available, their availability particularly for CSF needs to be increased and the State Animal Husbandry & Veterinary Department should initiate control programme of the important diseases like CSF and FMD. Strengthening of the vaccine production and storage facilities in the region will help in getting the vaccine at the right time. Besides, due to porous international borders there are chances of new diseases entering into this region. Recently, porcine respiratory and reproductive disease (PRRS), which possibly entered through Myanmar had caused serious problems in pig production in Mizoram. Many diseases like swine flu, Nipah virus infection, Japanese encephalitis and Cysticercosis etc. are communicable to human beings, and pigs may play important role in spreading the infections, therefore awareness about the diseases amongst the pig rearers in particular and the society as a whole is required.

Cross bred pig variety Lumsniang developed by the AICRP on Pig and ICAR-Research Complex for NEH region, Umiam

**Adopting innovative means to reach out to stakeholders:** Although, intensive farming has its own benefits, for sustaining the livelihood security of people in areas where fruits of development has not reached, family farming or backyard farming plays an import role. Need of the hour is to enhance the awareness among pig farmers regarding scientific practices and veterinary care at farmers door step for sustaining pig production. To reach the rural farmers distributed over remote geographical areas, innovative means based on information technology and telecommunication must be employed. Establishment of toll free numbers dedicated to piggery stakeholders, maintaining database of different players in pig value chain, SMS casting, making available piggery related information especially on marketing, health management etc., through mobile

apps must be taken up.

**Making AI facilities available in all states of NER:** Crossbreeding of indigenous pig population can bring about changes in growth potential, pork production, reproductive efficiency etc. Artificial insemination (AI) with semen from exotic pig breeds like Hampshire, Yorkshire, Duroc etc., can bring about significant increase in production capacity. To realize this possibility, one semen collection and processing facility must be established in each state and satellite AI centres must be established in each of the districts of NER. However, cross breeding programme should be initiated in a planned manner and each of the NE states should have pig breeding policy to avoid problems in future.Besides, the cross bred pig varieties developed by the ICAR-NRC on pig and other AICRP on pig centres located at Assam Agricultural University and ICAR-Research Complex for NEH region, Umiam, Meghalaya need to be promoted and included in the breeding programme to enhance the pork production. Stress should also be given to characterize the local pig germplasms in the NER and to conserve the indigenous pig breeds.

**Establishing cooperative pig farming and processing:** Concept of cooperative production and processing which brought about white revolution must be inculcated in piggery for ensuring sustained and collective growth. For this purpose, establishment of viable Pig breeders' federations and cooperative societies must be encouraged.

All these initiatives can be successfully implemented in time bound manner if resources of piggery promoting Institutions, developmental agencies, NGOs, academic institutions etc., are pooled under the coordination of North East Council or any other suitable agency.

**PORK/PIG PRODUCTION AND REQUIREMENT IN INDIA AND NE STATES**

| | All India requirement | NE States |
|---|---|---|
| Total population | 1.27 billion | 40 million |
| Pork consuming population | 254 million (20 % of population) | 30 million (75 % of population) |
| Pork requirement | 10 g (considering 2 g i.e. 20 % of the total animal protein from pork) | 25 g (considering 5 g i.e. 50 % of animal protein from pork) |
| Total pork requirement per day | 2540 million g/ 2.54 million kg/ 0.00254 million tonnes | 750 million g/ 0.75 million kg/ 0.00075 million tonnes |
| Total pork requirement per annum | 0.93 million tonnes | 0.27 million tonnes |
| Yield | 38 kg | 38 kg |
| Number of pigs required | 24.39 million | 7.1 million |
| Present pig population | 10.29 million | 3.9 million |

## ROLE OF ICAR- NATIONAL RESEARCH CENTRE ON PIG

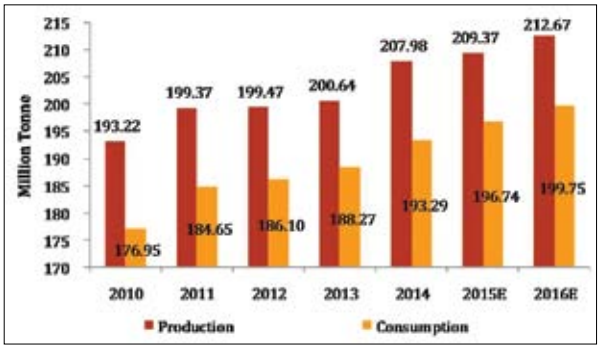
In order to strengthen the pig production in India by way of basic strategic and applied researches, the Indian Council of Agricultural Research (ICAR), New Delhi has established the National Research Centre on Pig at Rani, Guwahati. The vision of the institute is to bring in excellence in pig production, health and product processing through innovative research in order to provide technology backstopping for enhanced pork production, employment generation and poverty reduction among socially and economically weaker sections through the medium of pig husbandry. The ICAR - National Research Centre on Pig, Rani, Guwahati has initiated several steps which includes: Implementation of 'Mega seed project on pig' for regular supply of piglets of good genetic quality to the needy and All India Coordinated research on pig to develop region specific research and packages for scientific pig production in all the NE states and other parts of the country. Besides undertaking research, the National research centre on Pig is providing training on low-cost production technology, modern pig husbandry practices together with knowledge on artificial insemination and on disease management in order to produce good quality pork from healthy pigs, which can fetch better price. The centre has adopted 'pig villages' in specific selected areas and is regularly providing training on processing of pork for value added pork products for entrepreneurs/ progressive farmers in its state of the art slaughter and processing unit. ■

# SOIL HEALTH

# Indian Fertilizer Market

The Indian fertilizer industry has played a pivotal support role in the Indian agricultural industry. The growth in the use of chemical fertilizers amongst the farmers has been the secret of nation's green revolution in the late sixties. Today India is the third largest producer and second largest consumer of fertilizers in the world. The fertilizers industry is distributed between three major participants' viz., Private sector undertakings, public sector units and cooperative societies. The Government of India subsidizes fertilizers to ensure that fertilizers are easily available to farmers and the county remains self-sufficient in agriculture. The same has been achieved largely by controlling the price of fertilizer and the amount of production.

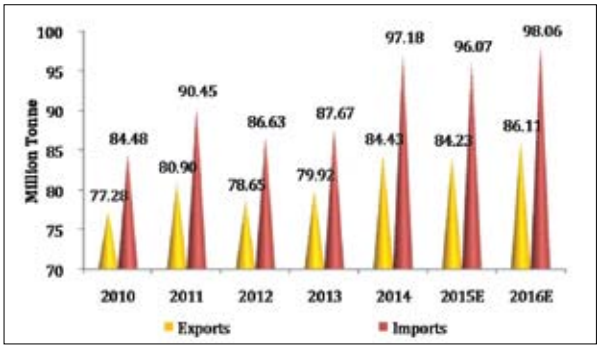
**INDIAN FERTILIZERS PRODUCTION AND CONSUMPTION**



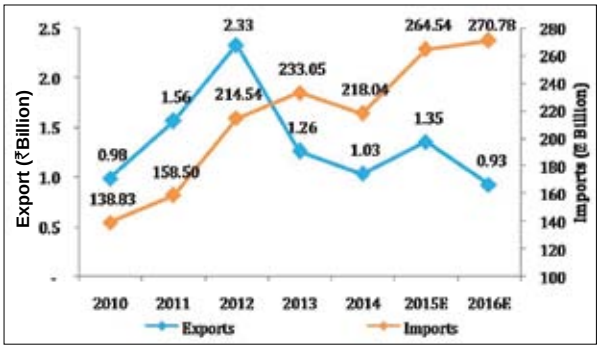

*Source: FAO Statistics and ICFA*

The production of fertilizers in India has increased at a CAGR of 1.48% during 2010-2014 and is expected to have reached 212.67 million tonnes in 2016. However, the surge in the consumption volume of fertilizers in India was quite high, at an annual growth rate of 20.23% during 2010-2014, while it is further expected to have increased to 199.75 million tonnes. This rise over time was due to land scarcity and increased demand for agricultural products.

**INDIAN FERTILIZERS MARKET TRADE BY VOLUME**




**INDIAN FERTILIZERS MARKET TRADE BY VALUE**



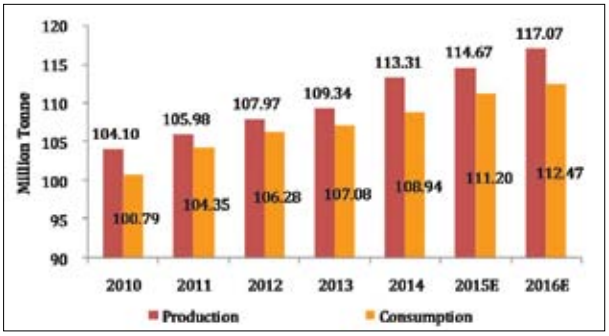

*Source: FAO Statistics and ICFA*

## INDIAN FERTILIZER MARKET TRADE ANALYSIS

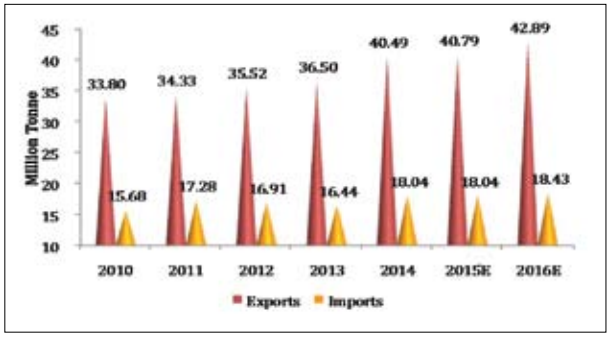
The Indian fertilizers market is largely dependent on imports from various countries, especially potash fertilizers. There is a shortage of raw materials in the country and the consequent dependency on imports is leading to volatile prices in the fertilizer industry. However, the new policies will help in stabilizing the raw material prices during the coming years.

In terms of volume, the imports of the fertilizers increased during 2010-2014 at a CAGR of 2.84%, while in terms of value, imports grew at a CAGR of 1%. However, in 2012, the volume of imports declined, whereas the imports in terms of value increased. This may be attributed to the

**INDIAN NITROGEN FERTILIZERS PRODUCTION AND CONSUMPTION**




**INDIAN NITROGEN FERTILIZERS TRADE BY VOLUME**




*Source: FAO Statistics and ICFA*

fluctuating foreign exchange rate.

## NITROGEN FERTILIZER MARKET

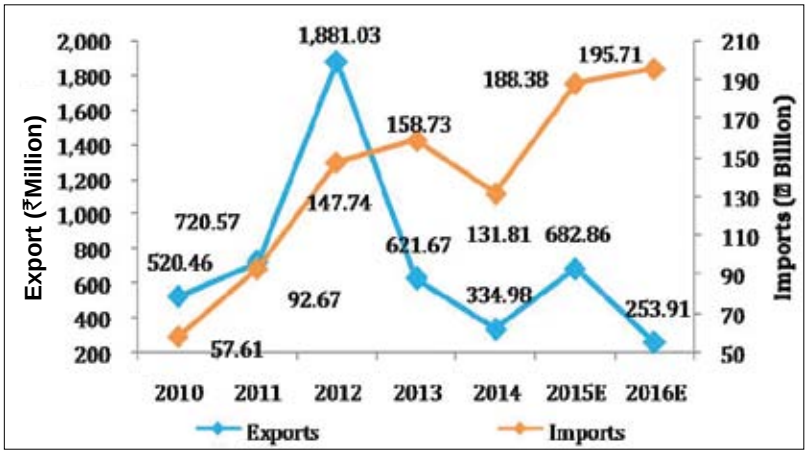
The nitrogenous fertilizers market is dependent upon the demand for grains and oilseeds crops that drives the fertilizer production uses. Fertilizer production uses 1.2% of the world's total energy out of which 90% is used for ammonia production, which is a key ingredient in the production of nitrogen fertilizers. The nitrogen fertilizer market price is driven by raw materials costs such as crude oil that saw volatility in prices with Brent crude oil and different gas price levels or mechanisms.

The production and consumption of nitrogenous fertilizers has increased over the years and is anticipated to have increased to 117.07 million tonnes and 112.47 million tonnes, respectively in 2016. During 2010-2014, the production increased at a CAGR of 1.71%, while consumption grew at an annual growth rate of 1.57%.The urea segment accounted for the largest share in 2016.

The trade for nitrogenous fertilizers has grown exponentially in the last few years. The trade, in terms of volume increased over the years, while in terms of value, there has been a fluctuating trend due to the volatile foreign exchange rate.

However, the major restraints of the nitrogenous fertilizers market are the trend toward organic food and non-food consumption, which in turn, is driving the demand for bio-fertilizers. The nitrogenous fertilizers market has a number of large- and small-scale firms. Acquisitions and expansions were the key strategies adopted by market players to ensure their growth.

**INDIAN PHOSPHATE FERTILIZERS PRODUCTION AND CONSUMPTION**




*Source: FAO Statistics and ICFA*

## PHOSPHATE FERTILIZER MARKET

The phosphate fertilizer consumption includes phosphoric acid based fertilizers and non phosphoric acid based fertilizers. The non phosphoric acid based fertilizers include phosphate in nitric acid based fertilizers and super phosphate.

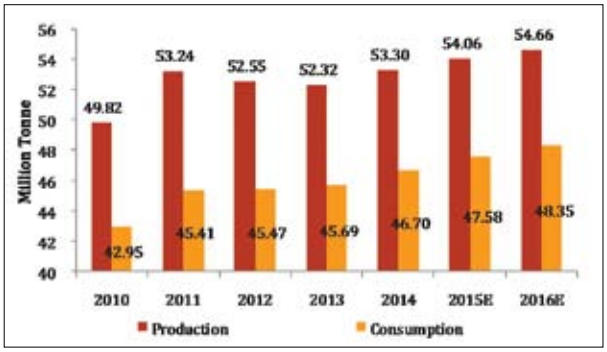
The demand for phosphate fertilizers has been increasing due to the growing population and increasing food demand. Increasing milk and meat consumption has necessitated large feed volume that in turn has increased the demand for maximum forage production.

However, India relies heavily on imports in order to meet its demand for phosphates. During summer 2013, a weakening currency challenged the profitability of importers and further reduced import activity. Lower domestic phosphate inventories and a slightly stronger currency have improved the outlook for DAP imports in 2014.

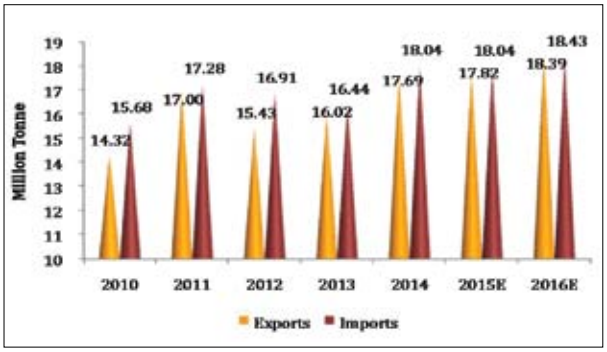
## POTASH FERTILIZER MARKET

Potash fertilizers are generally applied on vegetables, rice, sugar, fruits,

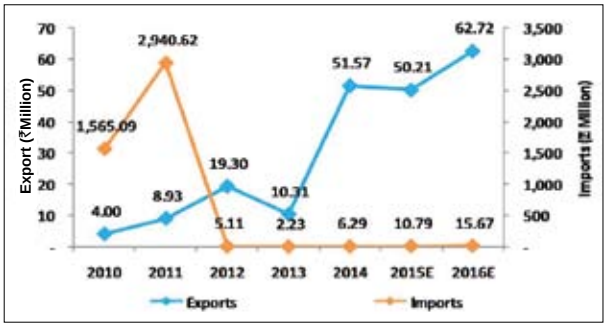
**INDIAN PHOSPHATE FERTILIZERS PRODUCTION AND CONSUMPTION**




**INDIAN PHOSPHATE FERTILIZERS TRADE BY VOLUME**




**INDIAN PHOSPHATE FERTILIZERS TRADE BY VALUE**

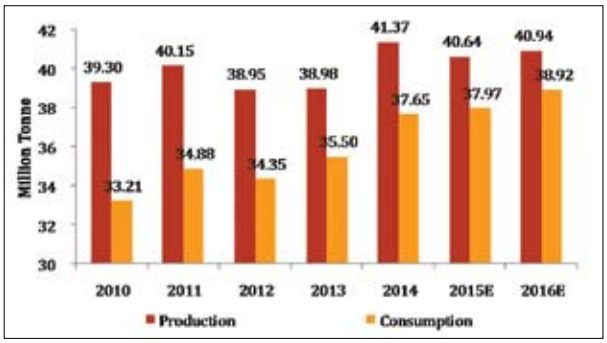



*Source: FAO Statistics and ICFA*

soybean, palm oil, and cotton owing to its capability to enhance crop productivity, crop yield, increase nutrient value, and resistance from diseases and harmful parasites. Rise in cattle feed consumption and increasing purchasing power in India are expected to contribute towards potash fertilizer market growth. However, variations in crop soil and climate condition in different regions are not much effective on some crops or soils, which might result in less demand.

India is one of the major consumers of the potash fertilizer; however, large amount of demand is met by imports as India does not have commercially feasible

**INDIAN POTASH FERTILIZERS PRODUCTION AND CONSUMPTION**



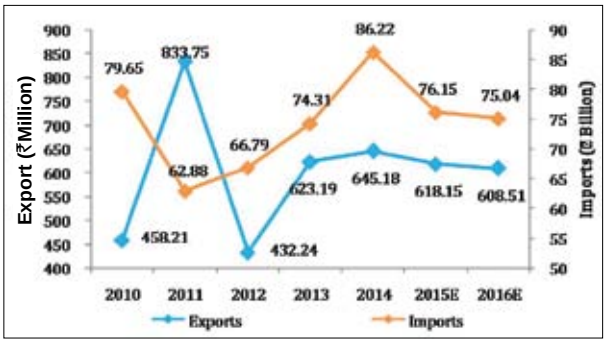

*Source: FAO Statistics and ICFA*

resources for the production of the same. However, India is anticipated to witness a notable increase in production owing to government support for technology improvement in farming sector.

India's Muriate of Potash (MoP) fertilizers import could reduce 5%-7% in the current fiscal i.e. 2017-18 due to firm global prices and cut in government subsidy. Last year, global potash prices were down, but this year it has increased slightly.

Chemical fertilizers have played key role in modern agriculture and in improving crop productivity of India. In spite of ranking second largest nitrogenous fertilizer producer and third largest phosphate fertilizer producer in the World, day by day the demand-supply gap of fertilizers

**INDIAN POTASH FERTILIZERS MARKET TRADE BY VALUE**




*Source: FAO Statistics and ICFA*

in India is increasing. It is leading to increased dependency on fertilizer imports. India has witnessed a range of activities in the fertilizer market over the last few years. The country has witnessed an increase in demand bio-fertilizers or organic fertilizers, as intense use of chemical fertilizers have caused severe damage to the health, ecosystems and ground water of the country. Also, the demand of micronutrients and secondary macronutrients witness a surge. ■

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# Soil Health Management in India

The nature and extent of deficiencies of nutrients in soil varies with soil type, crop genotype, management and agro-ecological situations.Soil organic carbon and nitrogen are primary indicators of soil health.

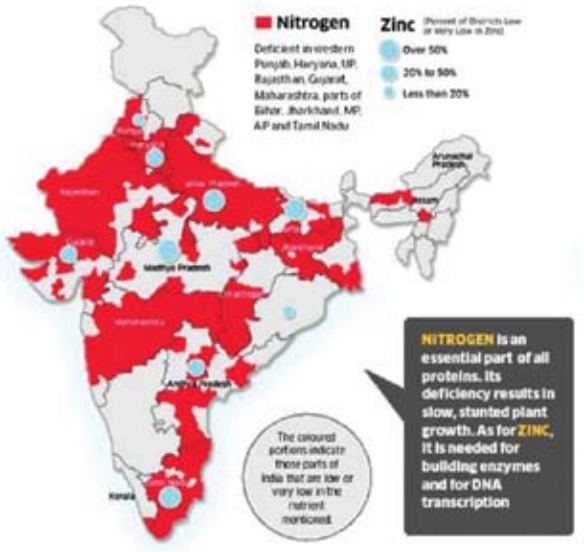
Most of the arable lands across the country show low levels of organic carbon with deficiencies ranging from 11% to 76%.

