AGRICULTURE TODAY
The National Agriculture Magazine

AGRICULTURE YEAR BOOK 2019

YEARBOOK2019

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EDITORIAL NOTE

Dear Readers,

With immense pleasure and pride, we introduce our most recent edition of the Agriculture Year Book. This edition is the fruit of the hard work and untiring efforts of a spectacular team, whose inspiration has always been our dedicated readers.

Agriculture Year Book of 2019 features articles penned down by the some of the brightest minds in Indian agriculture. These articles have evolved from years of experience and are treasure trove of information for anyone who follows agriculture segment. Innovations, initiatives and plan of action to solve the trying challenges in agriculture are important takeaways from this repertoire of articles. The year book 2019, besides featuring some of the best articles written pertaining to agriculture, 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 as 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 am thankful to Dr. MJ Khan for guiding us throughout the entire process of compilation and bringing out the best in us. My colleagues specifically Mr. Anil Kumar, Ms. Divya Sharma and Mr. Abdul Rehman deserve special mention whose untiring efforts in compiling the Agriculture Year Book 2019 were exemplary.

Anjana Nair

CONTENTS

AGRICULTURE YEAR BOOK 2019






Inspired by Science

Discovering the balance of producing more from less.

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AGRICULTURE DATA & ANALYSIS

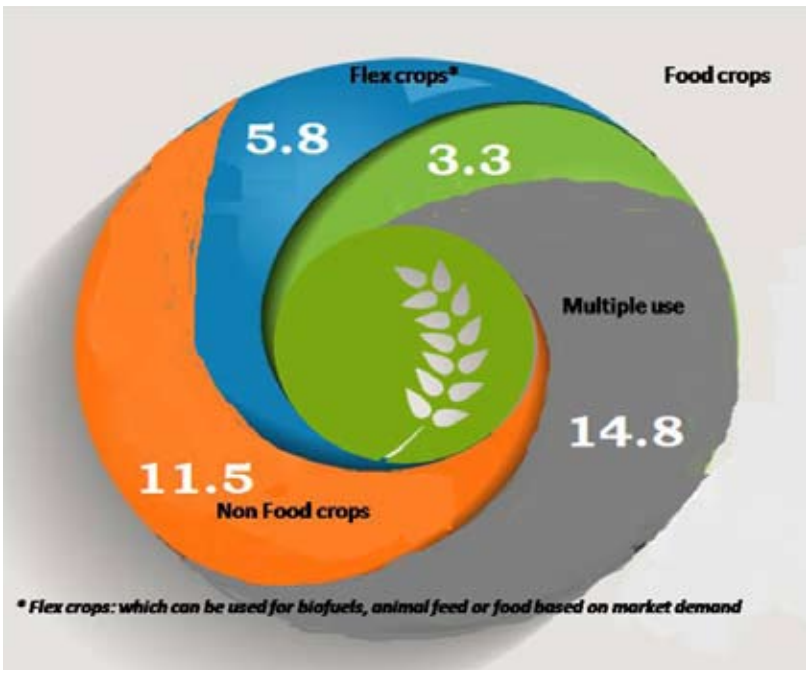
GLOBAL AGRICULTURE SCENARIO

As of May 2016, the world accounted to a total agricultural land area of 35 million hectares which has been acquired by various private agricultural companies across the world. While a very small part (3.3 million ha) of this total land is being used for food crop production, a larger part of it is actually used for multiple (14.8 million ha) use or for growing non food crops (11.5 million ha) which usually fetches better price than food crops. A considerable portion of 5.8 million ha is devoted to growing of flex crops, which have diversified commercial agriculture. In an overall basis, currently about 11 % or 1.5 billion ha of the worlds land surface of 13.4 billion ha is used in crop production. This mainly includes arable land and land under permanent crops. This area represents slightly over a third or precisely 36% of the land estimated to be to some degree suitable for crop production.

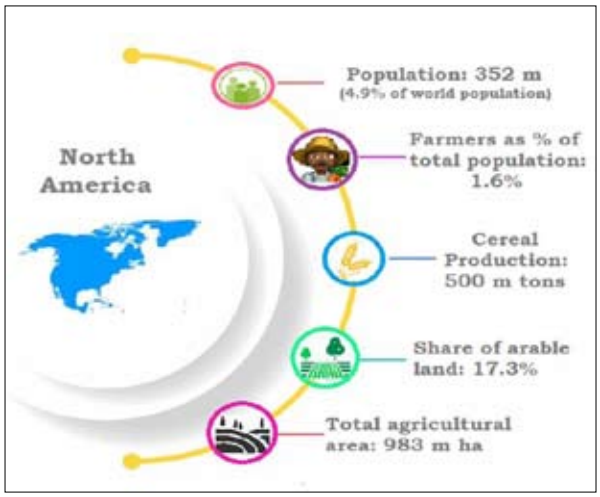
It is interesting to note the pattern of the average farm size across different regions of the world. While the average farm size ranges from 186 ha to 50.7 ha to 14.7 ha across North America, South America and Europe respectively, it is getting smaller in regions like Asia and Sub Saharan Africa although majority of the world's farmers live in these two regions. In these two regions, the average farm size is just over 1 ha indicating a large number of small hold farmers.

North America which houses 353 million people produces 500 million

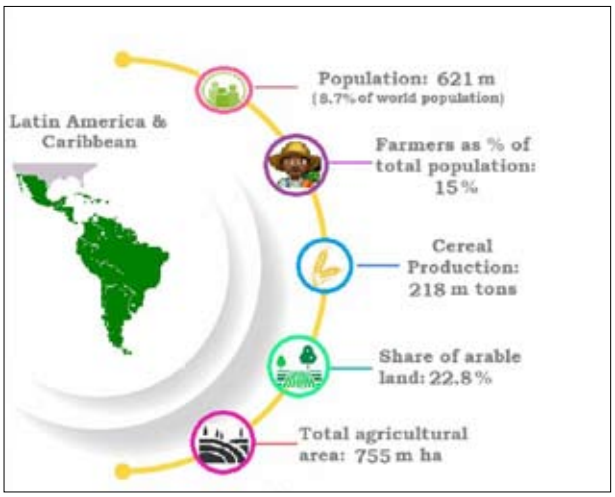
Global Land Use Pattern for Agricultural Land Owned by Agribusiness Companies (million hectares)



Agriculture Production Scenario in North America



Agriculture Production Scenario in Latin America & Caribbean



tonnes of cereals from a total agricultural land area of 983 million hectares. The percentage of farming population in this region is just 1.6% of its total population and the share of arable land is 17.3% of its total land area. Similarly, the Latin American and the Caribbean region where 8.7% of the world population (621 million) live produce 218 million tonnes of cereals from a total agricultural area of 755 million hectares and 22.8% of the arable land.

On the other hand Europe, which hosts 750 million people produces 485 million tonnes of cereals from a total agricultural land area of 473 million hectares. The percentage of farming population in this region is 5.5% of its total population and the share of arable land is 473 million hectares which is 58.8% of its total land area. Close by, the Sub Saharan African region produces 120 million tonnes of cereals, although this region has 54.5% of its total population as farmers. The share of arable land is 22.5% (843 million hectares).

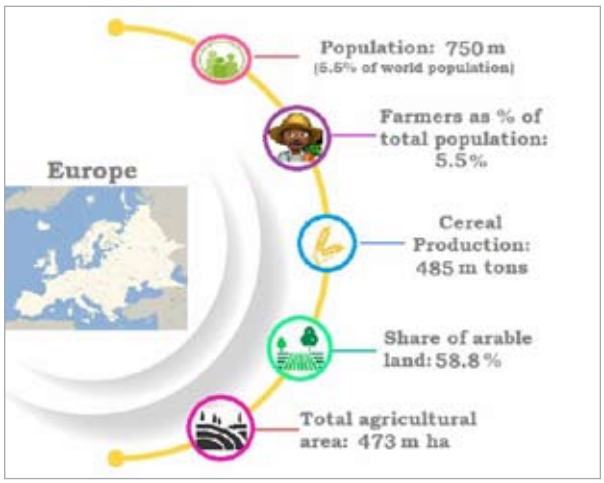
East and South East Asia and the pacific, which also contains agriculturally important and large countries like India and China is home to 52% of the global population (3709 million). This region produces 1009 million tonnes of cereals by a farming population which is almost 47% of its total population. The share of arable land in this region is 29.1% at 1374 million hectares. The Central, West Asia and North Africa produce 173 million tonnes of cereals from a total agricultural area of 983 million hectares.

It is also important to study the participation of women in agriculture across the world. In the backdrop of the Sustainable Development Goals, the world is increasingly recognizing the importance of women participation in various economic activities. Considering the indispensible role of the agriculture sector as an economic activity sustaining the human race, women farmers hold the key to future food security and sustainable agriculture. It is important to note that as one travels from the least developed across the developing to the developed nations, one finds a varying trend in the participation of women farmers who are also the land holders. Europe has the highest percentage of women farmers (24%) whereas the Middle East and North African region have the lowest, with just 4% of the

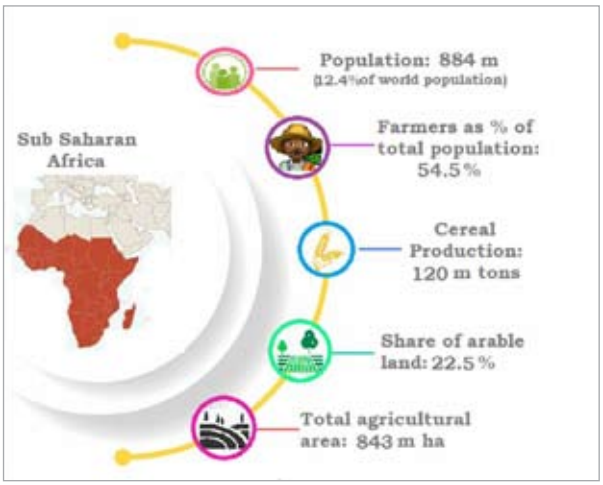
Average Farm Size (in Hectares) in Different Geographies of the World

Source: FAOSTAT

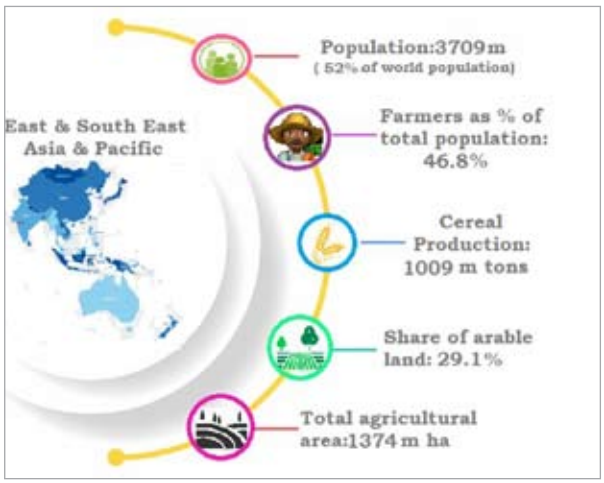
Agriculture Production Scenario in Europe



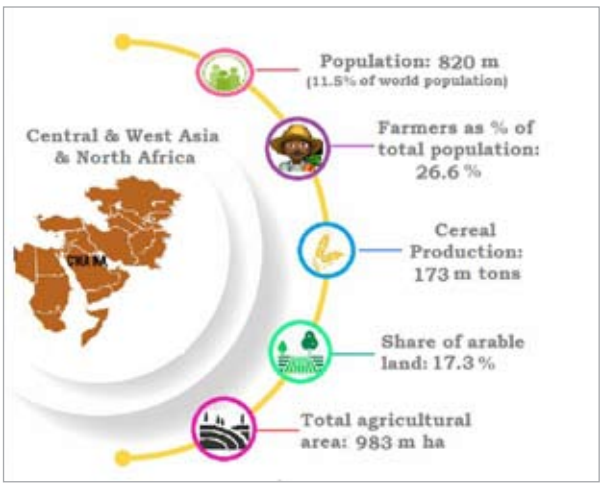
Agriculture Production Scenario in Sub Saharan Africa



Agriculture Production Scenario in East and South East Asia and Pacific



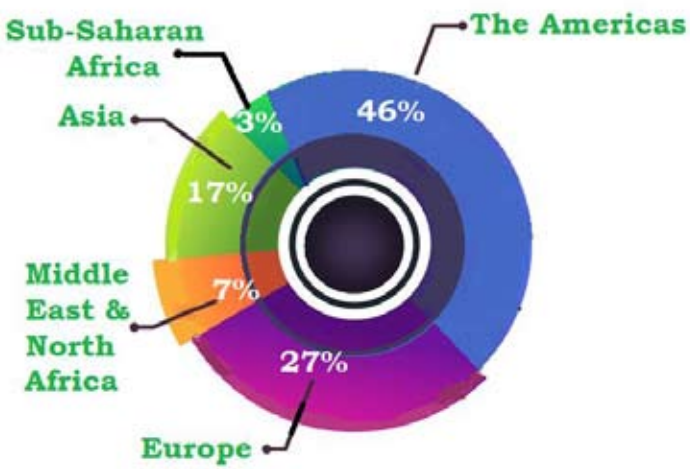
Agriculture Production Scenario in Central and West Asia and North Africa



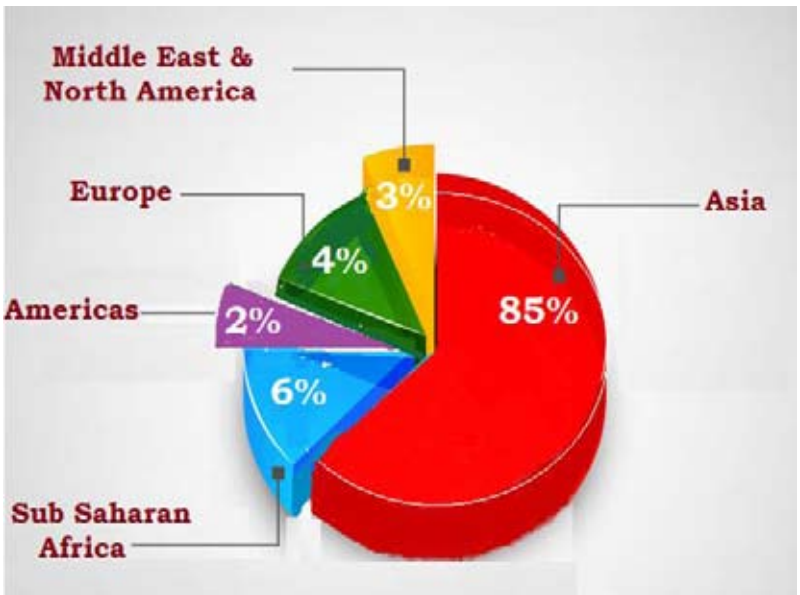
farming population as women farmers. The Sub Saharan African region, although has many of the under developed countries, has comparatively more percentage of women farmers (14%).

Global agriculture is marked by small-scale diversified farming. While productivity increases may be achieved faster in high input, large scale, specialized farming systems, greatest scope for improving livelihood and equity exist in small-scale, diversified production systems in developing countries. This small-scale farming sector is highly resilient, dynamic, and has been responding readily to changes in natural and socio-economic conditions. They are more adaptable to changes in their crop production portfolio, and specifically to increased demand by increasing aggregate farm output. Sub Saharan African region has the least number (3%) of the farms which are

Percentage of Farms Size over 10 Hectares across Different Regions of the World



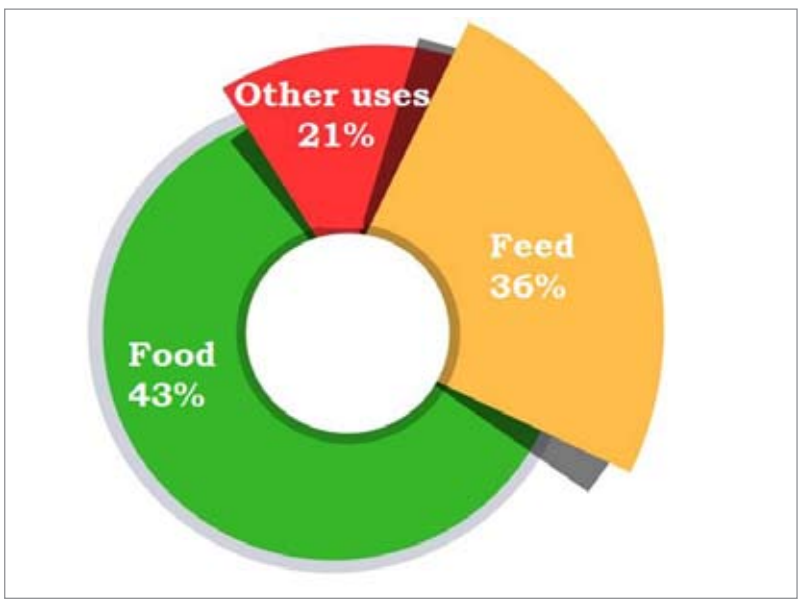
Percentage of Farms Size Lower Than 10 Hectares across Different Regions of the World



Source: FAO

more than 10 hectares, while the Middle East and Sub Saharan Africa has 7% farms of this nature. The Americas has the highest percentage of large farm size (46%) followed by Europe (27%) and Asia (17%). Comparatively higher percentage of large farm size in particularly in Asia is perhaps also an indication of a contrasting situation.

Utilization pattern of Cereals Produced Globally



Source: FAO

While there are a considerable number of small hold farmers in Asia, it also shows that large farms do exist indicating the existence of a wide disparity between large and small farmers. In general, the large-scale industrialization of agriculture in North and South America, Australia and Europe and the "Green Revolution" in Asia have led to impressive successes in increasing productivity and rationalization over the past fifty years. The increase in global agricultural production has outstripped population growth. However, the one-sided focus on productivity of industrial agriculture exploits the available natural resources of our planet to an untenable and unsustainable extent. The basic strategy to replace human labour with farm machinery, agrochemicals and fossil energy was fine all these years, but now stares at an impasse in times of climate change, dwindling oil reserves and overexploited natural resources.

Let us take a quick look at the ultimate pattern of use of the global cereal production. Farmers across the globe produce 4,600 kilocalories per capita per day on global average. Shockingly, only 2,000 are finally available for household consumption. Harvest losses, the conversion from cereals and oilseeds to meat (or in simple terms use of cereals as feed), distribution losses and food wastage eat up the calories in between. In the rich societies where food is merrily wasted on a huge scale, these global average values acquire extreme forms of food waste. In addition, an increasing share of arable land is not used anymore for feed and food production but for fuel, energy and fiber production. In short, only 46% of the global cereal production is ultimately available for human consumption, whereas 36% us used as animal feed and 21% is put to other uses. ■

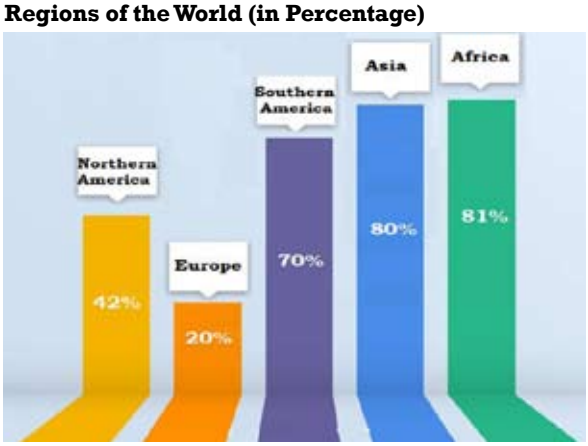
CLIMATE CHANGE AND AGRICULTURE

We human beings are the causative agents for Climate Change and as a consequence of our actions, we are exposing our future generations to a vulnerable situation. Agriculture is unavoidable to feed the mammoth human population. It is paradoxical that agriculture is facing the biggest threat from climate change and at the same time, it also one of the causative factors of climate change. Agriculture is by far the largest consumer of the Earth's available freshwater with 70% of water withdrawals from water sources and groundwater. The consumption of water currently is three times more than 50 years ago, and it has been projected that by 2050, the global water demand of agriculture is estimated to increase by a further 19% due to increased need for irrigation. This withdrawal of water by agriculture sector shows a wide degree of variations across different regions of the globe. This sector in Asia and Africa withdraws 80% and 81% water. In regions like Northern America (42% water withdrawal) and Europe (20% withdrawal), where agriculture sector consumes comparatively less water, industry sector consumes the major share of water leaving ever decreasing amount of water for human consumption. Within the Asian region, agriculture operations in South East Asia consume more than 90% water. In regions like these which is usually marked by densely populated areas, agriculture production during the past decades have resulted mainly because of huge investments in additional irrigation systems. In general, across the globe, irrigation provides around 40 percent of the world's food from just 20 percent of the cultivated area or 325 million hectares globally.

All this has resulted in a very less portion of water being available for human consumption, the least in Asia with just 8% water availability for municipal consumption. Europe, Northern and Southern America and Africa are currently left with 22%, 18% and 14% of water respectively for municipal use.

To understand the significance of judicious application of fresh water, it is worthwhile to study how water is used or lost and also viewing the total available water on the earth in terms of Green Water and Blue Water. Main source of replenishment of water is through rain. Of the total rain water being received on the Earth, about 60% is lost in the form of evaporation losses and this is what is called as the Green Water. The remaining 40% of available rainwater is termed as the Blue Water which ultimately flows into rivers, lakes, ground water, forms glaciers etc. It is 70% of this blue water that is being consumed by the agriculture sector, with a meagre 9% remaining available for human use on an average scale across the world.

Withdrawal of Water by Agri Sector in Different Regions of the World (in Percentage)



Availability of Water for Municipal Use in Different Regions of the World (in Percentage)

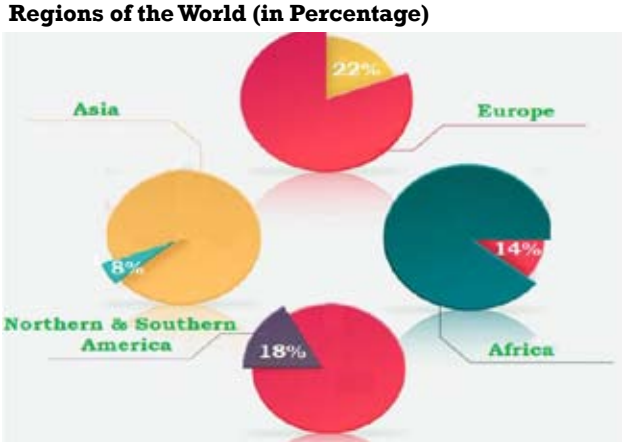
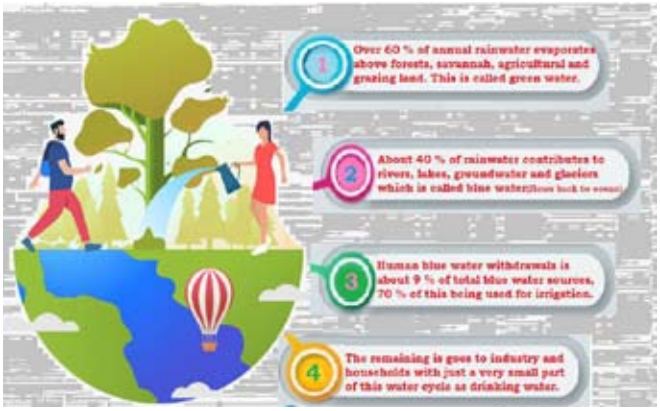
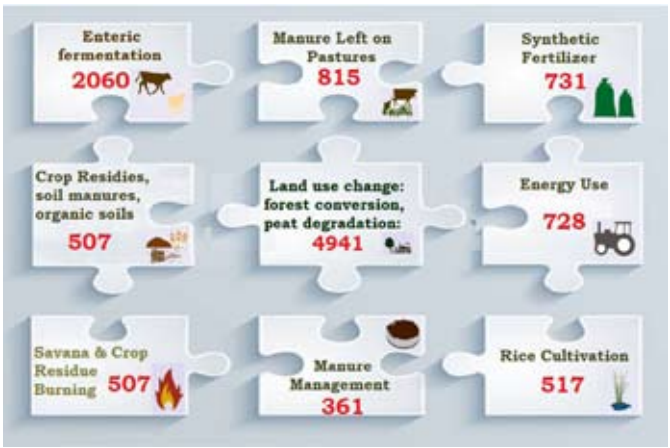


Illustration of Global Water Use

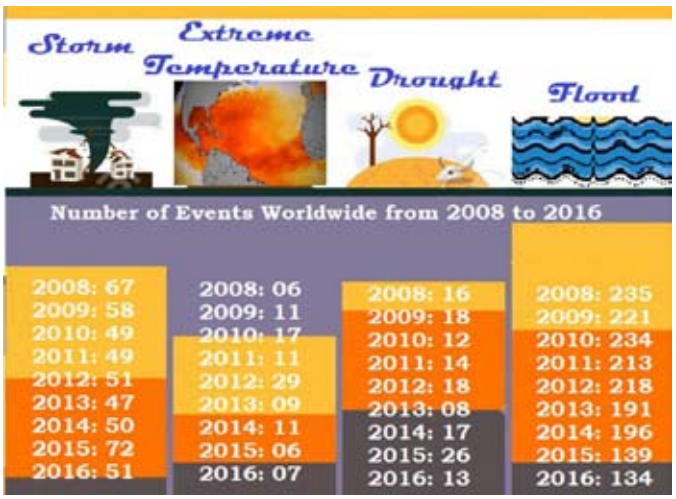


Source: FAO

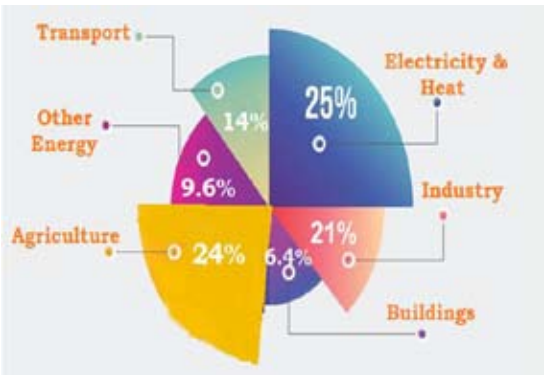
How Agriculture Sector is contributing to Global Warming (emission from the sector in million tonnes of CO2 equivalents)



Incidences of Major Natural Calamities across the World



Emission of Green House Gases by Different Sectors



The other major paradox that the agriculture sector is juxtaposed with is the fact that even though plants are grown as a resultant of human activities, the whole operation becomes carbon negative. Unfortunately, more carbon dioxide is contributed by the sector and more greenhouse gases are released from the farm sector than the total oxygen it contributes. It is an irony in itself and human race has to strike a balance between present survival and future existence of its race. Agriculture contributed 24% of the total green house gas emissions. It is higher than the industry sector, while the electricity and heat energy sector is the only sector emitting green house gases more than the agriculture sector (25%).

Enteric fermentation is a significant contributor to green house gas emission within the farm sector. It contributes 2060 million tonnes of CO2 equivalents. However, what is worrying is the massive release of about 4941 tonnes of CO2 equivalents of green house gases every year from land use change, forest conversion and peat degradation.

Occurrences of various natural calamities and extraordinary weather situations are getting more and more linked to changing climatic situation due to indiscriminate and senseless human activities. Droughts, floods, extreme temperature, storms etc. used to take place centuries before too but what is alarming these days is a regular pattern of occurrences of these natural calamities and occurrences in places where they were least likely to happen in the past. Various cities all of a sudden gets inundated, storms are striking in regular intervals, climate change is also increasing the odds of worsening drought in many parts of the World and extreme temperature is a common occurrence in various places.

GLOBAL FOOD PRODUCTION AND TRADE

Globally the production of wheat witnessed a marginal decline in 2018-19 as compared to the previous year. It was 730 million tonnes as compared to 760 million tonnes in 2019-20. The forecast for 2019-20 however indicates an increase in wheat production globally to 767 million tonnes. In contrast to the production, the utilization of wheat has increased consistently from 739 million tonnes in 2017-18 to the forecast of 757 million tonnes in 2019-20. A considerable percentage of wheat production is used as feed other than as food. In 2018-19, almost 19% of the total global stock of wheat was used as feed with 69% being used as food.

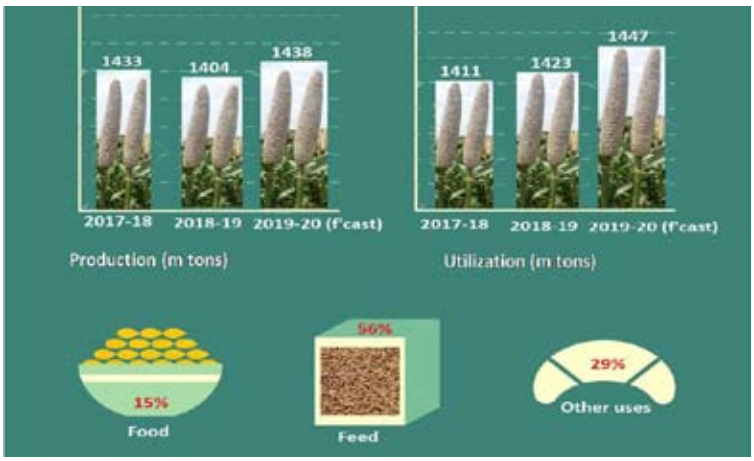
Globally, production of coarse grains has more or less remained stagnant in terms of production in 2017-18 and the production forecast for 2019-20. Despite a marginal drop in 2018-19, total global production of coarse grains was 1433 million tonnes in 2017-18 which is expected to increase to 1438 million tonnes in 2019-20. Utilization of various coarse grains has been increasing consistently. In 2019-20, the forecasted utilization is 1447 million tonnes. Coarse grain production holds particular importance for mankind. It is an essential source of food and nutrition for many people, including a large section of the poorer population across the globe. Coarse grains grow well in dry land proving to be a good source of livelihood for many farmers living in such areas with harsh climatic conditions. The use of coarse grain is most important in terms of its utilization in animal and poultry feed industry.

Rice production across the globe has remained more or less at a similar level in the recent years. The global rice production

Global Wheat Production

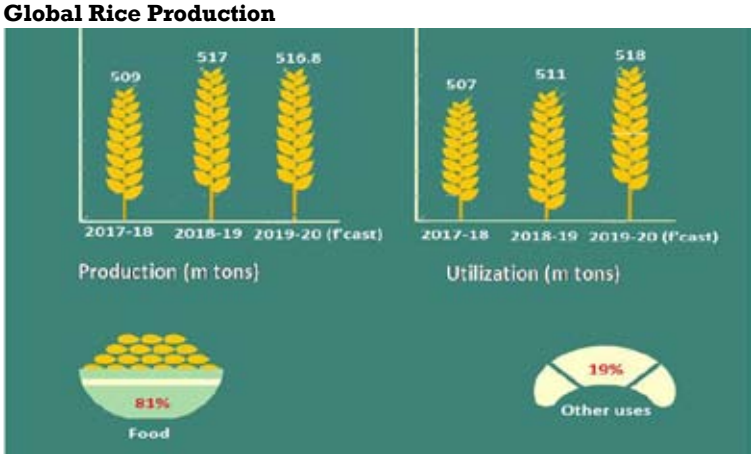
Source: WTO *Percentage Utilization in Different Forms*

Global Coarse Grain Production



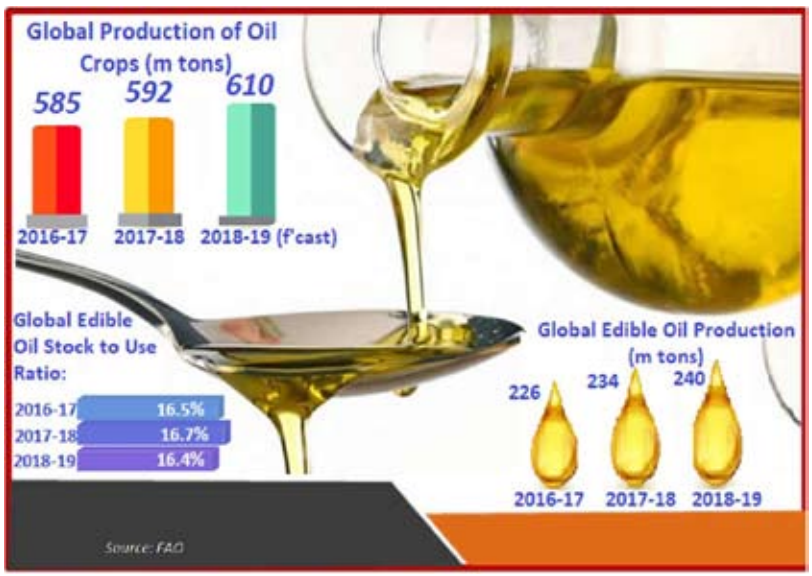
Source: WTO *Percentage Utilization in Different Forms*

Global Rice Production



Source: FAO *Percentage Utilization in Different Forms*

Global production Scenario of Oilseeds and Edible Oil

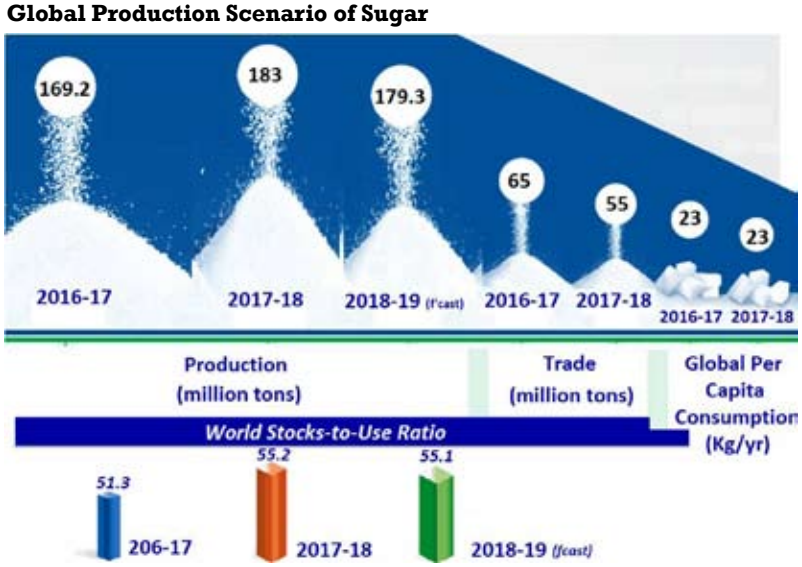


forecast in 2019-20 is pegged at 516.8 million tonnes. Rice production in most parts of the world has been challenged with low price realization at farmers' level. The only incentive that leads farmers to cultivate rice very year is the assured market for it but in terms of producer margins, the trend has been ever increasing all these years. In addition, the growing conditions and water scarcity is also acting as deterrent in rice production increase. However, rice is the staple food for more than half of the World's population and its importance therefore cannot be curtailed. Almost 81% of the global rice production is used as human food.

Production of oilseeds globally is witnessing small but consistent increase in production with concomitant increase in production of total edible oil. Oilseeds production is mostly driven by strong anticipation of increase in production area in important countries like Argentina and USA. Oilseed production leads to dual utilization: as edible oil and as meals and cakes. While edible oil production is increasing consistently, the market of meals and cakes are more prone to fluctuations. Recent outbreak of African Swine Fever in China led to massive decline in purchase of soymeal by the pig growers in China.

Sugar production across the globe has been fluctuating a lot in the recent past. There was shortfall in sugar supply for two consecutive years in 2015 and 2016. Global sugar production rebounded in 2017-18. Various factors like favourable weather conditions in important sugar growing countries like India, Thailand and China, cease of production quotas in EU etc. contributed to larger production. The production could have been more if Brazil had not had experienced a decline in sugar output

Global Production Scenario of Sugar



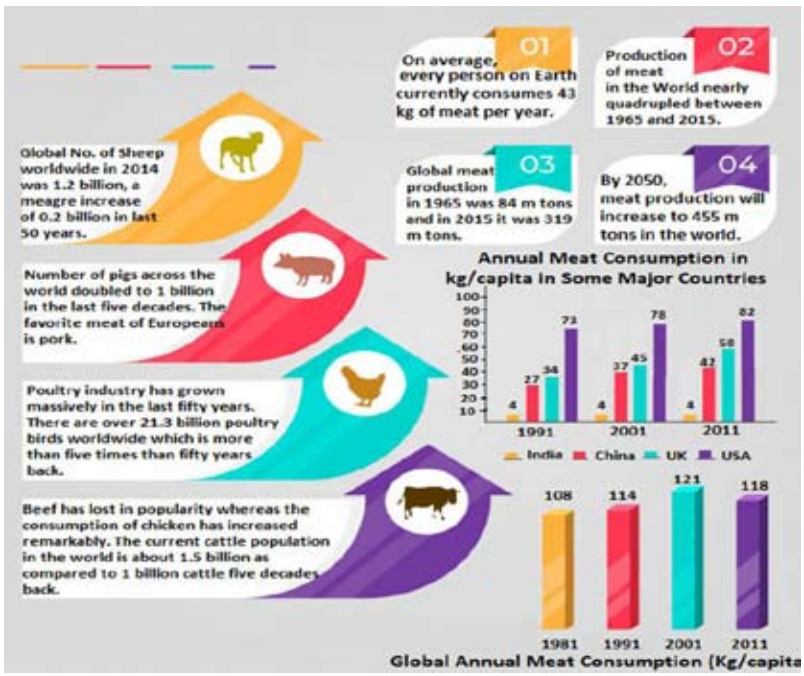
Production Data of Various Meat

as processing sugarcane into ethanol became more profitable than sugar production. Both sugarcane and sugar beet are expected to continue to expand in many of the countries where they are grown. Sugarcane still stands tall as a profitable crop as remunerative returns in comparison to alternative crops are usually high. Sugarcane will remain the main crop to produce sugar (about 86%) and is cultivated largely in tropical and subtropical countries in Africa, Asia and Latin America and the Caribbean.

Sugarcane cultivation however faces a unique contradiction or dilemma. While it is a remunerative crop for the farmers across the world, at the same time it is a huge water guzzler. Amid current concerns of climate change and that many places on Earth is shortly predicted to face acute water shortage, it has become a bone of contention as to how keep growing sugarcane but not use water abundantly to grow it. While micro irrigation is a solution in this regards, however in major sugarcane producing countries like Brazil, South Africa etc., adoption of micro irrigation by sugarcane farmers is still minuscule.

Pig meat production is expected to decline in 2019 as per the recent forecast. Bovine and poultry meat is expected to maintain a little increase in production. Market like China is expected to drive the demand and

Global Meat Industry at a Glance

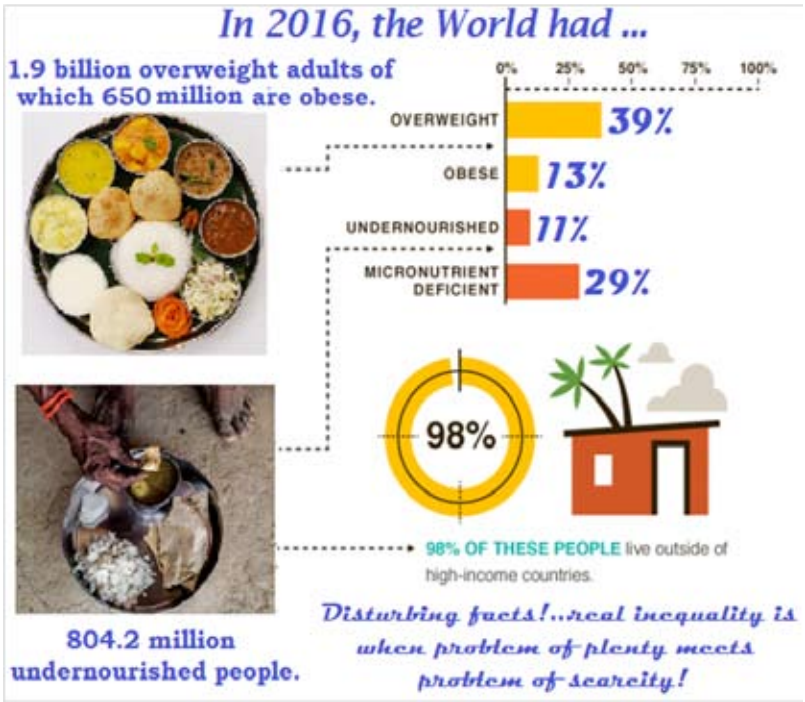


trade of meat on an overall scale. Traditionally USA has been one of the largest producers of meat, mostly bovine. The production forecast for pig meat in 2019 shows a marginal decline to 115.6 million tonnes from 120.5 million tonnes in 2018. The trade volume in pig meat is however expected to increase in 2019 to 9.1 million tonnes from that of 8.4 million tonnes in 2018.

In terms of the respective number of various animals that are important from meat production point of view, one can see a huge difference between what it was about five decades back and what it is now, particularly for pigs and poultry. Number of pigs across the world is about 1 billion, double of what it was fifty years back. Poultry industry worldwide has seen the most impressive growth in the last five decades.

FOOD AND AGRICULTURE

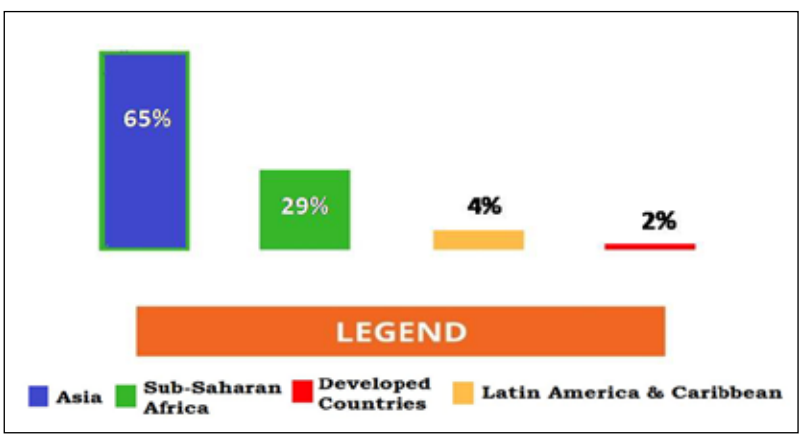
On one side there is plenty and on the other side there is scarcity. Interestingly, both abundance and scarcity are leading the world to a situation where the affluent and the poor sections of the human society are struggling with health issues. The World has about 1.9 billion overweight adults and most of these people are from the affluent section of the society. 39% of the world's population is overweight and 13% of it is obese, both leading to various health related issues. On the other hand, 804.2 million undernourished people in the World is undernourished due to poverty and extreme poverty. 11% of the World's population is undernourished and 29% is micronutrient deficient. Distribution of the poor is obviously highly skewed and almost 98% of the poor live in the countries outside the few high income countries.