## SOIL HEALTH MANAGEMENT

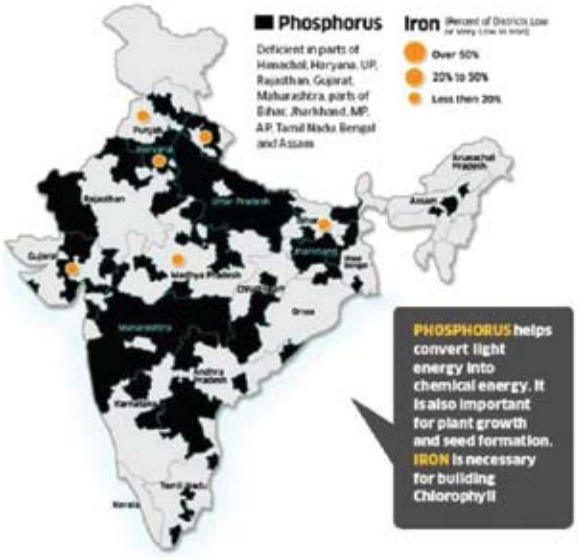
In order to improve the soil health of the Indian soils, government of India has initiated two major schemes namely,

- Soil Health Management Scheme (SHM)
- Soil Health Card Scheme

### NITROGEN AND ZINC DEFICIENT INDIAN SOILS



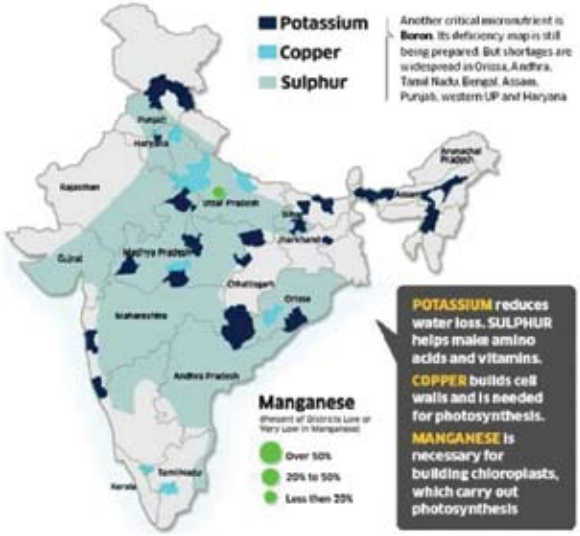

### PHOSPHORUS AND IRON DEFICIENT INDIAN SOILS




## SOIL HEALTH MANAGEMENT SCHEME

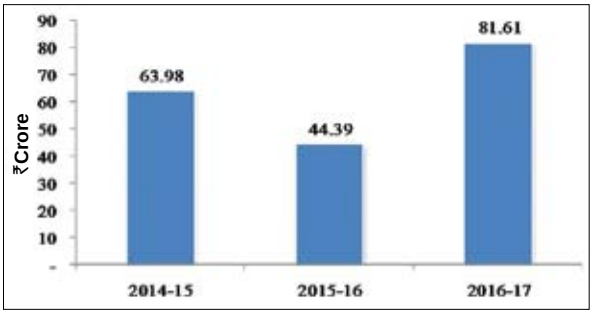
Soil Health Management (SHM) is one of the most important interventions under NMSA. SHM aims at promoting Integrated Nutrient Management (INM) through:

### PHOSPHORUS AND IRON DEFICIENT INDIAN SOILS

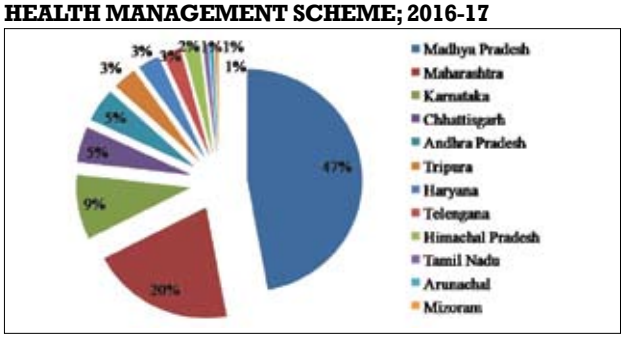



*Source: Company Presentation*

**FUNDS RELEASED UNDER SOIL HEALTH MANAGEMENT SCHEME**




**STATE-WISE FUNDS RELEASED UNDER SOIL HEALTH MANAGEMENT SCHEME; 2016-17**




*Source: Ministry of Agriculture and Farmer's Welfare, Note: 2016-17 till 30th Jan 2017*

- Judicious use of chemical fertilizers including secondary and micro nutrients in conjunction with organic manures and bio-fertilizers for improving soil health and its productivity;
- Strengthening of soil and fertilizer testing facilities to provide soil test based recommendations to farmers for improving soil fertility;
- Ensuring quality control requirements of fertilizers, bio-fertilizers and organic fertilizers under fertilizer control order, 1985;
- Up gradation of skill and knowledge of soil testing laboratory staff, extension staff and farmers through training and demonstrations; promoting organic farming practices etc.

This component is implemented by State Government., National Centre of Organic Farming (NCOF), Central Fertilizer Quality Control & Training Institute (CFQC&TI) and is sanctioned by INM division.

In 2016-17, the fund was released to only 12 states.

## SOIL HEALTH CARD SCHEME

In February 2015, the central government had launched the Soil Health Card Scheme. Under this programme, the government plans to issue soil card to farmers to help them get a good harvest by studying the quality of soil. The major components of the scheme are:

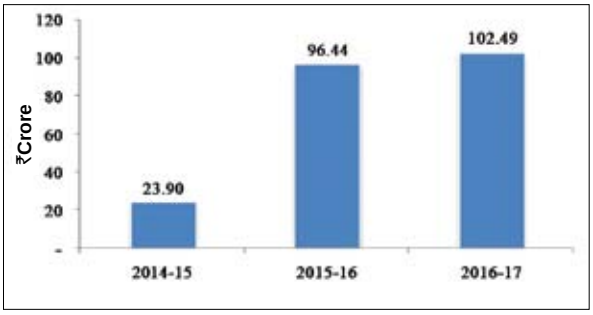

- Issue of Soil Health Cards
- Training for soil analysis
- Financial assistance for package of nutrient recommendations
- Capacity building and regular monitoring and evaluation
- Constitution of the Project Management Team (PMT)

The fund was released to the limited number of states during 2016-17, of which Uttar Pradesh, Madhya Pradesh, Maharashtra, Rajasthan and Karnataka were released maximum funds, which totaled to Rs.71.69 Crore, accounting approximately 70% of the funds released.

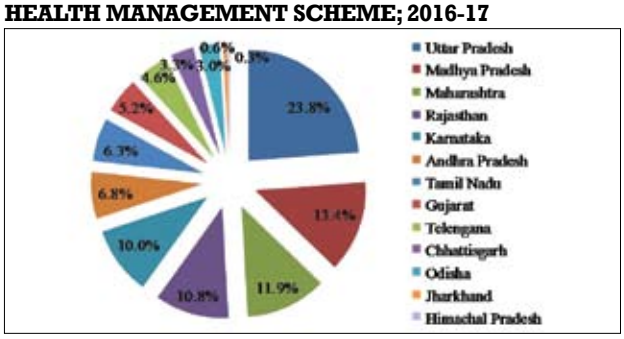
## PERFORMANCE OF SOIL HEALTH CARD SCHEME

The government of India has covered

**FUNDS RELEASED UNDER SOIL HEALTH CARD SCHEME**




**STATE-WISE FUNDS RELEASED UNDER SOIL HEALTH MANAGEMENT SCHEME; 2016-17**




*Source: Ministry of Agriculture and Farmer's Welfare, Note: 2016-17 till 30th Jan 2017*

**STATE-WISE SOIL HEALTH CARDS ISSUED TILL 11.05.2017**

| S. No. | State Name | Number in Lakh | | | |
|---|---|---|---|---|---|
| | | No. of Samples Entered | No. of Farmers Covered | Samples Tested | SHC Printed |
| 1 | Karnataka | 15.09 | 83.87 | 11.33 | 61.45 |
| 2 | Tamil Nadu | 13.64 | 52.32 | 11.81 | 41.64 |
| 3 | Chhattisgarh | 7.47 | 46.74 | 6.72 | 40.99 |
| 4 | Uttar Pradesh | 15.93 | 45.11 | 9.87 | 29.15 |
| 5 | Maharashtra | 12.60 | 37.56 | 10.63 | 25.53 |
| 6 | Telangana | 10.10 | 28.62 | 9.56 | 21.31 |
| 7 | Andhra Pradesh | 14.26 | 41.07 | 12.69 | 16.25 |
| 8 | Haryana | 5.94 | 15.52 | 4.75 | 12.17 |
| 9 | Odisha | 3.68 | 13.38 | 2.38 | 8.20 |
| 10 | Jammu & Kashmir | 1.60 | 6.80 | 1.19 | 4.81 |
| 11 | Himachal Pradesh | 1.16 | 6.04 | 0.94 | 4.74 |
| 12 | Gujarat | 20.45 | 30.62 | 15.23 | 4.71 |
| 13 | Madhya Pradesh | 5.75 | 11.96 | 2.88 | 4.01 |
| 14 | Kerala | 1.92 | 6.06 | 1.26 | 3.30 |
| 15 | Uttarakhand | 1.25 | 4.71 | 0.98 | 3.26 |
| 16 | Jharkhand | 1.08 | 4.74 | 0.18 | 0.69 |
| 17 | Meghalaya | 0.24 | 0.95 | 0.20 | 0.67 |
| 18 | Tripura | 0.20 | 0.66 | 0.17 | 0.61 |
| 19 | Sikkim | 0.12 | 0.50 | 0.11 | 0.45 |
| 20 | Goa | 0.22 | 0.22 | 0.19 | 0.19 |
| 21 | Assam | 0.17 | 0.62 | 0.04 | 0.14 |
| 22 | West Bengal | 0.91 | 2.38 | 0.03 | 0.11 |
| 23 | Arunachal Pradesh | 0.08 | 0.08 | 0.08 | 0.08 |
| 24 | Nagaland | 0.07 | 0.07 | 0.07 | 0.07 |
| 25 | Puducherry | 0.05 | 0.05 | 0.04 | 0.04 |
| 26 | Andaman&Nicobar Islands | 0.07 | 0.07 | 0.06 | 0.03 |
| 27 | Mizoram | 0.08 | 0.08 | 0.04 | 0.03 |
| 28 | Punjab | 0.17 | 0.18 | 0.04 | 0.03 |
| 29 | Rajasthan | 9.02 | 9.74 | 8.12 | 0.00 |
| 30 | Bihar | - | - | - | - |
| 31 | Chandigarh | - | - | - | - |
| 32 | Dadra & Nagar Haveli | - | - | - | - |
| 33 | Daman And Diu | - | - | - | - |
| 34 | Delhi | - | - | - | - |
| 35 | Lakshadweep | - | - | - | - |
| 36 | Manipur | - | - | - | - |
| | Total | 143.34 | 450.74 | 111.59 | 284.68 |

*Source: Soil Health Card Website*

approximately 45 million farmers under this scheme as on 12th May, 2017. The State of Karnataka has issued most number of the soil health cards to the farmers.

The government targets to cover all the farmers of the country by 2017. They are providing funds to the states to issue soil health cards to their respective farmers.

The following table depicts the total number of soil health cards printed by each state of India.

Over the years, farmers have increased their reliance on chemical fertilizers and have abandoned or reduced the use of organic manure drastically. Low levels of soil organic matter along with multi-nutrient deficiencies are the major stumbling blocks for bridging yield gap in Indian agriculture. Therefore, large quantities of carbon and other nutrients contained in agricultural and domestic wastes can be recycled to cut the rising costs of chemical fertilizers.

Incentives are required to promote the use of organic manure/fertilizers as well as biological sources like biofertilizer in order to encourage farmers to adopt INM approach. For example, options should be provided to the farmers to either avail DBT through cash transfer to their bank account or cash vouchers to buy organic manure from these recognized outlets. ■

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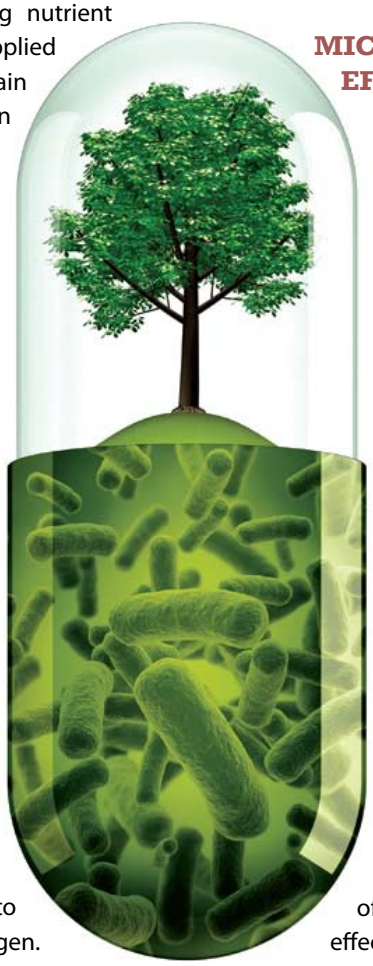
# ENHANCING NUTRIENT USE EFFICIENCY BY MICROBIAL INOCULANTS

The use of chemical fertilizers to enhance crop productivity has affected the biogeochemical cycles negatively and the leaching and run-off of nutrients from chemical fertilizers have led to environmental degradation. One of the main reasons for these problems is the low nutrient use efficiency of chemical fertilizers. Nutrient use efficiency (NUE) can be defined in many ways like agronomic efficiency (kg grain yield increase/kg nutrient applied), physiological efficiency (kg grain yield increase/kg nutrient taken by crop) and chemical efficiency or apparent recovery (kg nutrient taken up per kg nutrient applied). Low efficiency of applied nutrients is one of the main constraints in crop production and it is a major global concern with regards to food security for an ever increasing global population. In India in the past few decades use efficiencies for major nutrients like N, P and K has remained constant. This means large quantities of nutrients applied are lost which not only adds to the cost of production but also imparts detrimental effects on the environment like eutrophication and nitrate pollution. Nutrient use efficiency can be increased through various means like manipulation of application techniques, coating fertilizers like in the case of urea which is coated with different materials like neem, sulfur, gypsum, plastic and mud ball so as to enable slow release of nitrogen.

An ecologically supreme way of improving nutrient use efficiency is harnessing plant microbe interactions, as it causes zero damage to the ecosystem. It is widely believed that a vast diversity of microorganisms inhabiting rhizosphere, phylloplane and as endophytes assists plant in uptake of mineral nutrients and various other growth factors and through which they ensure better plant productivity and hence an improved nutrient use efficiency. Agriculturally important microorganisms can positively influence the use efficiencies of different plant nutrients like N, P, K and many other secondary and micronutrients.



## MICROBES IN N USE EFFICIENCY

Nitrogen is the primary nutrient and it is an important constituent of proteins, enzymes, nucleic acids and plays a major role in the establishment and maintenance of photosynthetic capacity, photosynthetic activity and sink capacity. Since the availability of nitrogen in the easily absorbable form is limited, soil external application of nitrogen becomes an absolute need. But much of the N applied to the soil does not find its fate in plant absorption. Only 30-35 % of the applied nitrogen is taken up by plants and the remaining is either fixed in soil or lost to the environment in the form of leaching and gaseous loss. Considering the cost of fertilizer nitrogen and the ill effects of lost nitrogen it is neces-

sary to improve the nitrogen use efficiency. The use of microbial inoculants to improve nitrogen use efficiency is an ecofriendly option available to the farmers. Barneix et al. in 2005 found out that inoculation with rhizobacteria, *Bacillus simplex* and *Bacillus flexus*in wheat improved nitrogen use efficiency and grain quality. In another study. Adesemoye and his group of researchers have shown that reduction of chemical fertilizers by 25 % than the recommended dose and supplementing with application of a PGPR formulation (*Bacillus amyloliquefaciens* IN937a and *Bacillus pumilus* T4), has resulted in the same level of plant growth, yield, nitrogen and phosphorus uptake as that of full dose of fertilizers. When it was further supplemented with AMF *Glomus intraradices* the same effect was achieved even with 70% of recommended dose of fertilizers. Nitrogen fixing bacteria both symbiotic (Rhizobia) and free living (*Azotobacter*, *Azospirillum* and various N fixing cyanobacteria) are also known to improve nitrogen use efficiency and also can provide atmospheric nitrogen. Hence inoculation with nitrogen fixing bacteria either at the time of sowing or at frequent intervals in the crop growth stages can reduce the application of chemical fertilizers. Arbuscular mycorrhizal fungi is known for increasing uptake of nitrogen and other plant nutrients just as they improve the uptake of phosphorus.

## MICROBES IN P USE EFFICIENCY

Phosphorus is the second most important plant nutrient after nitrogen and it is an integral component of nucleic acids, phospholipids, important in cellular membrane and provides compounds for photosynthesis in plants. In soil, P is present in large amounts but only a fraction of it is available to plants owing to very low solubility of phosphate salts in soils. Much of fertilizer phosphate applied to crop plants is fixed in soil and the total available phosphate has very low mobility. Plants have evolved a multitude of strategies to increase P uptake thereby increasing P use efficiency. Arbuscular mycorrhizal (AM) symbioses is the most wide spread strategy used by plants to improve P use efficiency. AM symbioses is a special kind of symbiotic relationship in which the micro partner (fungi) helps in P uptake and mobility in the macro partner (plants), and macro partner provides sugars and space for colonisation to the micro partner. AM symbioses, because of its large surface area can contribute to plant nutrition uptake especially phosphorus uptake. Since phosphorus is highly immobile element, the left over phosphates which are not absorbed by plants are easily absorbed in the bulk soil and hence a phosphate free zone occurs in the rhizosphere. But, the extraradical mycelium formed by fungal partner can extend beyond this phosphate free zone and help plants in absorbing phosphate available at a far off distance from roots thereby making the otherwise unavailable phosphates to available phosphates. *Glomus*, *Gigaspora*, *Scutellospora*, *Acaulospora* and *Entrophospora* are the most commonly occurring AM fungi (AMF).The role of AM fungi in improving

P use efficiency and general growth parameters is established in different crops by various research groups. Apart from AM fungi there is one more function group of microorganism called phosphorus solubilizers which improve phosphorus use efficiency alike AM fungi. Unlike AM fungi phosphorus solubilizers are not involved in P mobilization, but they solubilize fixed phosphates to available phosphates. A number of phosphorus solubilizing microorganisms have been utilized for tackling the phosphorus fixation problem in the soil. A few to name are *Pseudomonas striata*, *P.fluorescens*, *Bacillus megaterium* and *Aspergillus* sp. Such phosphorus solubilizing microorganisms can be used singly or in combination with other microbial inoculants like AM fungi and nitrogen fixers.

## MICROBES FOR USE EFFICIENCY OF POTASSIUM

Potassium (K) is the third most important plant nutrient which plays a key role in growth, metabolism and development of plants. An adequate supply of potassium to crop plants leads to well developed roots, fast growth and increased resistance to pests and diseases. Potassium, once thought of being adequate in Indian soils has been reported to be low in 21 % of Indian soils and medium in 51 % of arable land. Hence there is a need of immediate K fertilization of 72 % of Indian agricultural soils. Since the cost of potash fertilizer is dependent on global market, it's getting costlier every year which increases the cost of cultivation. An alternate option is use of microbe mediated technologies to improve potash use efficiency so that the input of potash fertilizer can be kept at a bare minimum. K use efficiency can be improved by inoculation of crop plants with potash solubilizing microorganisms and AM fungi. Organic acids produced by microbial inoculants are able to chelate metal and mobilize K from K containing minerals. Field trial were carried out with a PGPR (*Bacillus* sp.) and AMF (*Glomusintraradices*) in maize across two tillage system (no till and conventional tillage). It was shown that treatment of AMF in combination with PGPR improved the uptake of K along with N and P across the tillage systems.

## MICROBES IN USE EFFICIENCY OF OTHER MINERALS

Microbial inoculants have been shown to improve use efficiency of many other elements in addition to N, P and K. *Mesorhizobium mediterannium* when inoculated in barley and chickpea has shown to improve uptake of Ca and Mg along with N, P and K uptake. *Pseudomonas mendocina* in combination with AMF (*Glomusintraradices* and *G. mosseae*) have shown to improve the uptake of Ca, Fe and Mn along with improved uptake of N and P in lettuce. AM fungi have been shown to improve use efficiency of all major and micronutrients since they increase the surface area of roots.

Incorporation of microbial inoculants technology as a component of integrated nutrient management has dual benefits of high crop productivity in the short term and sustained production without deteriorating the soil health in the long term. Although a plenty of microbial inoculants are available to increase nutrient use efficiency, it has to be considered that no microbial inoculant is universal as their activity depends on soil type, plant grown and various other edaphic and climatic factors. Hence there is a need for widespread studies on different microbial inoculants for improving nutrient use efficiency of different crops under varied agro-climatic conditions. ■

# NHRDF STRIVES FOR ECONOMICAL & QUALITY PRODUCTION OF EXPORT ORIENTED HORTICULTURAL CROPS

## A. NHRDF LABORATORY SERVICES

1. Plant petiole analysis for grapes:
   A. Macro elements : Nitrogen, Phosphorus, Potash, Calcium, Magnesium, Sulphur.
   B. Microelements : Iron, Copper, Sodium, Zinc, Manganese
2. Soil analysis
   A. Ph, Electical conductivity, Water holding capacity.
   B. Macroelements: Organic Carbon, Nitrogen, Phosphorus, Potash, Calcium, Magnesium, Sulphur, Calcium carbonate.
   C. Microelements : Copper, Iron, Sodium, Chlorine, Zinc, Manganese, Boron.
3. Irrigation water analysis
   pH. Electrical Conductivity, Total Soluble Solids, Carbonate, Bicarbonate, Sulphate, Calcium, Potassium, Magnesium, Sodium Absorption Ratio &Chlorine.
4. Physiological disorders
   Identification of deficiency and toxic symptoms of mineral nutrients, recommendations for its prevention and corrective measures.
5. Quality parameters of vegetables and fruits
   Brix, Drymatter, Total Soluble Solids, Total Acidity, Pungency, Reducing, Non-reducing, Total Sugars and Macro/Micro elements.
6. Seed Testing
   Germination, Moisture and physical purity
7. Bud differentiation in grape.
8. Grape Wine Testing
   pH, Brix, Alcohol, Volatile acidity, Titrable acidity, Free $SO_2$, Reducing Sugar, Total Sugar and heavy metals.
9. Identification of diseases, insect pests of vegetable and fruit crops and recommendations for prevention and control measures.
10. Pesticide Residue Analysis in fresh fruits, vegetables and processed products.
11. Mushroom spawn and Pasteurized compost
12. AGMARK inspection of Grapes.

## B. NHRDF's Quality Seeds

The following varieties of onion and garlic developed by NHRDF and duly released by Ministry of Agriculture & Farmers welfare, Govt. of India, New Delhi.

### Onion varieties

1. Agrifound Dark Red
2. Agrifound Light Red
3. NHRDF Red
4. NHRDF Red –2
5. NHRDF Red – 4

### Garlic varieties

1. Agrifound White (G-41)
2. Yamuna Safed (G-1)
3. Yamuna Safed - 2 (G-50)
4. Yamuna Safed - 3 (G-282)
5. Yamuna Safed - 4 (G-323)
6. Yamuna Safed – 5 (G-189)
7. Yamuna Safed – 8 (G-384)
8. Yamuna Safed – 9 (G-386)
9. Agrifound Parvati (G-313)
10. Agrifound Parvati–2(G-408)

For seed availability and price etc. contact our centres at the addresses in our website www.nhrdf.com or at the following address:

Contact:

Director

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Zinc Nutrient Initiative
International Zinc
Association
New Delhi

# ZINC IN FOOD AND NUTRITION SECURITY

Zinc is one of the 17 essential elements necessary for the normal growth and development of plants. It is among eight micronutrients essential for plants. Zinc plays a key role in plants as a structural constituent or regulatory co-factor of a wide range of different enzymes and proteins in many important biochemical pathways. These are mainly concerned with carbohydrate metabolism, both in photosynthesis and in the conversion of sugars to starch, protein metabolism, auxin (growth regulator) metabolism, pollen formation, maintenance of the integrity of biological membranes and resistance to infection by certain pathogens.

Zinc deficiency in plants retard photosynthesis and nitrogen metabolism, reduce flowering and fruit development and prolongs growth periods, resulting in delayed maturity, lower yield, poor produce quality and sub-optimal nutrient-use efficiency. Some of the common deficiency symptoms of zinc in plants are, light green, yellow or bleached spots in interveinal areas of older leaves, the emerging leaves are smaller in size and often termed as "little leaf", the internodal distance in case of severe deficiency becomes so short that all the leaves appear to come out from the same point, termed as "rosetting".

Zinc has emerged as the most widespread micronutrient deficiency in soils and crops worldwide, resulting in severe yield losses and deterioration in nutritional quality. It is estimated that almost half of the soils in the world are deficient in zinc. Since cereal grains have inherently low concentrations, growing these on the potentially zinc deficient soils further decreases grain zinc concentration.

India is not an exception. About 40 per cent

soil samples analysed for available zinc were found deficient in India. There is a significant response to applied zinc in the soils deficient in zinc. In India, zinc is considered the fifth most important yield limiting nutrient after N, P, K & S in upland crops, whereas in lowland crops like rice, it is next to N.

The reasons responsible for the increase of incidences of zinc deficiency include large zinc removals due to high crop yields and intensive cropping systems, lesser application of organic manures, use of high analysis fertilizers, increased use of phosphatic fertilizers resulting in P induced zinc deficiency and the use of poor quality irrigation water.

The critical level of zinc in soils in India is considered as 0.6 ppm. However, there is a growing concern that it should be increased to 1.2 ppm or higher. In that case, the level of zinc deficiency would be escalated to higher deficiency level than what is being reported today.

At present, about 40% soils in India are classified as Zn deficient, on the basis of the existing critical limit of Zn (0.6 mg Zn kg-1 soil). However, crop response to applied Zn has been observed in soils above the critical limit also. Therefore, it is generally believed that critical level of Zn is site specific and one critical limit may not represent every soil type or crop.

## ZINC IN HUMAN HEALTH

Zinc is an essential nutrient for human health. There is no life without zinc. Recently, zinc deficiency - especially in infants and young children under five years of age - has received global attention. Zinc deficiency is the fifth leading cause of death and disease


in the developing world. According to the World Health Organization (WHO), about 800,000 people die annually due to zinc deficiency, of which 450,000 are children under the age of five. It is estimated that 60-70% of the population in Asia and Sub-Saharan Africa could be at risk of low zinc intake.

The possible solution to the zinc malnutrition in the humans may be i) Food supplementation, ii) Food fortification or iii) Biofortification. The former two programmes require infrastructure, purchasing power, access to market and healthcare centres and uninterrupted funding, which have their own constraints. In addition, such programmes will most likely reach the urban population, which is easily accessible, especially in the developing countries. Alternatively, the latter programme, Biofortification - fortification of crops especially food crops with zinc - is the best option for alleviating zinc deficiency. It will cater to both the rural and urban populations. It could be achieved through two approaches, Genetic biofortification and Agronomic biofortification.

There is a developing field of research on the biofortification of plant foods with zinc. This involves both the breeding of new varieties of crops with the genetic potential to accumulate a high density of zinc in cereal grains (genetic biofortification) and the use of zinc fertilizers to increase zinc density (agronomic biofortification). Although the plant breeding route is likely to be the most cost effective approach in the long run, the use of fertilizers is the fastest route to improve the zinc deficiency in diets. In order to replenish the zinc taken up by the improved cultivars, higher and sustainable use of fertilizers is inevitable.

## CROP RESPONSE TO ZINC FERTILIZERS

Crop response to zinc has been observed in all crops under almost all types of soils and agro-climatic conditions. While the response was found to be higher in grain crops like rice, fruits and vegetable crops also responded well to applied zinc. Extent of crop response depends on the status of zinc in that soil. Higher the zinc deficiency in soils, higher the crop response would be to applied zinc.

The zinc fertilizer consumption trend in India depicts that there was a significant increase in consumption in the last couple of years, precisely, after 2009-10, when additional subsidy on zinc fertilizers was announced through the Nutrient Based Subsidy (NBS) Scheme by the Government of India. This is the same year when Zinc Nutrient Initiative (ZNI) of the International Zinc Association (IZA) was launched in India.

To replenish the zinc taken up by the crops and to enrich the grains or edible parts with zinc, Zn fertilizers, such as zinc sulphates (hepta and mono hydrates), Zn-EDTA, fortified

fertilizers, customized fertilizers, micronutrient mixtures, etc. are being used. However, the zinc fertilizer use efficiency is abysmally low and does not exceed 2-5% in crops, which continues to be a challenge and, therefore, sustained research initiatives are needed to enhance the uptake of zinc through development of innovative fertilizer products.

Application of Nano technology in developing new innovative products like Zn-nanoparticles may be possibility. It may also address the so called antagonistic effect of Zn with P. Nanoscale or nanostructured materials as fertilizer carrier or controlled-release products for building of the so-called 'smart fertilizers' can enhance the nutrient use. Nano-fertilizers can precisely release their active ingredients in responding to environmental and biological demands.

However, the uptake, translocation, and fate of Nano-particles in plant system are largely unknown resulting in the rise of various ethical and safety issues surrounding the use of Nano-fertilizers in plant productivity. A systematic and thorough quantitative analysis regarding the potential health impacts, environmental clearance, and safe disposal of Nano-materials can lead to improvements in designing applications of Nano-fertilizers.

## ZINC FERTILIZER POLICY

As far as the zinc fertilizer policy is concerned, the role of zinc has been specially targeted through additional subsidy @ Rs. 500 per tonne under the Nutrient Based Subsidy (NBS) Scheme launched in 2010. The government is promoting the use of zinc under the National Food Security Mission (NFSM) also by providing an additional subsidy

to the farmers @ Rs. 500 per hectare for use of micronutrient fertilizers. In addition, the large fertilizers players are also coming into manufacturing and marketing of zinc fertilizers in India.

However, as we are aware, urea is out of the gambit of NBS Scheme. If it is considered in the scheme, the balanced fertilizer use would be encouraged. In addition, zincated-urea is not being produced or marketed in India due to some minor price disparity, which should be considered by the government keeping in view the widespread zinc deficiency in soils and crops, causing zinc malnutrition in humans.

Off late, in the recent launch of GST, a historic tax reform in India since independence, the rate on fertilizer has been reduced from 12% to 5%. This is a welcome move by the government which is benefiting the farmers. However, this is restricted to N, P, K fertilizers only and the secondary and micronutrient fertilizers are left out. The GST rate on micronutrients is not less than 12%. In fact, the GST rates should be at par for the micronutrient fertilizers mentioned in the FCO in order to encourage the balanced fertilizer use and extend the benefit to the farmers in the country.

## CHALLENGES AND WAY FORWARD

The key challenges in popularizing zinc in balanced fertilizer use for ensuring soil health as well as food and nutrition security are: 1) Urea is not included in Nutrient Based Subsidy Scheme, discouraging balanced fertilizer use, 2) Zincated urea included in FCO but not produced due to minor price disparity, 3) Higher GST rates on micronutrient fertilizers that are mentioned in FCO, 4) Quality of zinc fertilizers available in the market, 5) Availability of zinc fertilizers at the time of need of the farmers, 6) Development of new and innovative zinc fertilizer products for higher fertilizer use efficiency, e.g., Nano zinc fertilizers, 7) Generating site specific database on 'Soil – plant – animal – human continuum study on zinc' (a multidisciplinary approach), 8) Awareness of the extension & promotional workers and farmers – the last mile delivery. ■

# ORGANIC FARMING

# Indian Organic Farming Overview

There was 50.9 million hectares of organic agricultural land in 2015, including in-conversion areas, which constitute only 1% of the total agricultural land.

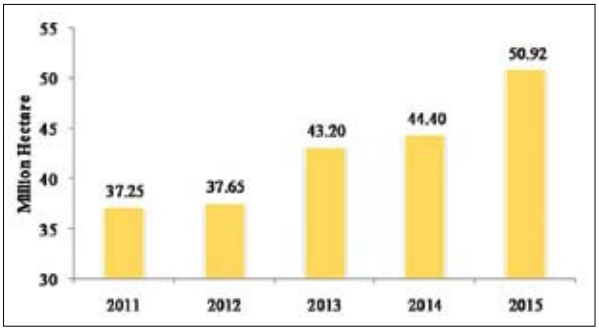
It was reported that there were almost 6.5 million hectares more of organic agricultural land in 2015 than in 2014. This is mainly because 4.4 million additional hectares were reported from Australia. However, many other countries reported an important increase thus contributing to the global growth, such as the United States (30% increase) and India (64% increase), both with an additional 0.5 million hectares, and Spain and France, both with an additional 0.3 million hectares.

## COUNTRIES WITH LARGEST ORGANIC AGRICULTURAL LAND

The ten countries with the largest organic agricultural areas have a combined total of 37.8 million hectares and constitute almost three-quarters of the world's organic agricultural land.

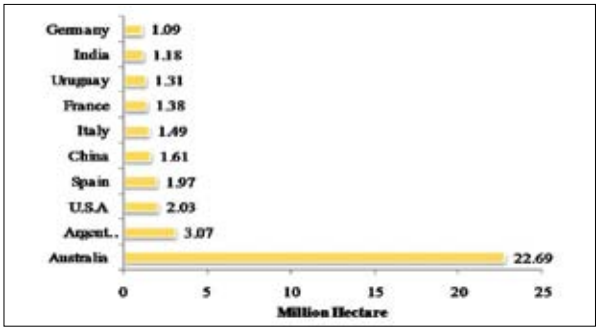
Australia, which experienced a major growth of organic land in 2015, is the country with the most organic agricultural land; it is estimated that 97% of the farmland are extensive grazing areas. Argentina is second followed by the United States in third place. However, India ranks at number nine, accounting 2.3% share of the total global organic

**GLOBAL ORGANIC AGRICULTURAL LAND**



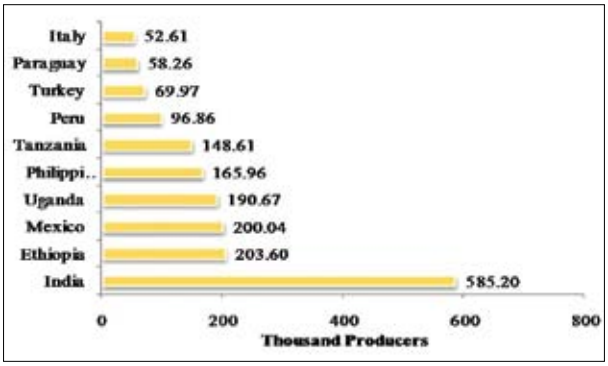

*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017 & 2013)*

**TOP 10 COUNTRIES WITH LARGEST ORGANIC AGRICULTURAL LAND; 2015**

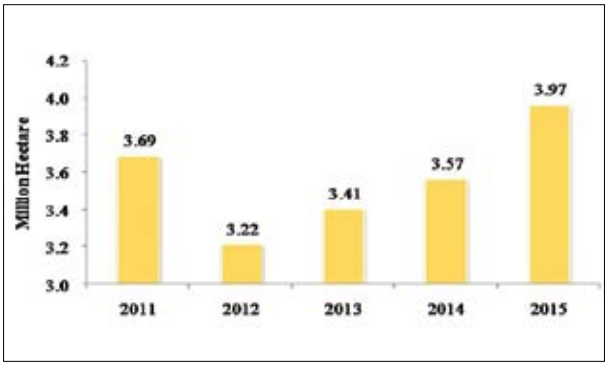



*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017)*

**TOP 10 COUNTRIES WITH MAXIMUM NUMBER OF ORGANIC PRODUCERS; 2015**




**CHANGE IN ORGANIC AGRICULTURAL LAND IN ASIA**




*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017)*

agricultural land.

## COUNTRIES WITH MAXIMUM ORGANIC PRODUCERS

There were almost 2.4 million organic producers worldwide in 2015, of which more than three-quarters of the producers were in Asia, Africa, and Latin America. The country with the most organic producers is India, followed by Ethiopia and Mexico.

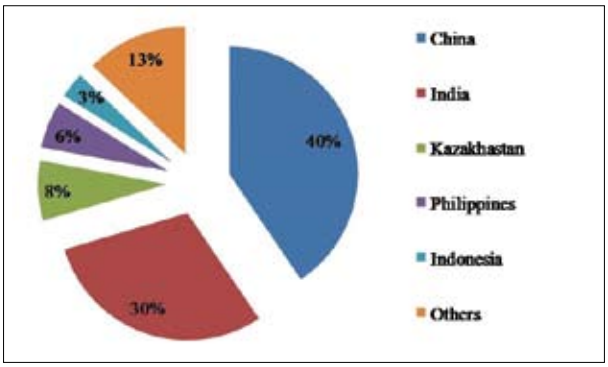
There has been an increase in the number of producers of over 160'000, or over 7%, compared with 2014. In 2015, Ethiopia, the Democratic Republic of Congo, Peru, Mexico, and Kenya reported significant increases. These five countries represent most of the total global increase.

## ASIAN ORGANIC FARMING OVERVIEW

The total area dedicated to organic agriculture in Asia was almost 4 million hectares in 2015, which was 0.2% of the total agricultural area in the region. However, the region constituted only 8% of the global organic agricultural land in 2015. Between 2014 and 2015, the organic area in Asia increased by almost 400'000 hectares or 11%.

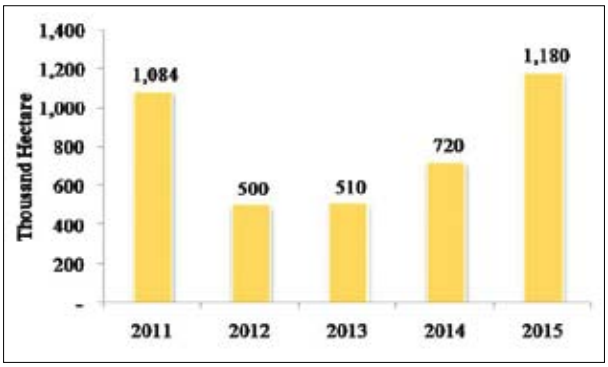
The country with the largest organic agricultural area is China (1.6

**MAJOR COUNTRIES WITH LARGEST ORGANIC AGRICULTURAL LAND IN ASIA; 2015**



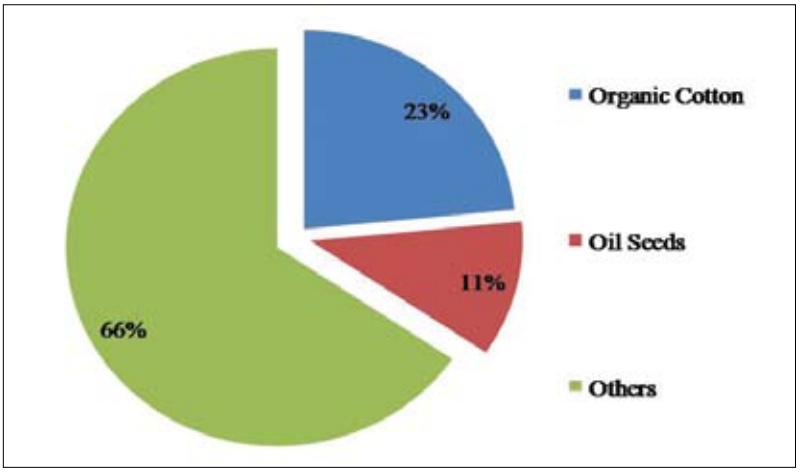

*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017)*

**INDIAN ORGANIC AGRICULTURAL LAND 2011-15**




*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017 & 2013)*

**GLOBAL ORGANIC AGRICULTURAL LAND BY CROPS**




*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017)*

million hectares), and the country with the most producers is India (585'000 producers). The countries with the highest organic shares of the total agricultural land are Timor-Leste (6.6%) and Sri Lanka (3.5%).