Source: WHO

Asia and countries in the Sub Saharan Africa is home to nearly 94% of the total undernourished people in the world. The basis of these calculations is a persons' daily energy requirement. Definition of hungry people has also evolved over time. Earlier, only a person with an inadequate calorie intake lasting for over one year is counted as hungry. However, over the years, a number of pitfalls could be identified in this kind of a generalised definition of hunger without regard to profession, body mass weight, geographical location etc. FAO in 2011 adopted a more holistic manner of defining poverty taking into consideration food supply, food loss and population data. It assumed that people are less physically active and smaller and that distribution inequalities are less marked than previously thought. The newly adopted UN Sustainable Development Goals have the aim of completely eradicating hunger and malnutrition by 2030.

Population in Different Regions as % of Total Undernourished People of the World

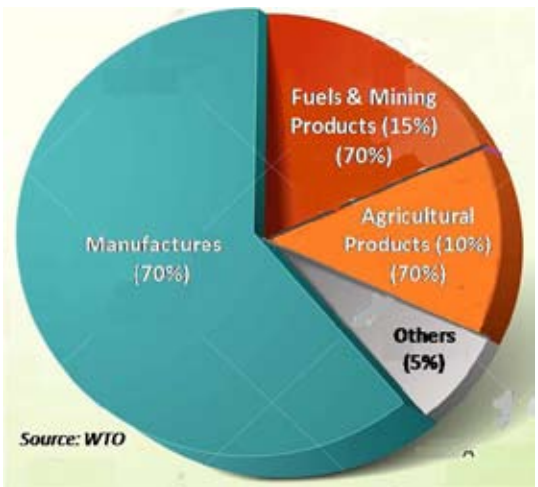


Source: FAO

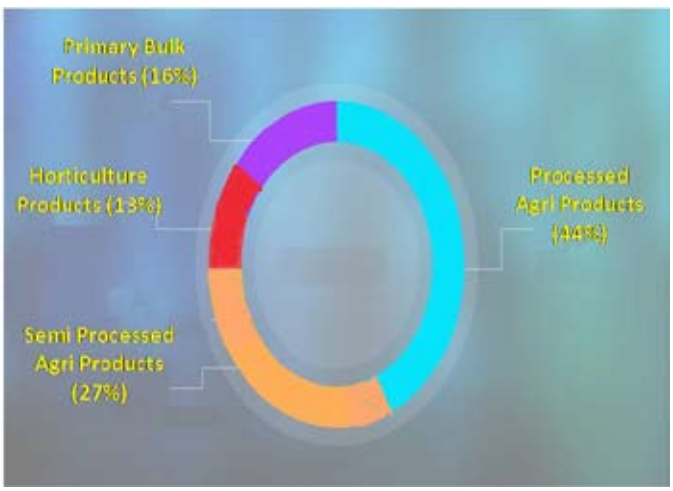
AGRICULTURE SECTOR AS A COMPONENT OF GLOBAL TRADE

Across the world, 10% of the merchandize exports are actually agricultural products. The majority share of 70% is occupied by manufactured goods. The pattern of global merchandize is generally skewed in terms of agriculture trade and in between different geographies. There is a wide dichotomy. For example, global production and trade of goods from the Sub-Saharan Africa to various other parts of the world is still largely confined to energy products and other commodities. The export portfolio of Latin American countries remain largely tied to agricultural goods and mining. Similarly, many exports from many developing countries are still concentrated on a limited number of products supplied to a limited number of destinations. Agricultural sector products for global merchandize mainly include food products, vegetable products,

Percentage Share of Various Product Groups in Global Merchandise



Percentage Share of Various Product Groups in Global Merchandise

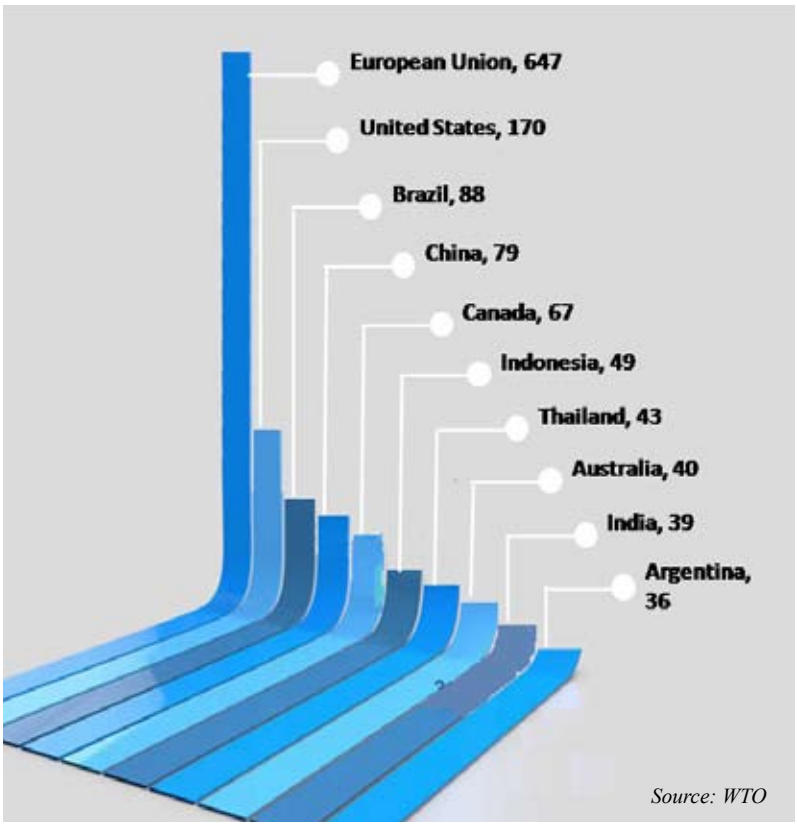


animal products, oils and fats, as well as tobacco and beverages.

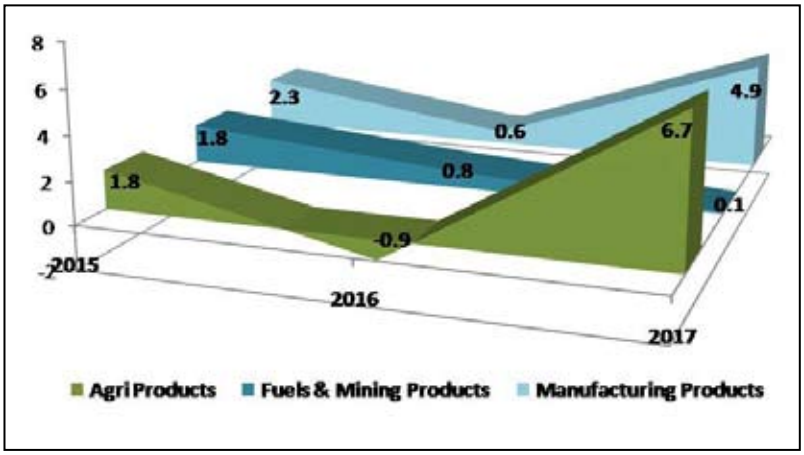
Processed agri products constitute the bulk of the agriculture products with a share of almost 44% of the total global agri products merchandize. Chocolate and processed coffee mainly dominates this segment. However, trade in processed products is usually dominated by relatively few exporting countries from the European Union and also countries like the United States. They have the biggest share of world export of processed agri products. Semi-processed products, such as oilseed cake and vegetable oils are the next major constituent of the agri merchandise representing 27% of the total agri exports worldwide. Horticultural products such as tomatoes, bananas, cut flowers etc. had the lowest share of about 13 % of the total global merchandise of agri products.

European Union has been traditionally the biggest exporter of agri products. In 2017, the total value of agri product export from EU was USD 647 billion. It exports a considerable quantity of various types of processed goods deriving from vegetable and animal products such as sugar, beverages, tobacco and prepared animal fodder. Apart from these, EU also exports a huge quantity of plants, vegetables, fruit, coffee, cereals, seeds and oil. United States of America is the second largest exporter of agri based products and in 2017, the value of export from USA was USD 170 billion. Important agri commodities exported by USA are corn, wheat, soybeans and cotton.

Top 10 Exporters of Agri Products in 2017 (Value in USD billion)



Trends of Contribution of Agri Sector Components

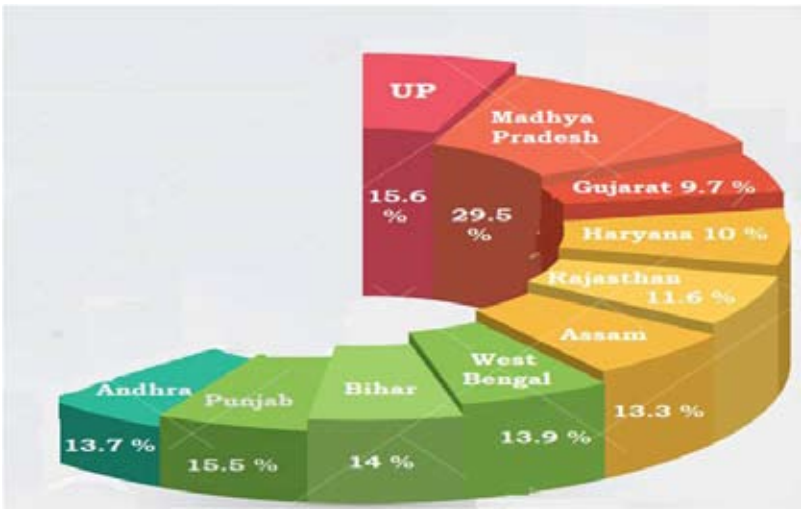


AGRICULTURE SCENARIO IN INDIA

At the National level, agriculture sector contributes almost 16% of the GDP. At State level, there is a wide variation in the percentage contribution of agriculture sector to respective State GDPs (GSDP). Among the major States which are also important from agriculture perspective in India, Madhya Pradesh has the highest contribution by agriculture to the GSDP, which was 29.5% in 2017. Punjab and Uttar Pradesh are the other States where contribution of agriculture sector is almost at par with the National average, Uttar Pradesh with 15.6% and Punjab with 15.5% of the GSDPs of the respective States. Gujarat which is considered to be an industrially developed State has almost 10% of its GSDP coming from the agriculture sector. All data in this section is taken from Ministry of Farmers' Welfare and Cooperation, Govt. of India.

It is also worthwhile to understand the rate of growth in the contribution of agri sector to the GSDPs of agriculturally important States in India. While the contribution from the agri sector to the GSDP of Maharashtra is the highest among all States in the Country (Rs. 11,263 thousand crores in 2016-17), the growth of the contribution in terms of Cumulative Annual Growth Rate (CAGR) it stands at fifth position with a CAGR of 8.5% between 2012-13 and 2016-17. The highest growth (CAGR) of the contribution of the agri sector in GSDP of a State has been registered by Madhya Pradesh. Between 2012-13 and 2016-17, the growth in the contribution to GSDP of Madhya Pradesh from the agri sector is 12.5% (CAGR). The State of Gujarat is second fastest one in terms of growth in contribution to the GSDP by agri sector at 10.7%. This indicates that Gujarat, which is known to be State to have made rapid progress in the industrial and manufacturing sector over the past years, have also been able to successfully steer growth of the

Contribution of Agri Sector as a Percentage of State GDP in Some of the Major States in India (2017)



Top 10 States in Terms of CAGR of Agri Sector Contribution to GSDP between 2012-13 to 2016-17 (only agriculturally important States being considered)

agriculture sector. This is an example where development and progress of the primary sector can go hand in hand along with the development of the development sector and also signifies the importance of the primary sector as a source of raw material for many secondary sector enterprises.

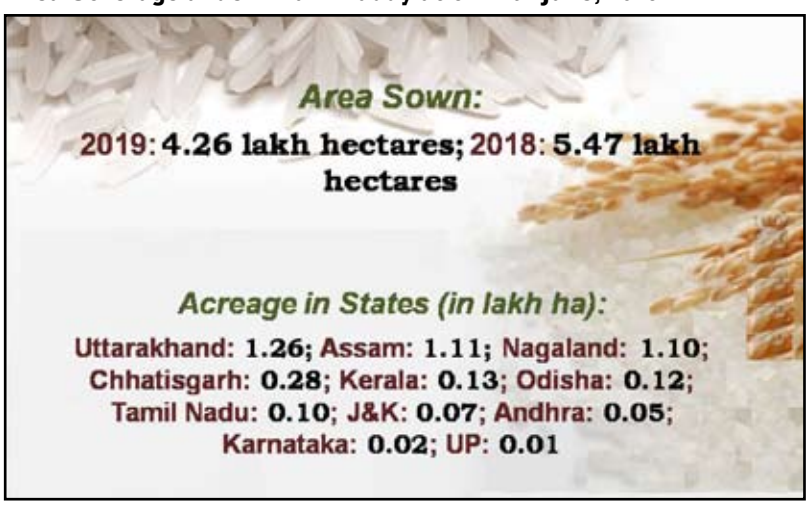
LATEST CROPPING SCENARIO IN INDIA

As on 26th June, 2019, the Indian monsoon was running behind schedule by more than 10 days but by June end, the monsoon is expected to ideally cover most of the landscape as the Arabian Sea and Bay arms meet over Central India and drive as one into West Rajasthan. Meanwhile, the Australian Bureau has further downgraded its El Nino 'watch' status to 'inactive.' The progress of the monsoon will help farmers to accelerate sowing of summer-sown crops, which has been lagging due to a delay in the arrival of monsoon rains. Let us take a look into the latest available updates on net sown area under various kharif crops as on 14th June 2019.

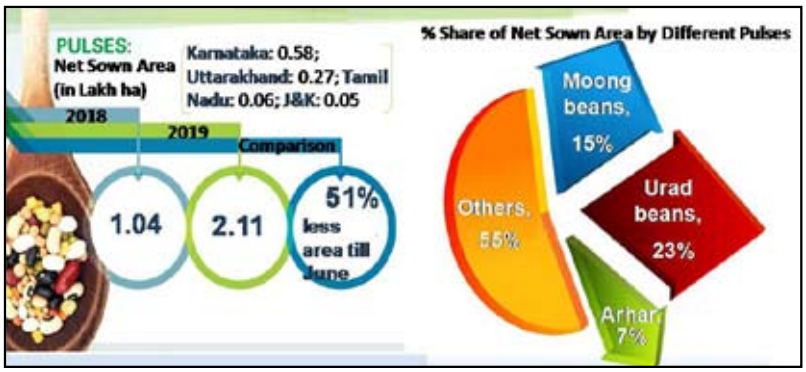
KHARIF PADDY

Acerage of Kharif paddy in 2018 was about 5.47 lakh hectares. This year till the middle of June, already 4.26 lakh hectares of land has been sown with Kharif paddy. It is expected that with the onset of the monsoon in full swing, more area will be brought under cultivation. Looking at the forecast of a near normal monsoon, albeit a little delayed, it can be expected that area under paddy could even surpass the area in previous year and the net production of this important food grain of the country could increase further this year. However, one important aspect to be taken into consideration is that the big states and which are also known to be major paddy growers in the country like Andhra Pradesh, Karnataka, Uttar Pradesh, Tamil Nadu, West Bengal etc. have so far reported considerable less net sown area under paddy as on 14th June this year.

Area Coverage under Kharif Paddy as on 14th June, 2019



Area Coverage under Pulses in India as on 14.6.2019

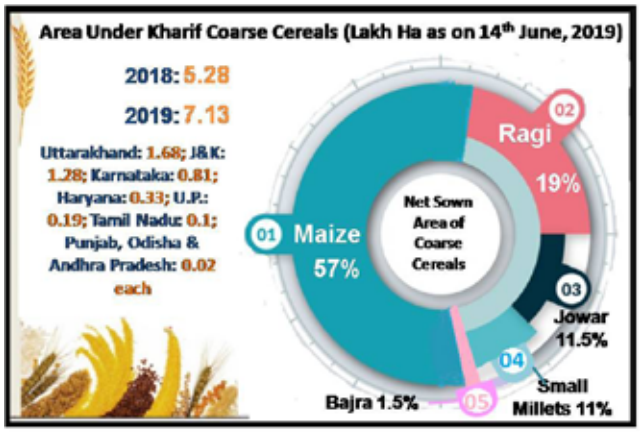


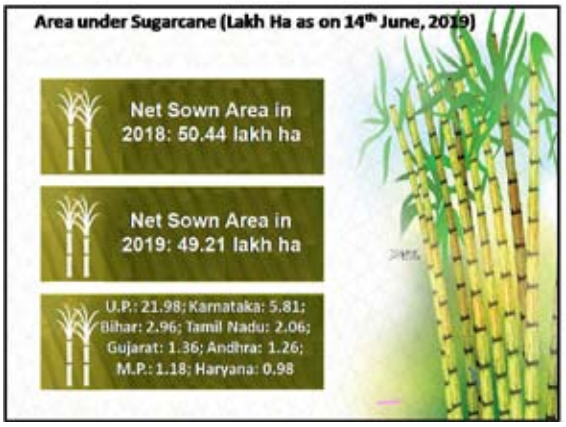
KHARIF PULSES

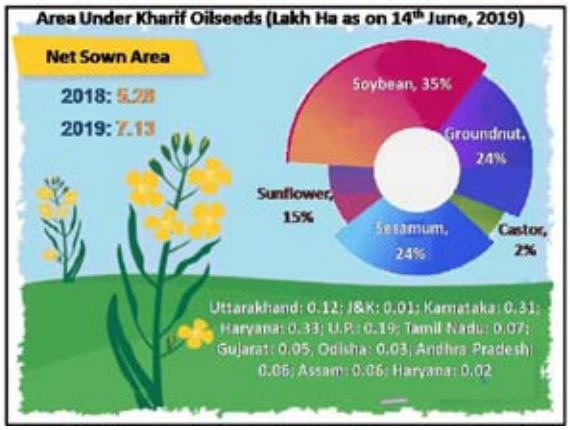
India has been consistently increasing the production of pulses in the last few years with record production in the previous year. The net sown area under different Kharif pulses altogether in 2018 was 2.11 lakh hectares. This year, the net sown area under pulses till 14th June of the current Kharif season is relatively low with just 1.04 lakh hectares being sown so far. But with just 51% of the set sown area as compared to the total net sown area of the previous area so far, pulse production in the Country faces a probability of shortfall this year. Among the different pulses, Moong, urad and arhar shares 15%, 23% and 7% respectively as share of the net shown area under pulses till the mid of June 2019. Karnataka has alone reported just a little above 50% of the total net sown area under pulses as of now with about 58000 hectares being sown so far.

KHARIF COARSE CEREALS

Many of the Kharif coarse cereals also known as the nutri cereals have been sown and till 14th June, 5.28 lakh hectares of land in different parts of the country has been sown with these crops. In 2018, the net sown area under coarse cereals during the Kharif season was 7.13 lakh ha. It is expected that the area under cultivation of







coarse cereals will pick up further with some of the major growing States still waiting for the monsoon to arrive in full scale so that sowing can be taken up. Among the major coarse cereals, maize has been sown in 57% of the net sown area so far. Ragi, Jowar, Small millets and Bajra occupy 19%, 11.5%, 11% and 1.5% of the area respectively. The hilly regions of Uttarakhand and J&K have reported sowing of coarse cereals over an area of 1.68 lakh ha and 1.28 lakh ha respectively. Other major States with considerably larger growing areas are yet to pick up sowing so far.

Planting of sugarcane in the country could surpass the area of last year if one considers the trend till 14th June, 2019. One of the major drivers for this can be considered to be the hike in Fair Remunerative Price of sugarcane announced by the Union Government in 2018. So far, 49.21 lakh ha of area has already come under sugarcane cultivation this year. With a favourable monsoon, the area under cultivation can be strongly expected to surpass previous year's area of 50.44 lakh ha. Uttar Pradesh has already reported a planting of the crop over almost 22 lakh ha.

Unlike pulses, various kharif oilseed crops have recorded encouraging sowing so far. As against a total area of 7.13 lakh ha under cultivation in 2018, this year so far oilseeds have already been sown over a total area of 5.28 lakh ha. Almost all the major Kharif oilseeds have been sown almost on an equitable manner with Soybean constituting 35% of the total area sown under oilseeds so far, while groundnut and sesamum occupying 24% each followed by sunflower and castor at 15% and 2% respectively. States like Karnataka, Haryana and Uttar Pradesh has already reported considerable sowing of oilseeds out of this total area under the crops so far.

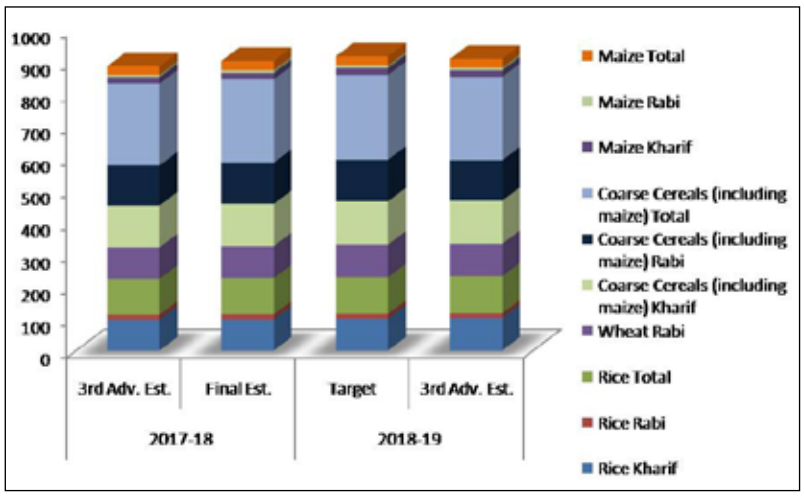
Like sugarcane, another cash crop cotton has also witnessed encouraging sowing so far in the Country. Last year the net sown area under cotton was almost 17 lakh ha and this year till 14th June, already an area of 15.32 lakh ha has come under cotton cultivation. However, with prediction of normal monsoon this year notwithstanding, how much further area comes under the cultivation of the crop will depend on the extent to which cotton farmers prefer to switch to other remunerative crops this year like maize or soyabean. Last year, cotton had witnessed a volatile market with average monthly model price hovering below the benchmark minimum support price (MSP), barring a few months, during the last one year. States like Haryana, Punjab and Rajasthan are so far the leading ones in terms of cotton cultivation area this year. Farmers of States like Gujarat and Maharashtra might switch to alternative and comparatively more remunerative crops this kharif season.

As regard to the other important fibre crops in the form of jute and mesta, almost 93% of the net sown area cultivated in 2018 has already been covered till June 14th, 2019. So far, 6.05 lakh ha area has already been sown with jute and mesta. West Bengal, the traditional leader of jute has already reported jute and mesta sowing over 4.47 lakh ha.

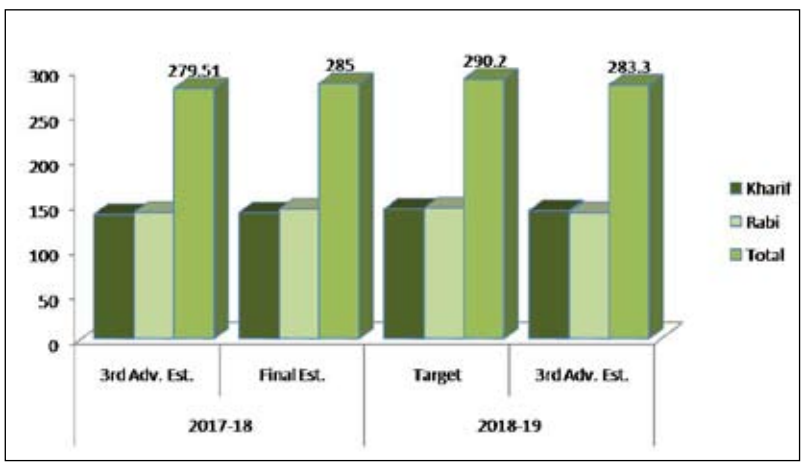
FOOD PRODUCTION IN INDIA (2018-19)

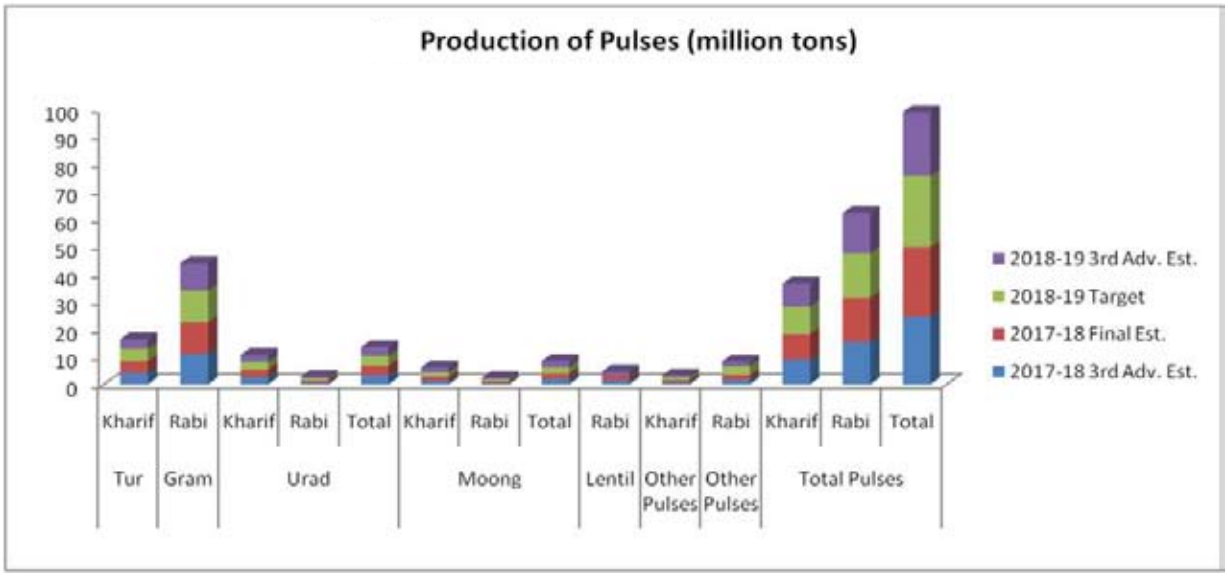
India saw an all time high and record production of rice in 2018-19. Against a target of 114 million tonnes, according to third advance estimates, India expected an output to 115.6 million tonnes of rice in 2018-19 with kharif rice contributing almost 102 million tonnes. The total output of rice in 2017-18 was 112.7 million tonnes. According to the third advance estimates, wheat production has also surpassed the target for 2018-19 with a production of 115.7 as against the target of 114 million tonnes. The total wheat production during the previous year was 112.7 million tonnes. This leaves India with sufficient food grain production along with opportunity to export a good quantity of rice in near future. However, India has fallen short of its target production of maize which is considered to be one of the important coarse cereals in the country. Total production is pegged at 27.8 million tonnes according to third advanced estimates for 2018-19 as against the target of 28.7 million tonnes of maize. As a matter of fact, maize production in 2018-19 is below

Production of Major Cereals and Coarse Cereals (million tonnes)



Production of Total Food Grains (million tonnes)





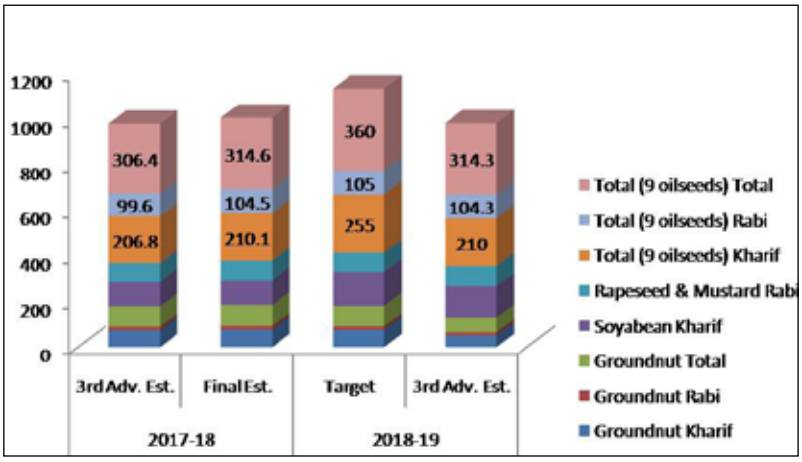
the total production of 28.7 million tonnes in 2017-18. Maize is a versatile crop with multiple use as food, feed, important ingredient in pharma and other industries, and increasing production of maize in the country can prove to be a remunerative crop for many farmers who have been growing less remunerative and traditional crops with volatile market prices.

With regard to the total production of coarse cereals including wheat, India posted a shortfall in production as compared to the target in 2018-19.

However, in terms of the total food grains production in 2018-19, the country has witnessed a shortfall when compared to the target. There was a production of 283.3 million tonnes of food grains in the Country in the year as against a target of 290.2 million tonnes. There was shortfall in both Kharif and rabi season food grains. India produced 142.7 million tonnes and 140.6 million tonnes of Kharif and Rabi food grains respectively as against the targets of 144.5 million tonnes (Kharif) and 145.7 million tonnes (Rabi) in 2018-19. This was mainly on account of deficit rainfall triggering drought conditions across many states which hampered pulses and coarse cereal production. Drought conditions in Maharashtra and Karnataka, two major coarse cereal growing states, seem to have adversely hit coarse cereals output.

Total oilseeds production in the country during 2018-19 is estimated at 31.43 million tonnes. This denotes a shortfall of 4.57 million tonnes from 36 million tonnes that was targeted during the period. The production of oilseeds during 2018-19 is almost maintained at the same level of 2017-18 (total oilseeds production: 31.46 million tonnes). However, when one considers the five years' average oilseeds production, production in 2018-19 was almost 1.8 million tonnes more. Due to deficit rainfall and drought like conditions in some of the major oilseeds growing States, Kharif oilseeds sustained a significant deficit in the target production. In 2018-19, total production of kharif oilseeds was

Production of Major Oilseeds (lakh tonnes)



Production of Sugarcane (million tonnes)

just 2.1 million tonnes against a target production of 2.5 million tonnes.

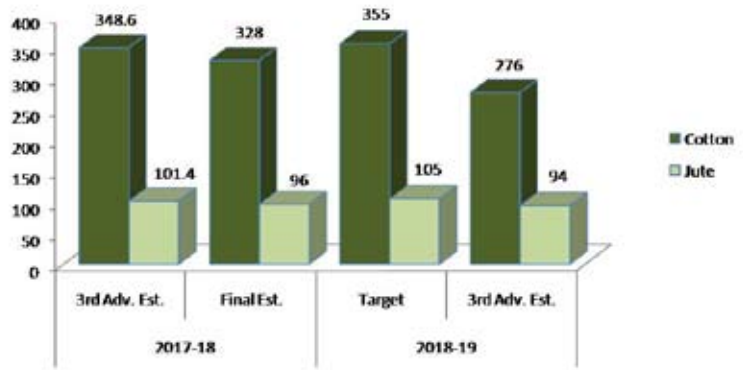
India had taken up an ambitious target of almost 26 million tonnes of pulses production in 2018-19. Though it failed to achieve the target by a short margin and ended up with a total production of 23.22 million tonnes. However, considering that 2017-18 it had actually surpassed the target of that year with record production of 25.42 million tonnes, it's encouraging that in the last couple of years India has been doing quite well in terms of pulses production. It is also encouraging to note that the production of moong dal, which sells at high price in retail market has exceeded the target production in 2018-19 (2.37 million tonnes as against a target of 2.35 million tonnes) meaning that moong farmers has had a remunerative price at their farm gate.

An important cash crop which is also highly water intensive in the form of sugarcane has been witnessing consistent increase in production in India. The crop witnessed year on year increase of 5% between 2017-18 and 2018-19 from 3799 million tonnes to 4004 million tonnes during the period. It has been consistently surpassing its target production both in 2017-18 and the following year. The increasing production and price volatility in the recent years for sugarcane prompted a Cabinet approval of the Fair and Remunerative Price (FRP) of sugarcane at Rs. 275 per quintal for a basic recovery rate of 10% last year. It was further decided to provide a premium of Rs. 2.75 per quintal for each 0.1 % increase in recovery over and above 10%. The cost of production of sugarcane for the sugar season 2018-19 was Rs. 155 per quintal.

Production of cotton was at 27.6 million bales (of 170 kg each) and production of Jute & Mesta was estimated at 9.4 million bales (of 180 kg each). Reduction in cotton production last year was mainly because of the fact that Telangana witnessed a reduction in production by about 2.50 lakh bales, Andhra Pradesh by 50,000 bales and Karnataka by 2 lakh bales. This happened due to the reason for that in the Southern Zone farmers uprooted their cotton plants on account of moisture deficiency as a result of which there is no scope for 3rd and 4th pickings. According to estimates of Cotton Association of India (CAI), estimated domestic consumption of cotton was 316 lakh bales in October 2018 which was lower by 4 lakh bales compared to the consumption figure estimated during the previous month of last year. CAI has estimated exports for the season 2018-19 at 50 lakh bales, which are lower by 19 lakh bales compared to the export of 69 lakh bales estimated during the last year.

Note: All data in this section has been taken from Ministry of Farmers' Welfare and Cooperation, Govt. of India.

Fig: Production of Major Cereals and Coarse Cereals (million tonnes)

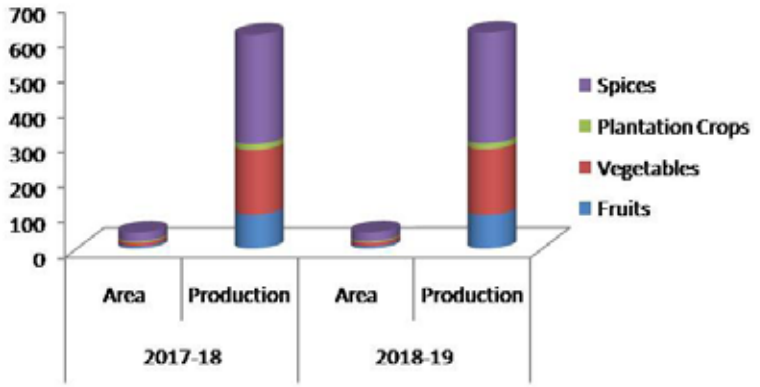


PRODUCTION SCENARIO OF HORTICULTURE CROPS (2018-19)

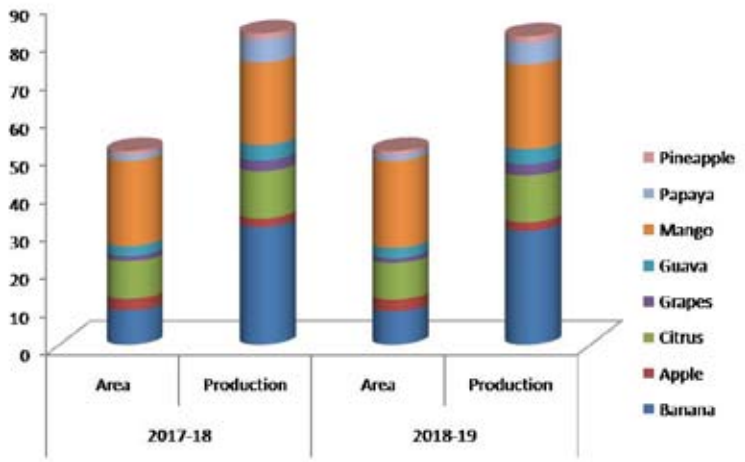
The total Horticulture production of the country is estimated to be 315 million tones during 2018-19 according to the first advance estimate which would be 0.95% higher than the 2017-18, and 8% higher than the past 5 years' average production. There has been a record production of Horticulture crops with production during the year 2017-18 according to final figures reaching 311.7 million tonnes which is 3.7% higher than the previous year and 10% higher than the past 5 years' average production. One more positive aspect about the horticulture sector of the country is that productivity for horticulture sector is on the rise over the past few years. For example, the productivity increased by about 3.45% in 2016-17 according to final estimates. as compared to 2015-16.

Fruits production is estimated to be around 97.4 million tonnes in 2018-19 (according to second advance estimates), compared to 97.36 million tonnes in last year. Productivity of fruits increased from 14.3 tonnes per Ha in 2015-16 to 14.6 tonnes per ha in 2016-17. As a matter of fact, India

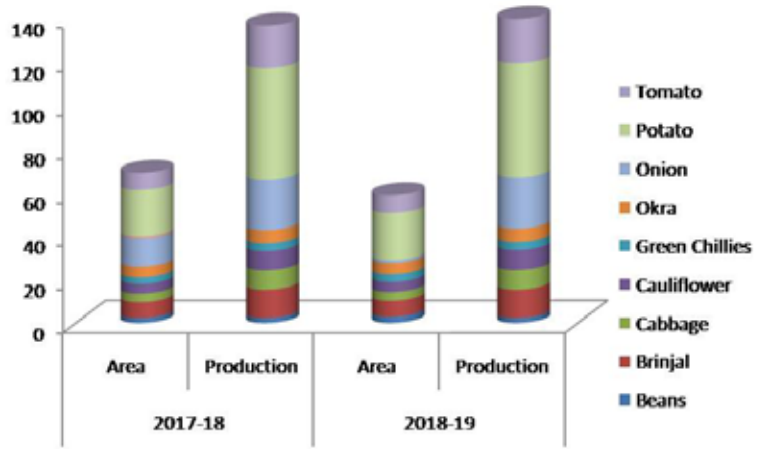
Production of Major Horticultural Crop Groups (Area: million ha, Production: million tonnes)



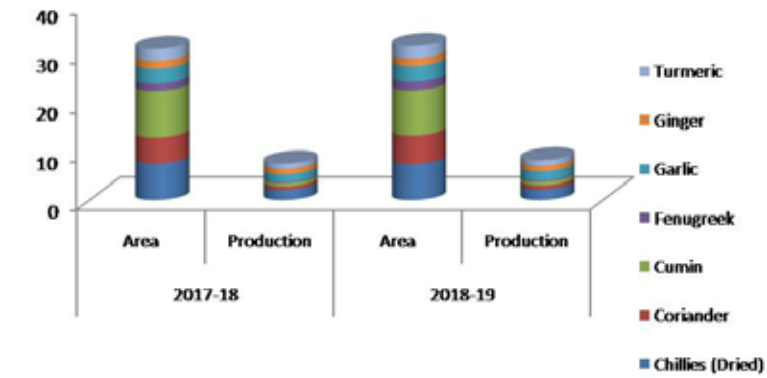
Production of Some Major Fruits (Area: lakh ha, Production: million tonnes)



Production of Some Major Vegetables (Area: lakh ha, Production: million tonnes)



Production of Major Spices (Area: lakh ha, Production: million tonnes)



is the largest producer of fruits in the world and is also known as fruit basket of world. The production areas of some of the major fruits in the country are located in the states of Maharashtra, Andhra Pradesh, Tamil Nadu, Gujarat, Karnataka, Uttar Pradesh, Bihar, Madhya Pradesh, West Bengal, Kerala, Jammu & Kashmir, Orissa and Assam.

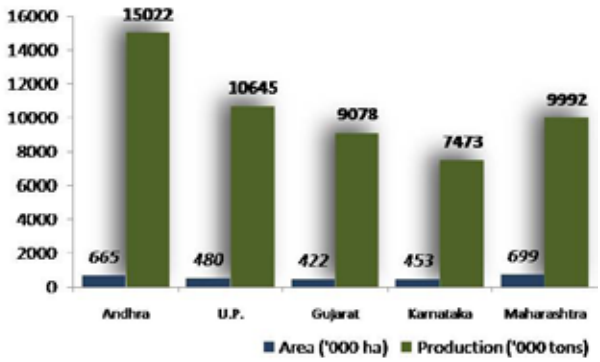
Vegetables production in India during 2018-19 is estimated to be around 187.36 million tonnes, which is 1.61% higher than the production of 178 million tonnes in 2017-18. It is also to be noted that during the previous year of 2017-18, record production of vegetables was about 5% higher than the previous year of 2016-17. Onion production is estimated to be around 23.3 million tonnes, which is slightly higher than production in 2017-18. Similarly, potato and tomato production in 2018-19 is estimated to be around 52.96 million tonnes and 19.66 million tonnes respectively, which is respectively 0.5% and 6.01% higher than production of the vegetables in 2017-18. India grows the largest number of vegetables from temperate to humid tropics and from sea-level to snowline.

Spices production in 2018-19 is estimated to be around 8.61 million tonnes, which is 6.01% higher than Production in 2017-18. India is known for its spices globally because of rich aroma, taste and texture and is the world's largest producer, consumer and exporter of spices. Besides quality like rich aroma, India's strength as a leading producer of spices in the world lies in the fact that it produces around 75 of the 109 varieties of spices listed by ISO. In the recent years, organic farming for spices is gaining great prominence in the country due to the increasing demand for safe and non-contaminated spices.

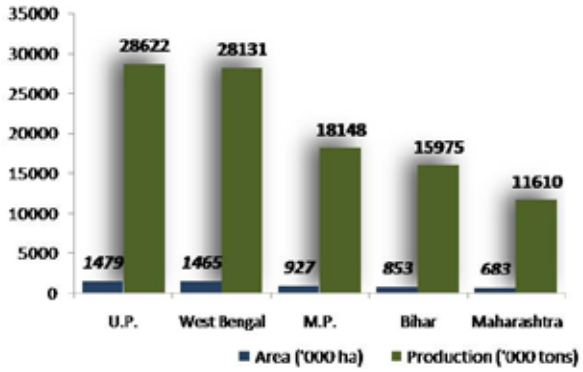
Andhra Pradesh is the largest producer of fruits in the country and far head of the second ranking state in terms of total production of fruits. In 2018-19, Andhra Pradesh produced a total quantity of 15022 thousand tonnes of fruits from a total area of 665 thousand ha under fruit cultivation, with a productivity of 22.6 tonnes per ha. In terms of productivity also, Andhra Pradesh ranks highest among the States. Uttar Pradesh ranks second, produces 10645 thousand tonnes of fruits from a total area of 480 thousand ha. The net productivity of the state in fruits is 22.16 tonnes per ha. Gujarat ranks third with a total fruit production of 9078 thousand tonnes from 422 thousand ha of land under fruit cultivation.