## INDIAN ORGANIC FARMING OVERVIEW

During the past decade, there has been significant growth in the area of organic agriculture. There has been almost a three-fold increase, from 0.53 million hectares in 2007- 2008 to 1.18 million hectares of cultivable land in 2014-15.

The significant growth is attributed mainly to conducive policies that have led to an increase in areas under third-party certification and Participatory Guarantee Systems (PGS). Some of the pioneering civil society organizations involved in facilitating PGS have influenced government policies in favor of PGS. India is among the few countries of the world where PGS is recognized and promoted by the government.

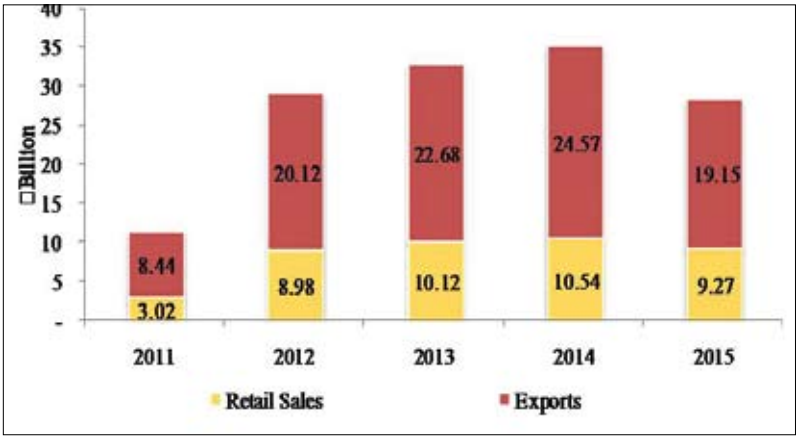
## INDIAN ORGANIC AGRICULTURAL LAND

The total organic agricultural land in India was 1.18 million hectares, accounting only 0.7% share of the total agricultural land in 2015, depicting large scope for adoption in organic farming in the country.

In addition to the area certified as organic, there are vast tracts of land that are traditionally organic but not certified as such. For instance, the State of Sikkim with an area of 700 thousand hectares has been declared as an organic state with regulations that prohibit the use of chemical fertilizers and pesticides. There are still other states that are almost entirely organic like the State of Nagaland. Besides, there are several rain-fed farms mostly in the central part of the country that are organic by nature. The inclusion of such farms that are traditionally organic into formal certification systems will significantly increase the organic area under certification, and more certified organic produce will be available in the markets.

The organic produce in India is largely constituted by organic cotton and oil seeds. India is by far the largest producer of organic cotton globally, accounting for two-thirds of total production (66.9%). Despite an increase in both land area and number of farmers in 2014-15, production volumes of organic cotton actually declined by 13.4%, from 86,853 to 75,251 metric tonnes of fibre. This was largely due to the trend of farmers - both organic and conventional - moving away from cotton and introducing a higher proportion of grains, vegetables, and flowers, which offer higher returns, into their production systems, with flowers for wet markets and pharmaceuticals becoming increasingly lucrative for organic farmers. India was also one of the largest producers of organic oilseeds, globally, accounting 130 thousand hectares area in 2015.

**GLOBAL ORGANIC AGRICULTURAL LAND**

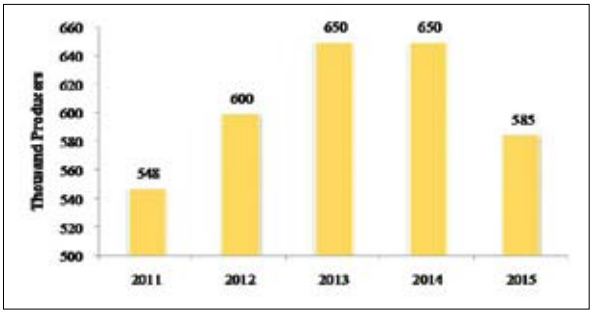



*Source: The World Organic Agriculture: Statistics and Emerging Trends 2017 Data Set)*

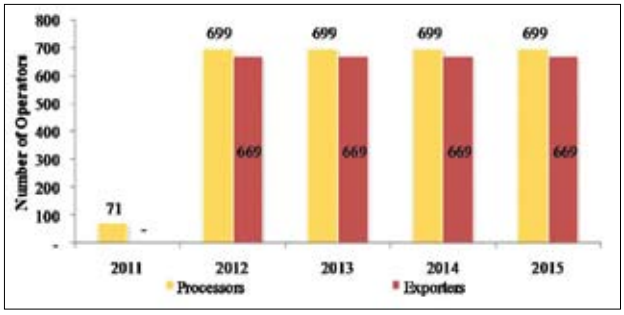
## INDIAN ORGANIC MARKET

Indian organic market can be segmented into domestic market and exports. Of the total organic market in India,

**INDIAN ORGANIC PRODUCERS 2011-15**




**INDIAN ORGANIC PROCESSORS AND EXPORTERS 2011-15**




***Source: The World Organic Agriculture: Statistics and Emerging Trends 2017)***

exports constituted approximately 67% of the sales in 2015.

However, the retail scene in India is beginning to see dramatic changes with the recent development of hypermarkets in most metropolitan cities. Today, every supermarket has an organic food section, and every large city in India has numerous organic food stores and restaurants.

There was a decline in both domestic market and exports in the above mentioned year as compared to the preceding year by 19%. This decline may be attributed to the unfavorable climatic conditions prevailing in the country, such as drought.

India had the maximum number of organic producers in the world with 585 thousand producers in 2015, despite a decline of 10% in the number of producers in comparison to 2014. The major reason for this decline was the unfavorable climatic conditions in the country as already mentioned above.

However, the number of exporters and processors has been constant since 2012. Major destinations for organic products from India include the U.S., the EU, Canada, Switzerland, Australia, New Zealand, South-East Asian countries, West Asia, and South Africa.

Organic production is not limited to the foods sector, but also applies to significant amounts of organic cotton fiber, garments, cosmetics, functional food products, and body care products. India's organic export markets would grow with the support of the industry, the government, and NGOs coming together to work with farmers. The future for markets for organic foods is definitely bright, as it is growing rapidly in the EU, in the U.S. and Canada, and in Japan and Australia, as well as in some developing countries. With growing consumer awareness of food safety, health, and environmental issues, the organic food sector has become an attractive opportunity for export from developing countries. ■

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# ORGANIC FARMING – SHIFTING APPROACH & PRACTICAL CONSIDERATIONS

Nobody would have thought it that in this modern era of gene revolution and high tech farming, organic farming will become a movement of people by the people for the mother nature. It has been a fact that use of fertilizers, pesticides, hybrid varieties GM crops and intensive cultivation practices along with mechanisation in India have led to achieve a record foodgrain production of 265 million tonnes in 2013-14 almost five times more since 1950s (50 million tonnes) and the credit goes to the scientists, farmers and policy makers for development & implementation of modern scientific production practices.

The ill-effects' of chemicals (Inorganic Fertilizers and Pesticides) used in agriculture have changed the mindset of some consumers of different countries who are now buying organic by paying premium price for health reasons. Policy makers are also promoting organic farming for restoration of soil health and generation of rural economy apart from making efforts for creating better environment.

Organic farming; for example – productivity, economics, environmental conservation, demand of people and alternative uses. In fact organic agriculture is an alternative cultivation model being practised by 2.4 million registered producers in 179 countries of the world. In total, 90.60 m ha area is under organic certification (agricultural and non- agricultural land). The global organic agriculture area has grown from 11 million hectare in 1995 to 50.9 million hectare in 2015 along with 61 standards and 468 certification bodies. The world organic market is now 81.6 billion US$. The all organic area in India during 2015-16 is 5.71 million hectares. This includes 26% cultivable area with 1.49 million hectare and rest 74% (4.22 million hectare) forest and wild area. The organic market from 5.85 lakh registered

organic producers in India is valued at Rs 5000 crores. About 87 countries of the world have developed organic regulations.

## CAUSE & EFFECTS

Reports of Standing Committee of Parliament on Agriculture (2015-16) mentions that the per hectare usage of these insecticides/pesticides is around 600 grams per hectare in India. We have a total 200 million hectares under cultivation. If we put the figures together, it comes to about 120 million kilograms of insecticides to be used. It means that about 12 lakh tonnes of pesticides are being used. Pesticide contamination and their residues in food commodities and feed have been a major concern among consumers in recent times. The data generated over the last four years indicate that on national scale, the contamination varies between 1.7% to 2.2%. Pesticides residue in crops / vegetables / fruits and effects of imbalanced use of fertilizers, mono-cropping and environmental pollution pose danger to human and ecosystem health.

All these observations and studies correlate to the fact that people need agricultural products developed through good agricultural practice (GAP) and it will rationalise the practice of imbalanced use of pesticides, fertilizers and other ill-healthy production & processing practices.

Now basic question is how to ensure the implementation of the good agricultural practices at the field level. A due certification & accreditation in the form of trust to the consumers of global village has given the different names from different corners of the world based on the experience & experimentation by the environment friendly


organizations. Soil Association in UK, Biodynamic Association in Europe and International Federation of Organic Agricultural Movement (IFOAM) are some of the organisations that helps the world to standardise the good agricultural practices.

The word "organic" is legally protected in some countries. In the EU, for example, this word has been protected since the early 1990s in English-speaking countries. The equivalent in French, Italian, Portuguese and Dutch-speaking countries is "biological" and "ecological" in Danish, German and Spanish-speaking countries. In countries like India, legal protection to organic farming is an issue and has many pros and cons, but favouring adoption of good agricultural practices and not 100% organic need to be customised.

## DEVIATION FROM PRINCIPLES: INDIAN SCENARIO

Today, all the stakeholders of agriculture & production sector agree to the basic principles of organic farming viz., principle of health, principle of ecosystem, principle of fairness and principle of care, but 100% avoidance of fertilizers & pesticides or chemicals in practice and comparative evaluation of integrated farming practices with pure organic farming practices is a real deviation in approach of work. Hence concept may be understood at the macro & micro level.

Organic agriculture conceptually considers ecosystem management approaches to deal with the micro-level problems of pest, diseases & individual farm management (especially shortage of organic manure). So doing organic farming at micro level & considering management of resources through ecosystem approaches is a big contrast in today's organic farming being practiced by farmers in India. In ancient India, whole ecosystem at village or broader level used to have default organic practices but lacked the sufficient scientific intensified crop and resource management technologies. This question needs to be addressed, if we turnout to adopt

organic farming practices at larger level. Further lawful allowance of the use of harmful banned chemicals & spurious chemicals in ecosystems in India or elsewhere is a big challenge to pursue organic farming in real sense at micro level as the harmful chemicals are being poured by non-organic farmers(farmers of traditional agriculture) without any caution. This will affect the organic practitioners who follow principles of organic farming for expanding business at the International market by adopting best regulatory mechanism with dissemination of right information at the level of all stakeholders.

There are scientific evidences that organic agricultural practices help in moisture conservation, increased carbon sequestration and lower emission of greenhouse gases besides improving and maintaining the soil quality and promoting environmental balance.

Today organic farming has become a choice of people and it is growing worldwide. Likewise, many governments of world are increasingly espousing this stream of agriculture. The Government of India, for instance, has implemented many programmes to promote organic farming such as Paramparagat Rashtriya Krishi Vikas Yogna and National Mission on Sustainable Agriculture; Declaration of Sikkim as the first Organic State of the country in January, 2016 etc.

The ICAR Network Project on Organic Farming and National Centre on Organic Farming under Ministry of Agriculture is working for research & development of organic farming across the country and providing various assistance to organic entrepreneurs and farmers.

Organic agriculture is also supportive to the development of entrepreneurship and employment generation in rural and urban areas. There are certain issues and constraints in large scale adoption of organic farming which needs to be understood.

Organic farms and food production systems are quite distinct from conventional farms in terms of nutrient, pest, disease and biodiversity management strategies. Organic systems adopt management options with the primary aim to develop whole farms, like a living organism with balanced growth, in both crops and livestock holding. This concept is land scape specific and cannot be replicated at other places to get the same effects. This is called "Production Syndrome". It is a challenge to prove it as a concept of science.

## SHIFT IN APPROACH AND FUTURE PERSPECTIVES

Scientifically, organic farming supports to mitigation of adverse effects of global warming, promotes ecosystem services and help in building up organic carbon& water holding capacity in longterm. But alternative resources of non-chemical management of nutrients, pest & disease control under sudden environmental changes and issues of advantages of carbon foot prints & healthy food need to be sought out. New generation has a mind-set of mobile, fast response services and high-tech less labour intensive management. In such cases, we need to shift from default or traditional organic agricultural practices to Organic Agriculture Intensification (OAI). OAI includes three main elements (i) closing the exploitable yields gap under traditional and organic agriculture (ii) improving soil quality & environmental sustainability and (iii) precision organic agriculture.

In India, value of export of organic products was USD 298 million which is expected to be 1 billion USD in 2022. The export of organic products is increasing at the rate 20-25 percent per annum. About 3600 retailers, super stockiest, showrooms, malls, 367 private companies and more than 10,000 stores are involved in the business of organic agriculture in India. Presently, 20 lakh hectare area is under certified organic cultivation which is very less in comparison to other countries of world.

Future of organic farming in India is time and space relative. Firstly, the increasing health & environmental awareness among people indicate that people want to buy organic products in want of good health, but at the same time not necessarily with high premium prices. Many farmers and well-to-do people have started organic cultivation on small area sufficient to meet out the family requirement of food especially foodgrains, vegetables & fruits. Secondly, farmers are organising themselves and doing organic cultivation through producers organisations which ensure good economic return, at least better than economic returns received from traditional farming. As the producers organisations will increase in the country, area under organic farming will increase. This will also promote international marketing of organic products. Interest of farmers in participatory guarantee system (PGS) of organic certification is increasing due to almost "No Cost Burden" on farmers. This will enhance the visibility of default and low input organic growers at national & international level.

Fluctuation in market prices, cost of production & availability of labour is a big factor in promotion of organic farming in India in future. This can be overcome by adopting mechanisation at group level and emphasizing on community based resource management practices of soil health, pest & disease management and adoption of business approaches by farmers.

## PRACTICAL CONSIDERATIONS

Life throws up very practical considerations. Food is getting more expensive and strategies are needed to eat well. It may be focused buying certain value products. It may be buying in bulk, scratch cooking or freezing. The food we buy and eat has wider impacts. Food choices are not made in isolation, the wider implications must be considered. Organic is a loose network of associations and assumptions. Consumers are unsure what organic is or why it is better. It is said that whilst it is possible to buy organic, it is difficult to shop organic. Availability of organic products is restricted and ranges are limited. Organic is assumed to be high quality, but the exacting standards are poorly understood, leading to suspicions and questions. Therefore, they struggle to justify the price of organic or buying the category more broadly.

Although, much progress on research in organic farming has been done, the new emerging areas of human health benefits, understanding the economics with environmental markets, climate friendly farms and carbon farming with organic farming system models need to be addressed in future. The certification systems of grower groups, participatory guarantee system, know your farm and know your food should be promoted in large scale.

It is necessary to think that "Can India emulate western countries in adoption and management of standard organic practices" where rules & regulations are strict and consumers are fully aware about their duties & rights? In India, societal obligations and participatory management methods are more successful. We should take into consideration these aspects regarding extent of scale of operations of organic farming in true sense. The concept of bio-village, organic village, organic district and organic state are now finding the place in Indian Society and Market. Because now on, understanding has developed among general population that misuse of chemicals and use of ill-healthy practices are affecting the health of people manifesting as cancer, high blood pressure and sudden outbreak of other Infectious diseases in different ecosystems.

Organic farming world over and in India has gained momentum and area under good agricultural practices is increasing. It is difficult to adopt 100% pure organic farming, adopting all basic principles of organic farming. Presently, there is a need of organic agriculture intensification in which science, technology and market orientation need to be fully integrated in defacto organic areas (hills) and rainfed/dryland regions of the country. It will contribute towards safe food security and climate resilience besides increased income of farm households. This approach will also positively contribute to the cause of human, livestock and ecosystem health, the basic objective of organic agriculture. ■

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# AGRICULTURE EDUCATION

# AGRICULTURE EDUCATION REFORMS IN INDIA

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Agriculture sector has been given the priority status in the Indian economy because directly or indirectly more than 50% of the total work force is employed in this sector. Agriculture contributes about 14% in national GDP and is responsible for about 12% export. Agricultural education provides couple of educational activities with the primary aim of achieving human resource development for the rural economies of nation. India's first green revolution was achieved by increasing about 5 times grain production, 9 times horticultural production, about 9.5 times milk production and 12 times fish production. This was perhaps due to the deep rooted agriculture education in this country. Education should lead to development of skilled human resource, basic research for knowledge generation, applied research for development of technology, system and package of practices and SMART livelihood by integration of Science, Management, Agriculture, Research and Technology tools.

Today we need high quality agricultural graduates equipped with problem solving and creative skills, with the ability to think and improve productivity of agricultural sector. Apart from the technical and generic skills, our graduates need leadership and entrepreneurial skills to build leading teams, and put innovations into practice and respond to competitive environments. There is need to articulate four T's i.e. Tradition, Technology, Talent and Trade to make agriculture an alternative field for livelihood and sustainable development. Traditional means what is our status as far as agriculture is concerned in our country, technology means what is present state of art of devices, system, process and package of practices available indigenously

and internationally. The concept of talent is how to use innovation and creativity among all stakeholders of agriculture to make this profession remunerative and finally there is need to introduce concept of trading in agriculture field i.e. how to federate farmers into business group.

It is observed that education must include knowledge (basics, fundamental, theory, practices,) to know what to do, skill to know how to do, ability to make work simple & convenient, experience for increasing efficiency and finally attitude & resources for doing work in actual. Thus we need updated Syllabus with proper articulation of quality and reform. Quality assurance in higher agricultural education in the country has been achieved through policy support, accreditation, framing of minimum standards for higher agricultural education, academic regulation, personnel policies, review of course curricula and delivery systems, development support for creating/strengthening infrastructure and facilities, improvement of faculty competence and admission of students through All India competitions. As first and most important step for quality improvement of education, the Indian Council of Agricultural Research has been periodically appointing Deans Committees for revision of course curriculum. In the series, recommendation of Fifth Deans Committee had been made considering contemporary challenges for employability of passing out graduates and to adopt a holistic approach for quality assurance in agricultural education and declaring Agriculture as professional degree. The committee

has recommended that in first year Agriculture courses related to traditional, in second year courses related to technology, in third year courses related to increase in talent of students and in final year courses related to trade or federating students into business group should be planned. Further, the Committee has also recommended to introduce ICAR funded 'Student READY programme (Rural Entrepreneurship Awareness Development Yojana) in each UG courses for one complete year period to promote skill development in the graduating students for specialized jobs in view of market needs and demands.

Student READY programme was conceptualized to reorient graduates of Agriculture and allied subjects for ensuring and assuring employability and developing entrepreneurs for emerging knowledge intensive agriculture. The proposal envisages the introduction of the programme in all the Agricultural Universities as an essential prerequisite for the award of degree to ensure hands on experience and practical training by adopting the following components depending on the requirements of respective discipline and local demands. Since Agriculture & its allied disciplines have been declared as Professional degree, therefore there is need to put more practical orientation, and efforts should be made to make our students job providers rather than job seekers. Component of this programme meant for entrepreneurship development is summarized as follows:

- Experiential Learning with business mode
- Rural Agriculture Work Experience
- In Plant Training/ Industrial attachment
- Hands-on training ( HOT) / Skill development training
- Students Projects

All the above mentioned components are interactive and are conceptualized for building skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, quality control, marketing and resolving conflicts, etc. with end to end

approach.

Experiential Learning (EL) helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This is a step forward for "Earn while Learn" concept. The Experiential Learning provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work. ICAR has established more than 426 such units throughout India in different AUs on various components. The main objectives of EL are to promote professional skills and knowledge through meaningful hands on experience, build confidence and to work in project mode and finally to acquire enterprise management capabilities

Hands-on training (HOT) / Skill development training aim to make conditions as realistic as possible. The biggest benefit of hands-on training is the opportunity for repeated practice. Training programs are more beneficial when they provide many opportunities for practicing a skill. The students will be provided such opportunities to become skilled in the identified practices/ methods and gain confidence. The ultimate aim is to make student ready to pursue the learned skills as their career. By participating in hands-on-training programs, the students will be able to strengthen their existing skills while learning new techniques. In university, where experiential learning unit cannot run on business mode,it may impart skill development through available experiential learning unit facilities in repair, maintenance & operations, etc.

The Rural Agricultural Work Experience (RAWE) helps the students primarily to understand the rural situations, status of Agricultural technologies adopted by farmers, prioritize the farmer's problems and to develop skills & attitude of working with farm families for overall development in rural area. This may be Rural Horticulture work. Experience for Horticulture students, Rural Fisheries Work experience for Fisheries students and so on for different streams of Agriculture Sciences.

In Plant Training (IPT)/ Industrial Attachment training, students will have to study a problem in industrial perspective and submit the reports to the university. Such in-plant trainings will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. In-

Plant training is meant to correlate theory and actual practices in the industries with the main objectives to expose the students to Industrial environment, which cannot be simulated in the university, to familiarize with various Materials, Machines, Processes, Products and their applications along with relevant aspects of shop management, to understand the psychology of the workers, and approach to problems along with the practices followed at factory, to understand the scope, functions and job responsibilities in various departments of an organization and finally exposure to various aspects of entrepreneurship during the programme period.

Students' Projects work provide opportunities to students to learn several aspects that cannot be taught in a class room or laboratory. It may be adopted based on the interest of student and expertise and facilities available with the College. It is observed that many students after graduation are interested for higher education, for them it is must to get first hand information related to identification of problems, experimental set up, observations and documentation. The student's projects may bring sense of report writing and research aptitude among graduating students. The Student's Project is proposed with the main objectives to impart analytical skills and capability to work independently, to conceptualize, design and implement the proposed work plan, to learn to work as a team-sharing work amongst a group, and to learn leadership qualities, to solve a problem through all its stages by understanding and applying project management skills, to do various implementations, fabrication, testing and trouble shooting and communication report writing skills.

Number of innovative steps has been taken by ICAR in order to attract talented students and creating visibility of Agriculture Education in India. These are as follows:

- Declaring Agriculture Education as Professional Degree. All degrees in the disciplines of Agricultural Sciences are declared as professional courses.
- Launching of New Agriculture Under graduate Course and syllabus based on Vth Dean's Committee.Courses of Agricultural sciences are designed through integration of Knowledge, Skill, Ability and Experience.

- Articulation of Tradition, Technology, Talent and Trading components in 11 different major group of Agriculture Education.
- Started new program at undergraduate level i.e. Biotechnology, Sericulture, Home Science revised as Community Science and Food Nutrition and Dietetics.
- Starting a new one year program for entrepreneurship leading to 'Student READY (Rural Entrepreneurship Awareness Development Yojana). Components of this programme meant for entrepreneurship development are Experiential Learning with business mode, Hands-on training (HOT) / Skill development training, Rural Agriculture Work Experience, In Plant Training/ Industrial attachment and Students Projects.
- Enhanced from the present Rs 1000 to Rs. 3000 pm/student for six months in student READY scheme.
- Implementation of model act in AU's for Good Governance.
- Celebrating December 23 as Agriculture Education day in every agriculture institute.
- Quality assurance in AUs through National Agriculture Accreditation Board.
- Setting Norms and Standard for Quality education, Rigor in Accreditation Process and Granted Accreditation to 60 SAU's.
- Linking Strengthening and Development Grant with accreditation of university.
- Evaluation & Monitoring for Quality Education for last plan.
- Started unstructured education for farmers, growers, milk men and entrepreneurs for Organic

Farming, Natural Farming and Cow based Economics under Unnet Bharat Abhiyan.

- Initiated Pt. Deen Dayal Upadhyay Unnet Krishi Shiksha Yojana through 100 training centres.
- Established 426 Experiential learning centers for Student READY Scheme.
- Formulation of World Bank sponsored National Agriculture Education Project for enhancing Faculty Competency, attracting Talented Students, creating visibility of Universities among different stakeholders and for Infrastructure Development as per present needs.
- Implementation of revenue generation at AUs through Capacity building, Training, Consultancy, Testing, Certification and Technology outreach approach.
- Development of Centre of Excellence in frontier areas as Information Technology and Artificial Intelligent, Safety, Security and Surveillance of networking, WRRRS and pollution control, Climate Change Mitigation, GIS and Remote Sensing, Nanotechnology, Biotechnology, Food technology and Energy Management and Conservation Technology and Management for Precision, Secondary improved, Speciality, Vertical Development etc.
- Implementation of Green Initiatives as per global needs i.e., Rain water harvesting, Solar Energy Utilisation, Composting, Waste water recycling and e-governance.
- Ranking of Agricultural Universities and initiating Score card for the same.
- Developed DPRs for establishment of colleges by integrating the commendations of Committees on Minimum Standards on Higher Education in terms of faculty strength, land requirement, departments and infrastructure.
- ICAR supports massively for enhancing student amenities through development grants for Student Hostels (Girls hostel), Repairs and renovations to hostels, Instructional Labs, Smart class rooms, Computer and internet facilities, State of art equipments and instruments, Educational museums, Sports and recreational facilities and Digital Library etc.
- Initiated draft bill for establishment of National Council for Higher Agricultural Education.
- Started National Talent Scholarship at PG level at the rate of Rs 3000/- p.m.
- Enhanced National Talent Scholarship at UG level from Rs 1000/- to Rs 2000/- p.m.
- Started Emeritus Professor Scheme on the line of Emeritus Scientists to attract retired Professor to continue in teaching work.
- Processed 9 more CAFT training centers.
- Initiated Extramural Research Projects addressing acute and felt needs to enhance the quality of agricultural education in identified thrust areas

It is expected that Agriculture education in India will produce competent human resource for research and for evergreen revolution in society, for adequate Employment and Entrepreneurship, for inducting World class IT capability in different practices and ultimately for increasing efficiency in inputs & thus higher productivity, enhanced income and environmental protection. Quality education for global competitiveness and creating models to play a key role in 'Digital India', 'Skill India' and 'Make in India' initiatives of Government of India will be the motto of ICAR. ■

# ICT & E-COMMERCE

# UNLOCKING THE POTENTIAL OF REGULATED MARKETS FOR THE FARMERS

Samir Shah
Managing Director &
CEO, NCDEX

Agriculture and allied activities remain the main livelihood option of around half of the Indian population, contributing nearly 15.1% in gross domestic product (GDP) in 2016-17 (at constant prices of 2011-12). Although the focus of the Indian government since Independence had been on improving food production and enhancing food security, the structural economic reforms and stabilization policies introduced in 1991 did not in particular include any specially designed package for the agricultural sector. Impact of the same was visible in the form of a sluggish agricultural growth and rampant farmer suicides.

Two successive drought years followed by the record foodgrains production last year and resultant price shocks forced the government to devise another set of reforms for the agriculture sector, this time focusing on farmers. Recognising that slow growth in agricultural income and rising disparities are the major sources of persistent agrarian distress which has become a serious challenge for the country, the government has made a strategic shift with a developmental mission of doubling farmers' income by 2022.

Management of the output side of the agricultural system remained a great challenge due to its complex, diverse and investment intensive nature. To deal with the same, a newer approach towards strengthening agriculture marketing system is needed where the synergies of different stakeholders are harnessed for the benefit of farmers.

## AGRICULTURE MARKETING: THE RECENT FOCUS OF THE GOVERNMENT

Various research studies show that the income earned from agriculture was not adequate to keep around 53% of farm households out of poverty, who operated on less than 0.63 hectares of land holdings. The low and highly fluctuating farm incomes is not only causing a detrimental effect on the interest in farming and farm investments but also forcing young cultivators to leave farming which can cause a serious adverse effect on the future of agriculture in the country. The level of farm income forms a crucial factor to address agrarian distress.

Indian agriculture is dominated by small and marginal farmers. Small holdings face challenges on economies of scale, integration of value chains, vulnerability to market volatility and other risks. The smaller farm sizes also restrict their bargaining power in both inputs as well as output sides of the market.

## ACCESS TO THE REGULATED MARKET REMAINS THE FULCRUM OF GOVERNMENT'S STRATEGY

Small and marginal farmers often struggle to sell their produce. Many are not linked to

**ANNUAL GROWTH RATE OF FARM INCOME IN INDIA (IN %)**

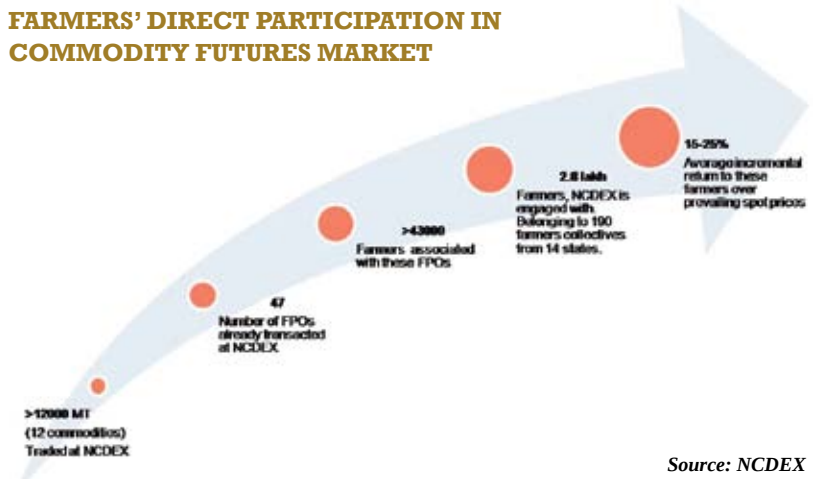
| Period | Agriculture value added at constant prices | Farm income for all farmers | |
|---|---|---|---|
| | | Market price | Real terms |
| 1993-94 to 2004-05 | 2.52 | 8.45 | 3.30 |
| 2004-05 to 2011-12 | 4.19 | 15.03 | 5.52 |
| 2001-12 to 2015-16 | 1.60 | 9.02 | -1.36 |

*Source: Policy Paper, Niti Aayog*

markets for a variety of reasons, such as remoteness, low production, low farm-gate prices, poorly organised markets, and lack of information and marketing know-how. Recognizing the specific need of farmers and addressing the distinct set of barriers they face is of vital importance to the farming economy and the most effective way to improve their income in a sustainable way.

The Government has initiated numerous reforms to bring competition and efficiency in the agricultural market to ensure remunerative prices for producers and reasonable prices for consumers. Reforms such as implementing electronic National Agriculture Market (eNAM), setting up warehouse registry, the Goods and Services Tax Act (GST), proposed new Agricultural Produce and Livestock Marketing (Promotion and Facilitating) Act, 2017 etc. are at different stages of implementation. The success of these reforms would play a crucial role in economic growth of farmers. If implemented efficiently and successfully, these reforms could bring the required push towards improving farmers net take home for their produce.

**FARMERS' DIRECT PARTICIPATION IN COMMODITY FUTURES MARKET**




*Source: NCDEX*

## LINKING FARMERS TO THE MARKET

Strong links to markets for smallholders is essential for increasing agricultural production and generating economic growth in rural areas. Improving these links creates a virtuous circle by boosting productivity, increasing incomes and strengthening food security. Better access by small producers to formal regulated markets means that they can reliably sell more produce at higher prices.

An agriculture market is said to be efficient when farmers earn more and consumers pay less. Commodity exchanges and other electronic markets are designed to enhance competition by connecting the largest number of buyers and sellers in the most cost-effective, transparent and regulated way.

Individual farmers are often not able to participate in the regulated market. Producer companies have emerged as a viable model to help smallholder farmers participate in emerging high-value markets. They integrate smallholders into modern supply networks, minimizing transaction and coordination costs while benefiting from economies of scale. Organization and collective action can help to enhance farmers' competitiveness and increase their advantage in emerging market

**IMPACT OF UNIFIED MARKET PLATFORM (UMP) ON PRICES RECEIVED BY FARMERS**

| Commodity | Price received by farmers | | Per cent increase in 2015-16 over 2013-14 | |
|---|---|---|---|---|
| | 2013-14 | 2015-16 | Nominal | Real^ |
| Tur | 3939 | 7672 | 95 | 16 |
| Urad | 3817 | 7976 | 109 | 12 |
| Copra | 5189 | 9325 | 80 | 43 |
| Turmeric | 5937 | 7931 | 34 | 13 |
| Groundnut | 3398 | 4346 | 28 | 14 |
| Chana | 3057 | 4541 | 49 | 15 |
| Bajra | 1261 | 1419 | 13 | 11 |
| Maize | 1257 | 1356 | 8 | 6 |

*^ Real prices computed after deflating with WPI of the commodity*
*Source: Policy Paper, NitiAayog*

opportunities.

Being the largest agricultural commodity exchange of the country, NCDEX has always been trying to connect to the farming community through innovative product and services. With Farmer Producer Companies and cooperatives emerging as viable aggregation vehicles for small and marginal farmers, both of input and output side, the exchange has been able to connect with them to provide a transparent online platform for them so that they can participate directly, realize better prices and manage their price risk through informed judgement.

In just one and half years of its efforts to provide farmers with an access to a national market, NCDEX has reached out to more than 280,000 farmers belonging to 190 farmer collectives. Further, over 43,000 farmers belonging to 47 FPOs have successfully used the exchange platform to hedge their price risks. They were able to lock in the price of their produce well in advance during the sowing stage of the crop itself. These farmers have realised15-25% higher net price as compared to the prevailing price at the time of harvest. Additionally, the direct access to regulated market helped them save over 3% in transaction costs as compared to costs involved in selling the produce in traditional market.

The higher income of farmers has become possible through a range of multifaceted developmental activities undertaken by NCDEX to upgrade post-harvest practices, build capacity for marketing, disseminate information, and harness innovative bank credit and trade finance mechanisms.

Additionally, lack of credit at the appropriate time, especially during post-harvest stage, makes small and marginal farmers vulnerable to distress sale. The debilitated earnings and adverse terms of trade force them to borrow from the village moneylender for day-to-day needs. Strengthening financial muscle of the farmers are required to break the farmer's dependency on intermediaries, and enabling them access better markets. NCDEX has created an efficient ecosystem to address the credit need of stakeholders. Commodities worth over Rs 800 crore are being pledged annually using NCDEX Comtrack system. So far, over R.s 2,000 crore has been disbursed against 6.4 lakh tonnes of commodities, currently valued at around Rs 3,000 crore. Also, farmers have availed the working capital finances against their produce kept in NCDEX accredited warehouses at a rate 3-6% cheaper than market rates.

Warehousing forms another critical requirement for agricultural

growth and development. Not only this helps in creating time and place utility of agricultural goods but also provides working capital finances against the stored goods. All warehouses have to issue a warehouse receiptas proof of material received and stored with quality and quantity mentioned on it. Soon to be launched warehouse repository – National E-Repository Ltd. (NERL) – will replace the current paper-based receipt system and will keep the records of all warehouses and movement of goods into/from them on real time basis in electronic form which can selectively be provided to all stakeholders concerned.

NCDEX has also been at the forefront of driving reforms in the primary agricultural market. The mandi modernization initiative undertaken by NCDEX e-Markets Limited (NeML) in alliance with the government of Karnataka has been a unique example of public private partnership stepping out for market modernization and development on this front. Rashtriya e-Market Services Limited (ReMS) – a joint venture between Karnataka Government and NeML commenced in January 2014 to focus on modernizing APMC markets by introducing a series of measures, viz. electronic auctions, grading of the produce, direct payment to farmers, global best practices, etc. Furthermore, the new market structure - Unified Market Platform (UMP), has brought in the transparency in price discovery, operational efficiency, cost savings and increase in realizations for the entire ecosystem of farmers, traders, mandis and government agencies in Karnataka.

UMP model of Karnataka has gained accolades and recognition for setting up a benchmark and for being an inspiration for other states. It has bagged a couple of prestigious awards such as the D.L Shah Platinum Award-2016 at 11th National Quality Conclave (NQC) 2016 by the Quality Council of India, and the 'Gems of Digital India Award 2017' for its successful implementation of agricultural market reforms to increase farmer incomes in Karnataka's APMC markets.

Niti Aayog has also recognized the positive impact of online marketing through UMP on the income of farmers. After the introduction of UMP, the model prices in mandis in Karnataka increased at a much higher rate than the increase in the wholesale price of the same commodity in the country. The average realization by farmers has increased by 38% in nominal terms and 13% in real terms (after deflating with WPI of respective commodity) in 2015-16 over 2013-14.

## THE ROAD AHEAD

Agricultural commodity market involves a diverse set of stakeholders in its value chain. An integrated approach is required across the stakeholders to create robust market linkages for farmers.

Moreover, there is a need to link the spot market with derivatives market in order to enable farmers with the freedom to sell across time, grade and location for better price realization. The new proposed Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017 has a provision of notifying warehouses, cold storage and silos as market subyards. There are around 350 plus warehouses approved with the NCDEX. These state of the art warehouses are readily available and are capable of serving as modern electronic spot markets and a critical point of integration. The exchange approved warehouses can be considered as starting point for declaring them as submarket yards which can provide immediate linkage to the stakeholders including farmers.

Introducing more and more commodities on commodity exchanges and introduction of exchange traded Forwards and farmers friendly Options could provide farmers with appropriate tools to get the best price for their produce and manage price risk efficiently. ■

Christophe Jacquet,
Chief Financial Officer,
Axereal-Boortmalt India
Holding Pvt. Ltd

# USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN AGRICULTURAL EXTENSION IN INDIA

## NEED OF ICT IN INDIAN AGRICULTURE

ICT in agriculture is an emerging field focusing on the enhancement of agricultural and rural development in India. It involves application of innovative ways to use Information & Communication Technologies (ICT) in the rural domain. The advancements in ICT can be utilized for providing accurate, timely, relevant information and services to the farmers, thereby facilitating an environment for more remunerative agriculture. Given the development scenario in Indian Agriculture, ICT movement is still evolving. However, all the ICT initiatives are not uniform with disparities between regions in the level and quality of telecommunications, information and the effort of individuals, public and private organizations, and differentiated nature of demand of the farmers in different areas. As a result, there have been many successes, failures, lessons learned and experience gained, so far. While these initiatives are intended to address the needs of the farmers through ICT, their actual usage and their ability to bring significant impact on the farm productivity and socio-economic development of the intended beneficiaries is to be understood. It is relatively unknown as to whether the ultimate beneficiaries actually use the facilities provided for them meaningfully to meet their needs. The common problems in adoption of ICT in rural segments are ICT illiteracy, availability of relevant and localized contents in their own languages, easy and affordable accessibility and other issues such as awareness and willingness for adoption of new technologies among the rural peoples etc. One critical aspect in the usage of ICTs for farmers and their groups, as seen in some of the ICT driven initiatives, is the involvement of human interface at the last mile indicating that there is a human dependency in transmission of

Information/Knowledge to farmers.