Uttar Pradesh is leading the country in terms of vegetables production with 2.86 lakh tonnes of production in 2018-19 from an area of 1479 thousand hectares. This translates into a productivity of 19.3 tonnes per ha in Uttar Pradesh. West Bengal is close behind as the second largest producer of vegetables in the country with a total production of 8.61 lakh tonnes of vegetables from an area of 1465 thousand hectares which translates into a productivity of 19.2 tonnes per hectare. What needs to be done in this age of improved and easy food

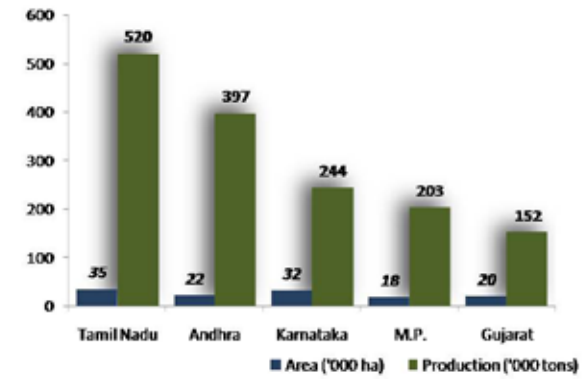
Top Five Fruit Growing States (2018-19)



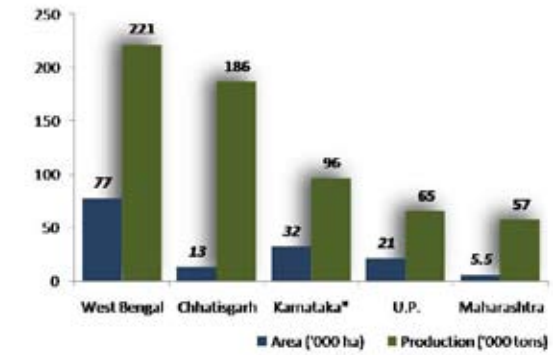
Top Five Vegetable Growing States (2018-19)



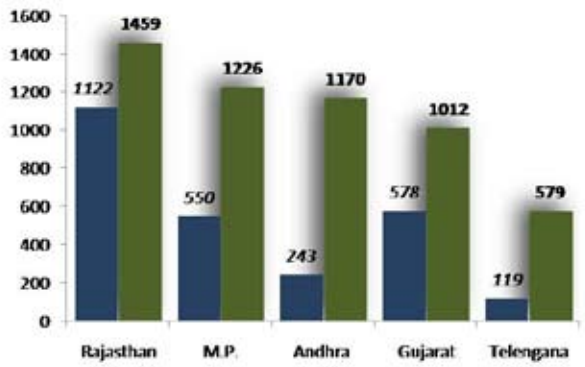
Top Five Loose Flower Growing States (2018-19)



Top Five Cut Flower Growing States (2018-19)



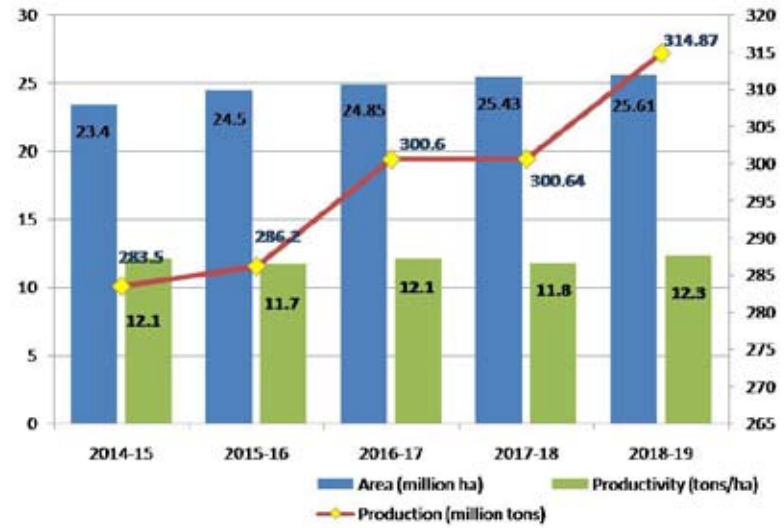
Top Five Cut Flower Growing States (2018-19)



processing technologies is adoption of food processing to minimise wastage, proper supply chain management of vegetables so that wastage during transportation from farm gate to the market is reduced and a demand driven production of vegetables is pursued so that market glut can be avoided. All these steps can help farmers realise better return from their vegetables.

Flower production in the country has got an important economic relevance, more so because many flower growers in the country are actually small and medium farmers. The Indian Floriculture market is estimated to be worth Rs. 157 billion in 2018. Growing at a CAGR of 20.1% during 2019-2024, the market is projected to reach Rs. 472 Billion by 2024. Floriculture business is usually carried out in the form of loose flowers and cut flowers. Tamil Nadu, Andhra Pradesh, Karnataka, Madhya Pradesh and Gujarat are the top five States in loose flower production. Production of loose flowers in Tamil Nadu in 2018-19 was 520 thousand tonnes from an area of 35 thousand ha. This translates into productivity of 14.85 tonnes/ha. Cut flowers

Rapid Growth of Horticulture in India

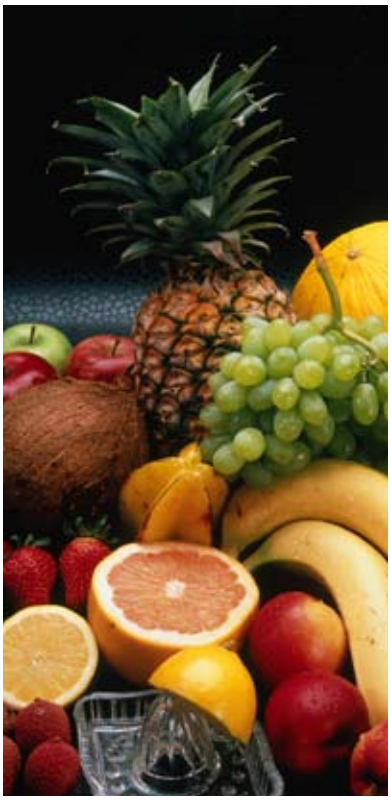


are generally sold at higher price than loose flowers. Chhattisgarh has the highest productivity with 14.3 tonnes/ha production of cut flowers and ranks second in terms of production of cut flowers in different States. West Bengal ranks first with a total production of 221 thousand tonnes of cut flowers from a total area of 77 thousand ha. Apart from West Bengal and Chhattisgarh, Karnataka, Uttar Pradesh and Maharashtra constitutes the top five States in cut flower production in India.

Rajasthan is the leading producer of spices with a total production of 14.6 lakh tonnes of spices production in 2018-19 from an area of 11.2 lakh ha. Madhya Pradesh, Andhra Pradesh, Gujarat and Telengana are the other States among the top five in India in terms of spices production. Rajasthan and Gujarat are also known as 'Seed Spices Bowl' and contributes a major share of total seed spices production in India. Spices cultivation in these two States assumes further significance from the fact that these two states are few of the most drought prone areas in the country. Spices cultivation usually needs less water and also fetches remunarative price to farmers through proper market linkage initiatives.

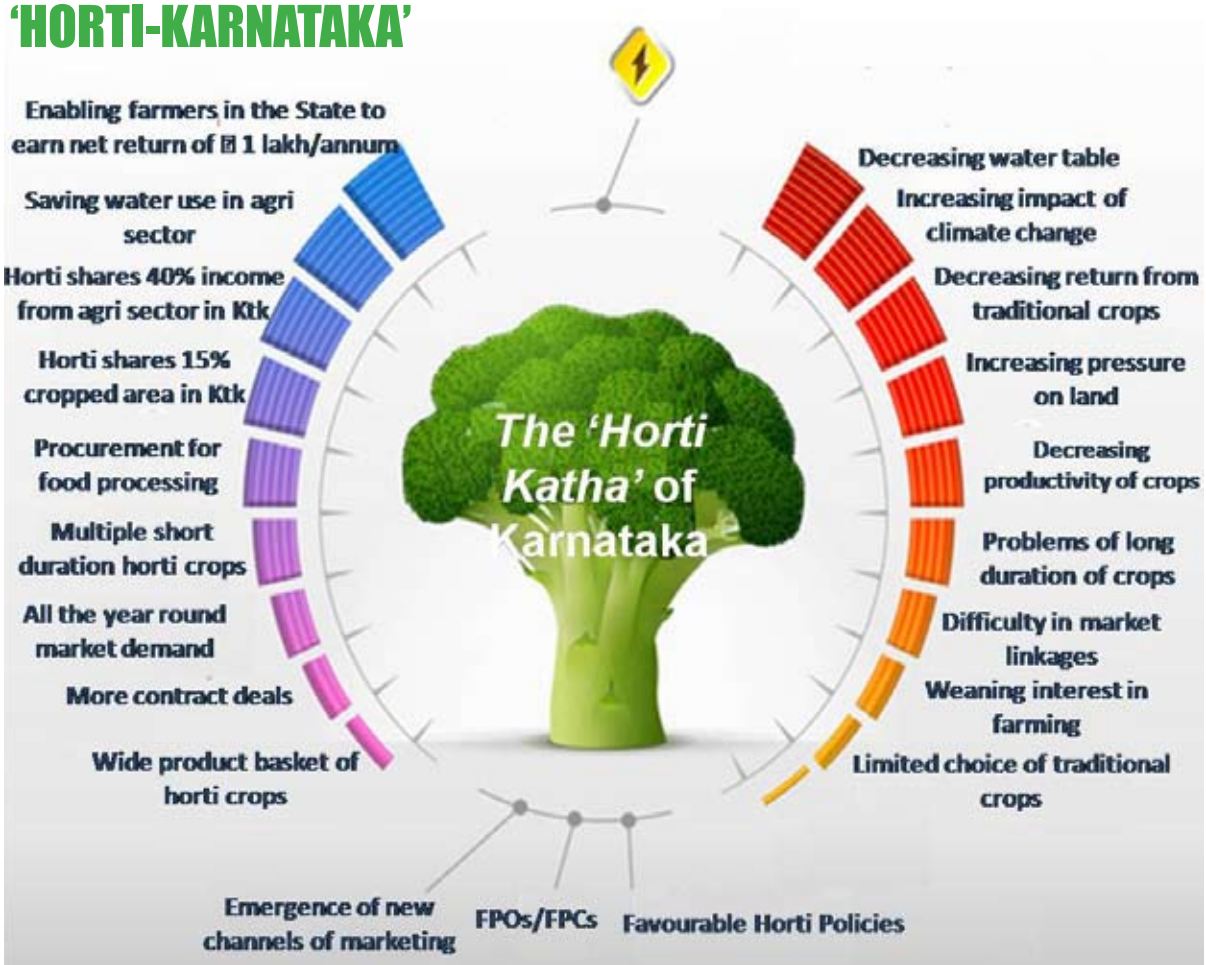
The horticulture sector of the country has witnessed a period of sustained growth in the recent years. The major drivers of this growth of the sector are increasing preference of farmers in various regions to shift to cultivation of more remunerative horticulture crops, changing food preference of middle class who prefer more fruits and vegetables in their daily diet these days, emergence of new food processing ventures, emergence of FPOs/FPCs dedicated to horticulture crop production, emergence of online agri-food retail platforms and a number of other related economic and socio cultural drivers.

The result is that in the recent past years, horticulture sector of the country has registered consistent growth. Total area under horticulture crops in the country has increased from 23.4 million hectares in 2014-15 to 25.61 million hectares in 2018-19. This represents a CAGR of 1.8% which is definitely encouraging when one considers the pressure on arable land in a rapidly developing country like India with the fastest GDP growth rate in the world. Production of all the



horticulture crops taken together has increased from 283.5 million tonnes in 2014-15 to 314.87 million tonnes in 2018-19, registering a CAGR of 2.1%. The productivity of the horticulture sector is currently 12.3 tonnes per hectare. Horticulture crops like vegetables are proving to be a boon for the Indian farmers because they are short duration crops that are mostly grown on small patches of land by marginal farmers, often in less than an acre of land. As land holdings become increasingly fragmented, production of vegetables ensure quick returns to farmers, compared to say, some pulse varieties that take up to six months to harvest. Another important aspect of the sector is that it provides a number of entrepreneurial opportunities for the youth of the country who are showing increasing tendency to leave the agriculture sector and migrate to cities in search of better source of livelihood.

HORTICULTURE GROWTH IN INDIA: A CASE STUDY OF TRANSFORMATION IN PROGRESS OF 'AGRI-KARNATAKA' TO 'HORTI-KARNATAKA'



In Karnataka, there are areas which are arid in nature, receiving barely 80 cm of rain annually. Many areas in the State of Karnataka have traditionally seen farmers grow a range of hardy millets, groundnut and other crops that can survive tough weather conditions. Water is scanty and in many places irrigation is done using water pumped from bore wells that run as deep as 1,500 feet! Hardships in many parts of agriculturally important regions of the State have not put off farmers and over the past decade, many farmers in the area have changed their fortunes for the better by growing an assortment of horticulture crops. Carrots, beetroots, fruits such as mangoes and grapes, and flowers such as marigold are spread across farms, some as small as one or two acres.

Particularly for the small hold farmers of the state, horticulture farming is boosting their earnings from their small landholdings. Albeit horticulture crops require more inputs in the form of manures, fertilisers and crop protection measures, farmers often plant two or three crops simultaneously to maximise yield from each acre. This is having a profound impact on farm incomes, water utilisation, land usage and employment patterns in the farming landscape of the State. So much so that many professionals from various other sectors including IT are giving up high paying jobs and career and taking up farming and growing high value horticulture crops.

Note: All data in this section has been taken from Ministry of Farmers' Welfare and Cooperation, Govt. of India.

EXPORT SCENARIO OF INDIAN AGRI SECTOR

To achieve the objective of doubling of farmers' income within its target time period and to infuse the much needed element of business approach in the agriculture sector, Indian agribusiness need to land on the global market with more vigour. Government of India in 2018 introduced a comprehensive Agri Export Policy to double agricultural exports from present level to US$60 Billion by 2022 and reach US$100 Billion in the next few years thereafter. This is a comprehensive and planned intervention from which one can expect good results in the coming days. Focus on export also in turn means that there is an imperative need in India to design action plan around increasing the export of agri commodities. While the current Agri Export Policy emphasises the need to design a stable trade policy regime, a continuous track of the export market, analysis, understanding and interpretation of various information, data and trends of Indian and global agribusiness scenario on a continuous and real time basis has become unavoidable. Apart from all the sections presented and analysed so far, this year's edition of Agriculture Year Book 2019 provides this section of an in depth and detailed analysis of the export scenario of various important agri commodities, processed food products and animal products. The policy recommends diversification of the exports basket, and seeks to boost high-value and value-added agricultural exports, including perishables.

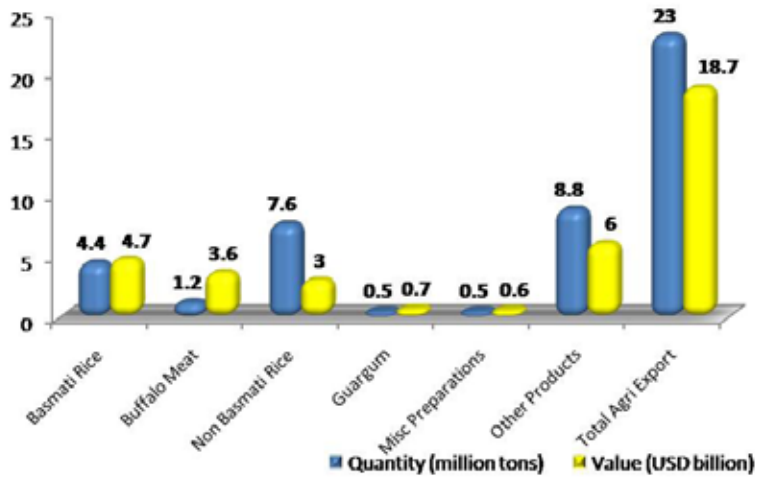
All the data in this section has been sourced from Directorate General of Commercial Intelligence and Statistics (DGCIS).

OVERALL SCENARIO OF AGRI COMMODITY EXPORT FROM INDIA

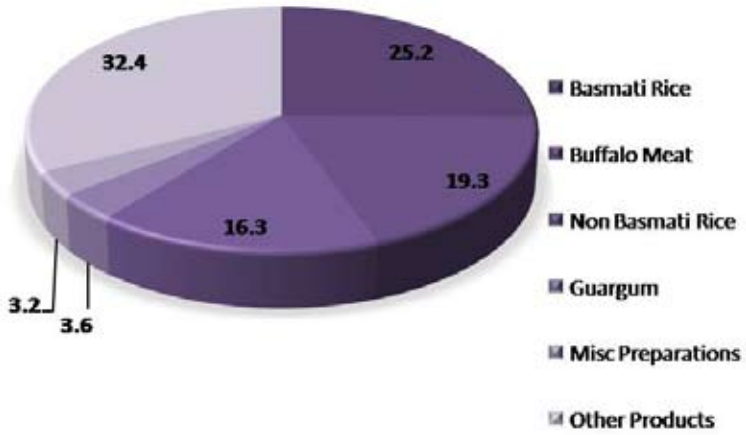
India in 2018-19 earned a total foreign exchange from export of agri commodities worth USD 18.7 billion from a total quantity of 23 million tonnes of various agri commodities and agri based products. India's agri export basket has been traditionally dominated by the export of basmati rice. A total quantity of 4.4 million tonnes of basmati rice was exported during 2018-19 worth USD 4.7 billion. India earned USD 3.6 billion from export of 1.2 million tonnes of buffalo meat, which is the second largest contributor in the agri export basket of the country. This marks an increase of 7% in terms of value when compared to the previous financial year of 2017-18. Rice (non basmati and basmati together) contributed a total value of USD 7.7 billion. Considering that rice production is witnessing continuous increase in the recent years, India can device further effective and contemporary policies and mechanisms including the options of finding new export market beyond the existing buyer countries. This will help the farmers earn significantly more from rice cultivation and help the country avoid wastage of a huge quantity of this food grain due to difficulty in storing such a huge quantity of reserve after meeting its internal food security. The share of high-value and value added products is less than 15% of the total agri export from India, compared to 25% in the US and 49% in China. In the backdrop of a robust Agri Export Policy launched last year, the focus should be now on exporting processed food products, which can fetch high value in global markets.

In percentage terms, basmati rice constitutes a little over 25% of the total export value of various agri

Total Agri Export and Export Data of Leading Exported Agri Commodities (2018-19)



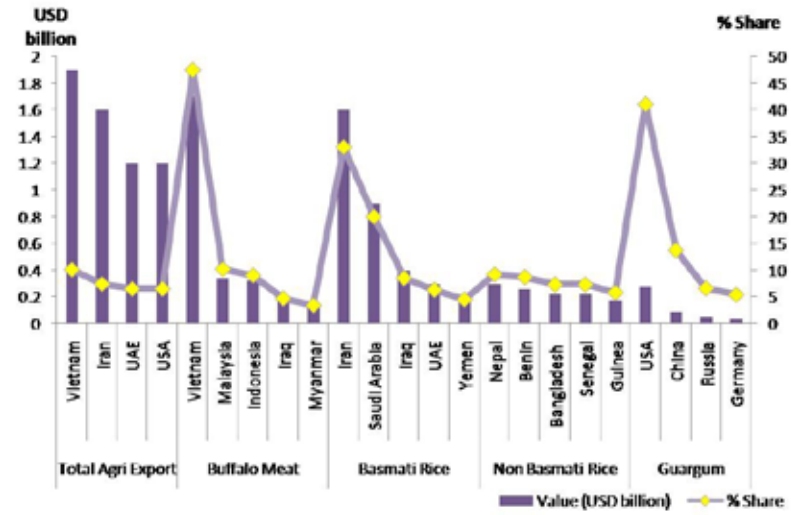
Percentage Share of Major Commodities Exported from India in 2018-19



commodities from India. Basmati rice industry recorded its highest ever exports of USD 4.7 billion in 2018-19 surpassing the previous high of about USD 4.5 billion in 2013-14. The growth has been driven to a considerable extent by strong demand from Iran and steady increase in international paddy prices for three years in a row. Contrary to the growth of basmati rice export, India has witnessed a plunge in export of its second highest agri product in the form of buffalo meat in 2018-19. China has imposed a ban on imports of Indian buffalo beef due to fears over foot-and-mouth disease. However, a considerable amount of the meat goes unaccounted for when Indian buffalo meat is smuggled into China through some of the neighbouring nations. A trade level discussion with China on this matter could actually help break the ice and also direct the export through legal channels.

Vietnam, Iran, UAE and USA were the top importers of agri products from India in 2018-19 FY. Vietnam imported USD 1.9 billion worth agri products from India followed by Iran (USD 1.6 billion), UAE (USD 1.2 billion) and USA (USD 1.2 billion).

Top Importers of Agri Products from India (total and for leading commodities), 2018-19



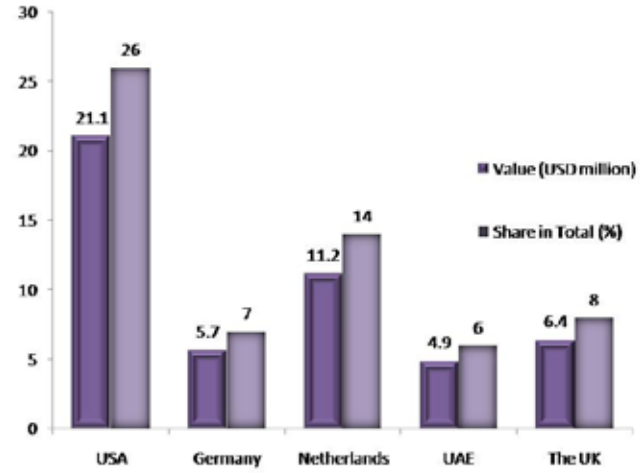
The share of these countries in India's total agri export ranges from 10.1% (Vietnam) to 6.5% (UAE and USA). Vietnam is the highest importer of buffalo meat from India, while Iran is the highest importer of basmati rice from India. Neighbouring Nepal is the largest export market for India in the non basmati rice segment, while USA is the highest importer of Guargram from India.

FLORICULTURE EXPORT

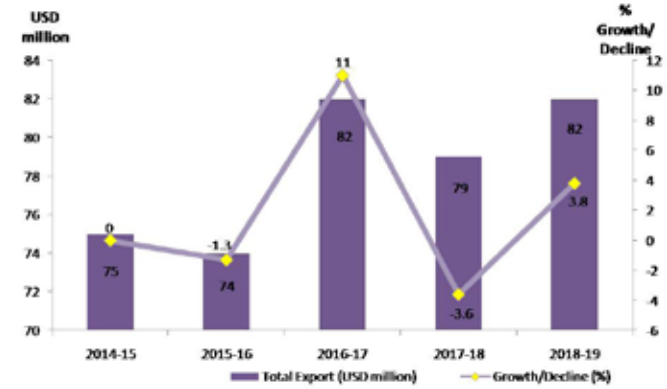
USA, Germany, Netherlands, UAE and UK were the top 5 importers of floriculture from India in 2018-19. USA imported USD 21.1 million worth of floriculture products from India, and shared 26% of the total value of floriculture export from India. The Netherlands is second largest importer with a total value of USD 11.2 million and a share of 14%. A study of the leading importers of floriculture from India reveals an opportunity for India to diversify its export into new markets. USA, Japan and Europe are the three main consumption centres and as such, there is considerable opportunity for India to increase its export in Japan and within the European Union.

During the last 5 years, floriculture export has witnessed a fluctuating trend but on an overall scale between 2014-15 and 2018-19, there has been an increase in export value from USD 75 million to USD 82 million. After a decline in 2015-16, the export of floriculture bounced back in the following year reaching USD 82 million before again suffering a decline by 3.6% in 2017-18. There should be focus to cushion the export market in this segment against shocks through finding new market and also to fix a target export value to be achieved in the next three years.

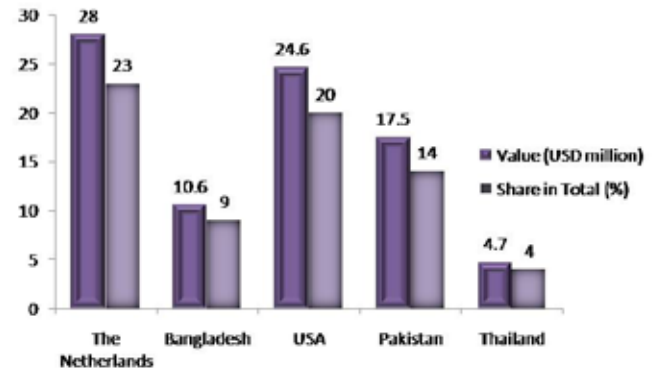
Top 5 Importers of Floriculture Products from India (2018-19)



5 Year Export Trend of Floriculture in India



Top 5 Importers of Fruits & Vegetable Seeds from India (2018-19)



FRUITS & VEG SEEDS EXPORT

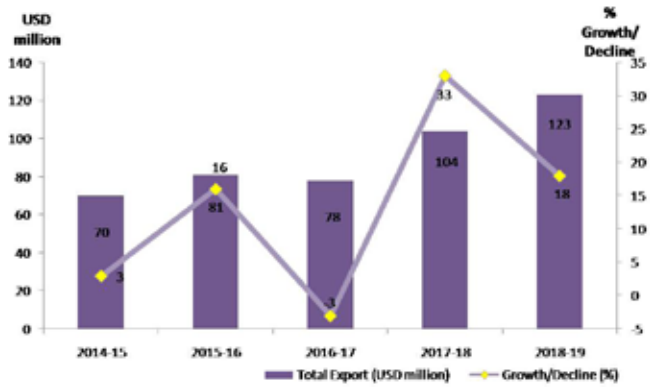
India is a major exporter of fruits and vegetable seeds. In 2018-19, the top five importing countries were The Netherlands, USA, Pakistan, Bangladesh and Thailand. Fruits and vegetable seeds worth USD 28 million was exported to the Netherlands. This country shares 23% of India's total export value earned from this segment. It is a strong point for India that distant and major economies like USA and the Netherlands are the top importers of vegetable and fruits seeds. However, strategically India should also focus more on its neighbouring countries to increase its export share in this segment. Although it exports good amount of vegetable and fruit seeds to some of the neighbouring countries like Pakistan and Bangladesh, it can devise a new two-fold strategy to increase its share of export to the countries where it is already strong and to find new markets which could be reached conveniently. The five year trend of export in this segment shows an overall increasing export, barring 2016-17, when the export dipped a little from USD 81 million in the previous year to USD 78 million.

EXPORT OF FRESH ONIONS

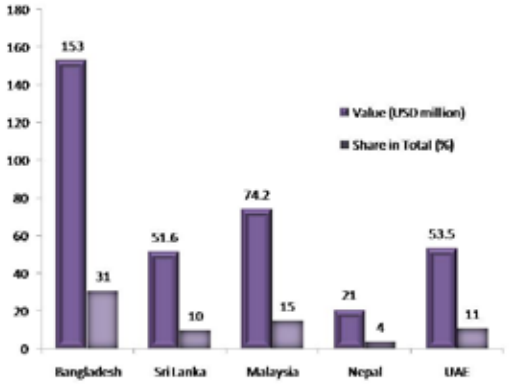
Bangladesh is the leading importer of onions from India. In 2018-19, the country imported USD 153 million worth onions from India. It alone accounted for 31% of the total value of onions exported from India. Malaysia is the second largest importer (USD 74.2 million) followed by UAE (USD 53.5 million), Sri Lanka (USD 51.6 million) and Nepal (USD 21 million). However, in terms of export future strategy for onions, India can take into consideration the huge gap between Bangladesh and Malaysia, its largest and second largest importer of onions respectively. This indicates a possible risk factor in terms of a skewed export market and in the event of any possible unfavourable geopolitical shift in these countries, India's trade in onion may suffer.

Onion is a very important crop for India considering the fact that it constitutes an integral part of numerous Indian cuisines. The level of production and maintenance of a stable price in the domestic market is crucial. The importance of onion in Indian lives is so much that this crop has earned the label of being a 'political crop'. The shortfall in production and high domestic price in the past has influenced

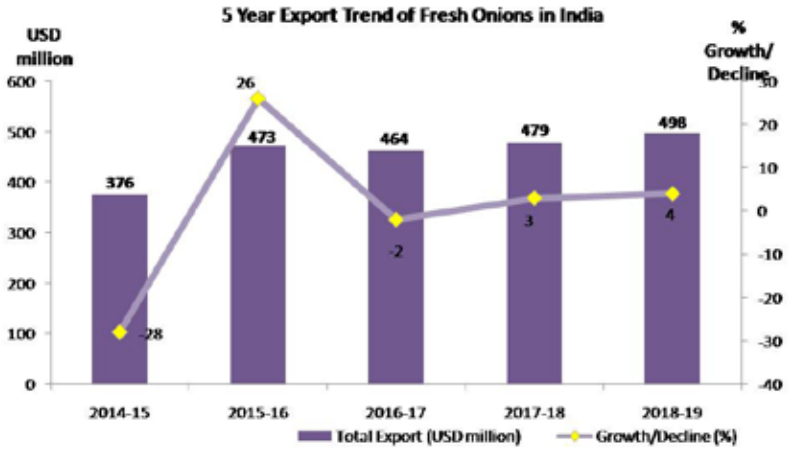
Year Export Trend of Vegetable & Fruit Seeds in India



Top 5 Importers of Fresh Onion from India (2018-19)



many elections. Despite all these factors, the fact that export of fresh onions from India has witnessed a more or less consistent increase in the last 5 years is encouraging.

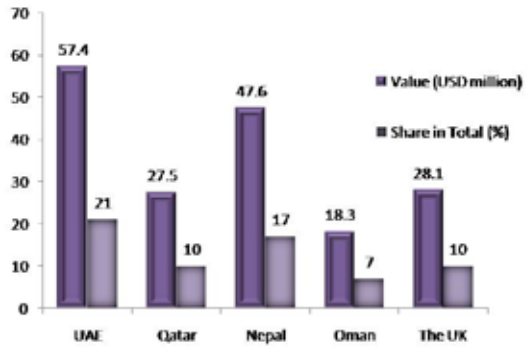


EXPORT OF VEGETABLES EXCLUDING FRESH ONIONS

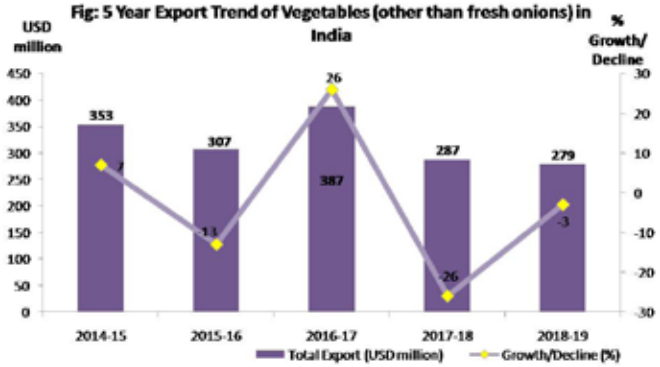
UAE is the largest importer of vegetables from India followed by Nepal, UK, Qatar and Oman. In 2018-19, UAE imported USD 57.4 million worth vegetables from India. In many of these top importers of fresh vegetables from India, a considerable population is Indian expats who are settled there. This factor and the relative proximity of these countries from India can be considered to be some of the major factors driving export in this sector. Improving the quality of packaging material can boost further vegetable export to comparatively far away nations. Minimum Reside Level (MRL) is another factor which has affected export of vegetables from India in the past to countries in the European Nations.

Though India earns a considerable value of foreign exchange from the export of vegetables, last year's trend reveals a story of inconsistency and a net decline in exports of fresh vegetables other than onions in India. During this period, the export reached its peak in 2016-17 to USD 387 million before registering a massive 26% decline to 287 million in USD 2017-18. This kind of a trend riddled with crests and troughs can impact

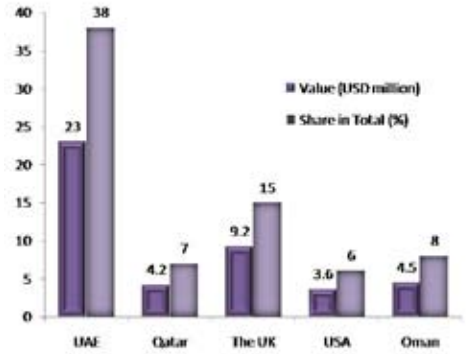
Top 5 Importers of Vegetables (other than onion) from India (2018-19)



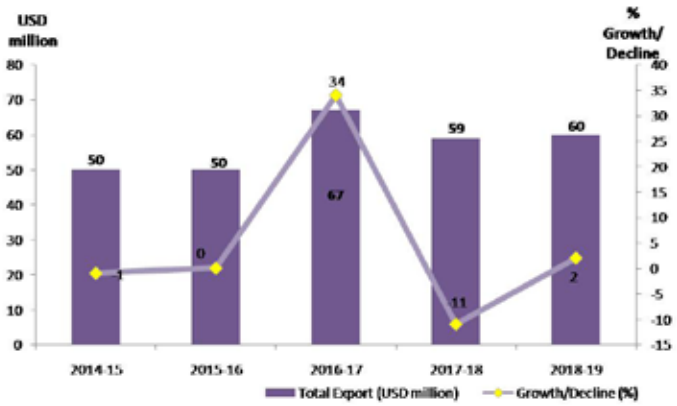
5 Year Export Trend of Vegetables (other than fresh onions) in India



Top 5 Importers of Fresh Mangoes from India (2018-19)



5 Year Export Trend of Fresh Mangoes in India



long term export and needs a strategic analysis followed by development of a reliable action plan for consistent and increasing export of vegetables in India.

EXPORT OF FRESH MANGOES

India is home to one of the most cherished varieties of mango in the global market - Alphonso. Other than this, many other varieties of mango are also exported. UAE is the largest importer of Indian mangoes and in 2018-19, it imported USD 38 million worth mangoes from India. Qatar (USD 4.2 million), UK (USD 9.2 million), USA (USD 3.6 million) and Oman (USD 4.5 million) are the other countries in the league of top 5 importing countries for mango from India. Considering that only few states in India contribute to the lion's share of mango production in the country, targeted approach can be adopted to boost export of fresh mangoes from these states.

Export trend of mangoes during the last five years depicts an overall increase in export from USD 50 million in 2014-15 to USD 60 million in 2018-19, marking a net increase of 20% during the period. However, on a year on year level, it shows fluctuating trends with the steepest rise in 2016-17 when India exported mangoes worth USD 67 million before declining considerably by 11 % to USD 59 million the next financial year.

GRAPE EXPORT

Grape is an important fruit in India from its export potential point of view. A study of the top 5 importers of grapes from India reveals a highly skewed market in favour of the Netherlands, the largest importer of Indian grapes with a total import of USD 113.6 million in 2018-19. There is a huge difference in value when compared to the second largest importer Russia which imported grapes from India valued at USD44.4 million in 2018-19. In terms of grape export, India can design a strategy that fosters equitable and increased grape export to avoid trade related risks that usually arises from being over dependent on any particular country.

Export of grapes definitely is a success story in Indian agri export domain. In a remarkable trend of increase, export of grapes has more than doubled in the last five years, from USD 158 million

Top 5 Importers of Grapes from India (2018-19)

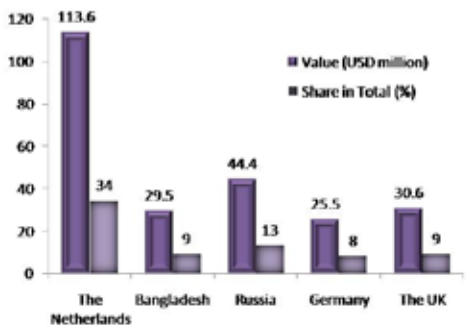
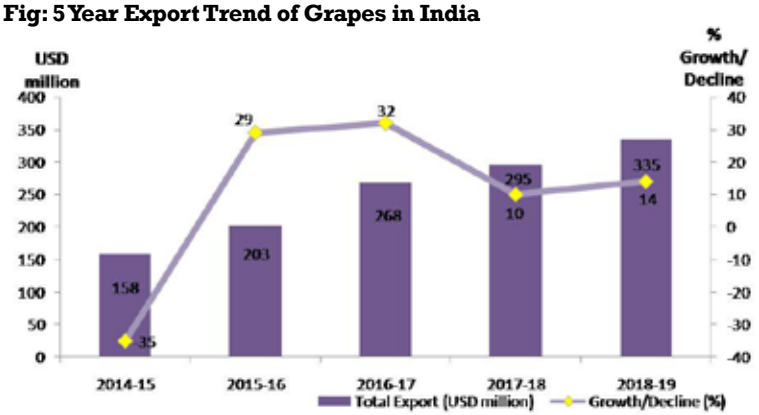


Fig: 5 Year Export Trend of Grapes in India



in 2014-15 to USD 335 million in 2018-19. Export has consistently increased during this period without any decline even in a single year between 2014-15 and 2018-19.

EXPORT OF PRESERVED CUCUMBER & GHERKINS

Preserved cucumber and gherkins have a good export market particularly in the European region. Though USA is leading market for preserved cucumber and gherkins, countries in the European region and Russia is the most important pocket for export of these preserved vegetables. In 2018-19, USA imported these agri produces in their preserved form valued at USD 39.2 million. France is the second largest export market in this segment which imported USD 22.4 million worth of preserved cucumber and gherkin from India in 2018-19. Three countries in the EU, namely France, Belgium and the Netherlands together imported nearly USD 60 million of preserved cucumber and gherkins in 2018-19.

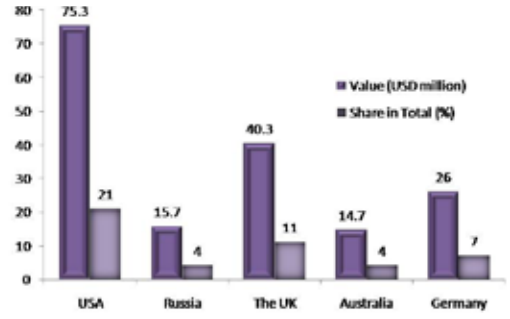
The export value in this segment has witnessed a net increase of 5% from USD 196 million in 2014-15 to USD 206 million in 2018-19. The growth trend was adversely impacted by two years of continuous decline in export in 2015-16 and 2016-17 when it witnessed successive periods of decline. In 2015-16, the export value declined by 23% as compared to the previous year to USD 152 million. It further declined by 8% again in the next financial year 2016-17 to USD 140 million. The export market bounced back in 2017-18 posting a massive increase of 42% and reaching a value of USD 199 million. Gherkin represents an interesting aspect of Indian horticulture. It is actually shunned as a vegetable in the domestic market but there are areas in states like Karnataka where it is grown on a large scale. This can be a good example of export oriented cultivation of horticulture crops, where domestic consumption is negligible but has a huge export market.

EXPORT OF PROCESSED VEGETABLES

The importance and relevance of food processing becomes even more pronounced when one considers the export potential of various vegetables in their processed form. Further development of the food processing industry will therefore be one of the most important critical success factors in boosting exports of Indian agri sector. Many of the western countries and countries in the European Union consume a lot of vegetables in their processed form. USA is the top importer of processed vegetables from India and in 2018-19, the total value was USD 75.3 million. The United Kingdom is the second largest export destination for processed vegetables from India with an export value of USD 40.3 million.

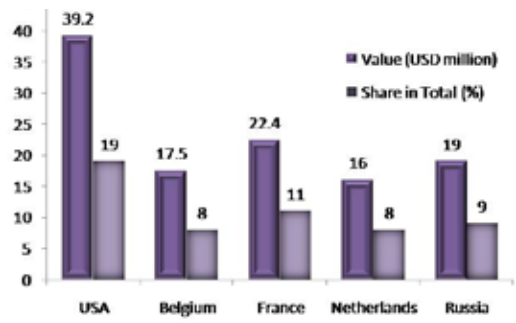
Barring one year in between (FY 2015-16), this sector has shown consistent growth in the last five year period. The export value has significantly increased by 13% from USD 313 million in 2014-

Top 5 Importers of Processed Vegetables from India (2018-19)

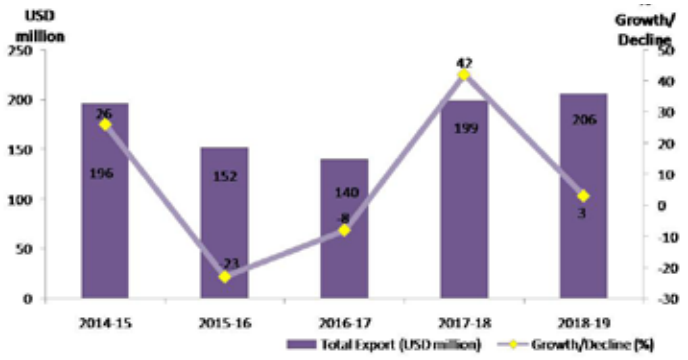


Top 5 Importers of Processed Vegetables from India (2018-19)

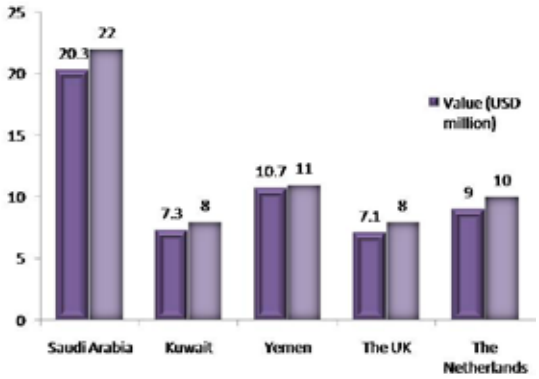
Top 5 Importers of Preserved Cucumber & Gherkins from India (2018-19)



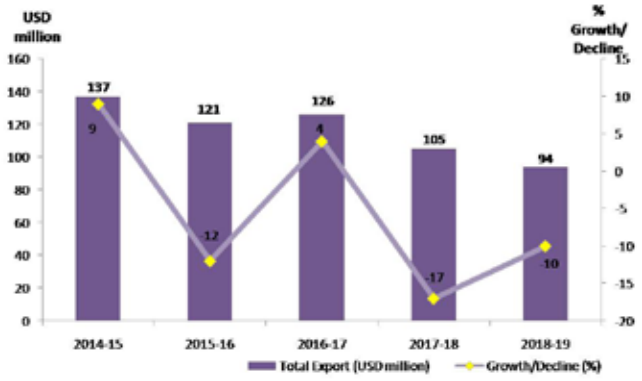
5 Year Export Trend of Preserved Cucumber & Gherkins in India



Top 5 Importers of Mango Pulp from India (2018-19)



5 Year Export Trend of Preserved Cucumber & Gherkins in India



15 to USD 355 million in 2018-19.

EXPORT OF MANGO PULP

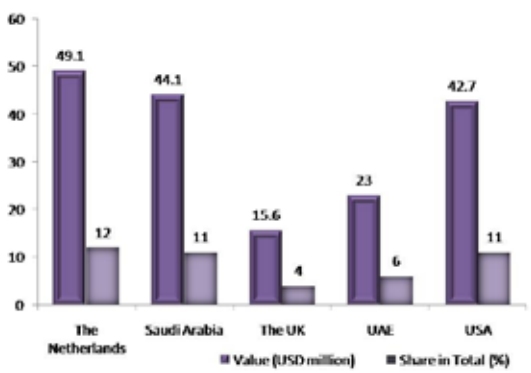
The relevance and importance of food processing further magnifies when one finds that mango pulp export exceeds the export of fresh mangoes which has already been discussed in one of the previous sections. 3 out of the top five countries in terms of importing mango pulp from India are from the middle east and adjoining region. Saudi Arabia, Kuwait and Yemen together imports about USD 38 million worth of mango pulp from India, with Saudi Arabia being the largest importer in 2018-19 with an import value of USD 20.3 million. The United Kingdom (USD 7.1 million) and the Netherlands (USD 9 million) are the other two countries among the top five importing countries in this category.

In the backdrop of the New Agri Export Policy introduced in the Country in 2018, products like mango pulp holds much of an importance. While mango is usually a crop that exhibits alternate bearing (producing more fruits in alternative years), it is food processing and products like mango pulp which can actually help to protect farmers from inconsistent production and earn valuable foreign exchange. The rapid decline in mango pulp export during the last five years is a point of concern.

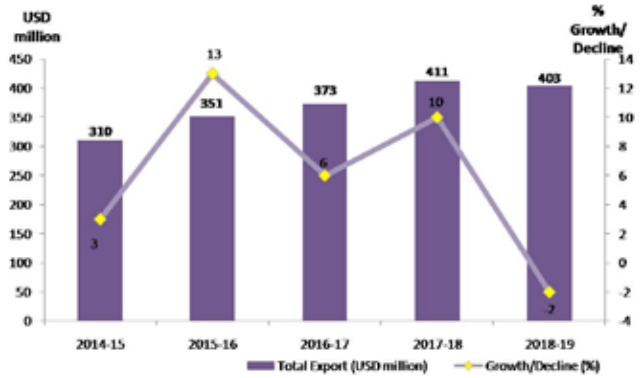
EXPORT OF PROCESSED FRUITS, JUICES AND NUTS

Netherlands is the top importer in the category with an import value of USD 49.1 million in 2018-19. Saudi Arabia follows as the second highest importer with an import value of USD 44 million, closely followed by USA as the third largest importer with a value of USD 43 million in 2018-19. UAE (USD 23 million) and the UK (about USD 16 million) are the other two countries in the league of top 5 importers of processed fruits, juices and nuts. Together, these top 5 countries import a combined value of

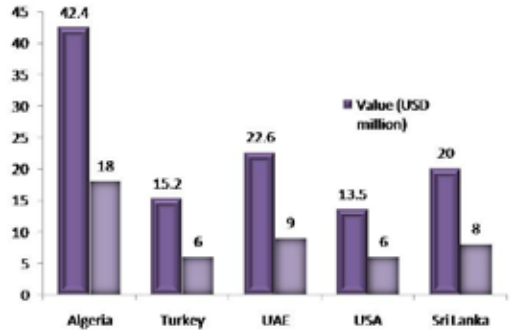
Top 5 Importers of Processed Fruits, Juices & Nuts from India (2018-19)



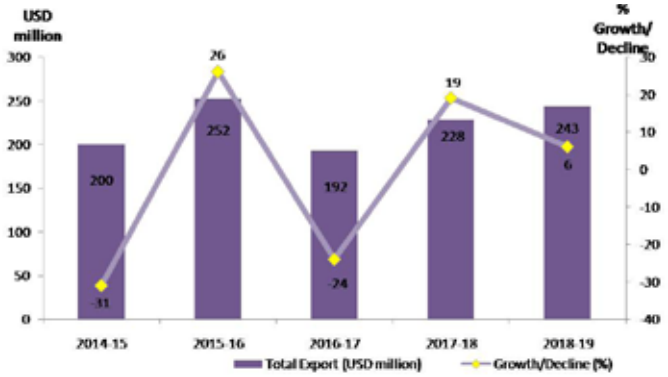
5 Year Export Trend of Processed Fruits, Juices & Nuts in India



Top 5 Importers of Pulses from India (2018-19)



5 Year Export Trend of Pulses in India



USD 174.5 million and shares 44% of the total exports by India in this category.

A look at the five year export trend in this category reveals a net increase of 30% which is an encouraging trend. The export has increased from USD 310 million in 2014-15 to USD 403 million in 2018-19 with a peak reached in 2017-18, when the export value was USD 411 million.

EXPORT OF PULSES

Pulses export in India is highly dependent on domestic production and ability to meet domestic consumption, failing which Government imposes export ban on pulses. In 2018-19, Algeria was the top most export destination for Indian pulses. Pulses worth USD 42.2 million were exported during the year constituting 18% of the total export value of pulses in India. UAE (USD 22.6 million) and Sri Lanka (USD 20 million) are respectively second and third largest destination of pulses in terms of export value.

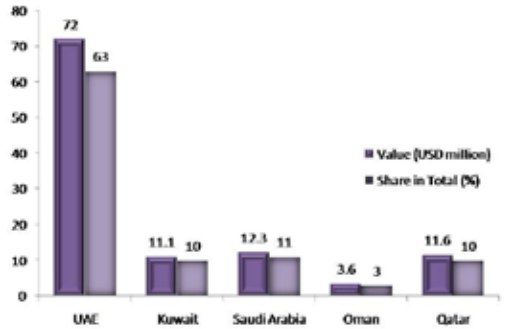
As already indicated, pulses export in the country is a story of regular fluctuations, mainly because of trade restrictions imposed from time to time during period of deficit production and consequent need to safeguard domestic demand and contain domestic prices. However on an overall scale between 2014-15 and 2018-19, the export of pulses grew by 21.5%. Considering the fact that there has been record production of pulses in the recent years and in the event of further increased production this year too export of pulses can be expected to continue to increase.

EXPORT OF CHIVON & LAMB

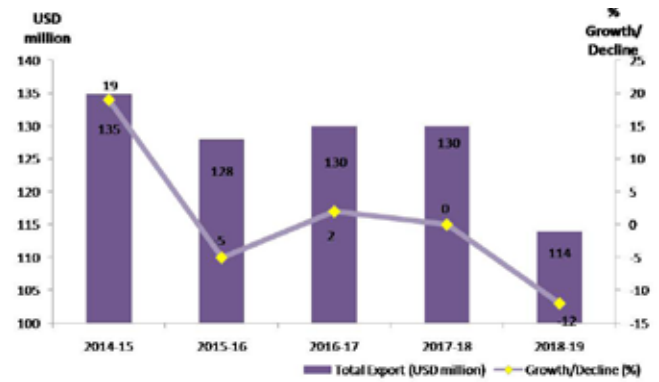
UAE is the largest importer of chivon and lamb from India and in 2018-19, it alone imported USD 72 million worth of these meats accounting for 63% of the total export of India in this category. States like Rajasthan, Jammu & Kashmir, Uttar Pradesh, Gujarat, West Bengal, Hilly regions of North and Eastern Himalayas are the major regions with maximum population of goat and sheep. However, only few of these states dominate the export sector leaving a wide room for developing the export potential of the other states where the population of goat and sheep are comparatively higher.

The export scenario of sheep and goat meat is on a serious downward spiral, threatening the livelihood and business of many farmers and exporters in this sector. 2018-19 witnessed a sharp decline to USD

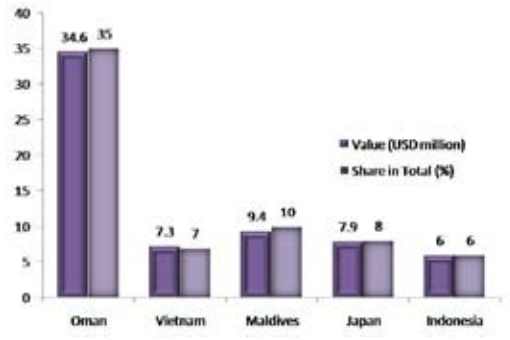
Top 5 Importers of Chivon & Lamb from India (2018-19)



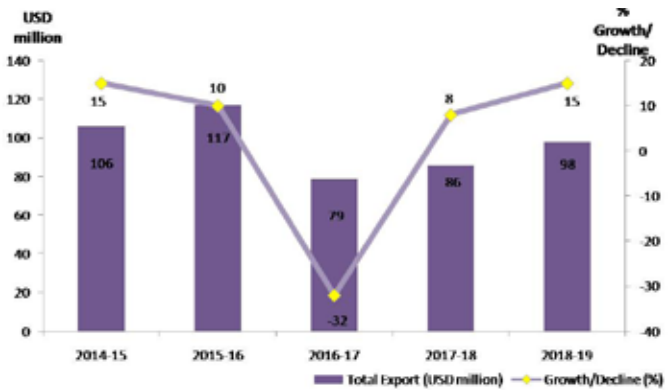
5 Year Export Trend of Sheep and Goat Meat in India



Top 5 Importers of Poultry Products from India (2018-19)



5 Year Export Trend of Poultry Products in India



114 million from USD 130 million in 2017-18. A major reason for this sharp decline could be attributed to government to ban exports by sea (mainly to the UAE). In 2018, the Shipping Ministry banned small country craft from exporting animals from Gujarat's ports.

EXPORT OF POULTRY PRODUCTS

Oman is the highest importer of poultry products from India accounting for 35% of India's total poultry export and a value of USD 34.6 million. Top 5 importers of poultry products from India together constitute 66% of India's total export in this category. Live Poultry of different weight categories, edible poultry meat (both fresh and frozen), eggs in shells, dried egg yolk etc. are the major categories which come under poultry products.

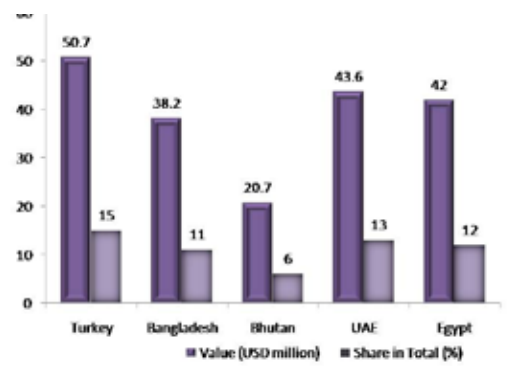
Between 2014-15 and 2018-19, the export value of poultry products in India has declined on an overall basis by 7.5%. India exported a total value of USD 106 million in 2014-15 which dropped to USD 98 million in 2018-19. The bright spot during this period was in 2015-16 when the export shot up to USD 117 million. The steepest decline was in 2016-17 when just USD 79 million worth of poultry products were exported by India.

EXPORT OF DAIRY PRODUCTS

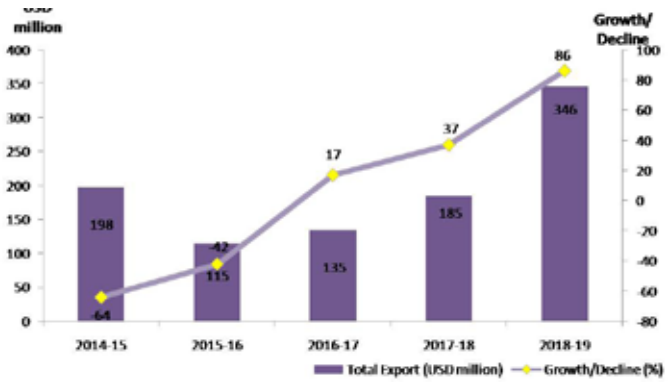
Dairy products constitute an important segment of the agri export basket of India. Turkey, Bangladesh, UAE, Bhutan and Egypt are the top 5 importers of dairy products from India and together they import USD 195 million representing a share of 57% of the total export of dairy products by India in 2018-19. Turkey has been a consistent major importer of dairy products from India and in 2018-19, it imported products worth a total value of USD 50.7 million from India. UAE is the second largest country with imports worth USD 43.6 million closely followed by Egypt in the third position with USD 42 million. The other two countries in the top 5 league are Bangladesh (USD 38.2 million) and Bhutan (USD 20.7 million).

2014-15 was a bad year for India in terms of export of dairy products because it witnessed a massive 60% decline in export compared to the previous year. However, the dairy export sector has bounced back after 2014-15 and has grown consistently since then till 2017-18. Last year was a rewarding one when India exported almost double the value of USD 185 million it earned in 2017-18.

Top 5 Importers of Dairy Products from India (2018-19)



5 Year Export Trend of Dairy Products in India



IMPACT OF ICT IN AGRICULTURE SECTOR

In the last few years, technology and digital medium is transforming the nature and mode of information dissemination for farmers and other stakeholders of the agriculture sector all throughout the world. Following is an exhaustive list of important apps that have been launched in recent years:

LOGO	APP NAME	ESSENTIAL FEATURES
	**RainbowAgri**	Host of services where farmers can talk to communities, users and farmers can buy and sell local products and buyers can even get live price updates.
	**MandiTrades**	One can get commodity prices directly provided by the Government of India, information on the produce and a map based view of available farm products with the ability to connect to a farmer through a simple phone call through this app.
	**Mpower Social**	Mpower's Livestock management System (LMS) aims to bridge the ease of access gap between veterinarians and livestock farmers. It connects the small holder to the livestock professionals via livestock intermediaries.
	**AgriApp**	One of the most liked apps by farmers of India. It is an online farming marketplace bringing Kisan, farming input/output, government service on an online platform. It also provides chat option for farmers.
	**Iffco Kisan App**	It is a small Android app in terms of memory with an easy interface to use providing information about the latest agriculture advice, latest mandi prices, and various farming tips. It also provides weather forecast information.
	**Agri Media Video App**	It is one of the most popular mobile apps for farmers in the video category. It is an online marketplace bringing farmers, agriculture input/output, farming retail and fulfilment service on an online platform.
	**FarmBee - RML Farmer**	It is available in 10 different Indian languages. It provides fertile agriculture content and information at every stage of the crop life cycle. A farmer can choose from 450 crop varieties, 1300 markets, 3500 weather locations. It also provides mandi price and weather forecast based on a user location.

	**Kisan Yojana**	It provides information about all Govt schemes to Kisan. It commutes the information gap between the rural people and Govt. It also provides the schemes of the different states Government.
	**Kisan Suvidha**	Launched by the PM Narendra Modi in 2016 to work towards empowerment of farmers and development of villages, the app design is neat and offers a user-friendly interface. It provides information on current weather and also the forecast for the next five days, market prices of commodities/crops in the nearest town, knowledge on fertilizers, seeds, machinery etc. The option to use the app in different languages makes it more widely accessible.
	**Pusa Krishi**	Was launched in 2016 by Indian Agriculture Research Institute (IARI) to help farmers get information about technologies developed and to help in increasing returns to farmers. The app provides farmers with information related to new varieties of crops developed by Indian Council of Agriculture Research (ICAR), resource conserving cultivation practices as well as farm machinery.
	**SmartGaon**	'SmartGaon' connects Indian villages and their residents to the world of information and technology. Its knowledge and information center, market place and helpline making the 'gaon' a 'SmartGaon'. It provides awareness about Government Schemes & Policies to Farmers and setup good digital Infrastructure in village so that all villagers can be connected across the globe
	**Crop Insurance**	The app helps farmers to calculate insurance premium for notified crops and provides information cut-off dates and company contacts for their crop and location. It can also be used to get details of normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified area.
	**AgriMarket**	This app has been developed with an aim to keep farmers abreast with the crop prices and discourage them to go for distress sales. Farmers can get information related to prices of crops in markets within 50 km of their own device location using the AgriMarket Mobile App.
	**eNAM**	eNAM is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. Small Farmers Agribusiness Consortium (SFAC) is the lead agency for implementing eNAM under the aegis of Ministry of Agriculture and Farmers' Welfare, Government of India.

IMPORTANT AND RECENT GOVERNMENT INITIATIVES FOR THE FARM SECTOR

MINIMUM SUPPORT PRICE (MSP) HIKE

In 2018, in a major decision, MSPs of all major agri commodities were substantially increased from the existing level. MSPs for kharif crops were increased ranging from Rs. 200 to Rs. 1827 per quintal. In the process, return ranging from 50% to 97% return over cost of production was ensured for the kharif crops. Similar substantial increase in MSPs was declared for various rabi crops. MSP for wheat was increased to Rs. 1840 indicating a return of at least 112.5% over the cost of production (CP) of Rs. 866. The revised MSPs crops like Masur (CP: Rs. 2532/quintal), Barley (CP: Rs. 860/quintal), Rapeseed and mustard (CP: Rs. 2212/quintal), Gram (CP: Rs. 2637/quintal) and Safflower (CP: Rs. 3294/quintal) represent return over cost of production of respective crops which are 77%, 67%, 90%, 75% and 50% respectively.

"PRADHAN MANTRI ANNADATA AAY

RISE IN MSP FOR VARIOUS CROPS, 2018

- Rise in MSP for 14 Important Kharif Crops
- Revised MSPs for Important Rabi Crops:

Crop	MSP (/qntl)
Paddy (Common)	1750
Wheat	1840
Masur	4475
Barley	1440
Rapeseed and Mustard	4200
Gram	4620
Safflower	4945

SANRAKSHAN ABHIYAN" (PM-AASHA)

The Scheme is aimed at ensuring remunerative prices to the farmers for their produce as announced in the Union Budget for 2018. It is expected that in addition to substantial increase in MSP, PM-AASHA scheme will help in MSP to will be translated to farmer's income by way of robust procurement mechanism in coordination with the State Governments. It is essential that if price of the agriculture produce market is less than MSP, then in that case State Government and Central Government should purchase either at MSP or work in a manner to provide MSP for the farmers through some other mechanism. With this approach, the Umbrella Scheme of PM-AASHA with three sub-schemes i.e. Price Support Scheme (PSS), Price Deficiency Payment Scheme (PDPS) and pilot of Private Procurement & Stockist Scheme (PDPS) was launched in 2018.

FAIR AND REMUNERATIVE PRICE FOR SUGARCANE

- Fair and Remunerative Price (FRP) that sugar mills pay to cane growers has been increased by Rs 20 per quintal, from Rs. 255/ quintal to Rs. 275/quintal
- This FRP of Rs. 275/quintal is for a basic recovery rate of 10%
- For recovery of each 1% over and above 10%, farmers will get an additional Rs 2.75% per quintal

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INTERNATIONAL

H.E. Mr. Bulat Sergazyuly Sarsenbayev
Hon'ble Ambassador
Embassy of the Republic of Kazakhstan

INVESTMENT OPPORTUNITIES IN AGRO-INDUSTRIAL COMPLEX OF KAZAKHSTAN

Due to vast territory, availability of varied landscapes and climatic zones, rich natural resources, Kazakhstan's agriculture has great potential, which suggests that in the 21st century our country can become one of the world's largest producers of agro-products and foodstuff supplies.

At present, the agricultural sector of the Republic of Kazakhstan, is one of the most rapidly developing sectors of the economy, ensuring not only the country's food security, but also its socio- political stability.

Today, about 821 million people in the world (of which 195 million in India, according to the UN), are undernourished on an ongoing basis. According to the forecasts of the World Bank (Global Economic Prospects, 2019), due to the rapid expansion of consumption, in the coming years, world food prices will continue their steady upward movement. By 2050, the world's population will exceed 9 billion with an annual demand of 14 billion tonnes of foodstuff (an increase of 2 times compared to 2009). At the same time, the current growth rate of foodstuff production does not keep pace with the increase in the number of inhabitants on Earth. In this regard, the provision of international markets with high-quality and affordable agricultural produce is of utmost importance.

In Kazakhstan, the agricultural cultivated land area is more than 210 million hectares (2nd place in the world per capita), while 180 million hectares of them are pastures (5th place in the world after China, Australia, USA & Brazil). The current load on the land resources is only 25-30%. These figures indicate a huge potential for development and the possibility of attracting investment in the agricultural sector. This is confirmed by the fact that over the past 5 years, Kazakhstan has attracted more than $ 1.3 billion in foreign direct investment in Agro-Industrial Complex.

The main task of the Agro-Industrial Complex

is to increase the share of finished processed products by increasing competitiveness, because today about 80% of agricultural products produced in Kazakhstan, are sold as raw material. The average annual growth rate of food production, in general, does not keep pace with the growth rate of consumption and income of the population, which contributes to growth of imports. The main share in the structure of food production is occupied by Foodgrain processing industry (22.3%), followed by Dairy (16.7%), Bakery (15%), Meat processing (13.6%), Oil &Fats (7.9%), Fruits&Vegetables (7.6%) and other industries (16.9%).

The country's leadership has set ambitious tasks for the Agro-Industrial Complex. In his message to the people of Kazakhstan dated January 10, 2018, "New opportunities under the Fourth Industrial Revolution", the First President of Kazakhstan, Mr Nursultan Nazarbayev indicated the goal to increase productivity of labour and export of primarily processed agricultural products, at least by 2.5 times by the year 2022. Another major task is the transfer of advanced agricultural technologies from abroad and their adoption by local farmers.

To achieve these goals, the Government of Kazakhstan is improving mechanisms and enhancing the volume of state support. In particular, if earlier the entire state support was 240 billion Tenge plus 60 billion Tenge of budgetary credit, which at the end of the year is refunded back to the budget, i.e. in fact, returnable funds, now an additional 100 billion Tenge will be allocated annually for the purposes of the State Program, as well as 200 billion Tenge to solve the problem of affordable lending to

priority Agro-industrial projects. Thus, the volume of state support increases by two times.

In accordance with the State program for the development of the Agro-industrial complex of the Republic of Kazakhstan for 2017-2021, it is planned to increase the competitiveness of the agro-industrial sector by increasing productivity of labour from 1.2 million Tenge per capita employed in agriculture in 2015 to 3.7 million Tenge by 2021, as well as the export of processed products from $ 945.1 million in 2015 to $ 2,400 million in 2021.

Kazakhstan has a State program for the development of agriculture "Agribusiness 2017-2021", which provides for various support tools, including subsidies in crop production and animal husbandry. At the same time, the most important role in the development of the industry is played by science and education: research institutes, laboratories, higher educational institutions of the agrarian profile. In general, the system of state support for the Agro-industrial complex is multi-level, consisting of the following domains: Subsidies and preferences, Target and concessional credit lending, Tax incentives, Government Support & provisioning.

The Ministry of Agriculture of the Republic of Kazakhstan is implementing a measure to reimburse 25% of investments in priority areas of the Agro-industrial complex. The procedure for obtaining subsidies is simplified and automated to a maximum. For example, the timing of the issuance of subsidies for mineral fertilizers is reduced to three working days. The decision on payment is made by the information system, without human interface.

At the same time, the Government has also introduced a set of investment preferences:

- Exemption from corporate tax for up to 10 years;
- Exemption from property tax for up to 8 years;
- Exemption from customs duties on imported equipment and raw materials;
- Provision of state natural grants (for land, buildings, structures, equipment, etc.)

If earlier the entire volume of state credit support amounted to 240 billion Tenge plus 60 billion Tenge of budgetary credit, then this year it is planned to allocate an additional at least 100 billion Tenge, as well as 200 billion Tenge to solve the problem of

affordable lending to priority Agro-Industrial projects. Thus, the total amount of state support increased by 2 times.

In recent years, Kazakhstan has significantly changed its tax policy in the direction of reducing the tax burden. In the Agro-Industrial Complex, a special regime is applied, providing for a 70% tax rebate.

The expansion of the work of financial institutions should be a powerful impetus for the further development of the Agro-Industrial Complex. In this regard, one of the important tasks is the re-orientation of Kazakhstan's second-tier banks towards lending to the Agro-industrial complex, as well as working with international funds. The transition from compulsory insurance to voluntary and from voluntary insurance to subsidizing insurance premiums is concluded. The system of credit partnerships is being improved, which will make it possible to attract extra-budgetary funds. These tools allow solving the main and urgent problem of farmers in terms of accessibility to sources of financing.

Currently, the Agro-Industrial Complex of Kazakhstan is facing a primary goal - access to world food markets with high-quality finished products. In this regard, attracting investment in Agro-industrial complex, transfer of new technologies and best practices comes to the fore.

Systematic work is underway to harmonize veterinary and phyto-sanitary requirements, harmonize legislation in the field of technical regulations, integrate into the WTO, the EAEU, and enter markets of neighbouring countries. Today, the veterinary legislation of the Republic of Kazakhstan is fully synchronised with international legislations.

Kazakhstan is part of a single economic area of the EAEU [Eurasian Economic Union] countries with a 180 million market. Much work has been done to gain access to the largest market in China, as well as with a number of countries in the Middle East. Negotiations are under way in final stage with Malaysia, Japan, South Korea and the European Union. An important issue is the coordination of import-export procedures for the supply of food supplies to India.

An important qualitative advantage of Kazakhstan is the environmental friendliness of products. Today "Made in Kazakhstan" is a symbol of natural organic ingredients grown pure in natural conditions.

As for the types of products themselves, already today the niche products are food products, for which Kazakhstan largely depends on imports: poultry meat, apples, cheeses and cottage cheese, sausages, fish and sugar. In general, for these types of products, production potential is more than $ 1 billion. The most promising competitive niche have been identified in order to effectively promote in global markets:

- Meat production and processing;
- Dairy products;
- Processing of oilseeds;

- Deep processing of grain;
- Fruits and vegetables.

Under the poultry program, it is planned to increase the level of poultry meat production by 3 times (from 200 thousand tonnes to 700 thousand tonnes) and thereby ensure import substitution.

There is the potential of raw materials (raw milk) for the production of dairy products: on average over the last 5 years, 5 million tonnes of raw milk was produced annually. Taking into account transport costs from Russia to Kazakhstan and the lower average cost of labour in Kazakhstan; local products have the potential to replace imported dairy products from Russia.

Currently, the area under oilseeds is 2.3 million hectares. At the same time, it is planned to increase in the coming years to 3.2 million hectares. Kazakhstan - has the competence to grow sunflower, safflower, rapeseed, flax, soy. The country is the 4th largest exporter of flax seeds in the world. The nearby Chinese market is with import dependence on oilseeds –of $ 38 billion a year.

Kazakhstan is a major producer of grain and flour. High potential exists in the deep processing of grain with the production of gluten, starch, and molasses. There are several large industries in Kazakhstan, where these products are used, but not enough production capacities to close import lots. Moreover, these products are in great demand in the global market. It is important to note access to cheap raw materials. At the same time, even the domestic market is not saturated, last year the imports of the above products amounted to $ 9 million.

In Kazakhstan, more than 500 thousand hectares are available for growing fruits and vegetables. In addition, the area of irrigated land is 1.5 million hectares; by 2020 it will be increased to 2.1 million hectares. And the current area of greenhouses is more than 1000 hectares. In general, the prospects for investing in this production are due to the following factors:

- Low cost of electricity.
- In the southern regions, the number of sunny days is 263 days, with an average summer temperature of about 25-27 degrees Celsius.
- Kazakhstan's import of tomatoes and apples in 2016 amounted to $ 42 and 41.6 million respectively.
- China's imports of the same products were $ 170 and $ 123 million, respectively.

In addition to the implementation of system and industry measures, there is support for large investment projects. Currently, the national operator in the field of attracting investments JSC "NC"KAZAKHINVEST"supports 36 ongoing projects with participation of foreign investors for a total amount of about $ 3 billion. At the same time, work with transnational companies that invest not only in capital, but also in new production technologies, introduce new approaches to management and the ability to export products internationally, under the logo of recognized global brands is of particular importance.

The Entrepreneurial Code of the Republic of Kazakhstan guarantees full protection of investors' rights and the stability of concluded contracts, and also very clearly regulates the work of state bodies in relation to investors (free movement of capital, repatriation of capital, freedom to use profits, including for foreign investors).

For investors who come to the agro-industrial sector in Kazakhstan, the key is not only making profits due to the presence of brilliant opportunities in global markets, but also long-term benefits. In particular, for Indian businessmen, there is an excellent opportunity to invest in food production in Kazakhstan, which has low cost and high quality, to ensure the food security of India in 21st century.

The representative office of "KazakhInvest" National Company, recently opened in Delhi. The main purpose of the office's activity is informing Indian companies about investmentopportunities,preferences and government support measures provided to foreign investors entering the Kazakhstan market (a.nuralina@ invest.gov.kz).

Embassy of Georgia in New Delhi

WINE IN A QVEVRI

Embassy of Georgia in New Delhi

HOMELAND OF WINE

The Georgians – one of the oldest nations of the world – have been living on the southern slope of the middle part of the Caucasus Range, near the Black Sea. According to researchers, it is the place where man "domesticated" the first vine and made the first wine, as long ago as approximately 6000-8000 BC.

The soil and climate diversity has greatly contributed to the development of viticulture in Georgia, where numerous varieties of vine and grapes have been cultivated from time immemorial, of which over 500 are of local origin.The ancient Georgian viticulture has been described in numerous legends and Greek and Persian manuscripts.

Wine is the national pride of Georgia. It is the holy of holies – an integral part of Georgian culture and the oldest tradition. Based on scientific and archeological research data, one may say with confidence that Georgia is a country of vine and wine, where many varieties of grapes have been developed, where the archaic vine growing and winemaking techniques have been preserved and are still being employed.

In the course of its centuries-old history, the country has developed a unique winemaking technique – pouring grape juice into qvevris, large clay vessels buried in the earth up to their tops, then sealed. Since antiquity, this knowledge has gradually developed and improved, nourished by experience. The qvevri and its technology have evolved over time, yet due to its uniqueness, it has reached us almost unchanged after many centuries.

ADVANTAGES OF USING THE QVEVRI

The benefits of making and storing wine in a qvevri is a subject highly significant for traditional Georgian winemaking. There are three key advantages focusing the qvevri in vinification: achieving a natural temperature balance in the qvevri; wine fermentation and aging; removing tartar from qvevri wine.

Winemaking in factory conditions that require chemical additives to render a desired stability and clarity to the wine is very different from the traditional methods using the qvevri and marani (wine cellar in Georgian). The latter process is natural and requires no chemical agents, provided that the qvevri and marani themselves are made and arranged according to proper standards.

The primary benefit of using the qvevri is that the wine temperature varies only a few degrees in winter and summer. The optional temperature for wine storage and maintenance is naturally maintained in a qvevri, while under factory winemaking conditions temperatures have to be maintained by costly equipment.

In qvevri-winemaking, the second and one

of the most important processes is the fermentation and aging. Qvevri not only stores the wine well but also contributes to the processes of fermentation and aging better than the other vessels.

In making a Kakhetian- or Imeretian-type wine in a qvevri, all processes are carried out chronologically and naturally, which under factory conditions, require different techniques and chemical additives.

Under factory conditions, the alcoholic fermentation in steel tanks is often accompanied by using European yeast culture. We believe that with these technologies, Georgian or European wines take on a uniform character and, as a rough comparison resemble bottled soda that is very similar all over the world, irrespective of where they are bottled. Such wines are almost completely devoid of any unique character.

Wine produced using the qvevri is characterized by its unique type, stability, high potential for aging, natural brilliance, distinguished flavor and aroma, high tannin content, and other positive properties. Maintaining wine in qvevri with a natural temperature balance and optimal fermentation temperature makes European yeasts unnecessary. Even in the case of Kakhetian-type white wines, the wine can frequently stay on the pomace until early spring.

One might wonder how such wine avoids the negative effects of the lees, or grape sediment. The answer is found in the very specific shape of the qvevri: the bottom of a qvevri is a particular form of pointed cone. At the end of fermentation, most grape seeds separate from the skins and sink to accumulate in the bottom of the vessel.

This process is further facilitated by mixing the pomace. Under the effect of pressure, the grape seeds in the bottom of the vessel are covered by the lees, which, under heavy pressure, cause the seeds to be separated from the wine. After fermentation has completed the grape skins remain floating on the surface under the effect of carbon dioxide inside the skins, while the lees sink to the bottom. Thus, the wine itself remains in contact only with the skins and extracts maximum substances that are beneficial for human health. It is reputed that Kakhetian-type white wines contain many more beneficial substances than European pomace-free fermented wines. The fact that qvevri-made wines are naturally stable and do not require the addition of any chemical agents for stabilization, is illustrated by Kakhetian wines, which are rich in tannins. These are known for their ability to bind wine proteins that would otherwise make the wine turbid. Therefore, Kakhetian wines are not prone to such wine turbidity, which explains the natural stability and brilliance of these wines.

The completion of fermentation usually coincides with a gradual decrease in the ambient temperature and cold weather. This favorably influences wine clarification and the removal of tartrates. Removing tartrates from wine in ancient times was carried out differently than today. In old fragments of qvevri walls very finely crushed pieces of flint have been found as admixtures (also found are other admixtures that have not been studied in terms of winemaking technology).

These presumably were used for the removal of tartrates from wine, which requires cold weather, as well as other effective techniques sometimes applied in wineries. In particular, tartrates were washed in alcohol and ground, and then added to wine. As a result, both the added tartrates and those naturally available in wine are then extracted. Since silicon is a high quality crystal and wine is in constant contact with it while in qvevris, this may produce the same effect as the addition of tartrates to wine. In addition to this, silicon in the qvevri walls reinforces the strength of the qvevri itself.

Tartrates are also removed from wine by alcohol formation. Qvevri wines and specifically Kakhetian-type ones have a high alcohol content, which naturally facilitates the removal of tartrates.

UNIQUENESS OF QVEVRI WINE

Even though qvevris are found everywhere in Georgia, almost every region has different winemaking practices. Formerly, some of these were classified as Kakhetian, Imeretian and Meskhetian winemaking. A number of factors, including local soil types, climatic conditions, local

customs and habits, the vintage year and the variety of grape and their chemical composition, conditioned all the practices found in a specific region.

For example in Kakheti, crushed grapes were fermented in qvevri with the whole chacha (grape skins and seeds). Whereas with Imeretian wine, only a third of the pomace was used during fermentation. The locality where the grape variety is grown and harvested affects taste as well.

A primary and very important technique of qvevri winemaking is leaving the wine on its own pomace both during fermentation and after. In this case, traditional Kakhetian winemaking is of special interest. The Kakhetian technology of making white wines in qvevri implies pouring rkatsiteli grapes into the qvevri with all their pomace, or else first crushing the grapes in a wine press and then adding pomace to the must in qvevri. In both cases, the alcoholic fermentation takes place using the total mass of pomace. Upon completion of the fermentation, when the floating pomace has precipitated, or settled to the bottom, the qvevri is filled up and lidded. There is some debate about whether Kakhetian wine should be left on its pomace for fermentation. Red wines are left with skins and seeds only during the alcoholic fermentation period, which may last from seven to ten days, or two weeks at most. However, to determine the length of time grape juice should be left on pomace, we have to consider the grape variety, the duration of alcoholic fermentation, ambient conditions, etc.

With white wines, the old Kakhetian method was to leave wine on the pomace from autumn until the following spring (beginning of March). During this period, wine acquired the typical Kakhetian character. The widespread opinion that wine that is fermented on the pomace for a long time becomes rough and substandard is unfounded. Wine turns rough and substandard only when the necessary standards and technological processes are not adhered to.

Wine from Kakheti that was fermented on the pomace acquires a dark straw, golden or tea color; it is absolutely clear and brilliant, noted for fruity tones and, very importantly, is naturally stable.

Not only is such wine devoid of cloudiness but it contains beneficial nutrients for human health. The alcohol extracts a maximum of beneficial substances from the grape pomace. When this unfiltered and unprocessed wine is bottled, it can still be preserved and stored well.

Wine quality is influenced by more than one factor of course. First to be considered is the qvevri itself – both its quality and cleanliness. Other factors are post-fermentation temperature; the grape variety; the vineyard location; the level of grape maturity and its chemical composition; the period of fermentation with the skins and seeds; and the hygiene of the marani. Also, if incompletely fermented, or if the wine in qvevri has not been kept on its own pomace sufficiently, it fails to develop all its beneficial qualities, and the qvevri will not have time to impart its qualities to the wine. Imeretian winemaking techniques use only a third of the pomace at most, which is poured into the qvevri from the winepress. White-grape varieties are used here as well.

Pomace-free fermentation is also used in Georgia. This so-called "European winemaking technology", has been practiced here since ancient times. Some Georgian provinces also blended the juice and pomace of several grape varieties, then fermented and aged this blend in qvevris. For example, in the Khidistavi village near the Kartli town of Gori, they knew how to make a wine which was famous throughout East Georgia called khidistauri. This was created by blending the Kartli grape varieties chinuri, tavkveriand goruli. Formerly, in Racha, the famous khvanchakara was made by fermenting a blend of alexandrouli and mujuretuli grapes.

However, Georgian winemaking methods generally call for fermenting the grape juice (tkbili) with the grape pomace (chacha) and aging it in qvevris. Even though European (pomace-free) winemaking technology has been long known and practiced in Georgia, only wine that has been fermented and aged for some time in the qvevri is customarily called Georgian "traditional wine".

Sometimes the wine and pomace are separated from one another after fermentation is over, or even prior to its completion, as in the case of Kakhetiansaperavi. However, the wine separated from the pomace should be returned to the qvevri and not to a different vessel (e.g. a barrel, tank, etc.).

According to an erroneous popular view, qvevri wine cannot be stored more than a year without deteriorating. Where the qvevri can no longer ensure quality storage of wine, the cause is not the qvevri itself but poor maintenance and sanitation conditions.

Qvevri wine can be stored unspoiled for a long period of time, if all the requirements are met concerning wine storage, marani

design and sanitation. Formerly, wine was stored in qvevris for decades, although wine quality and condition probably required periodic check-ups and interventions where necessary.

Properly maintained and washed qvevris and a well-arranged marani are the necessary preconditions for durable and safe wine storage. If a wine can be durably stored in oak barrels and steel tanks for years, it can be preserved all the better in a qvevri. In general, if the qvevri stores wine for at least two years, it means that it can do so for much longer periods as well.

SACRAMENTAL (ZEDASHE) QVEVRI AND WINE

Although qvevri winemaking is a subject unto itself, sacramental wine and qvevri can be regarded as a special phenomenon. Making sacramental wine does not differ greatly from traditional winemaking – the principal difference is in the conceptual and perceptual aspects of sacramental wine.

According to the Georgian language dictionary, sacramental (zedashe) wine is that which is used during religious ceremonies such as the celebration of the Eucharist (the Lord's Supper) or weddings. Another definition states that sacramental or zedashe wine is the best wine, specially reserved for religious holidays. The sacramental qvevri and wine culture was found throughout the country, however this phenomenon is more frequently encountered in East Georgia, specifically in Kakheti. Formerly, practically every marani had at least one sacramental qvevri buried in the ground. Almost all families with a marani kept a sacramental qvevri for wine intended for donation to churches and monasteries and for their own consumption during secular or religious holidays.

Sacramental qvevris served as a peculiar reference point and always occupied their own distinguished place in the marani. Other qvevris were placed in relation to the zedashe qvevri, depending on its location in the marani. The zedashe qvevri did not necessarily occupy the central place among other qvevris; quite the contrary, it was placed separately from other qvevris for quality storage in a cool, dark and relatively secluded place.

We lack data concerning the difference in the ordinary and sacramental qvevri-making technology. Differences have not been observed in the cases of liming and/or waxing of the zedashe qvevris, however it appears that sacramental qvevris had to be washed more thoroughly, and in the past, the procedure probably took longer than today.

Making sacramental wine requires special attention and care, starting with qvevri washing and marani hygiene and ending with fermentation, aging and storage. During alcoholic fermentation, the pomace needs to be regularly stirred inside the qvevri. This process must be repeated five times a day at least. In general, it is advisable that the pomace be agitated in the qvevri once every two or three hours at least, especially during fermentation.

When the fermentation is over, the pomace and wine are separated and the latter is decanted into another qvevri. Then the sacramental wine should be given a complete rest for some time. The first drawing of wine from the qvevri occurs at different times depending on the location, region, vintage year, and other factors.

Only red grape varieties are used in making sacramental wines. Using white grape varieties or even adding white grape juice to the sacramental wine is prohibited. Blending red and white wine is inadmissible even in the smallest proportion. Also, sacramental wines should have no contact with water. For this purpose, washed wine vessels (qvevri, barrel, glass-ware, etc.) must be used only when well dried. Grapes producing rosé wines should never be used in sacramental winemaking. In general, native Georgia red grape varieties are used, such as saperavi, dzelshavi, otskhanurisapere, Kartlian or Kakhetiantavkveri, shavkapito and other varieties.

QVEVRI MARKS

A qvevri mark is the incision made by the qvevri-maker on the neck of the vessel. The qvevri mark identifies its maker, its origin, the date it was made, etc. Frequently,qvevri marks let us know exactly where they were made and from where they were taken.

Most old qvevris are stamped with signs such as the qvevri-maker's initials, the artisan's full name, the year of manufacture, various ornaments, a cross, borjghali(a Georgian symbol of the sun with seven rotating wings), where it was made and its capacity.

According to the popular legend, the qvevri mark was also a mark of quality. Such marks could not be automatically passed on from father to son or grandson, but instead every qvevri-maker had to earn the right to stamp his own products.

In conclusion,the Georgian qvevri is a unique vessel with an original shape, an archaic simplicity and, most importantly, it has an indispensable role in the true Georgian winemaking tradition. Thus, the qvevri is a phenomenal vessel both in its form and in content!

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DIGITAL AGRICULTURE

MOBILE APPLICATIONS FOR EDUCATION AND EXTENSION MANAGEMENT

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Managing university affairs related to education and extension in timely and efficient manner is a pre requisite for any academic institution. In agricultural universities where education, research and extension are an integral part of academics, it becomes more important as our stakeholders also becomes diverse as compared to traditional universities. Hence flow of information across the administrative hierarchies and stakeholders particularly students and farmers become very important. Traditionally it is being managed through the system of files and papers. Though time proven and still in force in most of the institutions, it consumes a lot of time and process becomes person dependent. The recent developments in the field of ICT has much to promise. Several university management systems are also available, but agricultural university is different in rules and regulations and operating procedures. Hence a customized solution is required. In view of this, IGKV has developed and implemented a customized mobile applications for ease of doing business which can also be used by other agricultural universities.