Thus, there is a need to understand as to how far the ICT initiatives are able to address the farmers need so that better solutions can be developed to address those unmet needs.

3 important roles which ICT can play are in enhancing agricultural production, improving market access, and capacity building and empowerment.

## • ENHANCING AGRICULTURAL PRODUCTION

Farmers (especially small ones) often face threats from many issues like poor soils, drought, erosion and pests. Key areas where ICT can help improve this is by providing up-to-date information about pest and disease control, early warning systems, new varieties, new ways to optimize production and regulations for quality control.

## • IMPROVING MARKET ACCESS

Providing up-to-date information on the market prices of commodities, inputs and consumer trends. This can improve a farmer's negotiating position and their livelihood, while enabling farmers to make better decisions about future crops and commodities, and also the best time and place to sell and buy goods.

## • CAPACITY-BUILDING AND EMPOWERMENT

ICT technologies can be used to strengthen communities and farmer organizations strengthen their own capacities and better represent their constituencies when negotiating input and output prices, land claims, resource rights and infrastructure projects. Rural communities are able to interact with others via the use of ICT which reduces social isolation that they would otherwise be facing. Besides that, ICT technologies are able to make processes like law-making and land-title approvals more transparent.

## ICT'S POTENTIAL IN AGRICULTURE SECTOR

ICT enables vital information flows by linking rural agricultural communities to the Internet, both in terms of accessing information and providing local content. New information and communication technologies are generating possibilities to solve problems of rural poverty, inequality and giving an opportunity to bridge the gap between information rich and information poor and support sustainable development in rural and agricultural communities. As farming is becoming highly knowledge intensive, commercialized, competitive and globalised against traditional resource based approach, the need to adopt right means to bring in all players of agribusiness, cannot be over emphasized.

Innovations in ICT are of great help in offering a communication platform circumventing all traditional physical barriers and backwardness with its wider reach out and neutrality to social and gender bias; and it's inclusive nature of public and private sectors and its innate strength of offering a reliable, good and cost effective communication platform to various management agencies involved in the extension to and from to the farmers. With these features, ICT will definitely strengthen the current ongoing extension reforms in bridging gaps in access and in bridging rural economy with globalised markets.

Till date, the available Indian ICT public service delivery models in Agriculture sector are very few and are mostly in private sector viz., knowledge centre's of MSSRF), e-Choupal of ITC, Ikisan of Nagarjuna Fertilizers & Chemicals Ltd and Parry's corner. Besides a number of Agribusiness Corporate viz., TAFE, Mahindra and Mahindra and several others are adopting ICT in

their business. The Private sector initiatives are very critical and essential given the strong presence of the corporate in Agriculture sector. In Cooperative sector the often quoted old examples are Dairy Information Services Kiosk (DISK) of NDDB and wired village WARANA. Amongst civil society, GRASSO of West Bengal is pioneering the ICT access in farm sector. Increased realization of rural markets potential has become a driving force for the interest of corporate.

## ITC E-CHAUPAL

Effort driven by a company involved in grain trading

- 4000 Internet chaupals (kiosks) in villages to aid grain procurement, support agriculture
- Grain trading pays for ICT

## GRANT / AID DRIVEN

- M.S. Swaminathan Center (in Pondicherry focused on Agri and fishery applications)
- Tara-haat (focus on rural enterprises)
- Akshaya (in Kerala with Government support)
- Gyaandoot* (in MP with focus on e-governance)
- Rural E-seva* (in east Godavari in AP with focus on e-governance)

## FOR PROFIT INITIATIVES

- Drishtee (uses existing telecom infrastructure)

There are several models of ICTs in Indian agriculture, which have made a significant difference in the delivery of services in Indian agriculture like, the establishments of Kisan call centers, Gyandoot project, Bhoomi project, Village knowledge centers, AGMARKNET etc.


## KISAN CALL CENTERS (KCCS)

KCCs were launched on January 21, 2004 by the Department of Agricultural and Co-operation. The main technologies involved in Kisan call centers are:

- Desktop computer system with Internet connectivity.
- High bandwidth telephone line (preferably 128 kbps ISDN line).
- Telephones with headphones and teleconferencing facility (if required).

The main aim is to deliver the extension services to the farming community in the local languages. The farmer dials the help line, a toll free number, 1551, and the agricultural graduates provide the initial enquiry. If the queries handled by the agriculture graduates are not satisfactory to the farmers or the farmers want more information, the call is forwarded to level II and level III executives.

## VILLAGE KNOWLEDGE CENTERS (VKCS)

Village knowledge centers of MS Swaminathan research foundation were launched in 1998 in Pondicherry. The main aim behind the establishment of VKCs was to

provide sustainable food security in rural areas of Pondicherry. To fulfill this aim, it provides technical information related to agricultural inputs. It helps in procuring quality seeds, in providing information about the daily market priced from the government as well as private bodies, and advices farmers on rotation of crops as well as about the use of fertilizers and pesticides. VKCs receive information by voice mail, and disseminate it through any public address system.

## AGMARKNET

AGMARKNET, (Agricultural Marketing Information Network), is a joint venture of the Directorate of Marketing and Inspection (DMI) and the National Informatics Center (NIC). DMI and NIC are the sponsoring agency of AGMARKNET. It has increased the efficiency in marketing activities by establishing a nation-wide information network, which provides details about market functionaries, sold and unsold stocks, as well as the sources of supply and destination. These timely information data are helpful to producers, traders and consumers.

## ICT INITIATIVE BY AXEREAL TO INDIA FARMERS: SMARTBARLEY

Axereal is bringing smart Barley for Indian Farmers. It was launched at Kisan Kaushal Sangosthi at Sirsa in March 2016. Smart Barley is going to be boon to Indian agriculture. Through more than 40 comprehensive field performance metrics, ranging from yield to irrigation productivity, SmartBarley provides an interactive dashboard that allows growers to anonymously compare their crop practice and

AXEREAL INDIA

outcomes across other growers around the world. Leveraging benchmarking insights to assess regional gaps and opportunities, SmartBarley incorporates a portfolio of technology and management programs aimed at helping farmers improve yield and input efficiency, while also driving the high quality that is key to world class beers. While these programs start with a regional focus, leveraging best practices and shared resources across our global network. SmartBarley is not only delivering improved technologies and practices for barley, but also for other crops produced in rotation by our growers. Improvements facilitated by SmartBarley—such as advancements in nutrition management and soil health or improved irrigation technologies and scheduling—apply not only to barley but to the entire farm production.

There are three pillars of SMARTBARLEY:

### 1. SATELLITE FORECASTING

Utilizing satellite technology for protein and yield prediction, shared through interactive dashboard with growers

- Providing farmers with insights on expected performance
- Improving procurement decisions on coverage and pricing
- Visibility into Bud coverage through higher protein barley

Analysis driven by satellite derived indicators:

- Biomass production (weekly increase of biomass kg per ha);
- Leaf area index (depends on leaves area)
- Deficit of transpiration (per ha)
- Nitrogen in top leaves and N in whole plant (kg per ha)
- Identify correlations between climate, quality, varieties and crop management
- Understand the influences on crop productivity and quality
- Predict and mitigate crop failures – reduce crop losses due to yield and quality
- Direct origination program – move to the best areas for reliability and quality
- Predictive models that allow growers to protect yields and improve quality

### 2. NDVI NITROGEN MANAGEMENT

Yield is an important metric for growers, and maximizing yield while efficiently managing inputs plays an important role in grower profitability and environmental stewardship.

### 3. AGREE MET

SMART barley can help improve water management and reduce water consumption.

Farmers from Haryana, Rajasthan Benefited from SMART Barley. ■

O.P. CHATURVEDI
Director*
ICAR- Central Agroforestry Research Institute, Jhansi

# ROLE OF GEOSPATIAL TECHNOLOGIES IN AGROFORESTRY RESEARCH AND DEVELOPMENTIN INDIA

The applications of spatial technologies enable the storage, management and analysis of large quantities of spatially distributed data. These data are associated with their respective geographic features. For example, in agroforestry the type of tree species and associated crops would be related with a sampling site, represented by a point. Data on existing agroforestry systems and area dwell in might be associated with fields or experimental plots, represented on a map by polygons. The power of GIS lies in its ability to analyze relationship between features and associated data. Satellite images are used to identify what is growing, while GIS component is used to assess area, categorize it and locate its position on earth's surface to provide complete record of the site. Computer based Decision Support Tools (DST) help to integrate information to facilitate the decision making process that directs development, acceptance, adaptation and management aspects in agroforestry. Computer based DSTs include databases, geographic information systems (GIS), models, knowledge-base or expert systems and hybrid decision support systems.

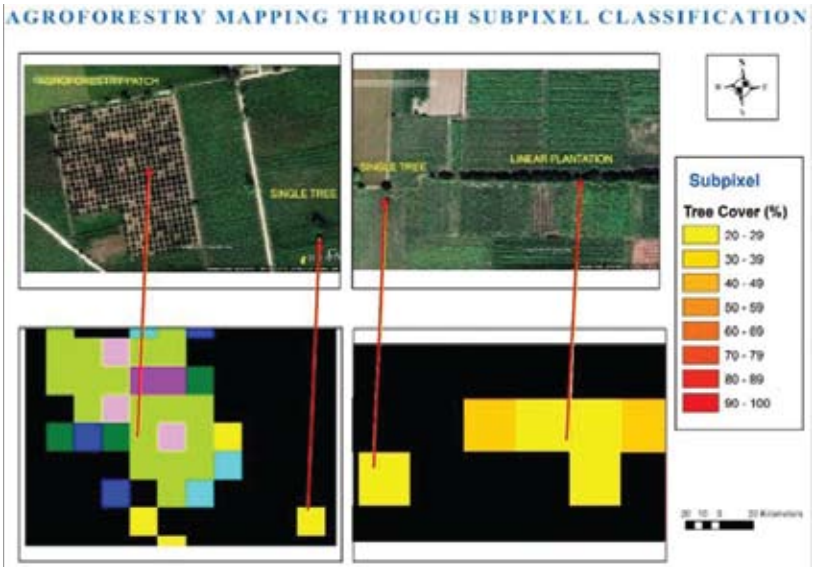
Spatial technologies like, Geographical Information System (GIS), Remote Sensing (RS) and Geographical Positioning System (GPS) have found applications in almost all areas. Natural resources management, biodiversity assessment, watershed planning, disaster management, forest cover mapping, crop acreage estimation, etc. are few of them. The integration of satellite remote sensing data into GIS is one of those great ideas which have made valuable contributions in other fields but need to be utilized in this area. Furthermore, remote sensing is often the most cost effective source of information for updating a GIS and it is a valuable source of current land use/land cover data. In agroforestry, these technologies may be used for mapping agroforestry area, estimation of carbon sequestration, identification of potential areas for suitable agroforestry interventions and more importantly in developing GIS based decision support system.

In India, the diagnostic survey and appraisal of agroforestry practices in the country revealed that there are innumerable practices in different agro-ecological zones. These systems/practices occupy sizeable areas and their accurate assessment is not yet done. Although different estimates at country level are available, they are not realistic as they are not based on ground verification.FSI has given an estimate of 11.15 million ha for

trees outside forest, whereas CAFRI's estimate of area under agroforestry was 17.45 million ha.

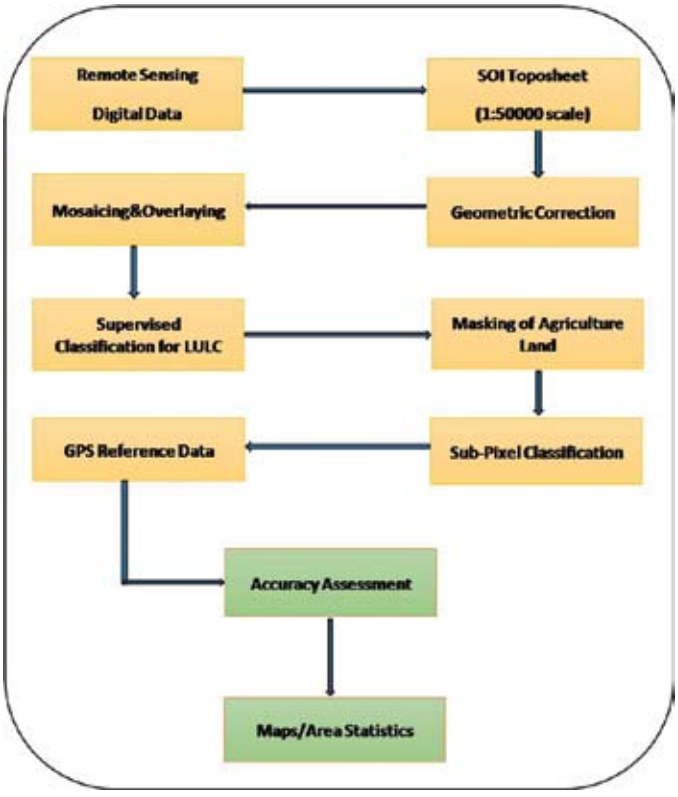
## AGROFORESTRY MAPPING THROUGH REMOTE SENSING

A major problem in estimating area under agroforestry is lack of procedures for delineating the area influenced by trees in a mixed stand of trees and crops. In simultaneous systems the entire area occupied by multi-strata systems such as home gardens, shaded perennial systems and intensive tree-intercropping situations can be listed as agro-forestry. The problem is more difficult in the case of practices such as windbreaks and boundary planting where although trees are planted at wide distance between rows (windbreak) or around agricultural fields (boundary planting), the influence of trees extend over a larger than easily perceivable extent of areas. Different methodologies have been developed for mapping agroforestry. In some, pixel based methods were used with high resolution remote sensing data whereas in others medium resolution data was used. Forest Survey of India (FSI) has used tree inventory and remote sensing technology for mapping trees outside forest, but bund plantations which is a part of agroforestry have not been included.



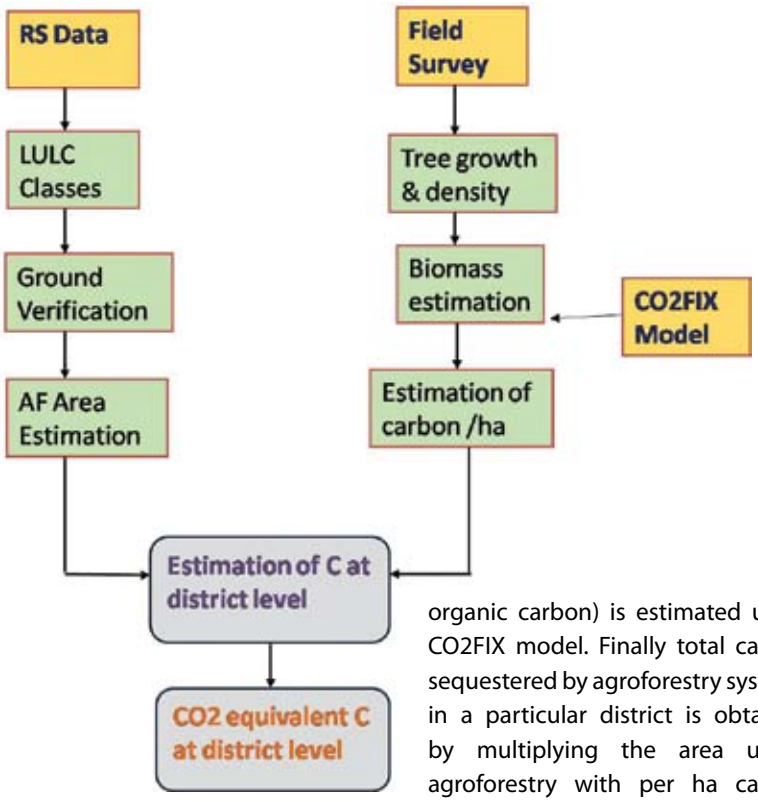

**IDENTIFICATION OF AGROFORESTRY SYSTEMS THROUGH SUBPIXEL CLASSIFIER**

**FLOWCHART SHOWING METHODOLOGY FOR AGROFORESTRY MAPPING**




However, the methodology developed by Central Agroforestry Research Institute, Jhansi (U.P.) may be adopted for mapping and estimating agroforestry area at district level. In this methodology, medium resolution remote sensing data (LISS III, 23.5m) has been used and sub-pixel classifier was applied. Besides, some wrong classification may happen with pixel based methods. Therefore, sub-pixel method of classification was applied on agricultural land because agroforestry exist on agricultural land only. Advantage of using sub-pixel classifier is that this method not only overcomes the problem of intermingling of sugarcane with young plantations, but also gives outcome in the form of per cent tree cover within pixel. This tree cover (20 to 100%) accounts for all types of agroforestry systems viz. scattered trees, boundary plantations and block plantations on farmlands.

## METHODOLOGY FOR ESTIMATING CARBON SEQUESTRATION AT DISTRICT LEVEL




## ASSESSMENT OF CARBON SEQUESTRATION UNDER AGROFORESTRY

Since the intensive survey for existing agroforestry systems at village levels is not possible because it is cumbersome and time consuming. Therefore, integrated approach including remote sensing, field survey and use of carbon/ biomass model may be adopted for assessment of carbon sequestration under agroforestry. Firstly, the area under agroforestry in a district is estimated through remote sensing using the same methodology discussed above. Secondly, field survey is conducted for collection of primary data on existing systems. Thirdly, carbon sequestration by agroforestry systems per hectare (including biomass carbon + soil organic carbon) is estimated using CO2FIX model. Finally total carbon sequestered by agroforestry systems in a particular district is obtained by multiplying the area under agroforestry with per ha carbon sequestration. In this way, we can estimate carbon sequestration under agroforestry systems at regional or country level, which would provide the potential of agroforestry in mitigation of climate change effects.

## FUTURE SCOPE IN AGRO-FORESTRY RESEARCH

In future, geospatial technologies can be applied in biomass/ carbon estimation of established agroforestry systems using high resolution/ hyperspectral remote sensing directly. The temporal pattern of spectral reflectance for agroforestry tree species over different ages or over different phenological stages can also be investigated with the help of hyperspectral remote sensing. Development of Digital Library of Spectral Signatures for major Agroforestry Species/ Systems would help in assessment of area under various agroforestry systems. Agro-climatic regions have different climatic, edaphic and topographic conditions, which may suit for some tree species. Suitable agroforestry interventions may be suggested according to these conditions at district or local level. So, it will be imperative to have Spatial Decision Support System (SDSS), which would help the planners and researchers in development of agroforestry.