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"IGKV" MOBILE APP

IGKV introduced the next generation experience through I Mobile Application to enhance quality and effectiveness of education and learning on favorite mobile/ tablet devices.

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"CROP DOCTOR" MOBILE APP AND "VEGETABLE DOCTOR" MOBILE APP

Crop based information system is accessible from all KVKs and Research Stations, and it provides the remedies for Diseases, Insects

agriculture at his field itself. This has enhanced the efficiency of the farmer a lot. The immediate solution of the Crop Doctor in the prescription form increased the effectiveness of the outcomes. Farmers need not rush to the KVK and other agriculture agency which save the cost of travel also.

E-KRISHI PANCHANG MOBILE APPLICATION

e-Krishi Panchang mobile app provides the information related to agriculture like agriculture advice, major work to be undertaken by the farmers during the month, information of government schemes, details of farm machinery. Apart from that, it tells about the jyotish panchang which is useful for the common people. e-Krishi Panchang is very useful Mobile App for the farmers as well the people associated with agriculture. It provides useful information in the form of text, speech and pictures.

and Nutrient deficiency/Excess for most dominant Crops such as Paddy, Wheat and Maize. Vegetable Doctor App caters exclusively to vegetables. Earlier, the technology was demonstrated by distributing Pamphlets, Banner, and Lectures. Now research information is being disseminated in digital forms. Crop based decision support system increased the efficiencies, transferring the technology to the farmers of Chhattisgarh. The effectiveness of outcome has been increased. Android Mobile Apps, "Crop Doctor" and "Vegetable Doctor", which can be downloaded from Google Play store have now reached every corner of the state including the most remote places and Naxal affected areas of Chhattisgarh. The most unique feature is that it can work offline that is without internet facility. The farmer can see problems related to

DIGITAL FARMING
TAKING FARMING TO ANOTHER LEVEL

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Agriculture is in the grip of a revolution. Technology is changing the world, and farming is catching up. The agricultural sector is one of the most crucial sectors for mankind. With exponentially increasing population and scarcity of resources, the agricultural sector is under constant strain. One thing is clear that traditional methods of farming cannot feed the masses for a long time. There is a need for the agricultural sector to revolutionize. While farmers have tractors and big machinery to aid them in their work, the industry remains one of the toughest and most strenuous, when it comes to manual labour. Farming operations are becoming increasingly sophisticated as they evolve with the developments of technology. Precision agriculture, using advanced technology and big data to improve crop production and practices, is seeing more efficient and educated farming procedures brought to life. Digital information about weather, soil conditions and crop health is already helping modern farmers optimize their harvest yields. Now experts want to create further intelligent digital tools to advance connectivity in agriculture, with the objective of conserving resources, safeguarding harvests and protecting the environment.

DIGITAL REVOLUTION IN AGRICULTURE TOOLS

The digital revolution is changing the face of agriculture, with the zeros and ones that make up binary code set to become the most important tools for farmers worldwide. Highly automated tractors and combines equipped with a vast array of sensors are already traversing our fields of corn, oilseed rape, soybeans and wheat, collecting data about plant health, yields, soil composition and field topography. Drones and satellites are likewise helping farmers work more efficiently by generating millions of relevant data points. Nowadays satellite imaging allows us to analyze a single patch of land at a resolution of just 30 centimetres.

The future of agriculture depends on its

Spraying by Drones

3D imaging by Drone

digital transformation. Farmers will benefit from each of these digital transformation trends in agriculture, giving them freedom from concerns over the environment, a better yielding crop and the ability to manage their crops in new and efficient methods. As our population continues to grow, our agricultural methods must grow with it. It's time to take advantage of the technology we have at our disposal to put food on our table and create peace of mind for our farmers.

Here are some technological advancements that brings a whole new dimension to modern agriculture-

• **Drones and Crop Monitoring-** When you're working in your garden, you can typically see all of your plants at once, but farmers work in fields that span hundreds of acres meaning the only way they've been able to get a bird's eye view is from a plane. Imagine the return on investment if farmers could visualize their crops using an aerial source—without having to charter a plane. Drones are being used for crop monitoring widely across the U.S. as a means to combat drought and other harmful environmental factors. Drones that produce 3D imaging can be used to predict soil quality through analysis and planning seed planting patterns. Drones are also being used to spray chemicals on crops while being careful not to penetrate groundwater. Recent studies have shown that drones can increase the speed of spraying by five times compared to other types of machinery.

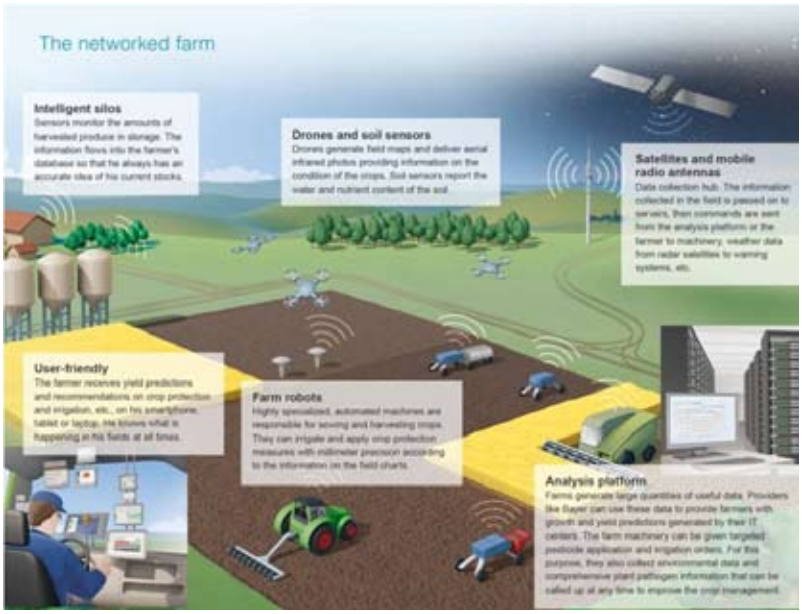
• **Farming and Robotics-** Much like using robots and artificial intelligence in other industries, robotics within agriculture would improve productivity and would result in higher and faster yields. Such robots like the spraying and weeding robots recently acquired can reduce agrochemical use. Some start-up robotics companies are experimenting with laser and camera guidance for identifying and removing weeds without human intervention. These robots can use the guidance to navigate between rows of crops on its own, reducing the manpower behind it. Some companies are creating plant-transplanting robots that add a new level of efficiency to traditional methods and finally, automation is being tested for fruit-picking and nut harvesting, something that has always seemed to be too delicate for robotics in the past.

• **RFID Sensors and Tracking -** After crops are harvested, RFID sensors can be used to track food from the field to the store. The end user, or the consumer, will be able to follow a detailed trail about the food they consume from the farm it came to the location where it was purchased. This technology could increase trustworthiness for manufacturers and their responsibility to provide fresh produce and goods.These tracking systems could reduce apprehension regarding allergens and health requirements for consumers. As for the farmer, the idea that their goods are being tracked will bring about a sense of relief. After all, they can ensure their products are making it safe to their consumer's table.

• **Machine Learning and Analytics-** Perhaps one of the most innovative pieces of the digital transformation is the ability to use machine learning and advanced analytics to mine data for trends. This can start way before

the planting of the seed, with plant breeders. Machine learning can predict which traits and genes will be best for crop production, giving farmers all over the world the best breed for their location and climate. Machine learning algorithms can also be used within the manufacturing aspect of agriculture, where consumers purchase their products. These algorithms can show which products are being purchased the most and which products are falling under in the market. Thus, creating proficient and effective forecasts for future farming.

• **Integrated Pest Management-** Integrated pest management (IPM) is absolutely critical to sustainable agriculture. Digitalization can and will help growers access the full toolbox of crop protection measures, so they can treat individual problems with the appropriate tool as part of an IPM strategy. For example, if a machine sensor knows what weed it is faced with, the sprayer can mix a solution and apply the proper herbicides. In practice this could mean, if a field contains a number of different weeds then various herbicides could be used to control the weeds. This will help prevent the use of one single product and will be useful in tackling issues such as resistance.

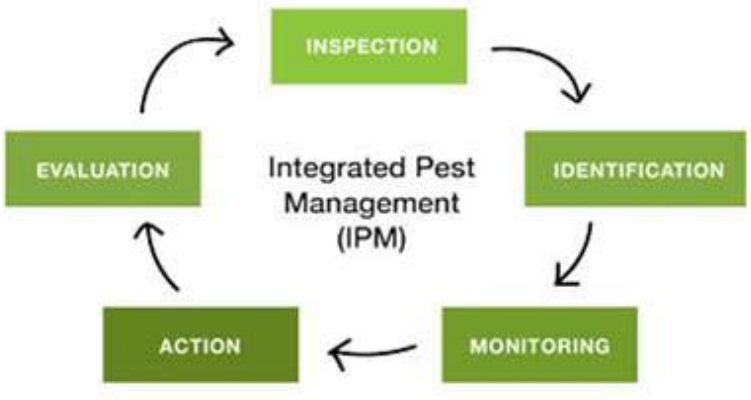


FROM PRECISION FARMING TO FARMING 4.0

Agriculture is a series of complex individual but inter-dependent processes. Agricultural work needs to be organised into efficient stages to ensure a good yield. Therefore, the success of a given product is based on a triangle formed by the farmer, technology and the service- and consulting concept.Two terms crop up at regular intervals: "Precision Farming" and "Smart Farming".

Precision Farming is an agricultural concept involving new production and management methods that make intensive use of data about a specific location and crop. Sensor technologies and application methods are used to optimise production processes and growth conditions. In contrast to conventional agricultural methods, using digital data can increase resource and cost efficiency as well as reduce environmental impact.

Information about the presence of different soil properties and productivity within a particular plot of land can be electronically retrieved from so-called field record files, enabling farmers to respond in real time. Satellite-controlled accurate lane guidance of agricultural machinery and intelligent sensors enable targeted application of seeds, fertilisers and pesticides. This enables seed quantity as well as fuel consumption to be reduced.Future concepts will not just be about size and volume. Attributes such as "smaller", "more intelligent", "more efficient" are also becoming more important, especially for medium-sized agricultural enterprises. Aerial images taken using drones provide valuable information about fields,



including for example soil quality, unwanted plants and plant diseases. Data is available relatively quickly and appropriate measures can be taken. Field robots are excellently suited to the gentle treatment of soil and plants because they are so lightweight. They are cloud-controlled and can be used to establish a specific sowing and fertilisation pattern. They are also able to remove individual weeds. However, drones and robots are only helpful to a limited extent on large acreages due to their limited flight/operating time. Large-scale crop cultivation still requires horsepower, harvesters and large agricultural machinery.

Smart Farming (also known as Farming 4.0 and Digital Farming) is the application of information and data technologies for optimising complex farming systems. The integration of smart agricultural technologies and modern data technologies enable seed planting to be adapted to a specific field to ensure an efficient production process. The application of information and data technologies support farmers in making informed decisions based on concrete data.

Smart farming is also based on precise control electronics. This paves the way for enabling agricultural machines to communicate among themselves as they can all access electronic field record files. But how does a farmer process all this information? There are farm management systems, agricultural apps and online platforms to support farmers. "Smart farming", often also referred to as "Farming 4.0", involves not just individual machines but all farm operations. Farmers can access real-time data on mobile devices (mobile phones or tablets). Data about, for example, the condition of soil and plants, terrain, climate, weather, resource usage, manpower, funding applications is collected, processed and evaluated. An agricultural business rarely purchases modern machinery and equipment from a single manufacturer. So choosing equipment providers not only depends on how efficient the equipment is, but also whether devices can be flexibly connected with each other.

ADVANCING THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)

Digital Agriculture has the potential to advance many of the SDGs. Below are some examples of areas of application across a wide variety of sectors.

SDG 2 Zero hunger

- Make better farming decisions by supplementing local knowledge developed over generations with real-time, detailed, environmental data.
- Increase yield per acre and reduced production loss, help improve food security and increase the food output, required to keep up with population growth.
- Improve transparency and sharing of information. By providing quantitative data on factors that have been difficult until now to measure and interpret, farmers will be able to improve their economic models. Financiers and insurers can also better understand risk to protect farmers financially.

SDG 6 Availability and sustainable management of water

- Waste less water through a better understanding of soil moisture, crop health and weather forecasting – provide only as much water to the plants as needed.
- Reduce chemical use and run-off into local water supplies.

SDG 8 Decent work and economic growth

- Give more power to those working in agriculture and support related innovations such as up-to-date agricultural pricing and trading – particularly the ability to facilitate trade without using intermediaries.

SDG 9 Industry, innovation, and infrastructure

- Improve resilience and effectiveness of food / farming supply chains through better integrated systems and information sharing.

SDG 11 Sustainable cities and communities

- Enable more sustainable city growth through better waste management as a result of improved integration across the food value chain.

SDG 12 Responsible consumption and production

- Provide information which allows consumers to be more responsible.
- Reduce waste through better decision making across the supply chain, using predictions of harvest yields and quality to improve planning.
- Reduce waste in storage through improved planning and by linking agricultural sensors with transport management systems to reduce food spoilage.
- Reduce the chemicals used, and improve long-term soil management through better planned crop rotations.

SDG 14 Life below water

- Allow increased freshwater fish-

ing by improving water quality with aquaculture technology.
- Reduce chemical run-off contaminating oceans.

SDG 15 Life on land
- Promote more sustainable land ecosystems through a more considered use of farming land and approach to forestry.

SDG 17 Partnerships for the goals
- Allow companies to partner to increase the impact on all the SDGs through improved availability of information.

DIGITAL TECHNOLOGIES FOR SMALL FARMS

Digital technologies can be particularly beneficial for small farms that cannot afford staff. Using digital field records and the information stored therein, farmers can cut out some of the steps during the planting and harvesting processes, transportation of produce from plot to barn, or documentation, operational analysis and funding applications. Drones and field robots can also be used for mapping and collecting data from farmland.

OPENING UP MANY NEW MARKETS

The advanced use of digital technologies in agriculture has the potential to meet growing global demand for food while ensuring the sustainability of primary production. The increased use of digital technologies in agriculture opens up many new markets. For more demanding and sensitised end consumers, farmers are able to create their own production chain for their produce. This is where start-up companies that create innovative products with intelligent systems come into their own. These systems document everything from crop cultivation, fields, mills, and processing plants in a way that customers can understand and trace.

The development of novel products also continues in the agricultural engineering sector. There is the expectation that innovative solutions will continue providing farmers with opportunities to feed the world whilst operating a profitable business. For example, agricultural GPS systems can contribute to further reductions in the quantity of fertilisers and pesticides used. The farmers can use their own electricity to power new, fully battery-powered, emission-free and virtually noise-free tractors. Other models offer system-based ballasting and tyre pressure adjustment for resource and soil conservation. Modern agricultural engineering products mean that agriculture leads the way in the areas of sensors, digital positioning, and optical recognition systems or data visualisation. Autonomously controlled harvesting machines have already become reality in agriculture: the machine processes information independently and makes at least partially autonomous decisions, while the farmer predominantly takes on a monitoring role.

CONCERNS OF DIGITIZATION

Digitisation is not just for farms. Digital technologies should be part of the curriculum in schools, universities and research institutions. Some universities are working on some projects specially focused on the development of Precision Farming and Smart Farming.

Information processing is increasingly taking place via cloud systems where data is automatically collected, analysed and stored. This data can be retrieved using any mobile device. The advantage of cloud systems is that the data sources can be used by service providers. Thus, the farmer receives extensive information and recommendations for action. It is important to highlight that the data belongs to the farmer, only he or she can decide with whom and to what extent to share such data.

The paradigm shift in agriculture has long since taken place. Opportunities for the efficient and in many aspects even sustainable management of farms are opening up. In spite of all this progression, one aspect that should not be forgotten is that the natural soil biology must not be destroyed and soil compaction and erosion must never result from the proper use of technology, especially on large agricultural areas.

THE FUTURE IS NOW

We are at the beginning of a journey to more digital farming. We will see incredible developments over the next 3-5 years, faster than anything we have seen before, and it will be founded on connectivity improvements and digital storage capacity. It will be unbelievable. However, we need to remember digital farming is not a substitute for hard work and generations of knowledge. It helps minimize the risk of making sub-optimal decisions – allowing farmers to be at their best from planting to harvest. Digital will also change our industry. We will see companies linking their services to outcomes – instead of selling a bottle of crop protection product; we will sell a field with controlled weeds and healthy crops, offering that as an outcome. It is an exciting time to be involved.

Price disseminated by commodity exchanges, helps taking well-informed decision and improves bargaining power

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Dr. Dilip Kulkarni
President-
Sustainable Agriculture
Jain Irrigation Systems
Limited

SMART FARMING SYSTEMS FOR HIGHER FARM INCOMES

Climate-smart agriculture, forestry and fisheries (CSA), as defined and presented by FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars:

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

The greatest challenge the world faces today is to produce enough food and generating adequate income in the developing world to better feed the poor and reduce the number of those suffering. We must produce more, use fewer resources, increase the value of the products so that the primary producer gets the benefit, and encourage him to produce more efficiently.

As we go along, the challenge is only increasing in magnitude; the global population is set to increase to 7.8 billion by 2025 and 80% of this increase will occur in developing countries. This factor puts a lot of pressure on Food Security and concomitantly on resources like water for irrigation.

By 2050, India should produce 494 million t (present 247 m t) from a net cultivated area of 145 mha (present 143 mha). The irrigated area then would be 145 mha (present 79 mha). We need water "Created" to bring about the increase

in Irrigated area. In addition, we can see the net cultivated area has come to a plateau. The Prime Minister's slogan of "Har Khet Ko Pani"can become reality only and only if we save existing water use with 3-4 times water use efficiency and very high water productivity factor. It is simple to conceive that without water saved from the existing irrigated agriculture it will be very hard to achieve the targeted area under irrigation.

Irrigated agriculture is the major contributor to the world food security for the last 4-5 decades. On a global scale, irrigated agriculture accounts for less than 20% of the total cropland area but yields 40% of agricultural output.

With growing irrigation-water demand and increasing competition across other water-using sectors, irrigating crops would be difficult proposition let alone bringing in a second crop in the rainfed areas.

McKinsey reports that the global water requirement is likely to rise from 4500 billion m3 to 6900 billion m3 by 2050 and this figure is 40 % more than the current accessible or reliable water supply.

Doubling agricultural output by 2050 will require increasing the rate of productivity growth to at least double. This will certainly require substantial investments in making rain fed agriculture more efficient.

In India, we have arrived at a critical juncture as far as our agriculture production is concerned. With just 48 % of agriculture land under irrigation, the contribution to GDP by agriculture is possible ONLY by bringing in more rainfed area into irrigated category to enable those dry land farmers to go for a second crop, after the rain-fed crop. Analytically, it is increasingly becoming clear that sheer increase in productivity in the existing irrigated lands cannot push GDP much. However, encouraging one rain-fed crop farmer to cultivate a second crop would hike the Agriculture GDP to up to 8%. By adopting farm level water harvesting and using the harvested water to raise a second crop, productivity can be enhanced from 2 t/ha (rainfed single crop) to 4 t/ha (micro irrigated using harvested water and raising two crops).

Doubling productivity in small farms is the need of the hour to achieve a sustainable growth in Agriculture.

Small farmers produce most of India's food, and do so with minimal resources. They get very little support both technically and financially. They are deprived of even the necessities like quality seed, and availability of water during crop season. At first, there should be a change in attitude towards them.

To transform subsistence farming into a viable commercial activity, smallholder farmers need quality seeds, appropriate fertilizers, improved land and water management practices. They also need access to markets, low cost finance, infrastructural facilities for storage and transport. They need access to knowledge and information through well-focused extension program. Above all the country should have policies that provide comprehensive support to these farmers.

The task may look daunting but it can be done. The inspiration from the past can be helpful, but India needs a second Indian Green Revolution, one that is based on smallholder farmers; that respects the multiple agro-ecologies of India and its many staple food crops; that works for comprehensive change across the agricultural value chain, and that does so while protecting the environment. A Second Green Revolution must help small and marginal farmers prepare for unprecedented challenges lying ahead. Production shocks from floods and drought will increase risks faced by farmers. Smallholder farmers, who depend almost entirely on rain-fed farming, will be most vulnerable of all. They must be able to adapt to the impacts of climate change, from higher temperatures to changes in crop diseases and pest outbreaks, and increased stress on agro-ecosystems that are already degraded. Adaptation will require technological and policy innovations, coupled with new farming systems like the use of advanced technologies.

Totally unconventional but revolutionary thinking is what is required at present

Few other unconventional ideas , that are at least not in serious consideration in the country ; are also of high need at this juncture; like reuse of waste water for farming and changing the method of irrigation for crops like rice and wheat in large areas.

The technology that assists us should increase the water productivity of these crops and divert the water

thus saved to other rain-fed crops, where a small change in irrigation cover can make a large impact on productivity.

On all India basis, while 65% primary cereals are irrigated, only 27% oil seed and 16% pulses are irrigated. Research has shown very high yield hikes in both these groups of essential commodities by limited irrigation. Can we tilt the irrigation practices favoring oil seeds and pulses?

I also list here a fundamentally new approach to our agriculture to achieve food security through resource security. The role of all of us including farmer, consumer and policy makers are clear.

- Treat farmer as "Entrepreneur"
- Focus on knowledge transfer and competency building of individual farmers.
- Convert agriculture to precision farming model and identify risks
- Provide Causes mitigation solution through PPP model
- Creation of supply chain infrastructure through cluster approach
- Provide capital subsidies and not consumption subsidies
- Create decentralized irrigation and power infrastructure for optimum productivity
- Create Integrated Soil-Crop-Climate-Market Plan on national basis
- Create a national forum between Centre and State on lines of finance commission
- Present separate agricultural budget in the parliament and create a committed agency for monitoring and evaluation, and timely course correction.
- Focus on increasing per capita income rather than productivity alone.

This model provides an integrated, comprehensive approach in transforming Indian agriculture: improved soils, good seeds, access to markets and enabling policies. All are important, and must work together seamlessly to drive results.

Indian agriculture grows only if the small farmers prosper and become self- supporting and contributing individual to the community. All our efforts are to enable him.

AT JAIN IRRIGATION, OUR OBJECTIVE IS TO INCREASE FARMER INCOMES, STRENGTHEN AGRICULTURAL VIABILITY AND CREATE A SUSTAINABLE SOCIETY

This is not as simple as it appears. In a world where realities are evolving all the time, there is a growing premium on our need to reinvent our existence so that our solutions can be customized around the contemporary. Over the decades, we have helped transform realities through the following initiatives:

- Extended farmers from subsistence crops to commercial alternatives
- Extended cutting-edge technology to legacy farm practices
- Widened our value chain from seed to soil to food processing to non-banking financial support
- Right-balanced the use of natural resources, demonstrating the principles of sustainable agriculture

It is our conviction that when you fuse modern-day innovation with one of the oldest livelihoods known to man, some remarkable transformation can happen. At Jain Irrigation, we have been able to transform the agricultural prosperity of entire regions, lift farmers out of relative poverty, stagger the rural-to-urban migration, strengthen national food security and increase India's respect as a dependable processed food provider to the world. Transforming lives; enhancing prosperity.

AT JAIN IRRIGATION, SUCCESS IS DERIVED FROM THE ABILITY TO QUESTION CONVENTION ACROSS EVERY MANAGEMENT TIER, FUNCTION AND INITIATIVE.

This warrants a need to explore a better way of doing things across the organization, locations and time. One of the most effective ways in which Jain Irrigation has transform edits business from the inside and realities on the outside is through its prudent evolution from a company manufacturing and marketing products into an organization delivering a holistic agricultural solution. Over the years, this company has delivered holistic value through the following initiatives:

•We enhanced farmer knowledge and aspirations to inspire an embrace of cutting-edge technologies

•We enriched the application of cutting-edge technologies across farms with the objective to generate radical improvements

•We facilitated farmer access to financial capital that would encourage them to invest more aggressively in micro-irrigation systems

•We focused on reducing the delivered cost of farm solutions that would enhance agricultural viability; we refused to increase tissue culture plant let costs for years; we introduced

the solar water pumps that would moderate energy costs

•We introduced (and customized) global best practices like JAINGAP that helped link the output of marginal farmers with global markets The result is that we aggregated diverse products into an integrated farm solution that has helped enhance rural prosperity.

We pioneered a tailor made drip irrigation technology for small holders in 1990's. While technology existed since early sixties, our innovation was in an integrated approach with view of creating shared value.

It was made possible by marrying the crop agronomy and irrigation technology for Indian conditions.

We worked tirelessly in R&D Lab and Soil before making the successful trials at farmers' fields.

RICE WITH DRIP

An innovative method of PADDY CULTIVATION with PRECISION FARMING ensuring prosperity and sustainable use of Water and Energy for Food Security

Economic Benefits

- Rice yield enhancement upto 40%
- Water Saving upto70%
- Energy Conservation upto 50%
- Water and Fertilizer use efficiency upto 80%
- Soil health protection, leading to consistent crop production

Health Improvement of farm hands

- Reduction of skin, respiratory and mosquito bite diseases

Reduction of environmental pollution

- Lower Nitrate leaching into water bodies
- No or low methane emission
- Ozone layer protection
- Global Warming mitigation

WHEAT WITH MICRO IRRIGATION

An innovative method of Wheat production with PRECISION FARMING offers several advantages to the grower and the society.

- Rainport protects wheat crop from heat stressIhigh temperature at grain filling stage
- Drip Irrigation and Fertigation during the crop life cycle and use of Rainport during grain filling stage enhances yield upto 50%
- Conserves precious irrigation water upto 50%
- Saves pumping energy upto 50%
- Micro Irrigation helps maintain right humidity / micro climate
- Reduces incidence of diseases and insects significantly
- Higher and cleaner straw production
- Reduces chaffiness & shattering of grains
- Micro Irrigation enables crop rotation (Wheat&Rice) with in termediate pulse crop during summer

MANGO WITH UHDP

Ultra-High Density Planting-means three times more mango yield, on the same acreage, in just three years! The innovative UHDP method of mango cultivation with PRECISION FARMING offers several advantages.

- Accommodates 674 plants per acre compared to 40 in traditional planting method
- Commercial yield in 3 years compared to 7-9 years in conventional planting, depending on the variety
- Increases yield and profit upto 300%, making Mango farming

remunerative
- Lower canopy enables-easy pruning and training, better disease & pest management, effortless & quick harvesting farm operations
- Bears fruit every year
- All varieties can be grown under UHDP

PRECISION FARMING FOR SUGARCANE

See to BELIEVE: Modified Crop Geometry, Subsurface Drip, And Very High Yields! Record yield in plant and ratoon, at sustainable rate of water, fertilizer and energy use

- Changed plants pacing from conventional to paired and wider rows
- Drip Subsurface Irrigation allows several ratoons and its management
- Drip Irrigation ensures excellent germination even for ratoon
- Better sunlight penetration in maturing canopy resulting in higher photosynthesis
- Irrigation and Fertigation through Drip, right in the root zone
- Enhanced water, fertilizer and land use efficiencies
- More number of ratoon crops per plant crop and increased income
- Very high yields of cane, upto 280% of conventionally planted
- Yields reach 100-120 t/acre
- Drip Irrigation achieves upto 50% water saving and reduced cost of cultivation
- Revolutionizing sugarcane production even for smallholders

COTTON WITH DRIP

Pre monsoon sowing with drip and better reflush management results in abundance of cotton

- Modified crop geometry, increased plant population
- Transforms conventional cotton farming into cash crop
- Reduces pesticide use by the advancement of sowing date before monsoon
- Drip irrigation results in better boll development
- Drip irrigation minimizes flower ropping
- Allows better reflush management and upto 300% increase in Yield is achieved
- Achieves higher water and nutrient use efficiency and reduces cost of cultivation
- This innovation prevents soil health deterioration because of reduced chemical use
- Provides opportunity for crop rotation with pulses or vegetables
- Drip-fertigation has brought back cotton cultivation in the areas where it was abandoned once

TISSUE CULTURE - NO ONLY FOR B A NAN ABUT ALSO POMEGRANATE

No Bacterial Blight, No Wilt, Early Maturity.Superiorplantingmaterial with Tissue Culture, ensures Better Crop & Bigger Profits

- Introduced Tissue Culture Pomegranate for commercial cultivation first time in the world
- Tissue Culture ensures disease free saplings
- Stops migration of Bacterial Blight

and Wilt diseases

- Achieves commercial harvest in two years
- Fruits are maintained throughout the canopy
- Higher yield and lower production cost
- This technology provides low or no mortality, uniform growth and development of plants

AGRO- VOLTAIC PRECISION FARMING

Integrated Food and Fuel Farming for Sustainable Development-The innovative Agro-Voltaic Precision Farming offers several advantages.

•Optimal use of resources such as Land, Water & Sunlight

•Precision Farming Technology Integrated with Renewable Energy

•Architecture of Solar panel & Crop Geometry ensures optimum conditions for crop growth

•A holistic approach to farming: TC Plants, Superior Seeds, Solar Energy, Drip Irrigation, Mulching, Fertigation, Automation & Hi-Tech Horticulture Practices

•Sub-surfacedrip,Sub-soild rainage, mulching & PV Panel as roof results in 99% water use efficiency

•PV Panel grid protects crops from extreme weather

•Rain water harvesting & recycling

•No or lower methane emission due to Drip Irrigated Rice

•Zero net Green House Gas emission reduces Global Warming effect and protects Ozone layer

•Food and Energy production from same land gives higher income

JAIN INTEGRATED IRRIGATION SOLUTIONS(JIIS)

These community-based projects, being undertaken extensively in India and now in Africa, are opening up new vistas for the developing world. They are creating a seamless connect between Macro and Micro, Infrastructure and Agriculture, Availability and Productivity, Cost and Value. This innovation ensures prosperity and sustainable use of Water and Energy for Food Security. This is a sensor based water delivery system with 24x7 availability of water with a crop specific productivity-enhancing package of practices more sustainably and with higher income.

धानुका खेती की नई तकनीक

हर किसान की खुशहाली के लिए

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रहिमन पानी राखिये, बिन पानी सब सून । पानी गये न ऊबरे, मोती, मानुष, चून ।।

वर्षों पहले से हमारे पूर्वज
पानी के महत्व का वर्णन कर गए है ।

पुराने समय में पानी का स्रोत
नदी, कुंए, झरने इत्यादी हुआ करते थे
और पानी का उपयोग
आवश्यकता अनुरुप होता था ।

आज आधुनिकता के दौर में
हम जमीन से जरूरत से ज्यादा पानी निकाल रहे है,
जो उपयोग कम और बर्बाद ज्यादा होता है ।
जिससे भू-जल दिन प्रतिदिन कम हो रहा है
और कुछ सालों बाद शायद पूरा ही खत्म हो जाये!

अब सवाल उठता है
कि हम हमारी आने वाली
पीढ़ी के लिए कितना पानी छोड़ना चाहेंगे ?

इस परिस्थिती को भांपते हुए
धानुका ने 2005 में चालू किया था,

"खेत का पानी खेत में – गांव का पानी गांव में"
बचायें पानी की हर बूंद ।

आप भी पानी बचा सकते है...
अपने घर में, स्कूल में, फैक्ट्री में, संस्थान में, गाँव में.....
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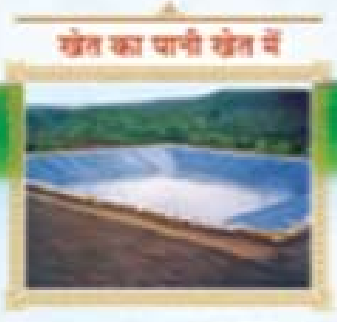

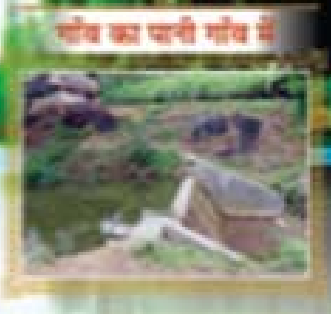

बचायें पानी की हर बूंद

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FOOD & NUTRITION

NUTRITION SENSITIVE AGRICULTURE: ISSUES AND IMPERATIVES

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FOOD SECURITY AND NUTRITIONAL SECURITY PARADOX

India accounts for about 2.3% of world's geographical area and 4.2% of its water resources supporting almost 18% of world's human population and 15% of the livestock. Agriculture remains the most important sector of Indian economy with 18% share in gross domestic product (GDP) at 2011–12 prices, 11% of exports and 53.3% share in total employment or workforce in 2013–14. India's production of cereals is next only to China and USA. Among the important cereals, India is the second largest producer globally of rice and wheat, and the top producer of pulses. India is also the largest producer of milk and second largest producer of groundnut, vegetables, fruits, sugarcane, and cotton. As per the fourth advance estimates for 2013–14, total food grain production in India has been estimated at 264.77 Mt (DAC, 2015). The per capita direct consumption of food grains has been declining and that of livestock products, fruits, and vegetables increasing for a fairly long time. Total food grain demand is estimated to be 291 Mt by 2025 and 377 Mt by 2050, whereas the total production is estimated to be 292 Mt by 2025 and 385 Mt by 2050, which is 2.0% more than the demand. But food security does not ensure nutritional security. According to Food and Agriculture Organization (FAO), food security has three components, viz., availability, access, and absorption (nutrition). Even if there is availability as well as access to food, there is no guarantee of adequate absorption or nutrition, especially since, nutrition depends on many other factors such as the condition of pregnant women, breast feeding, health factors, hygiene, drinking water, sanitation, etc. And so, access to health care and sanitation facilities is among the key determinants of nutrition security.

India is one of the fastest growing

economies of the world. India dreams of becoming the Super Power of the East by 2050 leaving behind other countries of Asia. Sixty-four per cent of India's population will be in the working age group by 2020. At a time when leading economies like Europe, US, South Korea, Japan are ageing, India holds the advantage of having an increased working population which could further contribute to the GDP growth. But human resources can be channeled to productive purposes only when we have a healthy, energetic and skilled population who can be physically and mentally fit to embrace all challenges of life. One of the main indicators of progress of a country is its nutritional status and other health indices. India fares quite low in this aspect and hence, unless India overcomes this problem of under nourished population, it would be impossible to achieve any higher economic goals.

THE SUSTAINABLE DEVELOPMENT GOALS AND NUTRITION

The Sustainable Development Goals are a set of 17 Global Goals adopted by 193 member nations of United Nations in 2015 which aims to achieve targets by 2030. First, the SDGs represent an unprecedented set of opportunities to make commitments to nutrition. It is estimated that at least 12 of the 17 SDGs contain indicators that track important nutrition inputs. The largest numbers of indicators are found within the gender equality and health goals. Progress toward both of those goals is vital for improving people's nutritional status. If the nutrition community can help development partners in these and other sectors to move

NUTRITIONAL STATUS OF CHILDREN

INDICATOR	%*
Children (under-five years) who are stunted	38.7
Children (under-five years) who are wasted	15.1
Children (under-five years) who are underweight	29.4
Children (6-59 months) with anaemia1	69.5

*Source: Rapid Survey on Children (RSoC), 2013-14; 1National Family Health Survey (NFHS-3), 2005-06. Note: *Percentage of relevant population*

NUTRITIONAL STATUS OF WOMEN AND ADOLESCENT GIRLS

INDICATOR	%*
Pregnant women (15-49 years) with anaemia1	58.7
Women (of reproductive age) who are undernourished2	33.3
Women (20-24 years) who were married before the age of 183	30.3
Indian women who are underweight when they begin pregnancy4	42.2

*Source: 1National Family Health Survey (NFHS-3), 2006; 2UNICEF, 2015; 3Rapid Survey on Children (RSoC), 2014; 4Coffey, 2015.Note: *Percentage of relevant population*

these indicators faster, then they win and nutrition wins. Policymakers both inside and outside the nutrition community are realizing that ending malnutrition is well aligned with other development imperatives, such as slowing climate change, making food systems healthier and more sustainable, and helping businesses become more supportive of sustainable development.

INDIA'S NUTRITIONAL STATUS

Though there has been improvement in certain measures of nutrition metrics like stunting and wasting in children under five, still India has some of the highest number of under nourished children. Malnutrition is also responsible for lowering individuals' immunity to infections and diseases. India has the largest number of children (under-five years) who are stunted – that is, 48 million, or more than four times the number in countries such as Pakistan and Nigeria. The following table showing the percentage of children falling under the malnutrition indicators will help us to get a grasp of the whole fact.

Not only children but women also constitute a bulk of the malnourished population of India. The low nutritional status of women and adolescent girls reflect the deep societal discrimination that women in India face on a routine basis. The indicators in the table below show the magnitude of nutritional deficiency among Indian women, with a particular focus on the period of pregnancy. It is of significant concern that despite sustained growth and improvements in

food security overall, nearly 60 per cent of pregnant women in India are anaemic, the leading cause of which is poor nutritional intake. Acute nutritional deficiency during pregnancy has long term effects on the mother as well as the life of the child.

AGRICULTURE AND NUTRITION LINK

As already mentioned above, the root of nutritional insecurity begins right from lack of availability of nutritious foods. Nutritious (also referred to as "nutrient-rich") foods are foods of high nutrient content which include animal source foods (fish, meat, eggs, and dairy products), fruits and vegetables, bio fortified staples, fortified foods, traditional local crops (including neglected and underutilized species and wild foods) and special processed and fortified foods for populations with special needs. So in order to tackle this problem of under nutrition, agriculture can be leveraged to improve health and nutritional status of the population. Agriculture policy must be brought in tune with nutrition policy with incentives provided for encouraging the production of nutrient-rich crops such as pulses and oil seeds, and the cultivation of local crops for self-consumption. Policies for the agricultural sector must promote agricultural productivity, dietary diversification, and environmental security, thereby improving households' food security. All quarters of policy makers, institutions, governments and scientists the world over is now fully aware of the potential of the agriculture sector to influence the production and consumption of nutritious foods necessary for

healthy and active lives.

NUTRITION SENSITIVE AGRICULTURE

Nutrition-sensitive agriculture is an approach that seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner. The recognition that addressing nutrition requires taking action at all stages of the food chain - from production, processing, retail to consumption – has led to a broader focus which encompasses the entire food system. Making agriculture and food systems nutrition-sensitive necessitates taking action to address input quality, production, post-harvest handling, processing, retailing and consumption, in order to deliver safe and nutritious foods all year round to the consumer. The following discussion highlights the major issues in nutrition sensitive agriculture.

Diversification and sustainable intensification of agricultural production

Diversification approaches aim to increase availability and affordability of diverse foods. Sustainable intensification refers to strategies aimed at simultaneously improving productivity and environmental sustainability, which can be achieved through increasing species diversity in cropping systems or ecosystem-based strategies. Principles of sustainable intensification and diversification can be applied at different scales, from the national and regional level to the farming system to the backyard garden. Specific interventions can be popularisation Integrated Farming Systems, Nutri gardens, Market based approaches, Apiculture etc. among farmers.

Nutrition-sensitive post-harvest handling, storage and processing

A balanced diet is needed throughout the year to maintain good health and nutrition. Post-harvest handling, processing and storage contribute to: maintaining a secure supply of food (and thus of nutrients) throughout the year; preserving the quality of harvested raw material as it moves along the food supply chain from the producer to the market; reducing losses; and making fresh produce available in local markets as well as in distant locations. Food storage helps to maintain food quality over an extended period until its final use, permits its deferred use (on an annual or multiannual basis), guarantees the regular and continuous supply of raw materials for processing and helps to balance the supply and demand of agricultural products, thereby stabilizing market prices. At the household level, storage contributes to food security and nutrition by offsetting seasonal scarcity. The work of advisory services should be encouragement of farmers to process their products, safe storage etc. which not only ensures nutritional lock up but also increases producers' share in consumers' rupee.

Nutrition education and behaviour change communication

Many causes of poor nutrition are rooted in attitudes and practices that can be influenced by education: food taboos, long-established dietary and snacking habits, agricultural production decisions, food distribution in the family, ideas about child feeding, misleading food advertising, ignorance of food hygiene or negative attitudes towards fruit and vegetables. Nutrition education is also becoming critically necessary in countries experiencing a dangerous dietary transition to cheap processed foods rich in sugar, fat and salt. Social science research in this direction and educating farmers and consumers through extension services can be helpful in understanding the changing scenario.

Women's empowerment and gender equality

Women's empowerment and gender equality are at the nexus of the agriculture, nutrition and health sectors. Research shows that resources and income flows that women control have positive impacts on nutrition because they are more likely to be directed towards food, education, health and care. Gender-based inequalities between men and women have a strong impact on the population's nutritional status when women do not have access to family income or other resources (land, credit, information, etc.) or are not empowered to make decisions on their use and distribution. Furthermore, women's workloads (in fields, fetching water and fuel wood, domestic chores, etc.) can result in reduced time for child care, breastfeeding and food preparation. Moreover, heavy workloads can have a significant impact on pregnant women's health and nutritional status, increasing the chances that children are born with low birth weight (less than 2,500 g) and become stunted adolescents and malnourished adults. This process is called the inter-generational cycle of malnutrition. Gender equality and shared care responsibilities positively influence food security and nutrition as well as agricultural production. Inclusion of female extension workers to reach out to rural women to impart nutritional

awareness has become important.

RECENT INITIATIVES OF ICAR FOR NUTRITION SENSITIVE AGRICULTURE

Nutri-sensitive Agricultural Resources and Innovations:

Keeping in view the need for nutritional security in rural areas, a project called Nutri-sensitive Agricultural Resources and Innovations (NARI) is being implemented through KVKs for improving health and nutrition of rural population. This project is women centric and it is being implemented by the women scientists for the women of rural areas. The program is focused on empowering farm women with key areas like innovative practices to promote nutrition-sensitive agriculture, awareness and capacity development of various stakeholders, value chain, literacy campaign, etc. will be emphasized. This will encourage intensive exchange of knowledge, good practices and governance related issues to evolve a systematic policy framework for agricultural extension systems to promote nutrition-sensitive agriculture.The salient objectives of the project are given below:

- Creation of Awareness on Nutri Sensitive Agriculture among farming community through capacity development and different level of interfaces
- Promotion of Bio-fortified crop varieties for Nutritional Security among farm women and Children
- Promotion of Nutri Garden, NutriThaali, and Nutri Villages
- Development of Entrepreneurship among youth by producing nutritional products
- Promoting Nutri Sensitive innovative practices and Value chain development

Technological interventions to be focused on - family farming, strategy for linking agriculture to nutrition, Need-based skill development among women and youth, involving rural schools to create interest and awareness, bio-fortification of locally available food, round-the-year dietary pattern, nutri-thaali, Nutrition Smart villages, etc. is proposed to be taken up. All these would result in the transformation of agriculture into nutrition-sensitive agriculture having nutritional security among the resource-poor community also.

ICAR Institutes and Agricultural Universities have been involved in development and support for technology needs and KVKs to be involved for validation of technology in different locations and work as implementing agencies for developing Nutri villages. The project initially concentrates on gender and nutrition. About 100 KVKs/ ICAR Institutes/Agricultural Universities have been identified for association in the project. The project is aimed to include major programmes on production and product development of bio-fortified varieties of major cereal crops, fruits, vegetables, minor millets, linseed and root crop etc., having proven nutritional value.

NUTRI SMART VILLAGES IN MADHYA PRADESH

Madhya Pradesh still has high percentage (51 per cent) of

stunted children. The percentage of underweight children is 40 per cent. However, the malnourishment among boys is very high in the state. The stunting is as high as over 58 per cent and underweight is 49 per cent. This ambitious initiative has been launched by the Madhya Pradesh State Government with the belief that villages can be relieved of malnutrition by fulfilling the needs of villagers with local harvest through agriculture and subsidiary activities like animal husbandry and fisheries. To tackle the malnutrition problem, a new initiative has been taken by the ICAR-ATARI, Jabalpur in collaboration and support with Women and Children Development Department, Govt. of Madhya Pradesh to establish Nutri-SMART Villages (NSV) at the block level to showcase the nutritional security at the grass root level through nutritional availability and wide scale nutritional literacy for proper consumption of the same.

In this village, KVK scientists and WCD officials are coordinating the activities of all the line departments to support food and nutritional availability for the households as per the recommended dietary allowances according to their physical requirements and feasible source for its accessibility. The interventions are being made by making proper health survey and assessment of the households' capacity for consumption and absorption. The households will be transformed as Nutri-SMART family by gaining proper health condition which will lead to the conversion of whole village as Nutri-SMART Village. Proper data and observation are taken on four major indicators viz., Stunting (low height-for-age), Wasting (low weight-for-height),

- NSV - village having secured food availability,
- Scientific approach advocating "You grow what you eat"
- Crop plan-led nutritional security concept
- Promotes the traditional recipe based "Poshan Thali"
- NSV is the unique architect for nutrition-sensitive agriculture
- NSV could be considered a "minilab" for showcasing precise nutritional security

Underweight (low weight–for-age) and undernourished (low Body Mass Index, BMI) for measuring malnutrition level in children under 5 years. For children in the age 5 to 18 years, undernourishment is provided and for persons 18 years and above, BMI indicators provided separately for male female and rural criteria.

Agricultural advances are mainly measured in terms of how successfully they narrow the gap between current and potential production yields. Achieving success in nutritional security as well as food security also requires narrowing the "nutrition gap". Narrowing this gap first requires increasing availability and access to the foods necessary for a healthy diet and ensuring that, intake of those foods increases. Agriculture has a great potential to alleviate poverty and improve food and nutrition situation in vulnerable rural communities. While food security may increase the total quantity of food energy consumed – typically via increased production and consumption of staple foods – only nutritional security can guarantee the quality and diversity of food necessary for good health and nutritional status. The proposed conglomeration has chosen this topic to provide a professional forum for multi-stakeholder deliberations on the role and readiness in reducing the malnutrition by promoting nutrition-sensitive agriculture and nutritional literacy.

Following themes have been identified for intensive exchange of knowledge, good practices and governance related issues to evolve a systematic policy framework for eradication of the malnutrition from the Madhya Pradesh state effectively.

- Innovative practices to promote nutrition-sensitive agriculture and food security;
- Capacity development of women institutions/SHGs/FIGs/FPOs;
- Value chain and village trade related issues,
- Enabling suitable governance and policy;
- Nutrition literacy;
- Improving maternal and child nutrition.

Nutrition sensitive agriculture is the future of farming not only in India but throughout the world. With increasing number of people becoming health conscious day by day, nutri farming and nutri gardens will become one of the most remunerative farming alternatives for farmers rather than traditional farming of staple crops. Coupled with India's target to achieve the Sustainable Development Goals of zero hunger and proper nutrition, nutrition sensitive agriculture and integrating nutrition within extension service delivery seems to be a promising option for policy makers. ■

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SUSTAINABLE AGRICULTURE

SOLAR FARMING
CROP PRODUCTION WITH 1MW SOLAR POWER

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To meet the increasing demand of 21st century, world needs energy and food for its increasing population. Energy play important role in the development of any nation and India is the country of villages; therefore, the development of the rural economy is ultimately the development of India.

India, faced with twin challenges on energy and environmental front, has no option but to work towards increasing the role of renewable energy in the future energy systems. Renewable energy technologies vary widely in their technological maturity and commercial status. In India, renewable energy is at the take-off stage and businesses, industry, government and customers have a large number of issues to address before these technologies could make a real penetration. India with large renewable energy resources (solar PV, wind, solar heating, small hydro and biomass)is to set to have large-scale development and deployment of renewable energy projects.

Indian agriculture has witnessed a significant change in energy use pattern with the shift from the draught animal and human power to the machines, electricity and petroleum fuels. This shift occurred due to increased mechanization, commercialization and diversification towards high-value crops, and will require more commercial energy in agriculture sector in future. The total energy input in Indian agriculture has increased from 84,729 GWh in 2001 to 2,04,293GWh in 2018 whereas the agriculture sector's contribution to the Gross Domestic Product (GDP) decreased from 54% in 1950-51 to 15.4% in 2015-16. Agricultural growth has been volatile over the past decade, ranging from 5.8% in 2005-06 to 0.4% in 2009-10 and -0.2% in 2014-15.

In order to keep pace with the development, there is rise in energy use but it has adverse effects on greenhouse gas emissions on climate due to burning of fast depleting fossil fuels. In this context, we need to harness and use more and more renewable forms of energy, especially solar energy that is plentiful on most parts of the country. Also, at several locations, harnessing wind power and utilizing biomass could be effective alternatives. Solar based devices may also work in an integrated manner with small wind turbines as hybrid devices. At present, about 16% of the country's installed electricity generation capacity is contributed by

renewable sources e.g. wind, solar, bioenergy, hydro etc., which is about 71.5 GW as on 31st July, 2018. In agricultural sector, energy is directly used for pumping irrigation water, operating different mechanized farm implements/tools and processing of foods. Share of agricultural sector in total energy consumption is about 7-8% and further increase in energy use from its present value of 1.6 to 2.5 kW/ha is expected to meet the production target of next 20 years.

RENEWABLE ENERGY SCENARIOS IN WORLD VIS-A-VIS INDIA

India ranks 7th in the world in total renewable energy installed capacity, while China tops the list followed by USA and Germany. In China, wind energy and hydropower installations are major contributors to renewable whereas in USA, geothermal energy and in Germany, solarPV is the dominant contributor. India ranks 5th in the world in total wind energy installation after China, USA, Germany and Spain, whereas it is 10th in world among solar PV installation. Globally, 15% of the world population has no access to electricity. India today is home to one-sixth of the world's population, but accounts for only 6% of global energy use and one in five of the population - 240 million people - still lacks access to electricity according to World energy council, 2015. Therefore, much effort is needed in India to fulfill future energy demand, specifically through renewable energy sources.

RENEWABLE ENERGY IN AGRICULTURE-SCOPE IN INDIA

India has an estimated renewable energy potential of about 900 GW from commercially exploitable

sources. Among the total renewable potential, wind power potential is about 102GW at 80 meter mast height, solar power potential of about 750 MW assuming 3% wasteland is made available and bioenergy potential of 25 GW.

FUTURE PROSPECTS OF RENEWABLE ENERGY IN AGRICULTURE

Considering the potential of solar energy, few avenues of its utilization in agriculture is given below:

(i) Solar PV operated water lifting / pumping system: Water is the primary source of life for mankind and one of the most basic necessities for crop production. The demand for water to irrigate the crops is increasing. For sustainable production from agricultural farms, irrigating the crops at right stages is highly important. Pressurized irrigation systems e.g. drippers, sprinklers etc are of great importance in 'crop per drop' mission, however, ensured power supply is essential to operate these systems. Solar PV pumping systems may be quite helpful to operate the pressurized irrigation system. Specifically, solar pumps may be useful as water lifting devices in irrigation canals and also to evenly distribute water in command areas and thus will reduce the wastage of water. At present, about 16 million electric pumps and 7 million diesel pumps are in operations in the country for irrigation purpose; however they are highly energy intensive and therefore if replaced with solar pumps may greatly contribute to country's energy security. Till December 2015, 29669 pumps have been installed in the country, which are mostly of 2 or 3 HP pumping system, which has been recently appended with 5 HP pumping system. These solar pumps have the capacity to withdraw water from a depth of about 75 m and therefore may be beneficial in those areas where groundwater is not deeper than it. Moreover, solar pumps are directly operated by solar irradiance and therefore diurnal, and seasonal variations of it play a key role in implementation of solar PV pumps in a place. In arid and semi-arid regions of the country, clear sky

condition with average irradiance of 5-6 kWh/m2/day is available for 300 days in a year and thus solar pumps can be operated for about 6 hours a day and most of the period in a year.

(ii) Agri-voltaic or Solar farming: Agri-voltaic land utilization system or solar farming is proposed to either ascertain a portion of land for erection of PV modules in a farmer's field or introducing crop cultivation in the same piece of land where PV panels are erected for electricity generation purpose. By adopting such system, the risk of loss due to crop failure during aberrant weather events may be marginalized in farm scale and may prove to be an effective drought proofing strategy. PV panels are placed in a solar power plant for electricity generation conventionally in long rows with sizeable areas left blank by default to avoid shading of one row by another. These inter- panel areas and below -panel areas can be effectively utilized for growing such crops that can tolerate certain amount of shade for different durations of the day. In arid zone, this small amount of shading actually serves as a boon by stopping evaporation of water as well as reducing transpiration losses. Secondly, all solar PV plants in arid zone have a problem of deposition of a fine film of wind born sand on panels requiring a water spray to clean it. This water washes down the panel into the soil. Thus, there is an availability of partially shaded space and recurrently available washout water, which can both be harnessed for growing crops. Ideally, crops for these sites should be such that it is not taller than 50-70 cm, preferably perennial, spreading, and do not interfere in any way with the functional efficiency of solar power plant.

Keeping the sustainable goal of providing affordable and clean energy in mind, the Anand Agricultural University established a 1 MW Solar PV Pilot Project with Gujarat Industries Power Company Limited to experiment, research and demonstrate the production of various crops in the farm area including the area under PV panels at Amrol village of Gujarat. On 1.5 ha cultivable area, total 3240 number of solar panels each of size 2 x 1 m, 310 Wp capacity were installed in 17 rows. The distance between two rows was 10 m and the spacing between two solar panels was varied as 25 mm, 150 mm and 250 mm. The height of solar panel was 2.0 m so as to carry out mechanized farm operations easily. The effect of shadow of the panels and the spacing between the panels on the growth / yield of various crops was studied and compared with the control. The crops like groundnut (peanut), soybean, pearl millet, pigeon pea, wheat, mustard, okra, green gram were cultivated during Kharif, Rabi and Summer seasons of the year 2016-17. Subsequently crops like; maize, cotton, amaranthus, chilli, green gram, etc. were grown during 2017-18. All the crops were irrigated through drip irrigation system using the power produced through solar panels.

The analysis of results indicated 18 to 19 % power generation with Capacity Utilization Factor (CUF) of 4320 to 4560 kWh / day. The power

generated was sold to Madhya Gujarat Vij Company Limited @ INR 3.22 / kWh. The lowest yield reduction upto 18 % in Kharif and Rabi crops was found, in case of solar panels with 250 mm spacing compared to control. Whereas for the same panels, higher yield upto 6% was found as compared to control in Summer crops. The farmer could get the benefit of power generation along with crop production as the additional income.

(iii) Solar based processing of agricultural produces: Processing of agricultural produces like drying, cleaning, grading, winnowing etc. is important for value addition. There are already well established solar thermal and PV based devices available commercially and many specific technologies have been developed by different institutes for farmers and villagers. For example, inclined solar drier have been found quite useful to dry different agricultural produces along with maintenance of quality of the produce. Animal feed solar cooker have also been found to augment the milk production from cattle by providing them quality boiled feed. Solar water heater also has great potential in different processing stages. Solar PV winnower cum drier helps in cleaning of agricultural produces and also helps in preparing dried products. Solar PV operated duster helps in applying agricultural chemicals in agricultural field to protect crops from pests and diseases. Passive cool chamber may be useful for on-farm short term storage and preservation of fruits and vegetables.

(iv) Solar PV hybrid devices: Small wind aero-generators in hybrid mode with solar panels are useful for off grid renewable energy based electricity generation. These devices are quite useful considering their 24 hour generation potential. Solar PV panel is capable of generating electricity during day time and clear sky conditions, whereas small wind turbine of Savonious design at low heights is capable of harnessing wind energy during both day and night and even on cloudy days. In agricultural farms, installation of such hybrid devices along farm boundary not only will protect crops but also will generate electrical energy that can be used in different farm operations.

Recently, Prime Minister of India has set a target of installing 100 GW of solar capacity by 2022 in the country. A target of installing 175 GW of renewable energy capacity by the year 2022 has been set, which includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power as an effort to increase the efficiency of energy use.

In view of the success of this Agri-voltaic or Solar Farming Pilot Project, the Government of Gujarat framed a policy and launched a scheme – Suryashakti Kisan Yojana (SKY) in July, 2018 with an outlay of INR 8700 Million to cover 12400 farmers of 33 districts with a plan to generate 175 MW. Under this scheme, the State and Central governments will give 60 per cent subsidy on the cost of project. The farmer is required to take 5 per cent cost, while 35 per cent will be provided to him as an affordable loan with interest rates of 4.5-6 per cent. The scheme duration is 25 years, which is split between 7-year period and 18-year period. For the first 7 years, farmers will get INR 7 per kWh and remaining period will get INR 3.5 per kWh sold. ■

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AGRI BUSINESS INCUBATION CENTRE-A WAY TO SUSTAINABLE DEVELOPMENT

Haryana is fast emerging as one of the most favored investment destinations in India. The globalization of markets and a buoyant economy have given a tremendous impetus to the industrial sector in Haryana, which already has a competitive advantage in terms of strategic location, basic infrastructure as well as large skilled, educated and young workforce. Besides, the State has investor-friendly policy environment. However, Haryana is basically an agrarian economy, producing variety of food and cash crops, along with dairy products and fisheries.

Unfortunately the increased production has not resulted in a proportional increase in the farmers' income. This is mainly because of the emphasis on primary produce and not linking it to market and secondary process product development. The next revolution shall come through development of the value chain and sharing the profit with primary producer, the farmer. Entrepreneurship development, therefore, is an integral part of farming process to increase the profitability of farming. Marketing of agricultural produce and getting a fair return is a big challenge for most farmers.

Major Universities are promoting a culture of respect for entrepreneurship by including the courses in their curriculum, setting up technology and business incubators, setting up entrepreneurship cells, providing sustenance allowance to student entrepreneurs, introducing break year concepts and deferred placements.

The Chaudhary Charan Singh Haryana Agricultural University has developed technologies in all potential areas of agriculture covering crops, bio-technology, food products, agricultural engineering etc. and trying to reach the real clients of its technologies through Agri business Incubation Centre (ABIC) and has taken initiatives in developing entrepreneurship through training, capacity building, networking, mentoring, marketing & incubation facilities for young, small and medium size entrepreneurs to promote the technologies developed by the

University. In addition, the emphasis is also laid on handholding, regulatory & advisory services which are an important link for the success of any enterprise.

Agri Business Incubation Centre is hosted at Chaudhary Charan Singh Haryana Agricultural University (CCSHAU) Hisar, Haryana and supported by National Bank for Agriculture and Rural Development (NABARD). ABIC intends to promote agribusiness and entrepreneurship development with the concept of growth through innovation, upgradation of technology and skill development. To fast track growth in these areas, we have taken it to the next level by providing incubation support through our incubation centre. This incubation Centre is intended to nurture all intended potential agripreneurs. NABARD Chairman, Harsh Kumar Bhanwala laid the foundation stone for Agri Business Incubation Centre (ABIC) in CCS Haryana Agricultural University, Hisar on February2, 2018.

The ABIC at HAU is among the first two centres funded by NABARD any where in the country, the other being in Madurai district of Tamil Nadu. NABARD has sanctioned a grant assistance of Rs 11.75crore towards the capital and recurring expenditure of this centre. The centre will provide single-window access for all agri business activities within the institution for consultancy, consortia and incubation, encourage associations to lead the projects in the initial stages, meet the specific objectives of mobilizing resources, obtaining finance, transferring risk and performing specific investment activities.

There is a huge gap between the research findings and commercialization of agriculture business idea. The gap between the idea and the real time market can be bridged by the Agri Business Incubation Centre.

Agri Business incubation centres are newer and popular organizations to support and accelerate the development of agribusinesses. The primary role of Business Incubator is to facilitate the aspiring entrepreneurs by providing them with a technical knowhow, easy availability of capital, infrastructure and expertise. The ability and creativity of the Incubatee can be utilized by the incubator to promote new enterprise, which in turn benefit both parties. They are now recognized in both developed and developing countries as a new way to promote entrepreneurship development and technological innovation at the small and medium enterprise level. As a 'one stop' basis service provider, Agri Business incubator enables them to reduce their costs by sharing the facilities.

The focus areas of Agribusiness Incubation Centre are: Agriculture Sector, which includes Agri Input, Warehouse Management, ICT in Agriculture, Dairy, Farm Mechanization, Development of New Variety, Organic/Precision Farming, Floriculture, Apiculture, Processing and Value Addition, Agri Waste Management, Quality Assurance, Certification and Branding, Nursery Raising, Marketing, Tissue Culture, Bio-gas / Bio Fertilizer Production, Mushroom & Bio-pesticide production, Production & Protection of Crops and Fisheries. The Incubatees can also obtain services in Supply Chain Management, Post Harvesting Technology, Nutrition & Health, and Animal Husbandry and other allied sectors.

Incubators help entrepreneur to save operating costs, they can share the same facilities, advantage of lower lease rates or subsidized patents, help with their financing needs by referring them to angel investors, banks and venture capitalists. In addition to financial help, start-ups also need guidance on how to compete successfully with established industry players. Incubators can tap into their networks of experts and executives, who can provide management guidance and operational assistance.

By helping Agri Businesses prosper, incubators assist in creating long-lasting jobs for their host communities and development of agri based industry, farmers and nation. ■

"RAINBOW MODEL"

TO ENSURE FOOD FOR EVER INCREASING POPULATION OF THE NATION IN SUSTAINABLE AND ECO-FRIENDLY MANNER

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Technologically fuelled innovations in different decisive areas of agriculture ensured the food and nutritional security of the nation. "Green revolution" ushered in 1967-68 was the first monumental drive after the independence which served as an excellent example of political will and technological excellence for ensuring food and alleviation of poverty. Introduction of high yielding varieties, use of chemicals fertilizers, pesticides and irrigation technologies were the major stakeholders of its success. Soon India was transformed from 'the begging bowl' to a 'bread basket' in food grains. The success encouraged us and "Operation Flood", manoeuvred the "White Revolution" in India and made our country self-sufficient in milk through the cooperative structure. Breakthroughs in the various fields' viz., cooperative system, farm mechanization, renewable energy, precision farming, seed replacement, vaccines for the animals, antibiotics, diverse range of pesticides, biotechnological approaches, etc. sustained the green and white revolution. However, still we have not reached the position where we can ensure food and nutritional security for the entire human fraternity. Things are going to be more miserable as India's population of 1.36 billion is expected to

reach 1.53 and 1.68 billion by mid-2030 and mid-2050 respectively, making it the most populous country in the world. Available genetic potential of most of the crops and animals have been exploited, and plateaued. Sources of various inputs are depleting. Resurgence of pest and development of virulence in pathogens to breakdown resistance of crop is quite common. Apart from these, the chemicals in the agriculture have irreversibly exacerbated the ecosystem and the precious environment. It is well figured out through average crop response which was about 50 kg of food grain per kg of NPK fertilizer during 1970-71, steeply fell down to about 18.70 kg during 2010-11. The consumption has been increased about 13 times during the period; however, the food grain production grew 2.3 times merely. Consequently, the pesticides borne diseases and deformities have been frequently observed in all

the animals including human. Under the circumstances, it would be over-optimistic to assume that relationship between the use of chemicals and yield would remain linear in the future.

There is an urgent need to design strategies where we can selectively take advantages of innovative technology keeping the disadvantages at bay. We need to make constructive use of the collective capacities of traditional as well as modern science by fusing them to work together to solve common agricultural and natural resource problems. This Technology fusion must involve a transformation of existing vogue technologies through a combination process facilitated by proven eco-friendly technology. The ecofriendly technology might be entirely new or improvement of the old technology which has lost its existence. The technological fusion is distinguished from the so-called breakthrough technology, which is the linear technological development replacing an older generation of technology for its short term lucrative benefits.

The concept of Integrated Farm Management (IFM) needs to be popularized. It offers a complete farm business approach that delivers more sustainable and diversified farming. The proposed "Rainbow Model" integrated in IFM offers fusion of modern technology and traditional methods to deliver prosperous farming that enriches the environment and engages local communities. It involves meticulous use of outputs of one enterprise component as inputs for other related enterprises. This holistic approach encompasses diversification where crop, fruit & vegetable production, animal husbandry, poultry, fisheries can be integrated partially or completely. Innovation in farming for maximising production through optimal use of local resources, effective recycling of farm waste for productive purposes, community-led local systems for water conservation, organic farming are the key features of the system.

To ascertain the continuous supply of food grains for the food and nutritional security and the protection of precious environment, a "Rainbow Model" to emphasize the farm management in sustainable manner is presented.

RAINBOW MODEL

"Rainbow Model" is a model which encompasses approaches that integrate biological and ecological processes targeting diverse components of farm management to minimize the use of harmful non-renewable inputs. It diversifies agriculture to maximize per unit output and minimize deleterious effects on ecosystem and society. Seven different components of agriculture viz., 1) efficient nutrient management, 2) addition of organic carbon in soil, 3) use of bio-fertilizers, 4) augmentation of safe chemicals and bio-pesticides for the crop protection, 5) efficient water management, 6) enhancing seed replacement rate and 7) food processing and value addition, amicably fused in the "Rainbow Model". If this model is implemented efficiently, it can bring "Rainbow Revolution" to ensure food and nutrition for ever increasing population of the nation in sustainable and eco-friendly manner. Different components have been discussed here under.

1) EFFICIENT NUTRIENT MANAGEMENT

Most important and voluminous input in agriculture is fertilizer. Unfortunately, the diversity in their types for the particular nutrient is less. Among the different nutrients, Nitrogen, Phosphorous and Potash are the major nutrients. There has been a steady growth in the production and use of chemical fertilizers in agriculture after the green revolution. Among all the chemical fertilizers, Nitrogen, in the form of Urea is the most used fertilizer. About half of the applied nitrogen, in the form of conventional urea, is not assimilated by the plant and therefore leaches into the soil, causing extensive groundwater contamination. On the contrary, neem coated urea can slow down the release of nitrogen by 10-15 per cent. From January 2015, the central government has made it mandatory for urea manufacturers to produce neem-coated urea up to a minimum of 75 per cent of their total production of subsidised urea, and has allowed them to go up to 100 per cent. This offers an excellent example of improvement of existing technology and its large scale implementation. Such innovations need to expand to all the nutrients to enhance their efficiency. Another noteworthy development where the waste of one industry was used as an input of another is use of press mud of sugar industries. Press mud was the troublesome waste of sugar industries and its management was difficult. Navsari Agricultural University (NAU), Navsari developed a technology, where the waste press mud was seasoned and used for the multiplication of a biocontrol fungi Trichoderma spp., used for the biological control of soil borne diseases. This has efficiently used the press mud and substantially contributed to the management of soil borne diseases.

2) ADDITION OF ORGANIC CARBON IN SOIL

Another issue in the nutrient management is the reduced level of organic carbon in the soil. Due to the reduction in number of livestock and increase in the cropping area, the conventional sources of organic carbon viz., farm yard manure, compost and green manure are practically not feasible. It has impaired soil health seriously by adversely affecting the soil biota, particularly the microbes. There must be some technological fusion for the conversion of non conventional source of organic carbon in the soil. Banana pseudostem sap produced from the banana pseudostem waste through mechano-microbial digestion is one of the best alternatives which apart from the increasing soil organic carbon have many multi faceted significance. Soil and Water Management Unit of NAU, Navsari is pioneer in the work. The transformation of waste into the best has not only resolved the pollution issues created by the cumbersome banana pseudotem waste, but also has presented an excellent source of many essential plant nutrients and plant growth regulators. The fibre obtained during the process also fetches premium price and enhance farm profitability.

3) USE OF BIOFERTILIZERS

Microbes are the hidden and silent treasure for the agriculturists and ecosystem. However, all the microbes are not beneficial and many of them cause diseases. It is the equilibrium between the beneficial and harmful microbes in the soil which decide, whether it is ideal for crop production or not. Contribution of microbes in the recycling of

nutrients is most significant. There are certain groups of highly efficient microbes which play a pivotal role in fixing atmospheric nitrogen and mobilizing phosphorous, potash and other nutrients. Department of Plant Pathology of N.M. College of Agriculture, NAU, Navsari, Gujarat, initiated efforts to revitalize soil and increase production by reducing the quantum of chemical fertilizers through use of Biofertilizers containing different bacteria viz., *Azotobacter, Acetobacter, Azospirillum, Rhizobium,* Phosphate Solublizing Bacteria, Potash Mobilizing Bacteria and a Plant Growth Promoting Rhizobacteria, *Pseudomonas*. Efficacy of these microbes increases significantly if there is adequate carbon in the soil. Technology has the potential to cut down the use of chemical fertilizers by fifty per cent and categorically reduce the quantum of chemical fertilizers in the soil. There is an imperative need to make the technology more versatile through amicable fusion of participatory approach and industrial excellence so that it can win the confidence of farmers.

4) AUGMENTATION OF SAFE CHEMICALS AND BIOPESTICIDES FOR CROP PROTECTION

In the middle of last century, use of chemicals as pesticides started in agriculture. It has fatally messed up the entire ecosystem and proportion of various categories of organism substantially deviated from the ideal. There is a dire need to introduce safe chemicals through proper designing

of target specific chemicals and amalgamating it with Biopesticides. There are enormous microbes that can be used as insecticides, fungicides, weedicides, nematicides, etc, that need to be exploited unconditionally in different ecosystem and provision should be made to use the consortia of these suitably designed through research and participatory approach. An excellent example of biological control of pyrilla *(Pyrilla perpusilla),* a devastating insect of sugarcane crop in South Gujarat was established by the scientists of NAU through introducing, acclimatizing and domesticating an ectoparasitod *Epiricania melanoleuca* in the ecosystem. Such examples need to be replicated in other pests and disease management activities. Another example of ecofriendly management of insect is, Nauroji Stonehouse Fruit

Fly Trap for the community pest management by installation of traps on the large scale.

5) EFFICIENT WATER MANAGEMENT

Water itself is not a serious problem for agriculture, however, the distribution and improper handling of water has made it a scarce commodity. When rain comes, if we are not prepared for water harvesting and recharging available source, and huge amount of water drains away rendering it unfit for any purpose. NAU, has developed technologies for drainage of excess water from the farm, water harvesting as well as of growing crop by using minimum water through subsurface irrigation. The concept of "Per Drop More Crop" the brain child of Gujarat Government, now has become slogan of entire farming community of the nation. It is indeed a role model and has to be taken up with more enthusiasm till it is not used for its maximum level. Rigorous planning, developing, distributing and managing each drop of the water can indeed independently revolutionize agriculture as a whole. To this effect Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation 'Har Khet ko pani' in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities.

6) ENHANCING SEED REPLACEMENT RATE

Revolutionary benefits of the highly proclaimed information technology are not being utilized in the agriculture properly. Concomitantly, balance between demand and supply of a particular commodity at a particular time is highly distorted. This is more commonly observed in the popularization of newly developed superior variety and its timely replacement. These grievances can be addressed by the fusion of seed development, production, marketing and distribution channel. Conceptualization and implementation of seed village programme jointly by the breeders, seed production machineries marketers and farmers. NAU, Navsari has developed more than 70 high yielding value added varieties of different crops and facilitating the seed replacement by the concept of seed village. A linear growth in the seed replacement ratio has been observed after the implementation of the project.

7) FOOD PROCESSING AND VALUE ADDITION

The sevenths and last complement of proposed "Rainbow Model" is to strengthen food processing and value addition. Developing food processing technologies that are environmentally friendly and efficient can substantially contribute to its

value chain and food security. It can markedly reduce the agri-product from deterioration before it reaches the consumer. Industrialization with proper crop planning, transportation and distribution by excellent coordination of the crop producer, marketer, food processor and supply chain machineries can substantially reduce the post harvest losses. A model processing unit and Centre of Excellence on Post Harvest Technology, NAU, Navsari has developed many value added products and publicized the pathway for processing different commodities and enhance their utility. ■

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ORGANIC AGRICULTURE IN INDIA-PROBLEMS AND PROSPECTS

Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on the minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. Organic food crops are grown without the use of chemical pesticides or fertilizers. Genetically modified organisms do not qualify as organic nor do irradiated foods.

There are many definitions for organic agriculture but all converge to state that it is a system that relies on ecosystem management rather than external agricultural inputs. It is a system that begins to consider potential environmental and social impacts by eliminating the use of synthetic inputs, such as chemical fertilizers and pesticides, veterinary drugs, growth regulators, genetically modified seeds and breeds, preservatives, additives and irradiation. Instead the system relies on site-specific management practices of crop rotation, animal and plant manures, mechanical weeding and biological pest control that maintain and increase long-term soil fertility and prevent pest and diseases.

It is clear that an organic production is a process claim rather than a product claim. The basic rules of organic production are that natural inputs are approved and synthetic inputs are prohibited. But there are exceptions, and though certain synthetic inputs determined to be essential and consistent with organic farming philosophy, are allowed such as insect pheromones.

Organic agriculture is one of several approaches to sustainable agriculture and many of the techniques used such as inter-cropping, rotation of crops, double-digging, mulching, integration of crops and livestock are practiced under various agricultural systems. What makes organic agriculture unique, as regulated under various laws and certification programmes, is that almost all synthetic inputs are prohibited and `soil building' crop rotations are mandated. Organic agriculture is a broad spectrum of

methodologies and systems based on specific and precise standards of production aimed at achieving optimal agro ecosystems socially, ecologically and economically sustainable.

INTERNATIONAL GUIDELINES ON ORGANIC AGRICULTURE

The International Federation of Organic Agriculture Movements (IFOAM) has brought out the worldwide guiding principles for organic agriculture and these inter alias include:

- To encourage and enhance biological cycles within the farming system, involving microorganisms, soil flora and fauna, plants and animals,
- To promote the healthy use and proper care of water, water resources and all life therein.
- To encourage renewable resources in locally organized agricultural systems,
- To work with materials and substances that can be reused or recycled, either on the farm or elsewhere,
- To give all livestock conditions of life which allow them to perform basic aspects of their innate behaviour.
- To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats,

The Codex Alimentarius Commission (CAC) has developed Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods. CAC is an intergovernmental body with over 180 members, within the framework of the Joint Food Standards Programme established by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), with the purpose of protecting the health of consumers and ensuring fair practices in the food trade. The Commission also promotes coordination of all food standards work undertaken by international governmental and non-governmental organizations.

These guidelines provide an agreed approach to the requirements which underpin production of, and the labelling and claims for, organically produced foods. The aims of these guidelines are:

- to protect consumers against deception and fraud in the market place and unsubstantiated product claims,
- to protect producers of organic produce against misrepresentation of other agricultural produce as being organic,
- to ensure that all stages of production, preparation, storage, transport and marketing are subject to inspection and comply with specified guidelines,
- to harmonize provisions for the production, certification, identification and labelling have organically grown produce,
- to provide international guidelines for organic food control systems in order to facilitate recognition of national systems as equivalent for the purposes of imports and
- to maintain and enhance organic agricultural systems in each country so as to contribute to local and global preservation.

PROSPECTS AND CONSTRAINTS OF ORGANIC FOODS

Increasing demand for organic food

The demand for organic food is growing very fast worldwide due to food scares created by ill effects of chemical residues in conventional food. Use of certain chemicals such as chlorinated hydrocarbon insecticides have been linked with human cancer, chlorophenoxy herbicides linked with lymphoma and dioxins contaminants in herbicides linked with dangerous consequences on human health have created scares. Growing worldwide environmental concerns due to the effect of pesticides and fertilizers on biodiversity has also increased the demand of organic food. Health Conscious Consumers especially between the ages of 45 and 54 are giving fresh organic produce the top priority. Declining cost of organic food production and narrowing of price gaps between conventional

food and organic food have also favoured organic food. With the fast growth of retail outlets around the world for organic foods, their sales are expected to grow. Organic foods are currently sold in a wide variety of venues including farmer's markets, natural product supermarkets, conventional supermarkets, and club stores.

Constraints on Farm productivity

There is a significant time gap between discarding synthetic inputs and restoration of sufficient biological activity to the land such as growth in beneficial insect populations, nitrogen fixation from legumes during which pest suppression and fertility problems are typical. The degree of yield loss varies, however, and depends on factors such as the inherent biological attributes of the farm, farmer expertise, and the extent to which synthetic inputs were used under the previous management system.

Organic agriculture requires significantly greater labour input than conventional farms. This is especially true in areas of low ecological potential. However, when labour is not a constraint, organic agriculture can benefit from underemployed labour in rural communities in developing countries.

Environmental Impacts and Sustainability

The explicit goal of organic agriculture is enhancement of sustainable agriculture. But negative impacts may occur and organic agriculture is not an exclusive method for sustainable farming. The soil and water protection and conservation techniques of sustainable agriculture used to combat erosion, compaction, salinization

and other forms of degradation are evident in organic farming. The use of crop rotations, organic manure and mulches improves soil structure and encourages the development of a vigorous population of soil micro-organisms. Mixed and relay cropping provide a more continuous soil cover and thus a shorter period when the soil is fully exposed to the erosive power of the rain, wind and sun. Properly managed, organic farming reduces or eliminates water pollution and helps conserve water and soil on the farm.

Organic farming integrates livestock into the system to add income through organic meat, eggs and dairy products. Tree crops and on-farm forestry integrated into the system provide shade and windbreaks, while providing food, fuel and wood. Integrated agri-aquaculture may also be found within diverse organic agricultural systems. Economic objectives are not the only motivation of organic farmers; their intent is often to optimize land, animal, and plant interactions, preserve natural nutrient and enhance biodiversity, all of which contribute to the overall objective of sustainable agriculture to preserve natural resources and ecosystems for future generations.

THIRD PARTY CERTIFICATION SYSTEMS

There is consumer demand worldwide to have assurance on integrity of products available in the market. This has introduced a component of credible certification of the organic management system which is based primarily on a yearly surveillance of the agricultural enterprise. Also at the producing and processing level, national standards are also developed against which the processing operations and plant conditions can be inspected and verified. In order to maintain their integrity, certification bodies or authorities which certify the procedures of the operator should be independent of economic interests with regard to the certification of operators.

"Organic" is a labelling term that denotes products that have been produced in accordance with organic production standards and certified by accredited certification body or authority. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people.

For the application of the accredited certification body or authority, countries should identify a competent authority responsible for the approval and supervision of such bodies. The national competent authority when making its assessment should take into account the following:

- the standard inspection/ certification procedures to be followed and precautions which the competent authority undertakes to impose on operators subject to inspection,
- the penalties which the competent authority intends to apply where irregularities and/or infringements are found,
- the availability of appropriate resources in the form of qualified staff, administrative and technical facilities, inspection experience and reliability,
- the objectivity of the body vis-à-vis the organic establishments subject to inspection.
- The competent authority or its designate should:
  - o take cognizance of any irregularities and/or infringements found and penalties applied and
  - o withdraw approval of the certification body where it fails to satisfy the requirements.

Current Status of Organic Certification in India

Indian organic food industry has taken cognizance of the imperatives of global market. India is home to 30 per cent of the total organic producers in the world. It has therefore taken initiative to launch a vigorous programme for quality and food safety improvement both in organic processing and service sectors. The basic aim is to implement and to obtain third party certification as a proof of adherence to organic management systems which is increasingly getting importance in international market.

This has generated demand for certification services and has resulted in multiplicity of certification agencies to meet the growing demand. There are many certification agencies now operating in the country. Though all certification agencies profess to operate according to international norms for certification, their procedures and modus operandi are at best varying.

The process of certification of different certification agencies vary considerably despite international and national criteria being available. The certification process is not really centering around assurance to quality of organic food and process, but as business proposition, and certificates are awarded without proper scrutiny of organization's capability and system implementation process. They compromise their own procedures set out for certification for getting more clients. Surveillance to certified companies often gets low priority. The entire attention is paid to get new establishments by certification bodies. Moreover surveillance audits become rituals and do not stimulate continual improvement or at best maintenance of the system. The most important aspect of certification is auditing and unless capable and competent auditors are deployed, certification system will not have sound approach. Though accreditation system has laid firm criteria of competence of auditors technical area wise, but certification bodies find it difficult to deploy auditors exactly meeting competence requirements sometimes due to wide

array of technical areas covered by them. There is a lack of uniformity in auditing approach and practices. The auditors' interpretation of organic management system requirements vary considerably due to lack of their calibration by certification agencies to be consistent. The certification bodies hire auditors from a wide market of auditors available some time on cost considerations rather than their credibility and competence.

ACCREDITATION OF CERTIFICATION BODIES

Internationally a system of control has been established to oversee operations from the farm operations, national competent authority, certification body and then accreditation system. Throughout this chain of control system standards come to play the role of providing basic norms for operation of farm establishment, operation of official authority, certification body and ultimately the accreditation body. For instance in India there are norms under National Programme for Organic Food (NPOP) for operation of farms producing different crops, control on certification system and finally accreditation operated by Agricultural Processed food export Development Authority (APEDA) Government of India.

After the certification body has established certification system and gained sufficient experience in certifying organic establishments, it can apply for accreditation for enhancing its credibility and international acceptance of its certificates in accordance with the applicable accreditation standard ISO IEC 17065 Conformity Assessment-Requirements for Bodies Certifying Products, Processes and Services.

Accreditation body needs to have more rigorous periodic surveillance on the certification bodies they accredit. This appears to be the weak point. This is perhaps the reason why certification body approach varies considerably and variability exists in their operation. Accreditation agencies should provide same level of vigilance on the certification system. There should be more witness assessments on certification audit practices by accreditation bodies to bring uniformity in application of international criteria.

6. CONTROL ON ORGANIC PRODUCTS IN INDIA

India is bestowed with lot of potential to produce all varieties of organic products due to its various agro climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. The state of Sikkim has been declared as organic state.

Implementation of National Programme for Organic Food (NPOP)-The Government of India has implemented NPOP which involves the accreditation programme for Certification Bodies, standards for organic production, promotion of organic farming etc. The NPOP standards for production and accreditation system have been recognized by European Commission and Switzerland as equivalent to their country standards. Similarly, USDA has recognized NPOP conformity assessment procedures of accreditation as equivalent to that of US. With these recognitions, Indian organic products duly certified by the accredited certification bodies of India are accepted by the importing countries.

Recently Food Safety Standards Authority of India has brought out a new Food safety Standards (Organic Foods) Regulation 2017 which regulates the following aspects:

- Organic Food Labelling and Certification.
- Traceability.
- Requirement to comply with the provision of the other regulations made under the Act
- Imports and Reciprocity.

If organic agriculture is to get a legitimate place within sustainable agriculture programmes, it has to respond to farmer and consumer demands. Organic agriculture may contribute to the overall goals of sustainability. First, organic farmers and processors, in their attempts to adhere to rigorous certification standards, may discover new and innovative production technologies and inspection systems such as risk based inspection. Second, organic agriculture may provide market opportunities for farmers and processors who choose to alter their practices to meet certain consumer demands. Finally, organic agriculture promotes the national and international thinking on sustainability by creating awareness of environmental and social concerns that merit attention.

There is a need to reorient organic certification and accreditation systems to develop seamless control system to preclude any fraudulent practices to retain integrity of organic production and products in the market place. This may include introduction of national organic food surveillance system defining the roles and responsibilities to agencies involved. ■

Sonalika CSR Aiming High for A Cleaner Sky

CROP RESIDUE MANAGEMENT

Q. Sonalika has always been focused on addressing the growing issues of Society, What according to you is the growing concern currently?

A. Every year during winters, an age old ritual of burning the residue of harvested crop fills the air with toxic smog. The root cause behind it is the advent belief in the farmers' minds that crop residue burning is a normal practice. Farmers believe burning of crop residue is a normal practice which has been passed to them from their ancestors. We need to address this growing concern at the earliest in order to save our environment.

Q. How Sonalika is addressing this growing concern?

A. We with the help of our partner organizations aimed at turning the mind-set around with an effective and proof-checked solution, i.e. Crop Residue Management through Happy Seeder and turn this into a new ritual.

In alignment with the same, we have adopted 25 villages in Karnal, Haryana under Crop Residue Management Initiative and with our efforts we have made them almost free from stubble burning. This initiative has benefited *12,353 acres of land and *1,44,700 lives. The solution not only helps prevent pollution, but also increases the revenue of the farmers. This year, while sustaining the 25 villages, we have adopted 25 more villages to make them free from stubble burning.

With the support of our on-ground partners, a workshop is also now in place, known as Sonalika Kisan Baithak, which facilitates to the farmers connected with us. In this workshop, we educated them about climate-smart farming along with its benefits in the form of revenue. Till now, over 210 farmers have taken oath to stop crop residue burning and contribute towards environment. We have also organized several events like Collective Social Responsibility to spread the solution for Stubble Burning.

Q. What are your future initiatives in order to serve the society?

A. We are looking into new initiatives in near future that will improve the way we serve our society. Through our dedicated and selfless on-ground partners, we are sure that they will be executed with good speed. Our vision of future involves a society where children are healthy with better education, women are empowered with equal independence of thoughts and decision making skills and the society as a whole is more focused towards hygiene, cleanliness & gender sensitivity. We can only lead a good life if the environment we live is treated with integrity, purity and we are continuously working with an aim to provide better and healthier life for every individual in the society.

*Figures indicated are our internal estimates.