Application of GIS and RS technology in agroforestry is so far very limited in India. Although these technologies have great potential in agroforestry research and may be used for estimating system production (biomass/yield), assessment of carbon sequestration, identification of areas suitable for agroforestry intervention, etc. However for these applications, library of spectral signatures, spatial decision support system are pre-requisite. With the advent of hyperspectral remote sensing satellites, not only identification of tree species can be done but tree canopies leaf area index can also be assessed. Besides this tree counts, their heights, canopy structure can also be easily measured with the help of synthetic aperture radar (SAR) microwave remote sensing data. Therefore there is need to develop Spatial Decision Support System (SDSS) for agroforestry development in India, which would help the planners and researchers in identifying suitable agroforestry systems for various agro-climatic regions. ■

***R.H. RIZVI, Principal Scientist and***
***A.K. HANDA, Principal Scientist***
***ICAR- Central Agroforestry Research Institute, Jhansi***

# गुजरात सरकार द्वारा सर्वग्राही कृषि व्यापार नीति ( २०१६-२१ ) घोषित !

कृषि और सहकारिता विभाग,
गुजरात राज्य

विजय रुपानी
मुख्यमंत्री, गुजरात सरकार

## पूंजी निवेश सबसीडी

- कृषि एवं खादय प्रसंस्करण उधोगकी योग्यता प्राप्त लागत का २५% जो अधिकत्तम ५० लाख मील सकती है।
- कोल्ड चेन, फुड रेडीयेशन प्रोसेसींग प्लान्ट और पेक हाउसीस प्लान्ट की योग्यता प्राप्त लागत का २५% जो अधिकतम ५०० लाख तक मील सकती है।
- ग्रामीण क्षेत्रो में प्राथमिक विषय संसाधन केन्द्रों /संग्रह केन्द्रों की योग्यता प्राप्त लागत का २५% जो अधिकतम २५० लाख तक मील सकती है।
- रीफर वेन की योग्यता प्राप्त लागत का २५% , जो ५० लाख तक मील सकती है।

## बैंक एण्डेड ब्याज सबसिडी

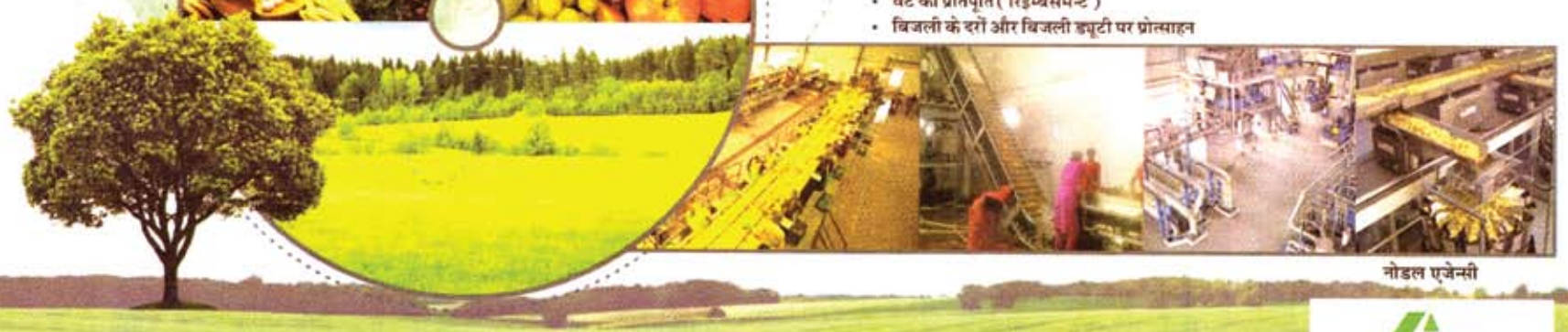
- कृषि एवं खादय प्रसंस्करण उद्योग के लिए ७.५% बैंक एण्डेड ब्याज सहाय अधिकतम १५० लाख तक मील सकती है।
- कृषि एवं खादय आधारित ईनफास्ट्रकचर प्रोजेक्ट के लिए ७.५% बैंक एण्डेड ब्याज सहाय अधिकतम ५००.०० लाख तक मील सकती है।
- अनुसूचित जाति, अनुसूचित जनजाति, शारीरिक रुपसे विकलांग और महिला उधमियों के लिए अतिरिक्त १% ब्याज सहाय।
- युवा उधमियों ( ३५ साल से कम आयु ) के लिए अतिरिक्त १% ब्याज सहाय।

## एर फ्रेट और समुद्री परिवहन सबसिडी

- एर और समुद्री परिवहन सबसिडी, भुगतान किये गए परिवहन शुल्क के प्रतिवर्ष २५% के दर से अधिकतम रुपये १०.०० लाख तक सहाय मील सकति है और जैविक उत्पादनो के लये ४०% दरसे, अधिकतम १५.०० लाख प्रतिवर्ष सहाय मील सकति है।

## अन्य योजनाएँ

- गुणवत्ता प्रमाणन मार्क
- कौशल विकास
- वैट की प्रतिपूर्ति ( रिइम्बर्समैन्ट )
- बिजली के दरों और बिजली ड्यूटी पर प्रोत्साहन



नोडल एजेन्सी

गुजरात एग्रो इंडस्ट्रीज कोर्पोरेशन लिमिटेड
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# AGRICULTURE EXTENSION

# FARMER INCUBATION CENTRE

Amita Sharma, Assistant Professor, Institute of Agri Business Management and B.R. Chhipa, Vice-Chancellor, Swami Keshwanand Rajasthan Agricultural University and Rajasthan University of Veterinary and Animal Sciences, Bikaner

Agricultural education is vastly different from other streams like engineering, medicine, science, arts, commerce etc. It should be more pro-farmer than mere an academic certification. However, students passing out from agriculture colleges rarely do farming and mostly join industries related to farming inputs, thus serving more of industry rather than farmers in real terms. The farmers still look for these industries for their produce which in real terms are getting benefited themselves rather than farmers, making farming the least viable option. In order to make farming economically viable and considering the need for doubling the income of farmers within the next five years as envisaged by our beloved Prime Minister, the advances in agriculture through knowledge, technologies and techniques have to be spread across the farms and farmers. It is thus, the need of the hour to establish the farmer incubation center(s) on the lines of business/ startup incubation centers in other business activities.

Business Incubation Centers (BICs) are the facilitation centers to develop a business idea into full scale operation business in a very short period of time that generally ranges between three months and 24 months. The aspiring incumbents apply to BIC and BIC facilitate the candidate in terms of knowledge, skills, networking, expert advisory and sometimes, finances for starting the business. The mentorship of BIC remains active until business succeeds. In the same manner, Farmer Incubation Centers (FICs) can be conceptualized and opened throughout the country to develop farmers towards professionally managed, effective and efficient farming practices.

The farmer Incumbents (FIs) can be given a land in the university campus to experiment with knowledge and techniques taught or he/she may do it on his/her own land. FI should be able to access the knowledge, tools and techniques through both modes—class room and online. On gaining good amount of practices and standards set by FIC, the FI can be recommended for finances from the banks. The banks can see the record of farming practices through feedback reports. Then the banks will be at ease to finance these FIs.

The conceptual framework of farmer

## THE BUSINESS INCUBATION CENTER SERVICES VS. FARMER INCUBATION CENTER SERVICES

| The Stage of Development | Business Incubation Center Services | Farmer Incubation Center Services |
|---|---|---|
| Pre-Incubation Stage | Idea generation, Idea assessment and Idea validation | The Crop selection according to soil type, capital available, the irrigation and farming system facility availability, other commercial activities being carried out by the farmer, assessment of his or his family's experience in farming, considering marketing scenario of the crop selected. |
| | Training for different purposes | Training on different aspects of farming like seed selection, seed treatment, seeding methods, irrigation and fertilizers management, disease diagnostics knowledge, crop management practices training, harvest management training etc. |
| | Defining Final Business Model | Defining the entire crop selection to reaping harvest programme, preparing cost benefit analysis, preparing a risk management plan to counter the uncertainty in prices, weather conditions etc. |
| | Validating the business model through internal and external evaluation and final shaping of business model | The final draft of farmer incubation with selected crop is then put for evaluation before panel of internal and external committee and preparing final draft of ready-to-go crop programme for execution. |
| Incubation Stage | Access to finances | The capital requirements at each level of crop cycle from seed purchase to crop harvest should be outlined and accordingly, financing requirements and resources should be schematically arranged. The knowledge of various subsidies and financing avenues should be provided and facilitated. |
| | Obtaining legal permissions and physical setup | The farming needs land title clearances especially for financing, making cooperatives, paper work for applying for subsidies etc. Obtaining physical setup like electrification, the pond construction, solar system implanting, irrigation system setup etc. |
| | Education and access to knowledge, mentoring and coaching | The basic training, education and planning to maintain the farming systems, physical infrastructure etc. |
| | Networking, technology access, business basics and marketing skills, Human Resource (HR) training, defining the exit strategy and planning the expansions | The farmer needs market access. The networking and technology can help him find good buyers and hence fair price for his harvest. The basic business and marketing skills, HR training for labor management etc. should be taught. If business takes a downturn, farmer can be guided for safer exit with minimum erosion and if business thrives, helping the farmer in developing expansion plans. |
| Post Incubation Stage | Business diagnostics for identifying gaps and strengths | The farm diagnostics can be put in place after full operational stage of farming. It will help farmer in preparing for the gaps in practices so that he can minimize his operational losses and maximizes outputs. |
| | Marketing and innovation consultancy, clustering and internationalization | The harvest storage, logistics arrangement, packaging training, warehouse management, agriculture residue management, price negotiation, clustering with other farmers and farmers organizations, readying output for industries and exports (e.g. GAP certification consultancy). Developing plans to compete with imports etc. Consultancy for financing the expansions. |

incubation center should be built in the lines of business incubation centers (BIC). The BIC provides services which can be divided into three types-a) Pre-Incubation Stage b) Incubation Stage and c) Post Incubation Stage. According to, blog worldbusinessincubation.wordpress.com, there are about 20 different types of services required to incubate business.

In the pre-incubation stage, the services included are idea generation, idea assessment, idea validation, training for different purposes, defining the final business model, validating the business model through internal and external evaluation and final shaping of business model.

In incubation stage, the business enters into concrete business entity. The incubation services in this stage support the business from early growth to early maturity phase. The services include access to finances, obtaining legal permissions, physical facilities, education and access to knowledge, mentoring and coaching, fund raising, networking, technology access, business basics and marketing skills, human resource training, defining the exit strategy and planning the expansions.

In the post incubation stage, the business reaches an operational level momentum. The services provided by BIC are mainly business diagnostics for identifying gaps and strengths, need of further legal and administrative procedures, marketing and innovation consultancy, clustering and internationalization etc.

These three types of services belong to business incubation center. Similar modeling can be done for farmer incubation center (FIC). The following table draws the outlines of FIC services based on services provided by BIC.

The modes of FIC facilitations should be in both types—online and offline. The online and offline modes will be helpful in reaching the farmers in greater numbers. The FIC should compulsorily operate in vernacular languages so that farmers can comprehensively understand and imbibe. In almost every Panchayat, solar powered community centers are available. These centers can be utilized to create farmer incubation centers.

The universities and educational institutions are craving for funds every now and then. The grants from governments are not sustainable in future. The farmer incubation centers can be profit making centers for mentoring universities and institutions. There is a huge potential of revenue generation with the concept of FICs. The following streams of revenue can be expected from FICs-

1) Registration Fees
2) Sales proceeds from Certified Seeds
3) Fees from Diagnostic and Testing Reports
4) Professional Services Fees
5) Fee based or margin based aggregator services for various activities of harvest management
6) Harvest sales facilitation fees or margin

There can be more revenue streams across the scope of various farming activities. This way, intellectual capital of universities/institutions and the actual beneficiary-the farmer can have close interface and operational level implementation of scientific farming activities.The farmer exigently needs better and scientific practices. Universities engaged in agriculture education needs to make farming more effective, productive and efficient. The Farmer Incubation Center is the interface that brings both farmer and university closer. The extension services provided by agriculture universities and departments can devise the practical framework of developing and implementing FICs.Thus, the farmer and universities can secure and develop their future hand in hand with these FICs. ■

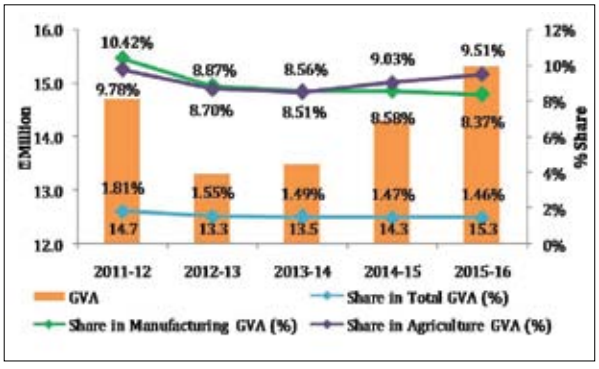
# FOOD PROCESSING

# Indian Food Processing Industry

Over the years agricultural production in India has consistently recorded higher output. India ranks number one in the world in the production of Milk, Ghee, Ginger, Bananas, Guavas, Papayas and Mangoes. Further, India ranks number two in the world in the production of Rice, Wheat and several other vegetables & fruits. Abundant supply of raw materials, increase in demand for food products and incentives offered by the Government has impacted food processing sector positively.

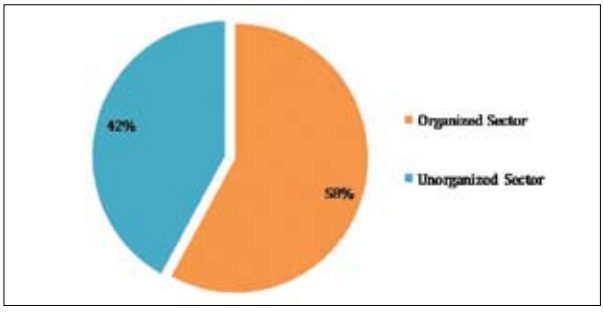
Annual Growth Rate of Food Processing Industries sector during 2015-16 was 7% as compared to around 4.9% in Agriculture and 8.06% in Manufacturing. Food Processing Sector has also emerged as an important segment of the Indian economy in terms of its contribution to GVA, employment and investment. The sector constitutes as much as 8.37% of GVA in Manufacturing and adds 9.51% to the GVA of Agriculture sector.

### CONTRIBUTION OF THE INDIAN FOOD PROCESSING INDUSTRY IN THE COUNTRY'S GVA




*Source: MOFPI Annual Report 2016-17*

### INDIAN FOOD PROCESSING INDUSTRY BY SEGMENTS




*Source: Company Reports*

## INDIAN FOOD PROCESSING INDUSTRY

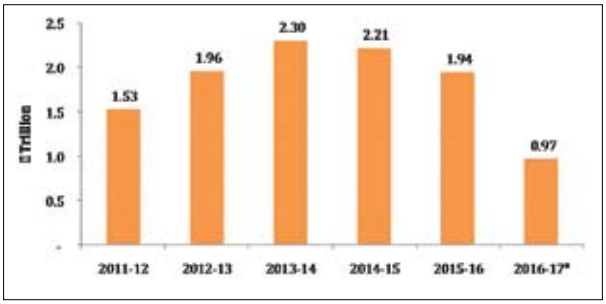
In India, the food sector has emerged as a high-growth and high-profit sector due to its immense potential for value addition, particularly within the food processing industry. The Indian food processing industry accounts for 32% of the country's total food market, one of the largest industries in India and is ranked fifth in terms of production, consumption, export and expected growth. It contributes around 14% of manufacturing Gross Domestic Product (GDP), 13% of India's exports and 6% of total industrial investment.

The unorganized sector accounts for 42% of India's food processing industry. The sizeable presence of small-scale industries points to the sector's role in employment generation. Though the market falls under the unorganized sector in the country, the organized sector has a larger share in the secondary processing segment than the primary one. Rice mills account for the largest share of processing units in the organized sector.

## INDIAN FOOD PROCESSING INDUSTRY – EXPORTS

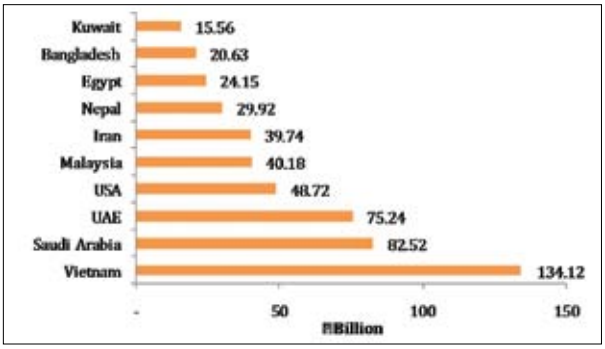
With globalization and increasing trade across the borders

**INDIAN FOOD PROCESSING INDUSTRY EXPORTS**




*Source: MOFPI Annual Report 2016-17*
*Note: 2016-17* - April 2016 to September 2016*

**INDIAN FOOD PROCESSING INDUSTRY EXPORT DESTINATIONS; 2016-17**




*Source: Ministry of Food Processing Industries, APEDA,Ministry of Commerce and Industry and Company Reports*

approximately about 460 mn tonnes of food valued at US$ 3 billion is traded annually. India has thus, a great potential for global trade in agricultural and processed food products. The share of food processing exports in total exports was around 12% in the last few years. During 2011-15, India's exports of processed food related products have been growing at a CAGR of 23.3%.

Accounting for 28.4% of the overall export value of key processed products, animal & related products accounted for the largest value share in 2016-17. However, growth in food product exports has been aided by the significant improvements in product & packaging quality; & greater private sector participation.

India has a location advantage as it is geographically close to key export destinations (Middle East, South East Asia). USA is the top destination for processed products from India, while Vietnam, Saudi Arabia, Iran & UAE are the other major destinations for Indian exports.

## FDI IN INDIAN FOOD PROCESSING INDUSTRY

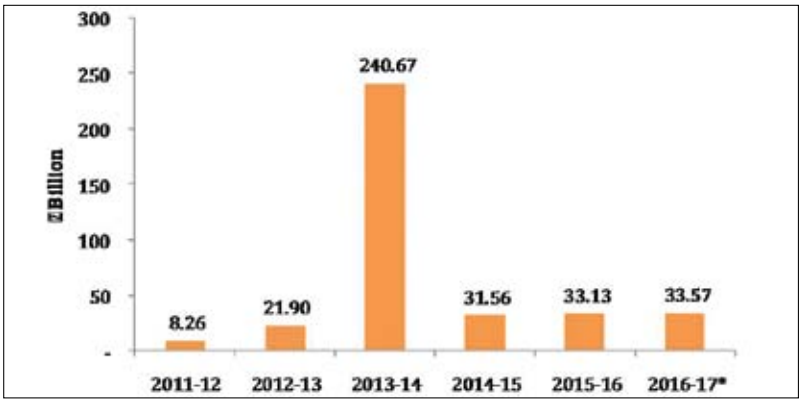
The industry is witnessing significant reforms by the Government of India and several State governments with 100% FDI under government approval route for trading, including e-commerce, in respect of food products manufactured or produced in India; enhanced investment in the food processing sector; proactive steps simplifying 'ease of doing business', delisting of horticulture crops and insurance schemes to support the vulnerable farmers and farm products. These will make the sector more competitive and market oriented.

However, demand growth, supply advantages & policy support have been instrumental in attracting FDI. The government's main focus is on supply-chain related infrastructure, such as cold storage, abattoirs & food parks.Foreign Direct Investment (FDI) equity inflows in FoodProcessing sector in the country during last 6 years and current year is as under.

10 Japanese brands such as Marubeni Corporation, Ise Foods, House Foods Group & Kagome are planning to invest in India to source for raw materials. The Japanese firms are also planning to invest in cold chains & other infrastructure.

Going forward, the adoption of food safety and quality assurance mechanisms such as Total Quality Management (TQM) including ISO 9000, ISO 22000, Hazard Analysis and Critical Control Points (HACCP), Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP) by the food processing industry offers several benefits. It would enable adherence to stringent quality and hygiene norms and thereby protect consumer health, prepare the industry to face global competition, enhance product acceptance by overseas buyers and keep the industry technologically abreast of international best practices.

**INDIAN FOOD PROCESSING INDUSTRY EXPORT DESTINATIONS; 2016-17**




*Source: Ministry of Food Processing Industries, APEDA, Ministry of Commerce and Industry and Company Reports*
*Note: 2016-17* - April 2016 to September 2016*

**Mr. Siraj Chaudhary**
Chairman
Cargill India Pvt. Ltd

# An Integrated Approach to Agriculture & Food processing to drive Equitable and Sustainable Economic Growth

For India, agriculture has always been important in driving the economy. In the years since its independence, India has made immense progress in agriculture and food security. Indian population has tripled, but food-grain production more than quadrupled; there has thus been substantial increase in available foodgrain per capita.

Agricultural sector has been the cornerstone of Indian economy and it accounts for almost 14% of India's gross domestic product (GDP). Agriculture is an important sector, which determines growth and sustainability, and plays a vital role in the development of India, with over 60 percent of the country's population deriving their subsistence from it. Most of the rural population in India depends on agricultural practices for employment and livelihood. Indian economy in agriculture has shown a steady growth in the last two decades. The economy is also experiencing regular changes in its demographics, lifestyle, and domestic consumption. The agriculture industry in India is growing at a great pace and is expected to grow many folds in the near future.