An interaction on growing issues of society with Mrs. Surbhi Mittal Director, Sonalika CSR

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For more information give us a missed call: 8448587854

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PROTECTING THE PLANTS AND ENVIRONMENT WITH INDIGENOUS TECHNICAL KNOWLEDGE AND PRACTICES IN TRIBAL TRACTS OF ANDHRA PRADESH

Indigenous technical knowledge (ITK) is the actual knowledge of any particular population that reflects the experiences based on tradition and includes more recent experiences with modern technologies. Unlike the so called modern technologies, the ITKs are evaluated, refined and fine tuned by generations across centuries for their suitability to varied circumstances and situations. Therefore, these ITKs are more broad based, ecologically sound, environmentally safe, socially acceptable, economically resilient and moreover practical in its totality, all that is essential to call any practice, a technology.

Indigenous knowledge (IK) is, broadly speaking, the knowledge used by local people to make a living in particular environment. It can be defined as "A body of knowledge built up by a group of people through generations of living in close contact with nature".

The high altitude tribal zone of Vizianagaram district in Andhra Pradesh is endowed with rich, time tested wealth of traditional knowledge, which is, to a great extent undocumented. Adulate efforts have not been made to identify and document the traditional practices popular with the tribal farmers of the tract. The information pertaining to some of the indigenous tribal farming practices and their scientific rationality is discussed here under.

DUSTING OF ASH ON VEGETABLE CROPS

Vegetable crops are majorly grown in these rainfed pockets especially Chilli, Brinjal, Tomato, Beans etc., During early stages of crop growth,

these vegetables are attacked by Aphids, Aphids suck the plant sap, affect tender flowers and pods resulting in stunted growth, cupping of leaves and low yields. For aphid control, the tribals dust the affected areas/crops with firewood ash in the early morning. The rationale behind this practice is that the finely powdered ash gets adhered uniformly all over the plant surface due to morning fog and when the aphid attacks the plant its trachea gets blocked with ash causing asphyxiation, thus keeping the aphid population under control.

USE OF SPIDER WEBS IN PADDY FIELDS

During tillering stage, the paddy crop is attracted by leaf folder and stem borer. Tribals collect spider webs from the nearby forest and place 25-40 webs on small branches in one acre paddy field.

ANAPA TUMBA – STORAGE STRUCTURE

A hole is made on a big bottle guard. The interior is scoped out and water along with ash is poured in it. It is kept aside for two days and the hollow

bottle gourd is cleaned with water and dried for 5-10 days. This indigenous storage structure is known as "Anapa tumba" used to store seeds of redgram, blackgram and other pulses upto 5kg. The rationale behind this is that seeds can be stored for longer periods preventing them from stored grain pest attack upto 10 years.

The seeds of paddy, pulses and oilseeds are stored along with leaves of neem, tulasi and pongamia to protect seed from storage pests as neem and tulasi act as insect repellants.

SMOKING IN VEGETABLE GARDENS:

Tribal farmers smoke their vegetable gardens with any readily available slow burning material preferably during early mornings as well as late in the evenings. Creating smoke helps in checking the population of pests like aphids and tender bodied insects due to asphyxiation and also act as deterrent for the adult insects to settle and lay eggs on these crops. Generally the movement of wind is relatively slow or stable and the humidity levels in the atmosphere are high which facilitate uniform distribution of smoke through the crop canopy. Smoke also acts as insect repellent.

Kodo millet straw smoking is practised by the farmers to reduce scale and aphid attack in redgram and beans.

SPRINKLING OF CURD RICE ON PADDY FIELDS

Tribals of this region make a practice of sprinkling curd rice on the fields of paddy during vegetative and tillering stages. This is an age old traditional practice by which the tribals offer prayers to village goddess and offer

the cooked rice, pray for high yields and then sprinkle on the fields. The rationale behind is control of stem borer and leaf folder. The birds get attracted to the sprinkled rice and come to feed on it. While feeding, they may, by chance, feed on the larvae of the pests that are attacking the crop. Thus, the pest damage can be reduced.

GROWING OF PULSES ON SLOPES :

Most of the tribal tracts are undulating and sloppy. The tribal farmers cultivate pulses on mild slopes, leaving the limited plain lands for other crops. Pulses are very sensitive to moisture supply. They cannot tolerate either water logging or moisture stress. Water logging for more than 24hrs – 36hrs results in complete failure of pulse crops. Moreover, water and soil fertility requirement of pulses is very low. Thus, by growing on slopes, drainage is provided to the pulse crops like paddy, maize etc. Hence the practice appears to be technically sound.

HANGING OF MAIZE COBS AND PULSE SEED OVER CHULAS:

After harvest, the Maize and pulse seeds tied in a cloth are hanged over chulas in the kitchens at a height of six to seven feet above the furnace. As it rains almost every day during the monsoon season and the weather is very humid in this area, this practice prevents seeds from stored grain pest due to smoky conditions in the kitchen.

BIOFENCING OF DRY SOWN PADDY AND REDGRAM CROPS WITH MESTA :

During Kharif, Mesta is grown as a border crop around dry sown paddy and redgram fields in the tribal tracts. Mesta crop acts as a trap crop or border crop, protecting from cattle and other ruminants. Besides its soil conservation abilities, the raw jute (Gogu) obtained from Mesta is utilized for income generation in a number of ways like making of mats, bags, designs, decorations etc. which has good demand in this area.

IN SITU CATTLE/SHEEP / GOAT PENNING :

In situ cattle, sheep, goat penning is a very prominent practice in the tribal tracts. During night time, cattle are penned to a rope in a series of line at a particular patch in the field for a period of 3-5days and then shifted to another place. Like this, the entire field gets covered with cattle manure in a given period of time. The logic behind this practice is that the soil becomes enriched with cattle manure due to which the soil fertility status gets improved before sowing of the crop.

USE OF FISH TAIL PALM LEAVES IN PADDY FIELDS :

Tribals use plant materials like fish tail palm leaves in paddy fields. They erect 25-30 leaves per acre in the paddy field for the control of leaf folder and stem borer. The rationale behind is that these leaves exude alkaloids which are believed to prevent the pest attack.

SPRINKLING OF COW DUNG AND URINE ON VEGETABLE CROPS :

Cultivation of vegetable crops for most of the year is a common practice in this tract. Tribals practice sprinkling of the mixture of fresh cow dung and urine on the canopy of vegetable crops at regular intervals. Urine contains a certain amount of soluble nitrogen that can be absorbed by the crop plants directly through their foliage and contribute to growth. The fresh cow dung emits an offensive odour and acts as an insect repellant. The adult insects find an unfavourable environment.

SPRAYING OF LIQUOR :

Local liquor is sprayed on the Banana plants to control sucking pest.

Musidi leaves (Nux vomica) are used as green manure and also to control the termite attack in dry paddy.

Tribal farmers used to grow Jatropha plants around the groundnut field as catch crop for red hairy caterpillar.

Spraying of 5% neem seed kernel extract is practiced by the farmers in red gram, if pod borer is observed.

Deep summer ploughing is practised by the tribal community after receiving shower during pre-monsoon period to kill soil borne insects and conserve enough soil moisture.

Mulching with crop wastes and leaves collected from the forest is practiced in pineapple fields to conserve soil moisture and improve water holding capacity of the soil.

Laying of stone bunds around the field across the slope is practiced to prevent soil erosion and to conserve soil moisture.

The 8-10 cartloads of soil from the tanks was applied to the field during summer to improve water holding capacity of the red soils.

Fencing the crop field with old sarees is a common practice observed in tribal areas to protect the crop from wild boars.

Spraying with Tobacco leaf extract, custard apple leaf and seed extract along with neem seed kernel extract is a common practice to control insects and pests. ■

POULTRY

BLACK MEAT CHICKEN (BMC): THE KADAKNATH WAY

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Everyone who purchases food for their family does so for a different reason, with different needs, wants and goals in mind it may be taste, cost of birds, values or convenience. No matter what kind of chicken you choose – be it organic, free-range, slow growing, or conventional chicken you will have a nutritious, delicious, simple and versatile meal that your whole family is sure to enjoy. Similarly, the protein diet you are providing to your young children or consumed by athletes or players, it should be free from antibiotics/pesticides or any unwanted medicine, whether it is in milk, meat or any veg. meals.

In India due to lack of welfare laws and rules, people depend on milk, meat or eggs which are not good, contaminated, having bacterial populations more than recommended dose or it may be some times adulterated.

Most of the broiler chicken available in the stores today come from flocks that grow to market weight in about 48 days on average, using fewer natural resources,therefore more sustainably from business point of view. But as far as welfare of birds are concerned, rearing birds like 'factory farming' compromise their meat quality and food safety as lots of antibiotics and vaccines have been used to raise them faster. Several scientific techniques have been used like DNA mapping and animal health diagnostic tools to detect underlying traits like leg muscles, heart health, susceptibility to disease, bone density and joint health to identify the best birds to breed, improving both the health and size of the next generation of chickens. Slower-growing" chickens or "Heritage breeds" like chickens can take almost twice as long to reach market weight – about 81 days typically because they do not convert

feed to muscle as quickly. As such, these products are typically three to four times more expensive than their conventional counterparts; their growth rate is less but natural.

KADAKNATH BIRDS

Among all the three types of meat - red meat, white meat and black meat, the black meat, which is predominantly obtained from chicken, is considered as very rare and precious across the world. Today more than twenty five breeds and breed groups with fibromelanosis (fm) expression are known in the world, and almost all of them originate from south eastern Asia. Most popular is silkie (China), Ayam Cemini (Indonesia), Oke (Vietnam) and Kadaknath (India). The Kadaknath chicken meat from Jhabua district of M.P has received geographical Indication (GI) tag from Chennai based GI Registry and Intellectual property India in 'Meat product, Poultry & Poultry meat' category.

Kadaknath, rare bird with slow growth rate,is a unique, medium sized indigenous breed of fowl found in Jhabua and Dhar district of Madhya Pradesh, locally known as Kala masi because the bird is black inside and outside including skin, feathers, legs, meat, blood, etc. The average weight of Kadaknath female is 1 to 1.2 kg and that of male is 1.5 kg. Kadaknath is very popular among the tribes mainly due to its special capabilities such as adaptability to local environment, colour, disease resistance, meat quality, texture & flavour. The tribal value the breed for its cultural as well as its health values and also consider it sacred. The bird is high in iron and amino acids and low in fat. It tolerates extreme heat and cold climatic conditions and requires minimal management inputs.

The breed is disease resistant and hardy, and thrives well on kitchen/ agriculture waste.

Different strains of Kadaknath are known to exist such as Kadaknath

with black plumage, black with golden linings and black with white linings.

Flesh of Kadaknath is very tasty and contains 25% protein against 18% in broilers.The meat and eggs are reckoned to be a rich source of protein and iron. It is reported to have some medicinal value. Kadaknath flesh has got an aphrodisiac property. In other words, kadaknath is a healthier alternative to broiler chicken.

SPECIAL FEATURES OF KADAKNATH:

Kadaknath is known for its dark black colour which is due to rich melanin pigment. Flesh is rich in protein (25-27%), with low fat (0.1-1%). Medically, the Kadaknath black chicken meat contains certain hormones; blue pigment and essential amino acids, which are required in human body to increase the blood cells, and haemoglobin. The bird is resistant to diseases in its natural habitat in free range conditions. Kadaknath chicken is said to contain many kinds of amino acids and vitamins.Kadaknath chicken contains Vitamins B1, B2, B6, B12, C and E, niacin, protein, fat, calcium, phosphorus, iron, nicotinic acid, etc.

Abundant clinical experience has indicated that Kadaknath chicken has a peculiar effectiveness in treating women's diseases like sterility, menoxenia (abnormal menstruation), habitual abortion, blood leucorrhoea and also aids in curing pulmonary problems – tuberculosis (TB), heart

KADAKNATH PERFORMANCE PROFILE

1- Body weight at 24 weeks (g)
Male – 1.2 kg
Female – 1.0 kg
2- Age at sexual maturity (days)- 180
3- Annual egg production (number) per bird-82-85
4- Egg weight at 40 week (g)- 38-40
5- FCR - 4kg/1kg
6- Fertility (%)- 55
7- Hatchability FES (%) -62

diseases, neurasthenia (a condition of nervous debility supposed to be dependent upon impairment in the functions of the spinal cord), and children's osteomalacia (a condition marked by softening of the bones). source-CPDO Mumbai.

The eggs of Kadaknath chickens can be used effectively to treat severe headaches, faintness, asthma and nephritis (acute or chronic inflammation of the kidney). The eggs are also an ideal nutritive supplement, especially for old people and high blood pressure victims, since the cholesterol content is lower and free amino acids are higher than that of other kinds of birds.

SCOPE AND LIVELIHOOD SECURITY:

This high priced breed is reared at KVK Jhabua, the only center in which Kadaknath Birds have been maintained scientifically in India since 1990. During survey by the scientists of KVK Jhabua, it was observed that the population of this bird is declining rapidly and it is under threat of extinction and genetic erosion. The Kadaknath birds reveal appreciable degree of resistance to diseases than any other exotic birds in its natural habitat in free ranging.Looking at the popularity of Kadaknath bird in other states, especially Maharashtra, and emerging demand in metro cities, it has been felt that the production of kadaknath chicks has to be multiplied manifold to cater to the increased demand.Under NAIP Project in 2015 hatchery was established, and breeding and conservation of this breeds started. It was also supplied to almost all states of India to maintain the population. Now kadaknath chicken is easily found in Maharastra, M.P, Punjab, Haryana, Gujarat, UP, Rajasthan, Orissa, Karnataka, Telengana, NCR-Delhi etc., where on large scale kadaknath farming is carried out under the technical guidance of KVK Jhabua (M.P).

Now some of the entrepreneurs involved in kadaknath business, export kadaknath meat to different countries, and youth are adopting it as a start-up for their livelihood security. Some of the Kadaknath farms like 'Ashiskadaknath farm' Paradkar agro farms, established branches in different states to supply chicks to farmers and sell adult birds.

Considering the renewed interest of the Kadaknath farming, there is need to accept it as a business enterprise and need more extension, research and cooperation from government agency to explore the birds more. ■

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Ricky Thaper
Treasurer,
Poultry Federation of India

INDIAN POULTRY INDUSTRY AT A GLANCE

STATUS OF POULTRY INDUSTRY IN INDIA

India has a population of 1.25 billion people and the number is growing every year. The focus is on "Development" meaning Good Food, Better Health & Living conditions to everyone. Presently Indian people spend more money on food when they earn more. Eggs and chicken are accepted by almost all communities and are available at reasonable prices. Due to growing consumer demand for egg and chicken during last two decades, India has emerged third in egg production and fifth in broiler production in the global poultry production charts.

As per in available data (2018), the egg production has reached up to 82 billion from few millions 20 years ago and the broiler production has reached to 4.3 million tonne. Total poultry feed production in India is 22 million tonnes. Poultry is the most organised sector in animal agriculture and it is valued at Rs one lakh crores (US$15.38 Billion). The growth rate is 5-6 percent in layers and 8-9 percent in broilers per year against the growth of agriculture as a whole which is around 3 percent.

Poultry production and consumption in India is predicted to grow further in coming years due to younger generations' trend of shifting from vegetarianism to non-vegetarianism.This trend is seen due to increasing urbanisation; moreover with the increase in per capita income, awareness regarding balanced and nutritious food habits will create more and more demand for chicken and eggs in coming years in this country.

Eggs and chicken, two poultry products have the most to gain since they are popular, has no religious burdens and are economically most suitable fitting into the purchasing capacity of the common man in the country. The broiler meat consumption pattern shows that around 62 percent meat is consumed in 10 major cities

and the rest 38 percent in other cities including a very small percentage being consumed in villages.

GROWTH OF POULTRY PRODUCTION:

India is leading at 9 percent in the poultry growth followed by Brazil at 7 percent, United States of America with 2.1 percent and China settled with just 2 percent.

As per available data and recommendation by National Institute of Nutrition, the per capita consumption should be 180 eggs and 11 kg meat. However, still India is trailing in these areas and is settled with 64 eggs and 3.9 kg chicken meat per person per year. In comparison with other countries, where USA is leading in consumption with 253 eggs per capita; China 206; Pakistan 115 and Bangladesh 96. The production of eggs is largely (nearly 85 percent) contributed by commercial poultry farms and remaining production is from household/backyard poultry.

To achieve further growth, there are challenges like transportation, waste management to convert it into bio-gas energy, use of solar energy, disease diagnostics etc.Issues like proposal on ban on Cage rearing and negative role of certain Animal Welfare Organizations are also certain issues at present. Compared to USA and Europe, the Indian situation is different. For cage-free campaigning program in USA, you will find that ample land is available there in comparison to India where the farmer is totally dependent on the land which is decreasing day by day due to urbanisation.

DISEASE SCENARIO

Bird flu episodes first broke out in Nandurbar district of Maharashtra State in India in 2006. Similarly a

major Bird flu outbreak was reported in West Bengal in 2008. The infection was caused by H5N1 subtype of the Influenza A virus in which 13 districts of West Bengal were affected. Last outbreak of AI was in Karnataka State in 2017. Samples were sent for testing to National Institute of High Security Animal Diseases in Bhopal, which confirmed AI virus.

Role of state Governments and the Department of Animal Husbandry, Dairying and Fisheries, Government of India is worth praising who took all necessary precautions to control the outbreaks of bird flu. Advisories were issued and teams of experts were deputed to the affected areas to assist in control and containment measures as per Office International Epizooties (OIE)guidelines.

The concerned State Governments had carried out operations as per 'Action Plan on Preparedness, Control and Containment of Avian Influenza'. Due to efforts by Department of Animal Husbandry, Dairying and Fisheries, GOI, the situation could be controlled without wasting time. Similarly, the State Governments and the Government of India have provided information and given guidelines to the poultry farmers to adopt bio security in their farms to prevent any further outbreak.

ROLE OF VARIOUS POULTRY ASSOCIATIONS

Several Poultry Associations like;Poultry Federation of India (PFI), the Compound Livestock Feed Manufacturers Association (CLFMA), National Egg Coordination Committee (NECC), Indian National Federation of Animal Health (INFAH), Broiler Coordination Committee (BCC) and several other national and regional Associations played an active role by providing guidelines to poultry farmers and consumers by organizing technical seminars, placing advertisements in print and electronic media for creating awareness on health benefits of consuming poultry products. Many State Governments have agreed to provide boiled eggs (cheapest source of digestive protein) to school children under Mid Day Meal Schemes towards nutritional security.

Poultry India under the brand of "Poultry Protein" held road shows in various cities to promote the consumption of eggs and chicken. Other Poultry Associations also distributed boiled eggs among students and common men during their specific road shows. Campaigns conducted by these Associations received overwhelming response among consumers.

RESEARCH

At present, research is focused on use of certain feed additives which may be able to check the spread of highly pathogenic avian influenza. Feed additive is a supplement, and birds need to consume a nutritious and balanced diet which leads to improved immunity status of birds, helps preventing diseases and to maintain good health and achieve optimal production. The most valuable type of products by far in animal health is neutraceuticals (60 percent), followed by biological / vaccines (25 percent) and medicinal

feed additives (15 percent). The pressure of regulatory challenges and animal welfare issues will bring more attention of farmers to the preventive health care in the near future

Good hygiene and bio security measures need to be maintained at the farm all the times.

Imminomodulators and antioxidants have been found useful in reducing the severity of Avian Influenza (AI). The use of Immunity boosters and antioxidants such as vitamin A, vitamin E, vitamin C, selenium, zinc and several others is strongly recommended as feed additives. Besides their role as antioxidants, recently role of zinc and selenium has been reported to be anti-viral as well.

Preventive use of acidifiers and probiotics,is strongly recommended. Probiotics should be started in the very first water given to the day old chicks on their arrival, and should be continued daily for at least 15-20 days. Probiotics do not allow harmful bacteria to colonize in the intestine through competitive exclusion and also boost immunity. Subsequently, acidifiers in feed / water can be used to keep the pH below 7 to avoid secondary infections due to E.coli, thereby avoiding use of antibiotics and address issues of antimicrobial resistance.

Regarding the role of E.Coli in poultry, it is the most common secondary bacterial invader / infection, and there is growing resistance against E.coli for commonly used antibiotics. Therefore, the continuous use of good and effective probiotics and acidifiers, both in water and feed is very helpful in controlling E.coli infection. In addition, acidifiers also reduce the adherence potential of E.coli, Salmonella and Clostridium by disrupting bio film production.

INTEGRATION IN POULTRY OPERATIONS

Because of uncertainties of broiler rates, a paradigm shift is occurring in operations in broiler sector. Farmers are adopting Integration in farming and this is saving farmers from losses due to uncertainty of market. The support and services to farmers in Integration are being provided by many poultry companies, making the poultry sector totally into modern commercial level. This is not only ensuring remunerative prices to farmers but also preventing their losses due to market fluctuation, leading to improvement in farm management, FCR and production of good quality chicken. All major Integration companies have now started processing and marketing through their outlets

FOOD PROCESSING IN INDIA:

The entire Indian agriculture value chain is set to change drastically and food processing is going to be one of the main industries of the country in next 10 years. In terms of market size, the Indian food market was worth $193 billion in 2016 and is expected to cross $540 billion in 2020. The sector has been growing at the rate of 10-12 percent annually.

The farm to kitchen chain is going to change in India, like elsewhere, with increased agricultural production, better storage facilities, more food processing and changing consumer food preferences.

About the potential in India, at present only about 10 percent of agricultural produce is processed at present in the country, leading to a lot of wastage and Government is putting all efforts to increase food processing. The industry enjoys many fiscal incentives, including preferential credit under priority sector lending. “There is 100 per cent FDI (foreign direct investment) allowed into food processing sector and we have seen inflows increasing 40 percent over the last year.

The Indian Cold chain system, which is unorganized and dominated by traditional cold storages owned & operated by domestic companies and majority of them are located in Uttar Pradesh, Gujarat,Punjab and Maharashtra. Under the present Government, this sector would come up in a big way. With the announcement of Foreign Direct Investment (FDI), the investor from abroad would also enter into this venture as there is ample scope with compelling future opportunities.

The market will be facilitated by favourable government initiatives and enhancement in technology to improve the quality of storage and transportation facility. The market will witness a transition from traditional cold storages to fully integrated cold chain projects which would bring about efficiency and increased productivity of cold chain companies. Furthermore, with the rising exports of seafood, dairy products and other perishable items, major players will upgrade their facilities in order to store a large variety of products under a wider temperature range and this market will cross INR 470 Billion by 2022.

In the Government of India’s policy initiatives towards doubling income of farmers by 2022, poultry sector is going to be a major contributor.Poultry sector is the most organized of all agricultural sectors in India with a growth rate of 7-9 percent and it is evolving into a very vibrant and modern industry. ■

DOUBLING FARMERS' INCOME

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UNEXPLOITED HORTICULTURAL CROPS IN KONKAN REGION OF MAHARASHTRA- STRATEGIES TO NURTURE

The Konkan region of Maharashtra state is a long and narrow strip covering an area of 30,728 sq. km., it comprises of seven districts viz., Mumbai City (175 sq. km.), Mumbai Sub-urban (446 sq. km.), Thane (4,861 sq. km.), Palghar (4,697 sq. km.), Raigad(7,152 sq. km.), Ratnagiri (8,208 sq. km.) and Sindhudurg (5,207 sq. km.).

The Konkan region of Maharashtra has dissimilar soil and agro climatic conditions than rest of the regions in Maharashtra which make agriculture and allied sectors in this region different. The region is known for wide biodiversity with respect to horticulture and forestry.

HORTICULTURE SCENARIO IN KONKAN

The Alphonso variety of mango which belong to the Konkan region, is the choicest variety of mango owing to its delicious taste and processing qualities. The cashewnut varieties developed by D.B.S.Konkan Krishi Vidyapeeth namely Vengurla 4, Vengurla7 are not only preferred for planting throughout India but also countries like Vietnam. These two crops occupy around 4 lakh hectares in the region and are the major pillars of economy of Konkan. However, the other horticultural crops in the region like Jamun, Jackfruit, Kokam and Karonda are also very imperative due to unique composition of phytochemicals and processing qualities. These crops have remained neglected so far, and are still underutilized. The commercial production technology as well as the improved fruit processing technology of these valuable crops have been developed by the D.B.S.Konkan Krishi Vidyapeeth.

Apart from these major crops, Konkan

region is a home to several distinct perennial crops. Among these Surangi *(Mammea suriga)*, Vatsol / Monkey jack fruit *(Artocarpus lacucha)*, Vavding *(Embelia ribes)*, Triphal *(Zanthoxylum piperitum)* and Kadikokum *(Garcinia cambogia)* are very unique. These crops are found growing naturally in the Konkan region. However, due to more focus on fruit crops viz., Mango and Cashew, the above mentioned potential crops remained neglected. These underutilized crops are rich in neutraceuticals. Importantly, though the plantations of these crops are unorganized, their support to Konkan economy is of few crore rupees. Nowadays, most of the citizens are health conscious. World Health Organization estimates that about 80% of the world population depends on traditional herbal medicines for their primary health care. The different components and chemical extract of these neglected crops are being used as possible source for new drugs.

JACKFRUIT *(Artocarpus heterophyllus)*

Jackfruit is popularly known as the poor man's food in the eastern and southern parts of India. A rich source of vitamin A, C, and minerals, it also supplies carbohydrates.

Tender jackfruits are popularly used as vegetable. The skin of the fruit and its leaves are excellent cattle feed. Its timber is valued for furniture making, since it is rarely attacked by white ants. The latex from the bark contains resin. Pickles and dehydrated leather are preserved delicacies. Canning of flakes can be done. They can be bottled and served after mixing with honey and sugar. Nectar is prepared from its pulp. The rind is rich in pectin, which can be used for making jelly. The flakes, seeds, sterile flowers, skin and core contain calcium

pectate. They are considered as good sources of pectin.

Ripe fruit has high nutritive value. The ripe fruit also significantly contributes to the nutrition of low income families as a source of vitamins, minerals and calories. It contains a fairly good amount of Beta carotene, a precursor of vitamin A. Jackfruit is an important source of pectin and contains about 1.9-2.2 per cent protein on fresh weight basis. Fructose, glucose and sucrose are the major sugars in all parts of the fruit, except in the outer spiny rind. Capric, myristic, lauric, palmitic, oleic, stearic, linoleic and arachidic acids are the major fatty acids, with varying proportions in different parts of the fruit. Dr. BSKKV, Dapoli released the Konkan Prolific variety of jackfruit which yields 420 kg fruits per tree.

JAMUN *(Syzigium cuminii)*

Jamun tree is tall and evergreen. Therefore, it is generally grown as avenue tree or as wind break. Though the fruits are liked by all and sell at a high price, it is still not grown as an orchard tree. Jamun is found all over India. Jamun fruits are a good source of iron and are said to be useful for troubles of heart and liver. The seeds of Jamun are an effective medicine against diabetes, and their powder is widely used in India to control diabetes. The tasty and pleasantly flavoured Jamun fruit is mostly used for dessert purpose. Konkan Bahadoli is the variety of Jamun released by DBSKKV, Dapoli which is high yielding variety (140 kg fruits per tree) and very popular amongst the cultivars in Maharashtra.

The fruit is usually shaken with salt before eating. The Jamun fruit has sub-acid spicy flavour. Apart from eating fresh it can also be used for making delicious beverages, jellies, ice cream, jam, squash, wine, vinegar and pickles. Jamun squash is a very refreshing drink in the summer season. A little quantity of fruit syrup is useful for curing diarrhea. A mixture of Jamun juice and mango juice in equal quantity is very good for quenching thirst for diabetic patient. Jamun fruit is used

for preparation of wine, particularly in Goa. The vinegar prepared from juice extracted from slightly unripe fruit is stomachic, carminative and diuretic, apart from having cooling and digestive properties. The pomade after extraction of juice contains considerable amount of anthocyanin, sugars and tannins which can be further utilized in beverage industry. The oil composition of Jamun has also been reported. Jamun seed can be used as a concentrate for animals because it is rich in protein, carbohydrates, and calcium. Its wood is used for railway sleepers. The timber is used in building for agricultural implements and well work, as it resists the action of water.

KOKAM *(Garcinia indica)*

Kokam is not eaten as a fresh fruit but is used more as a spice or processed into a drink. Kokam butter is also made from its seeds. Kokam trees are planted all over in konkan region and this fruit, which is very little known in other parts of India, is a plant of considerable economic importance. The fruit has an agreeable flavour and a sweetish acid taste. It is used in Konkan chiefly in the kokam which is prepared by drying the outer rind, soaking it repeatedly in the juice of the pulp and sun drying. Kokam contains 10 per cent acid, most of which is malic acid. It is used as a souring agent for curries. Kokam is also used for preparing syrups or ready to use drinks by adding sugar. These drinks are very popular and reported to have a cooling effect on body. Kokam rind contains hydroxycitric acid and is reported to be anthelmintic and cardio tonic. It is also said to be useful in piles, dysentery, tumors, pains and heart complaints. The root is astringent. Dried ripe kokam rind known as amsoleis is used in curry in place of tamarind. The seed yields a valuable edible fat known in commerce as kokam butter. It has good and non-food applications, and possesses export potential.

The oil is ordinarily extracted by crushing the seed into paste and boiling in water to give a solid fat which is greasy to feel and whitish yellow in colour. Kokam butter is regarded as nutritive, demulcent, astringent and emollients. Kokam seeds contain 23-26 per cent oil, which remains solid at room temperature and is used in many household, pharmaceutical, cosmetic, chocolate and confectionery preparations and even industrial preparations like manufacture of soap, candles and ointments for sizing of cotton yam, suppositories and cocoa butter substitute. It is extracted mostly as a cottage industry. Kokam butter, which is sold in market, consists of lumps or cakes of light grey or yellowish colour with a greasy feel and a mild oily taste. It is used mainly as an edible fat. It is used in skin care products because of its ability to soften skin and heal ulcerations and fissures of lips, hands and soles of feet. Kokam butter helps reduce degeneration of the skin cells and restores elasticity. Kokam butter is used in manufacturing soaps, balms, belly balms, foot care products and other emollient skin treatments. Konkan Amruta is the popular variety of Kokam (140 kg fruits per tree) developed by DBSKKV, Dapoli.

KARONDA *(Carissa carandas)*

Karonda(Carissa carandas) is a hardy, evergreen, spiny and indigenous shrub widely grown in various parts of Konkan region. It is grown commonly as a hedge plant. Fruits, sour and astringent in taste, are a very rich source of iron also containing good amount of vitamin C. Karonda is very useful in curing anemia. The fruits have antiscorbutic properties also. Ripe fruits are sub-acidic to sweet in taste with peculiar aroma. The fruits may be eaten as a dessert when ripe, or used in the preparation of fruit products such as jelly, sauce, Carissa cream or jelled salad. The unripe fruits are sour and astringent and can be used for pickles, sauces and chutney. The dried fruits can be candied just like cherry. The wine prepared from ripe fruits contains about 14.5-15 per cent alcohol and is very much liked by wine lovers. The unripe fruits yield milky white latex which can also be used in preparing

chewing gum and rubber. Fruits can also be used in dyeing and tanning industries. Karonda fruit is considered to be antiscorbutic. Root extracts are used in lumbago, chest complaints and venereal diseases. The wood of the Karonda plant is white, hard and smooth. It is used for making spoons and combs. The plant makes excellent strong hedge almost impossible to penetrate which can also be used for fencing to protect from animal pests. Konkan Bold is the variety of Karonda released by DBSKKV, Dapoli for the processing purpose.

SURANGI *(Mammea suriga):*

Mammea suriga (Buch, Ham. Ex Roxb) Kosterm is one of the important aromatic tree species of the Western Ghats, commonly known as Nagasampige in Sanskrit. It is an endemic tree species confined to Western Ghats of India. The plant is dioecious. It bears staminate flowers once in a year during the months of March and April, and the flower buds are globous, white or pinkish in colour.

It is cultivated for its sweet scented flower and handsome foliage. It is an excellent honey bee attractant. Fresh flowers are used for worshiping in temples and for personal adornment. Part of the plant which is of economic importance is dried flower, which persist its fragrance for a long period of time and thus is used in perfume industries. It is planted as an avenue tree. Wood is sometimes used for building purposes, planking and formats of boats.

VATSOL /MONKEY JACK FRUIT *(Artocarpus lacucha):*

The fruits of Vatsol /Monkey jackfruit (Artocarpus lacucha) are generally sweet sour pulp eaten fresh but

mostly made into curries. The flowers are used to prepare pickles and delicious sauce. Moreover, the tree is also used as food and timber. Timber and wood from this tree is used to make furniture, boats and cabinet. The extracted alkaloids are used in the medicines of heart attack and for curing cancer.

VAVDING *(Embelia ribes):*

Fruits are used in Ayurvedic preparations. Ayurvedic products like Vidangadi Churna, Vidangalauha, Vidanga Taila and Vidangarishta are also available. The fruits are astringent, anthelmintic, depurative,

digestive, diuretic, carminative and contraceptive. The paste is locally applied against ring worm and other skin infections. Seed powder is used to cure headache. The roots and leaves are astringent, thermo genic and stomachic. Powder from dried bark of the root is a reputed remedy for toothache. The plant is used as an anti-inflammatory drug to relieve rheumatism and fever. The fruit cures tumors, deworming, bronchitis, jaundice and mental disorders.

TRIPHAL *(Zanthoxylum piperitum)*

The fruit contains essential oils, flavonoids and isoquinoline alkaloids.

It is anthelmintic, antibacterial, antifungal and stomachic. It inhibits the synthesis of prostaglandin. It

is used in Korea in the treatment of tuberculosis, dyspepsis and internal parasites. The resin contained in the bark, and especially in that of the roots, is powerful stimulant and tonic. Generally, the rind of the fruits is used as a spice.

KADIKOKUM *(Garcinia cambogia)*

Kadikokuma tropical fruit also known as the Malabar tamarind, is a popular weight-loss supplement. It is mainly used for culinary purposes besides this it contains hydroxycitric acid. People say it blocks your body's ability to make fat and it puts the brakes on your appetite. It could help keep blood sugar and cholesterol levels in check, too.

All these crops are native of Konkan region, highly economical with remarkably reduced production cost and are better acclimatized with the existing climate of the region. All of them provide tremendous scope for extraction of valuable phytochemicals such as antioxidants and novel value added products. These plants can be very good intercrops which widen the scope of their plantation. It's a prime need to expand the area under these crops by motivating the farmers towards the plantation of these underutilized crops. It will greatly help to conserve biodiversity as well as to maintain crop diversification in the Konkan region. D.B.S. Konkan Krishi Vidyapeeth has undertaken survey, identification, collection of promising genotypes, standardization of propagation technologies and supply of quality planting material of all these precious crops. In this context, it is observed that the above mentioned crops can be profitable for the Konkan farmers with strategic planning.

In Konkan region, villages are scattered in clusters at hill sides. Every villager has his own traditional kitchen gardens in which they are cultivating vegetables, flowers etc. Accommodating these underexploited crops at household level in a Panchakroshi (cluster) mode will not only conserve these plants at every household but also facilitate greatly for organized marketing and value-addition. It will provide strong sustainable opportunities of employment to youths and farm women who possess potential to make Konkan farms economical and sustainable. The University with the involvement of NGO Lupin foundation has undertaken a village level survey of these crops. Accordingly, the cropwise Panchakroshi of villages are formulated. For example in Sindhudurg district, the villages Nemale, Tak, Arawali are identified for Surangi cluster. The villagers were imparted training on the technology, and quality planting material of Surangi is provided in these villages. Likewise, efforts are being taken to develop Panchakroshi for all these minor crops. After five/three years doing the programme in village suggested above, rest of tahsils will have to cover in remaining 5 years. Such type of contingent plan will help to increase the income of Konkan Farmers as well as to uplift the unexploited fruits crops in relation to their aesthetic value. ■

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CREATING INCLUSIVE, RESPONSIBLE AND SUSTAINABLE FARM VALUE CHAINS FOR INDIA

Farmer's suicides and rural distress is not new to India, but off late the silent suffering is snowballing into violent protests. While such protests many a times affect the daily life of the common people but solution is still farfetched. As a country we have following two huge challenges, first one is to address the insufficient income for the producers and second one is about sustainability in everything we do, this includes farming.

It is a paradox that afore mentioned signals of farm duress are happening when country has been harvesting record food grains than ever before. Governments' agricultural spending increased to 111% over four years up to 2017-18 but unfortunately the producers have not been gratified with a rightful remuneration for their efforts. An empirical evidence for the same is reflecting in this authors' research work with the women collectives of Mahila Arthik Vikas Mahamandal (MAVIM) sponsored by IFAD . In the major value chains of Red Gram (Tuar), Corn and Rice, it has been observed that producers share in the final consumers price hovers around 25% to 35% only. Our own studies have also demonstrated that there is a 25 to 40% value erosion in cases when individual farmers resort to distress selling immediately after harvest, which unfortunately is the case of majority of the situations. Hence apart from the stop gap, untargeted arrangement of increasing MSP year after year, it is high time India investigated into ways of improving producers' share in consumer spending pie towards farm produce products.

Another important factor to be discussed is, rudimentary share of rural women and youth in overall skilled and quality employments generated by farm commodities. Though 66% of national employment is generated from agriculture sector, lion's share of that is in farm

labour and other unskilled low paid farm jobs. A major reason for this can be attributed to the fact that the production areas and processing areas of country are mostly existing in mutually exclusive tracts separated by long distances. As part of a project sponsored by The Tata Trusts, the team at Arya Collateral Warehousing Services Pvt Ltd. had studied this topic and same can be discussed taking example of Madhya Pradesh. Wheat, Gram, Soybean and Paddy account for bulk of dry agri production in the state, contributing to 85% of the total production in volume terms. As on 2017, 92% of the Producer Collectives of the state registered under the companies act is lying in the maximum producing districts, still the share of these producer collectives in procurement by corporates or processors is negligible. Reason being only half of these are located in the corporate procurement hubs and only 10% of these are located in the processing hubs. The women and youth have important responsibilities in poor smallholder value chains, often absence of value addition activities result in scarce employment opportunities for them. The question is how can agri-commodity value chains contribute to generating large scale rural employment for women and youth?

While it is obvious the alacrity is required to act to ensure rightful share for producer in consumer end price and necessity of recognising value chain activities as central to rural employment generation, one may question the need to prioritise sustainability of value chains.

The answer to the same lie once again in our studies with 750 active Farmer Producer Companies in major clusters of India and their opportunity for bettering income by connecting to high price offering by market players. As per our findings, premium price paying clients are sensitive about sustainable sourcing and this can be a key determinant for them in selecting business associations and making buying decisions. Hence it is quite important to align with the objectives of those markets and players. Let us shortlist some points to be discussed in this article. Sustainable sourcing and factors impeding the same in itself a very large subject, hence authors of this article would like to highlight some specific issues which figured in their several studies.

Agricultural commodity warehousing is often fraught with application of hazardous chemicals that aggravates depletion of Ozone layer. Aluminium Phosphide (ALP) is used for controlling infestation in commodities stored in warehouses. Growing resistance to ALP over the years have prompted players to use higher than the recommended dosage or use of alternate banned chemicals. Such higher dosage and alternate chemical usage depletes the ozone layers. Traditional warehouses often require several rounds of pesticide spraying which is not very water efficient way of managing the commodities. Under normal circumstances for a period of six months storage of 5000 MT of commodities require about 1000 litres of water. This can be quite exploitative in geographies which are close to city dwelling areas which are already under considerable water stress. Hence above discussed dependence on Ozone depleting chemical interventions and use of large volumes of water leaves behind considerable negative environmental footprints by commodity warehousing industry.

Another serious issue which has very little awareness among consumers is the high human exposure to aflatoxin contamination through food chain. For the first time aflatoxin was detected as serious killer in 2004, when 150 people died in Kenya due to liver failure inflicted by aflatoxicosis. Aflatoxin, once enters the food chain, is difficult to be traced and stays undetected in dairy and poultry products. The Post-

Harvest storage practices of both the commodities play a significant role in determining growth of aflatoxin in food chain.

In the above sections of this article we have discussed about meagre role of producers in value chains and potential but underexploited status of value chains as income enhancement and employment generating opportunity. Also, about the necessity of creating responsible and sustainable value chains. In the following sections of this article our efforts are to discuss some field-tested practical solutions that have scope to be scaled up across country.

Our experience with hundreds of producer collectives proves that remarkable appreciation in Producer Income is possible by collective activism led aggregation of commodities followed by financial and marketing linkages. The now popular World Bank promoted model of Productive Partnership is one way to bring transformation of Farm Value Chains with due representation for Producers and their organisations. In this context, across the world there are successful models where corporate houses work with producer collectives to improve credibility of their credit applications through buy back guarantees. This is helping producers to use inputs at right time and quantities resulting in betterment of produce quality to mutual benefit. The resultant delayering of value chain from costly intermediaries, access to low cost credit and better prices have tremendous scope to bring irreversible prosperity for producers. As an enabling organisation, we catalyse such constructive models through innovative solutions to bridge gaps to effect these productive partnerships. Constraints related to insufficient storage spaces in rural areas are met through our offering of flexible Hermetic Storage Solutions. These structures which can be moved anywhere and installed in short time is empowering producers to store their produce in place of their choice. To fend off inhibitions of financiers due to past unpleasant experiences due to commodity price crashes, we have partnered with premier institutions like Rabo Bank Foundation to introduce price risk mitigation tool. This tool insulates financiers from possible risk of default due to commodity price crash.

It is this author's first-hand experience in Ethiopia that initiation of Value Chain activities invigorates stake holders dependant on it in the ecosystem resulting in a chain reaction of activities, increasing the market volumes transacted, improving business of processors and exporters, and in turn increasing opportunities for employment for local women and youth. Hence post-harvest value chain activities can play significant role in improving local employment. It is our endeavour to support value chain initiatives of producer collectives through facilitating linkages and capacity building programs.

Similarly, new age revolutionary storage solutions promise storage of commodities with absolutely zero use of water and chemical interventions. These systems which are being pioneered by us help to leave favourable environmental footprints. Further, the Post-Harvest management practices resulting in arresting of fungal growth in stored corn leading to negligible presence of aflatoxin in stored corn. This results in creation of responsible value chains supporting better nutritional and health profile of entire population.