With GDP contribution of 15%, agriculture is a key economic driver in India. India is the second largest producer of food in the world and spends more than a quarter of its expenditure on food and related items. Our agriculture services and agricultural machinery attracted foreign direct investment (FDI) worth US$ 1920.74 million and US$ 449.18 million respectively between April 2000 to March 2017. The Indian food industry is estimated to grow from present US$ 181 billion to US$ 318 billion by 2020. Also, the food processing sector in

India has the potential of attracting US$ 33 billion of investments in 10 years and generating employment for 9 million person days. Between April 2000 & March 2017, FDI in food processing industry in India stood at USD 7542.91 million

Agriculture has the potential for increased productivity and total output gains increase, as crop yields in India are still just 30% to 60% of the yields achievable in the farms of developed as well as other developing countries. Additionally, losses after harvest due to poor infrastructure and unorganized retail cause India to experience some of the highest food losses in the world.

Several studies suggest India could eradicate hunger and malnutrition, and be a major source of food for the world by striking a balance between "calories" and "nutrition" with a focus on better farming practices and adopting protein based crops; developing rail/road infrastructure and cold chains; enhancing the food safety and commercial & regulatory environment and encouraging food processing industry to make alternate crops worthy of consumption.

The reality of agriculture in India is that average age of farmer is going up and over the years, the interest of youth in this sector has been waning as they do not see this sector as a sector of employment by choice owing to inadequate returns. Several reasons have led to lower remuneration in this sector, including rising input costs, prices received being non-commensurate with the market rates, etc.

The prices which a farmer gets for his crop vary from season to season and year to year, resulting in inconsistent income generation. In comparison, wages across various other sectors have gone up. Even the landless labor is not necessarily worse-off, partly due to earnings from MGNREGA, which have gone up over the years. MGNREGA has in-fact reduced migration of labour, as now people have got an earning avenue at their home place itself. This has further aggravated the scarcity of agricultural labour in certain parts of the country and increased the cost of getting labour from outside.

It is indeed an irony that the agriculture sector in India has the highest dependency of population and still continues to face labour shortages. While the latter concern can be mitigated through mechanisation, the bigger concern, however, is to provide alternative employment avenues to the rural youth. Today's youth is highly aspirational and desires better quality of life but has limited means to achieve it. Keeping this in mind, the question arises as to what can be done to enable these youth to meet their aspirations.

One way is to create opportunities in the agriculture supply chain, which extends right from agricultural production to the food retail. Since food is a mass category, the employment potential linked to it is also vast. This however requires urgent skill development.

There is a requirement for food processing industry as the demand for food and agricultural products is changing in unparalleled ways. Higher urbanization, increases in per capita incomes and the growing numbers of women in the workforce engender greater demand for high-value commodities, processed products and ready-prepared foods. A clear trend exists towards diets that include more animal products such as fish, meat and dairy products, which in turn increases the demand for feed grains. There is also a growing use of agricultural products, particularly grains and oil crops, as bio energy production feedstock.

International trade and communications are accelerating

changes in demand, leading to convergence of dietary patterns as well as growing interest in ethnic foods from specific geographical locations. The nature and extent of the changing structure of agri food demand offers unprecedented opportunities for diversification and value addition in agriculture, particularly in developing countries. As a reflection of changing consumer demand, the 1990s witnessed a diversification of production in developing countries into non-traditional fruits and vegetables. The share of developing countries in world trade of non-traditional fruits and vegetables has increased rapidly in the recent past.

If we look back to the period of Green Revolution, it was public extension services along with improved seeds, fertilizers and irrigation which played an important role in increasing productivity and enhancing agricultural development. However, since then, the government's initiatives in agriculture extension services have dried up. Gradually, these agriculture extension practices have been taken up by the private sector like E-Choupal and Saathi, but these have been limited to areas where corporate sector had its own interest. In essence, if such and other innovative initiatives have to be scaled up across India, these would have to be largely led by the Government and Food is one thing which can have no dearth of demand and thus there is a potential for creating self-employment collaborative initiatives through Public Private Partnership (PPP) model.

For agriculture to find value in current times, it needs to be linked to the food industry. The future of jobs in agriculture sector lies not just at the farm, but on how we are able

to convert the produce into food and get the food on to the plate. In other words, jobs could be created anywhere in the value chain that connects the producers with the final consumers. Hence, we need to focus on skilling the people so that they can be employed at any part of this large value chain.

A lot of efforts are being taken with respect to 'Make in India', which also includes skilling people to produce processed food. While we may skill a large number of people in food processing, the absorption capacity of industry to employ them will remain limited and a large chunk of these skilled youth would have to consider entrepreneurship. In this process, we will create many entrepreneurs in food industry but their success and sustenance will depend on how effectively they are able to reach the final consumers.

E-commerce is one of the ways through which the producer can reach the final consumer bypassing all the intermediaries. There are enormous employment opportunities here which can be leveraged through appropriate skilling. For instance, a large number of food start-ups that are being set up need delivery boys. This in turn creates space for skilling local people for becoming drivers, and enables creation of decent livelihood opportunities. We need to take such leaps through vocational training to move ahead in job creation.

Given the consumer base of our country, food is one thing which has no dearth of demand and thus there is a vast potential for creating self-employment in this sector and making agriculture remunerative for farmers. Recent concepts such as Food Streets can be a platform in creating large scale employment. However, such concepts will only be successful if the role of food safety and quality control is well designed and in place. If we look holistically at creating employment across the entire food value chain, we have to expand the skill development initiatives beyond the food processing skills.

The role of food processing industry becomes extremely critical considering the immense and immediate challenge of feeding nutritional food to the over billion population of India. Over the past decade, India's unsatisfactory progress in health and nutrition improvement has been in stark contrast to unprecedented levels of GDP growth and poverty reduction. For example, the National Family Health Survey, showed that at the current rate of progress, India will not reach its millennium development goal target—to halve the proportion of underweight children by 2015—until 2043.

Therefore, an integrated approach to agriculture and food processing can not only be a provider of high quality, safe food for end-consumption, but be a growth catalyst in our economy through employment generation, providing a fillip to the agriculture industry and attracting capital.

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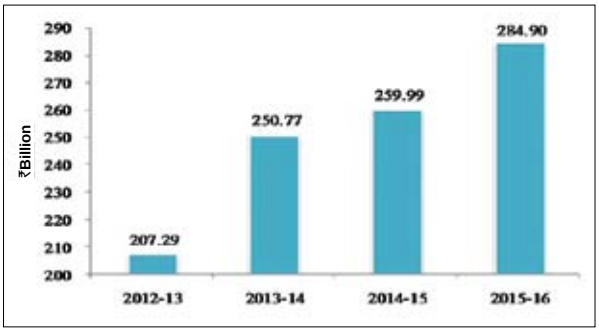
# Indian Plant Protection Market Overview

India is the fourth largest global producer of agro-chemicals after the U.S., Japan and China. This segment generated a value of Rs. 279.27 billion in 2015-16, increasing at a CAGR of 8.28%.

2015-16 has been a challenging year for crop protection chemicals market in India. As per Economic survey of India, agriculture sector has grown by 1.1% in 2015-16. The country faced weak monsoons with rainfall falling 12% short of expectations. A number of states were affected by drought like conditions especially during the Kharif season. 2015-16 has been a stagnant year for Indian crop protection industry.

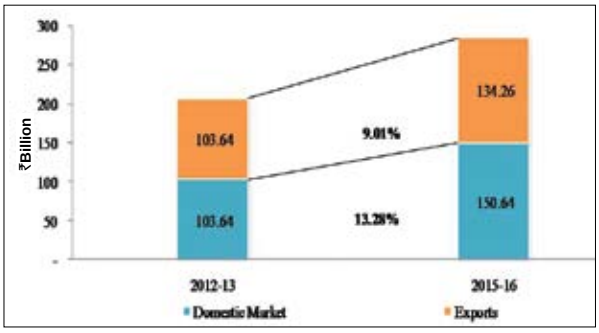
Approximately 50% of the demand comes from domestic consumers while the rest goes towards exports. The domestic demand is expected to grow at 6.5% per annum and exports are estimated to grow at 9% per annum during the same period.

**INDIAN PLANT PROTECTION MARKET**




*Source: FICCI, Tata Strategic Management Consultants and ICFA*

**INDIAN PLANT PROTECTION MARKET BY CONSUMPTION PATTERN**




*Source: FICCI, Tata Strategic Management Consultants*

## INDIAN PLANT PROTECTION MARKET BY SEGMENTS

The Indian plant protection market can be categorized into insecticides, herbicides, fungicides and others, which includes bio-pesticides.

The market is dominated by insecticides, which form almost 60% of domestic plant protection chemicals market. The major applications are found in rice and cotton crops. Fungicides and herbicides are the largest growing segments accounting for 18% and 16% respectively of total plant protection chemicals market.

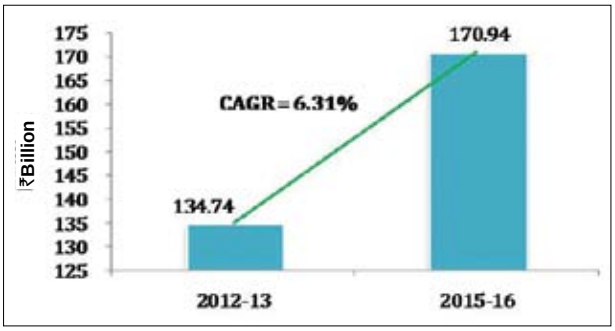
As the weeds grow in damp and warm weather and die in cold seasons, the sale of herbicides is seasonal. Rice and wheat crops are the major application areas for herbicides. Labor shortage, rising labor costs and growth in GM crops has led to growth in the use of herbicides. The herbicide consumption in India stands at Rs.26.20 billion in 2015 and is expected to grow at a CAGR of 15% during 2015-2020.

On the other hand, the fungicide industry in India has grown due to the growth in Indian horticulture industry, which has grown at a CAGR of approximately 7.5% over the last five years. The fungicides find application in fruits, vegetables and rice. The key growth drivers for fungicides include a shift in agriculture from cash crops to fruits and vegetables, and government support for exports of fruits and vegetables.

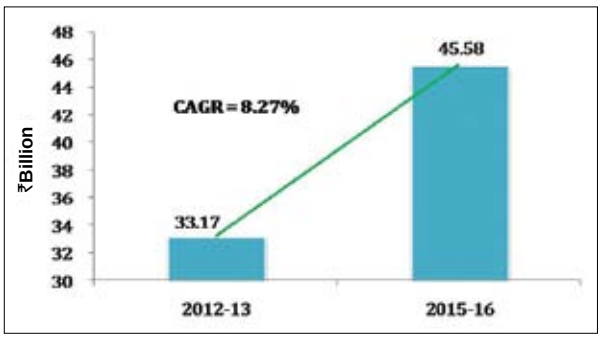
Bio-pesticides include all biological materials and organisms, which can be used to control pests. Currently bio-pesticides constitute only 3% of the Indian plant protection market; however there are significant growth opportunities for this product segment due to increasing concerns of safety and toxicity of pesticides, stringent regulations and government support.

Andhra Pradesh (including Telangana & Seemandhra),

**INDIAN INSECTICIDE MARKET**

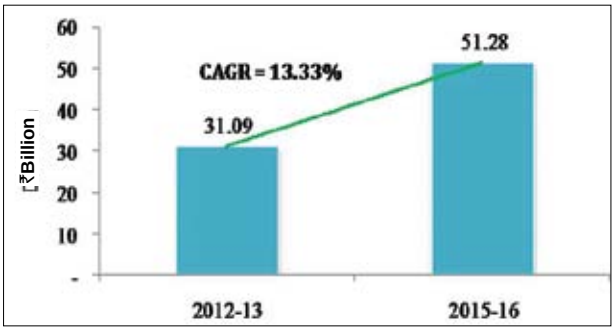



**INDIAN HERBICIDE MARKET**

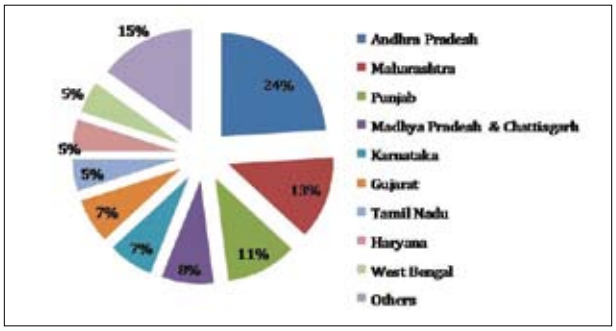



*Source: FICCI, Tata Strategic Management Consultants*

**INDIAN FUNGICIDE MARKET**




**INDIAN STATE – WISE PLANT PROTECTION MARKET; 2015**




*Source: FICCI, Tata Strategic Management Consultants*

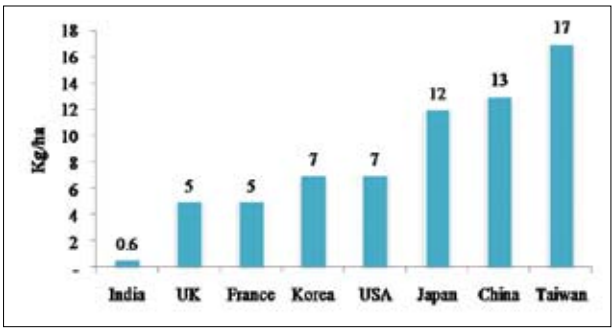
Maharashtra and Punjab are the top three states contributing to 45% of consumption of plant protection products in India. Andhra Pradesh is the leading consumer with 24% share. The top seven states together account for more than 70% of plant protection chemicals usage in India.

## GLOBAL AND INDIAN SCENARIO

The per hectare consumption of pesticides in India is amongst the lowest in the world and currently stands at 0.6 kg/ha against 5-7 kg/ha in the UK and at almost 20 times ~ 13 kg/ha in China . In order to increase yield and ensure food security for its enormous population agrochemicals penetration in India is bound to go up.

The export of pesticides from India has seen a strong growth over the last few years. Globally, India is the thirteenth largest exporter of pesticides. Most of the exports are off-patent products. The major exports from India happen to Brazil, USA, France and Netherlands. The key growth drivers are India's capability in low cost manufacturing, availability of technically trained manpower, seasonal domestic demand, overcapacity, better price realization globally and strong presence in generic pesticide manufacturing.

**PLANT PROTECTION CHEMICALS CONSUMPTION COMPARISON; 2015**




*Source: FICCI, Tata Strategic Management Consultants*

The plant protection industry is expected to grow at a significant CAGR during 2015-2020 as a facilitator of the Indian agricultural sector. The opportunities for the Indian plant protection industry will come from exports, higher production of generic products, product portfolio expansion, and growth in herbicides and fungicides. In coming years, the need for safe and effective use of plant protection chemicals will increase to brace with larger climatic variations and emergence of new invasive insects, weeds and diseases. Hence, it is important for companies to invest in science and practices which promote safe and judicious use of plant chemicals. ■

# BIOSTIMULANT AND BIONUTRITION IN AGRICULTURE

Roger Tripathi, President of Acadian Plant Health™ Division, Acadian Seaplants Limited, Canada

Biostimulant products are the fast-emerging category of agricultural inputs that help growers, the world over, deal with the most difficult challenges arising from climate change. Weather-related, abiotic stresses cause more damage to crops than biotic stresses caused by insects and disease.

Bio-stimulants improve soil health, help plants overcome abiotic and biotic stresses and help farmers grow more and better crops. Biostimulants are neither macronutrient fertilizers, nor are they crop protection products. Many of them are of natural origin and are becoming vital components of progressive growers' integrated crop solution programs. Their application, in addition to conventional crop protection products and synthetic fertilizers, improves the effectiveness of the growers' overall crop solution program. Biostimulants, as a category, are gaining recognition for contributing to increased crop yields, enhanced nutrient uptake efficiency, reduced losses due to environment stresses and increased growers' return on investment in a sustainable manner.

Biostimulants are generally acid based, extract based or microbial. Amino acids, fulvic acids and humic acids are most prominent, but with a slowdown in innovation, the global share of acids is decreasing. Innovation in extracts, derived mainly from seaweed, are gaining popularity, and their global market share is growing substantially. Other products,

such as microbial products are also gaining ground, but their share remains less significant.

The global biostimulants market is rapidly growing and at present is valued at approximately US$1.8 billion. Future Market Insights (FMI) in their report titled, "Biostimulants Market: Global Industry Analysis and Opportunity Assessment 2015-2025" estimates that seaweed-based biostimulants capture about 35% of the biostimulant market and they expect the sector to grow to US$4.1 billion by 2025. This segment is growing at about 11% per year.

There are more than 10,000 species of seaweed, but *Ascophyllum nodosum* is the most important and widely researched species for agriculture because of its unique biochemical composition. *Ascophyllum* thrives in the cold, clean, inter-tidal waters of the North Atlantic Ocean and through evolution has developed its own stress-fighting compounds.

Acadian BioSwitch™ technology liberates unique bioactive compounds present in *Ascophyllum nodosum*, the most beneficial seaweed for use in agriculture. This process also creates many new bioactive compounds that further enrich the final product. As thousands of field trials have proven, Acadian BioSwitch™ technology enhances natural processes within plants by switching on gene expression and production of active compounds that stimulate plant growth and protect against stresses. It helps crops overcome today's most critical growing challenges such as drought, chill, heat and salinity. The results are reduced risk, improved crop quality and maximum yield for a greater return on investment.

Growers need to know that the products they use on their crops are going to deliver superior performance after every application, year after year. Partnering with the National Research Council of Canada, Acadian Plant Health™ identified a 'biochemical fingerprint' for its products using nuclear magnetic resonance (NMR) technology. This fingerprint allows to easily distinguish our products from others and prove that they are biochemically unique and consistent.

At present, the Indian market is saturated with low-quality biostimulant products, many of which are derived from other seaweed species – not from *Ascophyllum*. Still, the Indian biostimulant industry is growing and there is an ever-increasing demand for high quality, innovative and sustainable technologies that are safe for the environment.

Biostimulants' reputation for contributing to soil health, mitigation of abiotic stress, improvements in yield, efficiency of nutrient and water uptake continues to gain global recognition in integrated agriculture. They can significantly contribute towards better yield and can play a significant role in doubling farmers' income by 2022.

# ANAND AGRICULTURAL UNIVERSITY

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Dr. N.C. PATEL
Vice Chancellor, AAU

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- Search of new frontiers of Agricultural Sciences
- Development of excellence in human resources and innovative technologies
- Service to farming community

**Foreign Collaboration**

- MoU with Lund University, Sweden for exchange of students and joint teaching & research activities
- University of Alberta, Canada for student and faculty exchange
- University of Copenhagen, Denmark for student and faculty exchange

**MoUs UNDER APPROVAL**

- Florida Agricultural and Mechanical University, USA for co-operative research and student and faculty exchange.

## { COURSES OFFERED }

### UNDER GRADUATE

- B.Sc (Hons) Agri. - 8 Semesters
- B.Sc (Hons) Horti. - 8 Semesters
- B.Tech (DT) - 8 Semesters
- B.Tech (Agri. Engg) - 8 Semesters
- B.Tech (FT) - 8 Semesters
- B.Tech (AIT) - 8 Semesters
- B.V.Sc & A.H. - 5½ Years

### POST GRADUATE

- M.Sc. (Agri) - 4 Semesters
- M.Sc. (Horti) - 4 Semesters
- M.Sc. (Agri.Mkt./Agril.Jour) - 4 Semesters (Distance Mode)
- M.Tech (Agri Engg) - 4 Semesters
- M.Tech - 4 Semesters
- M.Tech (FT) - 4 Semesters
- M.V.Sc. - 4 Semesters
- M.B.A. - 4 Semesters • Ph.D. - 6 Semesters

## POLYTECHNIC COURSES

- Polytechnic in Agri, Anand and Vaso • Polytechnic in Agri. Engg, Dahod
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- Polytechnic in Horticulture, Vadodara

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