It will be incomplete to close on this narrative about creation of inclusive, responsible and sustainable value chains, without specifying support expected from the largest stakeholder, the government. Large scale capacity building and skilling programs are an essential prelude to initiation of value chain activities by producer organisations. This magnitude of effort can be possible with convergence of several government intervention schemes in this direction. Policy level changes are required to leverage programs like NREGA and national skill mission in this direction. Import of equipment and tools facilitating value addition of farm commodities require to be made free of tariffs. At present prohibitive tariffs escalates cost of introducing these interventions and deter producers from implementing these tools and techniques that can make their value chains to be globally competitive. Interested enablers like ARYA has worked on price risk mitigation models, but these require large scale commitment of resources to test the model in wide geographies and to bring more collectives under the ambit of these programs. Agri value chain focussed NBFCs are expanding net of financial inclusion to reach primary markets. Government support in terms of subsidised credit is required to complement these efforts since it is costly to service remotely placed producers often fraught with default risk due to vagaries in climate. With proper government support, these enablers can certainly play a greater role in realising the Prime Minister's target of doubling the farmers' income. ■

PRESCRIPTION TO MAKE INDIAN AGRICULTURE PRODUCTIVE, PREDICTIVE AND REMUNERATIVE

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India being an agrarian country and agriculture being a State-subject, there is a need for calculated and balanced approach between the Union of India and the States to remove snag in agriculture in totality turning it into a dynamic venture.

AT THE LEVEL OF NITI AAYOG

Centre is often blamed for skyrocketing prices of agri-commodities in the event of crop failures, even though agriculture happens to be a State-subject! A pragmatic approach could be the formulation of 'Annual Balanced Crop Plan' (ABCP) assigning specific production targets to States, crop by crop, taking into consideration the total requirements of the Country. This should be deliberated, approved and allocated to States by NITI Aayog with appropriate budgetary support, followed by monitoring.

In no case, crop production programs in a given State should be based on convenience, taken up in a complacent manner. There must be comprehensive target-oriented production plans, meeting major agri-commodity requirements, locally. NITI Aayog must encourage State Agriculture Depts. to allocate irrigated areas to Pulses and Oilseeds, proportionate to mitigating deficiency levels, backed by incentives. The Central Govt. should come to the rescue of those States where climatic conditions do not favour growing a crop, profitably.

AT THE LEVEL OF ICAR:

A serious introspection is needed to decide continuity, redefining objectives and aligning goals of over 101 Research Institutes; 80 All India Coordinated Research Projects (AICRPs) of the Indian Council of Agricultural Research (ICAR -the apex body for agricultural research and education, established way back in 1929, and continues to exist with no major structural reorganization). Though the Dr. R A Mashelkar Committee submitted its recommendations about restructuring ICAR about a decade ago, this has been kept on hold. However, major recommendations may be still relevant. The irony is that, our Country has as many as 73 State Agricultural Universities (SAUs) and half a dozen Central Agricultural Universities (CAUs), all with similar mandates, leading to serious duplication of research and a very thin spread of resources; resources that are critical to the advancement of high-tech R&D to boost return on investment (ROI) and international competitiveness.

To begin with, ICAR may combine the existing individual crop-based research facilities into crop-group based National

Institute considering All Pulses, All Oilseeds, All Cereals, All Spices, All Fibre Crops, All Fruits & Vegetables, All Fisheries, including their respective Technology components, as well as All Animals/Veterinary Sciences, including Dairy Technology, and All Poultry and Avian Research Institutes, together.

Build a culture of co-existence and partnership with leading private seed industries by sharing knowledge, germplasm and facilities that are unique for the development of smart hybrids (with emphasis of non-GMOs first) in major Field crops and Vegetables. Pay more attention on water and nutrient-use-efficiency research to support and prop up rainfed agriculture.

There are acute shortages/ misuse of Breeder and Foundation Seeds of recently released varieties, resilient to climate changes with inbuilt resistance/tolerance to biotic and abiotic stresses. During the release of such varieties, it should be made mandatory for the concerned Institute/SAU releasing such a variety/ hybrid, to take up seed production in adequate quantities, using existing facilities created under the National Seed Programme (NSP) and roping-in their own Krishi Vighyan Kendras (KVKs)/Regional Stations. On production of Foundation Seed, the Dept. of Agriculture & Cooperation (DAC), Ministry of Agriculture (MoA) can allocate them to National Level Agencies (NLAs) for Certified Seed production and supply.

AT THE LEVEL OF DAC, MINISTRY OF AGRICULTURE, GOVT. OF INDIA:

Suspend all the routine schemes namely National Mission on Oilseeds and Oil Palm (NMOOP), Mission

for Integrated Development of Horticulture (MIDH), National Food Security Mission (NFSM), etc., that are in place since the last few decades, and continuing to exist, just by changing names, but having no matching impact in the target areas. The funds could be utilized where it is needed most in supporting seed production of novel varieties and linking it with ABCP at the State levels.

In the event of the merger of State Farms Corporation of India (SFCI) with National Seeds Corporation (NSC), there should not be 'Test Stock Seed Multiplication' of newly identified varieties any more under the DAC support. The budget for that purpose should be transferred to concerned commodity Institutes of ICAR/SAUs so that enough seed is produced for Minikit/ Front Line Demonstrations under the centrally sponsored schemes. This will help in promoting new/novel crop varieties released in the last 5 years, and thereby enabling farmers to realize higher yields, even under the adversities of climate change.

The NSC, wholly owned by DAC, MoA must stop purchasing seeds from open markets through a tendering process, often based on L1; this is the single biggest contributor to the gradual destruction of Indian Agriculture. Similar practices must be stopped with other NLAs for seed production and supply.

Present Seed Certification System, as practiced and endorsed by the DAC, MoA, is the biggest menace in Indian Agriculture (in fact could qualify as a scam of the highest order), which was documented and submitted to Joint Secretary (Seed) and Secretary Agriculture, DAC, MoA with facts and figures, State by State, for initiating corrective measures, a year back. Appropriate corrective measures must be initiated without further delay.

Equip the Food Corporation of India (FCI) with modern warehouses, silos to store food grains and food legumes, thereby avoiding wastage and compromising quality, with other logistic support.

Move towards corporate

agriculture by clubbing small-farm holders and dry-land farmers, and offering major stakes by roping in leading agri-business houses namely, Reliance, Godrej, Tata, etc.

Support State level Agro Industries Corporation for manufacturing of small agricultural tools like improved "ergonomic" sickle & spade, seed drill/planter, weeder, thresher, decorticator, sorter/grader, etc., following approved designs and involving local manufacturers, to be supplied to farmers.

Development of Watershed, in a mission mode, in rain deficient areas to recharge existing open wells, and to raise the level of aquifers. Also support land configuration for harvesting rain-water to mitigate moisture stress.

AT THE JOINT LEVELS OF MINISTRY OF AGRICULTURE AND MINISTRY OF COMMERCE:

Discourage private market players from unnecessarily importing important agri-commodities for personal gains, particularly in Pulses and edible Oilseeds, by raising the import duty. It is essentially required to ensure good crop prices for Indian produce and is in the best interest of the farmers. It will also serve as a confidence building measure by ensuring procurement and offering special incentives. Such steps may lead to achieve sustained self-sufficiency in Oilseeds and Pulses sector.

Money spent by DAC for promotion of organic agriculture will be a colossal waste unless the area converted to C-4 and certified by Agricultural and Processed Food Products Export Development Authority (APEDA) are further utilized for production of organic food and exported, besides marketing locally.

AT THE LEVEL OF MINISTRY OF FOOD PROCESSING INDUSTRIES, GOVT. OF INDIA:

Harvest and post-harvest losses in major agricultural produce is estimated at Rs. 92,600 crores annually. Similarly, losses in fruits and vegetables are close to 40,8000 crores. Unavoidably, matching investment is desperately needed for post-harvest storage infrastructures.

Services in pre-conditioning, pre-cooling, ripening, packaging, labelling, etc. should be made available.

Developing cold chains and quick transportation systems to save perishable fruits and vegetables and constructing "accessible" cold storages in large numbers for different crops in strategic areas.

Involvement of Council of Scientific and Industrial Research (CSIR) Institutes namely Central Food Technological Research Institute (CFTRI) and National Institute of Nutrition (NIN) in developing Nutri-Foods products using traditional nutri-cereals (kodo, quinoa, quality protein maize, etc.), and their appropriate commercial manufacturing processes for value-addition through inexpensive technology, primarily targeted towards the malnourished sections in the society. However, given the recent trends in Food & Nutrition, premium lines can also be developed for health conscious, middle to high income groups, which will make this venture profitable, while subsidizing the low-income groups.

SPECIAL PACKAGE FOR LANDLESS TRIBAL FARMERS:

Some cash incentives along with seeds of moringa, tapioca, elephant foot yam, sweet potato, vegetable (climbers) for backyard cultivation, besides a pair of goat/sheep, half a dozen poultry birds, and kits for rearing honeybees may be provided. Scheme for skill development of Tribal population for processing of local forest products may be launched. CSR Funds may be utilized for the purpose.

IN THE AREAS OF FOOD ADULTERATION

Literally, the Country is physically sick due to adulterated food, condiments, beverages, synthetic milk, milk-products, in addition to the malpractices of hoarding of pulses and other essential commodities aimed at creating artificial crisis and leading to skyrocketing of prices, thereby depriving access to food to millions of middle/lower middle class people. Such sinister acts must be stopped by bringing in appropriate legislations and, if required, deploying civil defense forces to win over this war of that is silently killing our countrymen.

Needless to say, every Govt. must adopt a pragmatic, down to earth approach to meet basic needs of Rural India and save millions of malnourished smallholder farm families, the lower middle class, and the landless half-starved people living below poverty level, who are subjected to untimely death, often by committing suicide.

I am asking on behalf of millions of my countrymen for these urgently needed reforms in Agriculture as a sector, because I know the Honorable Prime Minister has the will, courage and the utmost determination to deliver! ■

FARM INPUTS

Mr. Rajesh Patel
Captain Tractors

FARM MECHANIZATION

In the beginning of the agricultural era, humans used to work alone in the farm without using any external support. Later on, humans started using animals for certain farming operations. Still, animals were not able to perform important farming operations like inter cultivation, harvesting, spraying, hole digging, etc. For these operations, till decades, humans used to compromise on Quality, Time and too much physical work. Later on, mechanization came into the picture, and farmers started to mechanize their farm operations. Farm mechanization had set up a new era and agriculture revolution made them technically prosperous. Going with the definition of Farm Mechanization, it is the process of replacing animal and human efforts with mechanical approaches to make all farming operations easier, better, smoother, more precise, time saving, efficient as well as productive. Farm mechanization includes use of tractors, power-tillers, drones, combined harvesters, farm implements, aero planes and helicopters. Farm mechanization has also given a thrust to Precision Agriculture technologies which has got better with satellite imagery and satellite navigation systems.

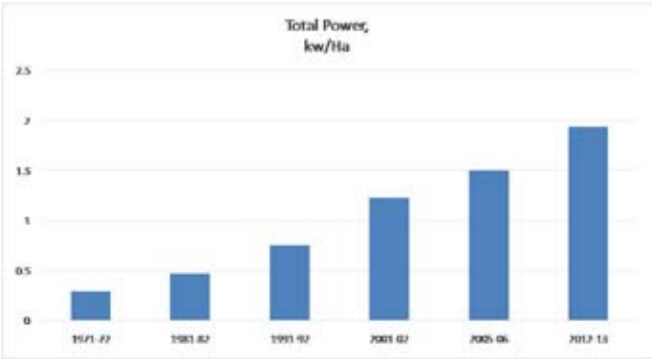
In India, farm mechanization is becoming the necessity of today's farmers. 85% of total land holders are small and marginal farmers. With the increasing inflation rate and migration of rural people to urban areas, availability of farm labour is going to be constrained. According to India Economic Survey 2018, percentage of agriculture workers to total work force was 58.2% in 2001 which is expected to be dropped to 25.7% in the year 2050. Farming is time sensitive. But, because of labour crisis, it becomes the toughest to handle in such situations and sometimes farmer has to suffer from loss or destruction of crop quality. Agriculture Mechanization can only be the answer for these kind of avoidable challenges. Farm Mechanization has an ability to increase the productivity up to 30% and it also helps reduce the cost of cultivation up to 20%. Moreover, it also saves valuable time and reduces drudgery of farmers.

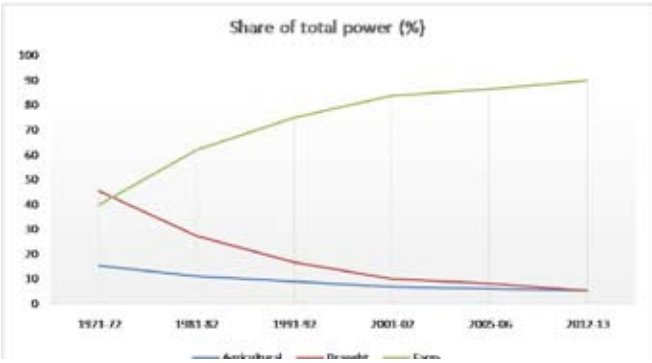
Rate of Farm Mechanization in India lies between 40-45%, where states like Punjab, Haryana as well as Uttar Pradesh have the most mechanized farms in the nation. In comparison to other countries like US (95%), Brazil (75%), China (57%) we are still way behind. Indian tractor industries have emerged as the largest in the world and account for about one third of total global tractor production. Indian Government has also started to support and encourage the Indian farmers for adoption of Farm Mechanization through loan and subsidies.

In 2016-2017, farm power availability was 2.02 kW/ha and Indian Government is aiming to increase it to 4.0 kW/ha by 2030. It has also set

Share of Total Power %				
Year	Agricultural Worker	Draught Animal	Farm Machinery	Total Power, kw/Ha
1971-72	15.11	45.26	39.63	0.295
1981-82	10.92	27.23	61.85	0.471
1991-92	8.62	16.55	74.83	0.759
2001-02	6.49	9.89	83.62	1.231
2005-06	5.77	8.02	86.2	1.502
2012-13	5	5.1	89.7	1.94

Source: IndiaAgristat





the target to double incomes of all Indian farmers by 2023.Sub Mission on Agriculture Mechanization (SMAM) that was launched in 2014-2015 has the following components - (1) Promotion of Agri Mechanization through training, testing and Demonstration, (2) Dissemination of Post Harvesting Technology and Management, (3) Establishment of Farm Machinery and equipment banks for custom hiring, (4) Financial assistance for promotion of mechanized operations.By 2022, size of farm equipment market in India is expected to reach 9 Lakh Crore. Measurement of mechanization cannot be done by only sales of tractors in the nation but it also includes mini tractors, power tillers, oil/diesel engines,etc.

CHALLENGES OF INDIA'S SMALL AND MARGINAL FARMERS

ECONOMIC CHALLENGES:

Unavailability of Loan and higher rate of interest are affecting Farm Mechanization. To promote mechanization, Indian Government provides subsidy as well as banks are providing loan at competitive rates of interest. Additionally, government is striving to recruit Gram Sevaks for more and more villages for better guidance and knowledge upgradation of latest technologies from all aspects of farmers.

Another solution can be to switch to Mini Tractors and mini tractor implements for 360-degree total farming solutions in all seasons' crops which are fuel efficient, compact in size, pocket friendly as well as safe in use and also economical to the farmers. Other machineries are also available in competitive prices which can be the alternate option.

LACK OF AWARENESS AND KNOWLEDGE:

Illiteracy of farmers are decreasing and interest of young generation in Modern Agriculture Innovations and Technologies is also increasing. However, there is still a generation of farmers who are unaware of the latest technological interventions. They live in such villages which are too far from National Highways. They still do not know about many revolutionary agriculture products which are available today in India. Agriculture Machinery Companies should focus more and more in demonstration activities, not just of tractors but also range of implements. Nonetheless, they should also provide training so that it can be efficiently, safely and operated at its best. Mini tractor industry has diverted the path of Agriculture Mechanization towards Compactness. Being very reasonable in prices, mini tractors are affordable. Even mini tractor's implements are also available in lower price range. Mini tractor implements also help reduce the operating cost which is quite lesser than the high HP

tractors.

UNAVAILABILITY OF SPARES AND SERVICE:

Core activities of an organization are being totally transformed digitally. This opened up the doors of Digital Marketing and Digital Media. Rather than going with traditional trends of Marketing, digital marketing is showing much potential. Social Media is being considered as a very effective tool for digital marketing and for exponential growth of sales. But, I have seen sometimes that social media reaches on such a location where company is not able to deliver the product and not available even for service. As a part of its solution, I would suggest to expand sales and service area, so that we can be available at maximum locations.On initial basis, we can cover the local spares and service providers on the remote locations. By providing the training to concerned service and spares providers, we can overcome the challenge of Unavailability.

FUTURE OF FARM MECHANIZATION

Walking with innovations and technologies, farm mechanization has also improved. Starting with just tractor, we are at the edge of most efficient, most powerful, most reliable, most comfortable and the safest agriculture machineries. Still, it is being upgraded with innovations in Nanotechnology and Information Technology. Future Agriculture Mechanization will bloom with Precise Agriculture. Farm Mechanization has been developed the most. But, now it is the time to have precision in each agriculture operations with the best optimization of fuel efficiency, compactness, highest quality in the lowest price, universally available

spares availability at any time as well as maximization of IT gadgets, lowest material wastage and lowest emission ratios. Today, compactness is highly accepted by the farmers and we are in the era of size optimization of each component used for agriculture machineries. It will be reflected in drop in prices and will give more strong reasons to have mechanized farms in nominal charges. This will also bring a hike in GDP, Per Hectare total crop productivity, Per Hectare total farm power utilization as well as overall food quality and quantity. Again more efficiency will result in less consumption of fuel, which actually helps the nation to cut down on the import of Crude oil.

Talking about the future technologies, it will be dependent on climate situations like Global Warming, Green House Effects, Acid Rains, etc. Also it will be affected by energy crisis and energy transformations as well renewable energy sources. We are living on a closing stock of petroleum. Tomorrow we will have to depend on renewable sources of energy. Government is focusing more and more on developing solar farms, wind farms, hydroelectricity plants, tidal energy power plants as well as OTEC. Farm mechanization is being developed in India in the form of electric tractors, solar operated tractors and machineries, automation of implements, better comfort of farmers i.e., facilities of Air Conditioned Cabin, Satellite connectivity and other IT gadgets. Drones, Airplanes and helicopters are also used for aerial applications of farm inputs, especially for larger farming lands. But in India because of land fragmentation, it is a difficult to have such an approach. Here, mini tractor is the best option to satisfy all your needs and to have 360-degree total farm mechanization solution in fragmented farms.

I believe that the next generation of Agriculture Mechanization will be developed by precision agriculture technologies, nanotechnology inventions as well as farm automation. Entire mini Tractor industries are working for refining agriculture mechanization and to give mechanized solutions for each farming operation.

R.G. Agarwal
Chairman
Dhanuka Agritech Ltd.

ROLE OF AGRO CHEMICALS FOR SUSTAINABLE AGRICULTURE

Agriculture for a sustainable growth need adoption of latest technology available in the world but unfortunately in our country we are not using the new technology. It will be appropriate to refer to the statement of the then Finance Minister, Mr. P. Chidambaram in his Budget speech dated 28.02.2008, when he said that our extension system has collapsed and we are looking for some alternate options but nothing so far has emerged. Despite some very good research work happening in our universities, our farmers have not reaped its benefits. In this big country, it is not possible for any individual institution to reach more than 14 crore farmers in more than 6 lakhs villages. Govt. of India has taken various steps on transfer of technology to farmers, but to achieve that mission, Public Private Partnership (PPP) is the only solution available as on date.

Govt. of India is focusing on Skill Development but in the field of Agriculture nothing much has been done. As per NSSO Survey, most of the farmers reach the private dealers for technology. The dealers may not be educated and due to vested interest of some of them, there are also chances of negligence until and unless Insecticides Act , 1968 and Rules, 1971 are properly implemented.

PUBLIC PRIVATE PARTNERSHIP (PP)

Dhanuka Agritech Ltd. took the initiative in 2001 as its first Public Private Partnership (PPP) and signed an MoU with Agriculture Department, Madhya Pradesh Government for working jointly for the Extension activities at Hoshangabad District, MP along with soil testing laboratory which was transferred to Dhanuka Agritech Ltd. We feel proud that within 3 years, the yield of Hoshangabad district was increased by 30-40 % and Madhya Pradesh Govt. got the National Productivity Council Award for recording the highest yield in this district.

We visualized it long back in 2006 when Mr. Satyanarayana Rao, IAS was the Director General of MANAGE, Hyderabad.He discussed about the programme in our association meeting and we were very much impressed and immediately started the first batch of 'Diploma in Agricultural Extension Services (DAESI)' for Input Dealers in Rajahmundry, West Godavari District, Andhra Pradesh and as a convocation, big programme was organized and more than 1000 dealers participated to share the message with the other dealers to understand the benefits.After this, we started 'Diploma in Agricultural Extension Services (DAESI)' with Anand Agri University, Gujarat and followed by Navsari Agri University, Gujarat and then Junagadh Agri University, Gujarat and Dr. Panjabrao Deshmukh Krishi


Vidyapeeth, Akola.

The right approach is to train all the dealers. The training should be made mandatory by Government of India before renewing their license. Graduation should be made compulsory and for existing licenses, this Diploma in Agricultural Extension Services for Input Dealers (DAESI) is necessary but unfortunately this course has not been started in various Universities.

RAIN WATER HARVESTING AND PROPER USE – 'PER DROP MORE CROP'

Despite our efforts to educate and inform farmers about the weather forecast,only very limited farmers are receiving district level weather forecast through SMS and mKisan portal. To minimize weather related crop losses, ICAR along with Indian Metrological department is targeting to issue alerts to 6500 blocks across 660 districts in country by 2020. As of mKisan portal report FY19 the pilot study in 200 blocks is underway. – Ministry of Agriculture, NITI Aayog signed a deal with IBM India to develop a prediction model for crop yield using Artificial Intelligence.

The possible alternative to this erratic rain fall and unirrigated areas is to start rain water harvesting. The check dams, ponds water conservations are to be taken up on a large scale with the help of local bodies and Government assistance in mobilizing the farmer's organizations like FPO by providing support from NABARD. Corporates can also come forward through their CSR activities on the above points for educating not only the farmers but in urban areas as lot of water is wasted in RO, and this water can be saved/stored and can be used for other purposes.

We are pleased to know that the Hon'ble Prime Minister has understood the gravity of the situation and has formed a new ministry named Jal Shakti to complete the pending irrigation projects at the earliest and maximum area comes under drip, sprinkler irrigation so that from same water, more areas can be irrigated increasing the efficiency of water use.

In North India where ground water level has gone below danger zone, growing water guzzling crops like paddy and sugarcane is a crime and alternative crop solution must be developed.

MARKETING INTER LINKING VALUE CHAIN

Government should promote pulses, oil seeds, maize and other coarse cereals and pay remunerative prices as in the case of paddy. We have various acts such as APMC, Essential Commodities Act which were formed with the point of view to provide farmers with remunerative price. These acts are now counterproductive and have not been able to safe guard the farmers' interest. The consumers end up paying 8 to 10 times more than what the farmer get due to middlemen. There is erosion of margins which legitimately must go to the farmers.

There is need to review all such laws and acts which are age old and are not serving any benefits to the farmers. Professor Ramesh Chand of NITI Aayog also referred to abolish all such laws and replace them with market driven economies by bridging the gap between farmer and end consumer.He is advocating to free the agriculture from all restrictions and thereby increase farmers' income.

Stressing on the need to conserve water, Prime Minister Narendra Modi on Independence Day said that the centre and the states will have to work together to save water and provide it to every household. He said that under the JalJeevan Mission, clean water will be provided to all. He mentioned that the government had allocated Rs 3.5 lakh crore for the project and the work on the JalJeevan Mission will progress with great vigour in the years to come. "The movement

Value Chain Component	Infrastructure requirement	Infrastructure Created
Reefer Trucks (Nos.)	61826	<10000
Ripening Units	9131	812
Integrated pack house (nos.)	70080	249

Source : Doubling farmers income, Ministry of Agriculture Committee Report,2018 DGCIS

towards water conservation has to take place at the grassroots level. It cannot become a mere Government programme. People from all walks of life have to be integrated in this movement.

INFRASTRUCTURE

Food storage facilities, cold storages and value chain linkages are required on a mass scale.Market linkages are also required to ensure that farmer is able to sell the produce directly through these Haat Bazaars, small mandis and self-help groups, cooperative societies. APEDA's role also needs to be broadened for making our agriculture export worthy and reach out to the world where ever there is a need and develop new markets. We have an edge ,being a tropical land with various climate zones, and growing maximum number of crops.

India needs an investment of INR 89,375 crore to improve the storage and transportation infrastructure facilities for food crops according to Dr. Ashok Dalwai Report on Doubling the Farmer Income Committee, 2018. 16% of the target set for creating integrated pack-houses, reefer trucks, cold storage and ripening units has been met. At an aggregate level, India's cold storage capacity is not at the required levels. However, 60% of these cold storages are located in just four states - Uttar Pradesh, Punjab, West Bengal and Gujarat. Further, existing cold storage capacity is confined mostly to certain crop types and not integrated with other requirements.

AVAILABILITY OF QUALITY AGRI INPUTS

The agro chemicals are perceived by the farming community as an important agri input in order of priority. First is seed, second is fertilizer, third is irrigation and the last priority is pesticide which is most important and works as Insurance to protect his crop.

There is a myth being spread by some of the NGOs because of their vested interest that pesticides are hazardous, carcinogenic and not safe to the environment. They are also responsible for degradation of the soil. We have number of papers published along with relevant data from various scientists/experts on this.There is book published on the information i.e. gathered and incorporated and this book with details of the products which are responsible for Cancer but in the world registry of Cancer no pesticide is mentioned.

Even regarding residue, there are traces and this myth needs to be

transformed into reality by facts. The book from Dr. Kanungo is available clarifying all the myths.

In this regard we would like to inform you that All India residue network under Ministry of Agriculture tested around 16000 samples of various food items every year and hardly in 2% samples residue was found above MRL. Mentioning that during 2008-18, a total of 1,81,656 samples have been collected and analyzed, out of which 3,844 (2.1%) samples were found with chemical residues exceeding Food Safety and Standards Authority of India (FSSAI) Maximum Residue Level (MRL). (Source: AICRP on Pesticide Residues, 2016. Annual Report 2014-15, Monitoring of Pesticide Residues at National Level, Ministry of Agriculture & Farmers Welfare, Govt. of India).

Dhanuka has made 12 episodes which were broadcasted by ABP News and are available in You Tube and I will advise especially to see our 12th episode on Myth Vs Reality where 3 scientists, Dr. Sandhya Kulshreshtha, Medical Toxicologist, Dr. K.K. Sharma, Director, All India Residue Networkand Dr. D. Kanungo, Ex. DDG and presently Chairman, FSSAI Committeeclarified the Myth spread by certain NGOs with vested interest against Pesticides.

Insecticide Act, 1968 was passed by the parliament with the sole objective of ensuring that only chemicals conforming to quality and which are safe are manufactured and marketed by the organizations. Such organizations must have the manufacturing facilities, the infrastructure and the quality standards through the laboratories in their premises. Unfortunately, there are spurious, duplicate, sub-standard and counterfeit products in the market.

As per the meeting called by Addl. Secretary, Mr. Jalaj Srivastava, Ministry of Agriculture who has been pursuing this with the registered companies,for more than 2 years,to submit their manufacturing, sales, purchases, import, export data. But only after lot of persuasion as per the list provided by Addl. Secretary, only 314 companies out of 4669 companies registered with CIB & RC at that time have submitted the data. 5314 companies are registered as on 22.07.2019. It is surprising that inspite of already such large no. of companies registered in every RC, many new companies are issued registrations without verifying all these registrations.

NON-GENUINE PESTICIDES

Genuine manufacturers are made to suffer as the spurious products have entered the markets in a big way. As per Industry estimate, there are maximum 100 companies who are National level players and 200 may be regional players.

The ministry of consumer affairs also has submitted the survey report and according to them 58% of the Agri products are duplicate in the market.

There are various clauses in Insecticides Act, 1968 and Rules, 1971 which are there to ensure that the quality standards are adhered in manufacturing pesticide but unfortunately they are not followed while issuing the license. The product with minor variations in quality is also marked as substandard and within the present law the criminal case is initiated on the manufacturer while such minor variations could be due to the errors in the testing of the samples in the government labs which are not NABL accredited. Instead of initiating penal action and criminal case such genuine manufacturers cases can be compounded and the case can be closed reducing the burden of unnecessary litigation in court and harassment by govt. officials and industry. We would like Government to review such laws as already in Company Act, some laws have been shifted from criminal action to civil action.

While concluding we would like to First appreciate the Present Government for making conscious efforts to improve Agriculture and the welfare of the farmers.If we have to target to achieve double digit growth in our GDP it is only possible if the agriculture grows. No country can grow if its farmers and agriculture does not prosper. Agriculture exports are to be given priority and Government has to promote Indian Agriculture produce in various countries by branding and making it viable to compete with the world.Ease of doing business is the fundamental of private trade growth. Farming must be made a respectable profession by increasing their income by ensuring they get MSP. Govt. must eradicate 58% fake agri inputs from market as reported by Ministry of Consumer Affairs. The trend of farmer's migration from rural to urban India must be reversed. Right price must be ensured to the farmers produce which they deserve and reduce the middleman role. Allow technology to come to India in Agriculture by making it easier by reducing the regulatory hazards which are undergoing a chain of cumbersome processes of entry of new molecules. We should give data protection to new molecules for minimum five years as given world over. ■

SEEDS

THE MISSING LINK: QUALITY SEEDS FOR SMALL AND MARGINAL FARMER

N. K. Krishna Kumar
Bioversity International,
New Delhi

The diversity of crops available in cereals, millets, grains and pod legumes, oilseeds, vegetables, fruits etc. is enormous and so is the seed diversity within each of these. While only a fraction of the agricultural crops is commercial, a vast majority predominately cultivated by small and medium farmers is usually under dryland farming. With the human population stretching beyond the carrying capacity, the need for enhanced productivity not compromising conservation of biodiversity is of paramount importance for future sustainable agriculture. Transfer of technology to poor and marginal farmers through a platform where science meets commerce and commerce meets the farmers' need is essential. Every industry including seed would look forward to a secure customer base and profit. Similarly, every customer looks forward to after sales service support. Small and medium farmers in developing countries depend on retailers and seed suppliers for the essential farm inputs such as seeds, fertilizers, pesticides etc. Bioversity International with the inputs from diverse stakeholders is exploring an option to create an e-platform where needs of seed growers will be matched with the availability of the seed with the producers. The platform will help in improving the services, value addition, e-market etc. provided to the farmers and thus will enhance the trust between seed suppliers and the users. Farmers, intermediaries like dealers, and seed suppliers could place seeds and be advised about what seeds are best suited. This information technology platform should function as an independent enterprise where seeds can be offered, sold and bought on a commercial basis. While the organized sector focusing on high value crops; large and

unorganized relatively poor farmers form the bulk of seed supply chain that is generally of low value (long tail). The IT platform should support both the short (high value crops of small quantity and long tail (low value but large quantity), but the social and economic benefits of the success should percolate to the long tail. Basically, the long tail in the seed sector portrays the "less-traded" but nutritionally and ecologically important crops or their varieties. The seed industry (both private and public) have a very developed "short tail" segment which has high volumes. The long tail has more diversity, but volumes are smaller due to the fact they serve a niche segment.

In the 21st millennium, the world is looking for sustainable development. Sustainable development cannot take place without sustainable development of agriculture. Everyone has a responsibility to increase livelihood security, food security, nutritional security and economic security of small and marginal farmers without which sustainable development is not possible. Indian agriculture is approximately valued about 300 billion USD of which 100 is the contribution of horticulture, 75 fisheries and animal sector and just about 60 billion USD or 20% come from so called dryland crops, cereals, pulses, millets, oil seeds etc. Unfortunately, 60-65% of population at least of small and marginal farmers are dependent on this 20% of the total agricultural income. This explains largely the rural poverty In India. Sustainable development is only possible when this 60-65% of the population which is dependent on the 20% of the total agricultural income are able to enhance their

socio-economic security. In order to do that development of agriculture in the dryland marginal lands is very critical, be it horticulture or agriculture. In that regard, their development is directly dependent on the provisioning of quality seeds, healthy seeds, and quality, disease-free planting material and other technologies associated with optimum use of the factors of production for increasing the level of productivity. Today crop production is dependent too much on chemical fertilizers and pesticides. Integration of biofertilizers, biopesticides as seed coat should be seriously considered.

In the developing world it is also true that the soil organic carbon is hovering around 0.2-0.3% and most of the essential beneficial microbes are rapidly disappearing. Micronutrient deficiencies are becoming very common and as a result in spite of the best seeds, the farmer is not able to realize higher levels of productivity. An integrating crop production system involving crop rotation to enhance the soil productivity, optimum utilization of water through scientific methods, application of micronutrients and beneficial micro-organisms, biofertilizers and biopesticides is the key. Today seed coating and seed pelleting can very effectively be utilized to address the issues of developmental requirements of seed through biofertilizers and biopesticides. Further there is a tremendous need of scientific information whether it is change in the weather patterns or occurrence of rainfall or the availability of seeds or marketing strategies of the product that is produced through the IT enabled software. Unless this is provided to small and resource-poor farmers sustainable development is not possible.

Many of the problems faced by the small and marginal farmers who basically grow dry land crops are related to more abiotic stress than the biotic stress. Centuries of selection was against risk associated with multiple abiotic stress which unfortunately in the narrow confines of institutes/laboratories has not received enough attention. Intelligence in trait-specific breeding should understand the natural wisdom of nature in distributing the genes among cultivated and wild relatives. In this regard we have a long distance to go in utilizing the CWR of minor millets, pulses, oil seeds and coarse millets where risk mitigation takes precedence over productivity.

Lastly, everyone has a responsibility to play in progressing towards SDG. It is possible when haves share with have-nots. Corporate Social Responsibility (CSR) in the seed sector should focus on less privileged, dry land farmers by focusing on dry land crops that need not be hybrids but one that is of good quality for enhanced productivity and sustainable agriculture. ■

IMPORTANCE OF SEED GOVERNANCE FOR SUSTAINABLE SEED SECTOR DEVELOPMENT

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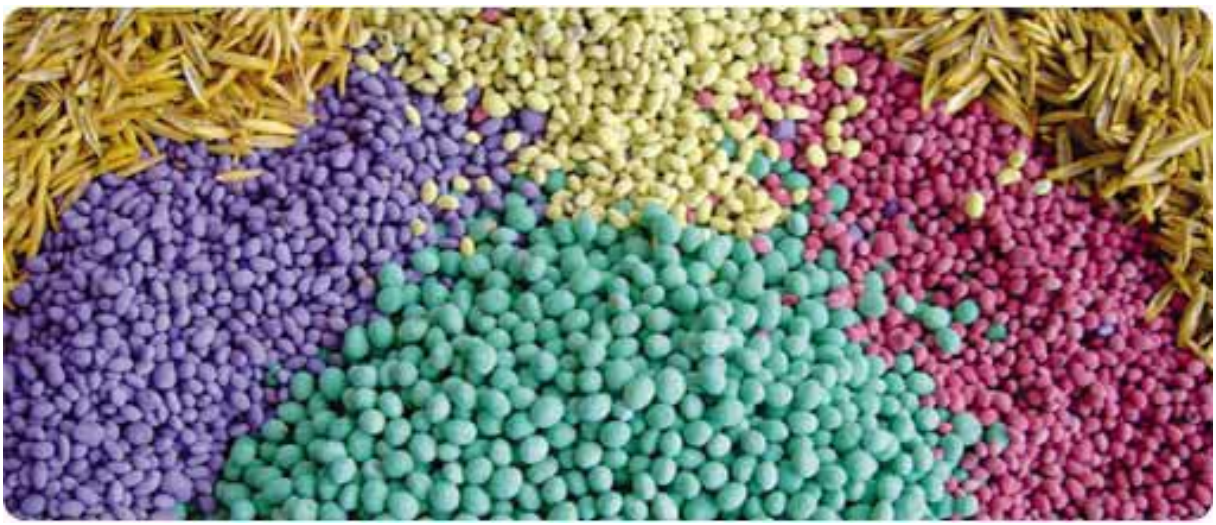
Seed contains the unique genetic information which expresses the gains in yield or other important traits to be expected from an improved crop variety. Hence it is the most vital input in crop production. Estimates indicate that the contribution of quality seeds to the total production may reach up to 45 percent with efficient management of other resources. Seed is also vital to national food security because of the key role it plays in maintaining upward trend in domestic food production through increased crop productivity. Global seed trade reached nearly USD 170 billion in 2017 with the prospect to reach up to USD 200 billion by 2030.

Seeds are distinguished by a number of properties associated with their role in farming. They are a commodity that can be traded. They are likely to harbour harmful organisms and thus are subject to business and trade policies. Other regulations such as intellectual property rights, farmers' rights and biological diversity rights are also applicable to seeds because scientific knowledge is often combined with farmers' traditional knowledge. Finally, as carriers of genetic information, seeds provide a tool for technology transfer and as such are able to increase output and reduce risks, and in some cases transform farming systems

SEED SUPPLY SYSTEMS

A seed supply system is a combination of components, processes, and their organizations, as well as the interactions and support involved in the production and marketing of seeds. It encompasses distinct steps in the entire chain: source of germplasm, breeding, multiplication, processing, quality control, certification, storage, and distribution.

The seed supply system evolved simultaneously with agriculture production systems some 11 000 to 12 000 years ago. This system, broadly known as informal (supply) system wherein farmers save seeds and exchange among them, was the only source of seeds and existed as the only system until the early 19th century. The role of seeds grew in importance with the emergence of modern agriculture propelled by industrial revolution in Europe and USA. Farmers began selection from natural plant



populations to develop more suitable pure line varieties for their farming/ cropping systems. By the end of the 19th century, thanks to re-discovery of Mendel laws, the breeding and seed production systems were organized on scientific and commercial basis which set the beginning of formal seed supply systems.

In the developing countries, including Asia-Pacific region, the informal seed systems is still the dominant one because of slow progress in switching over to formal seed systems, in spite of concerted efforts since the beginning of 1980s, through structural adjustment programmes. Although the process of transformation from informal to formal system is still slow, new issues are emerging which have profound impacts on household food security, erosion of germplasms, deterioration of livelihood systems of poor rural people, mainly women , separation of seed production systems from smallholder farming and conflict of interest between farmers and the seed industry.

A new system has been evolving, which is called semi-formal seed system, which fosters a commercial perspective in the informal seed systems, in essence scaling up with the provision of entrepreneurial skills, management expertise and financial resources to local communities, farmer cooperatives, NGOs and other groups interested in producing seed for the local market. The advantage of this system lies in its ability to serve remote areas, work in close collaboration with local farmers, produce seeds of diverse varieties including, land races, local varieties, farmer-bred varieties and populations, and thus increasing the supply of seeds of a large number of locally adopted varieties. These are the characteristic

that differentiate them from large private seed companies that produce or market seeds of a limited number of varieties imported or developed through the formal plant breeding sector. Functionally, they are seen as developments in between the formal and informal seed supply systems. The FAO regards it as the best way of ensuring the availability and quality of non-hybrid seeds for food and feed crops in developing countries.

MAJOR STEPS IN ESTABLISHING A FUNCTIONAL SEED PRODUCTION AND SUPPLY CHAIN

Seed law and policy

This is the entry point for most countries to provide the key governance input into shaping the development and evolution of the seed sector through developing, amending, and modernizing rules, regulations and policies. The main governance challenges at this step are to:

-provide adequate safeguards for protecting the interests of farmer-based seed producing organizations and small-scale seed enterprise and expanding their role in seed supply chain at each successive stage of opening up the domestic seed market with the new opportunities for investment by the private sector;

-explore opportunities for flexibility in standards and procedures that allow low-costs and alternatives methods suitable for use in small-scale and farmer-based seed systems thus enhancing their competitiveness in the seed supply chain;

-update seed policy to reflect changes in seed legislation, methods, procedures, and resources for implementation following a comprehensive process of public hearing.

Varietal development

This is the key step to stimulate and sustain a healthy growth in the seed sector by ensuring a steady supply of new crop varieties that farmers can use to replace older varieties and address existing and new concerns in the crop production systems. The main governance challenges at this step are to:

-increase efficiency and effectiveness of crop breeding

programmes by seeking a paradigm shift in approaches, methods, tools, and procedures with the goal of tilting the focus away from developing varieties for uniform cultivation practices in a wide geographical area to varieties that are suitable for cultivation in specific agro-ecological conditions addressing.

-make greater use of participatory approaches- participatory varietal selection, participatory plant breeding, community seed growing, in situ conservation and use of landrace, traditional varieties and other plant genetic resources-for foster and cost-effective breeding and seed multiplication.

VARIETAL REGISTRATION

The main purpose is to ensure that varieties introduced to the market are useful, distinct, and help overcome the problem of the same variety being known by different names or, on the contrary, the problem of many different varieties being known by the same name. The main governance challenges at this step are to:

-recognize that compulsory registration of varieties slows the introduction of new varieties and restricts market access for landraces and farmer-developed varieties;

-understand that complex administrative procedures entail investment of extra resources in conducting trials delaying the arrival of new varieties in the market;

-devise registration system that is simple, time-saving, flexible and effectively caters to the needs of different segments of the seed supply chain

VARIETAL PROTECTION

The key governance challenge at this step is to understand the importance of intellectual property

rights (IPR) and implement it through recognized legal instruments, such as plant breeders' rights and national plant variety protection systems. The emphasis on IPR is driven by increasing commercialization of the seed sector as a result of trade liberalization, entry into the market of private companies and international agreements imposing restrictions on free movement, exchange, and use of seeds and associated plant genetic resources in absence of IPR protection.

SEED QUALITY CONTROL

The main purpose is to ensure that all seeds entering formal trade channels are of good quality and farmers are protected from illicit practices in seed trading. It is particularly important because farmers cannot determine quality of the seeds they sow and plants they grow in the field. The main governance challenges at this step are to:

-devise alternative approaches to seed quality standards and methods of implementation that are flexible, cheap and less time-consuming and can be adapted with greater efficiency in smallholder crop production systems;

-create local level capacity for self-declared quality seed production through investment in training farmers in seed crop management, seed selection, and storage aimed at improving quality of seeds traded through the informal farmer-based seed systems.

SEED CERTIFICATION

This is concerned with quality control of seed multiplication and production. It is basically a methodology to ensure that varieties are true to type. The main governance challenges at this step are to:

-ensure that seed certification standards and procedures adopted by the SCA are uniform throughout the country and that the agency functions in close linkage with technical and related institutions;

-undertake a periodic review of seed certification standards and procedures to ensure a systematic increase to superior varieties and a continuous supply of comparable material through careful maintenance;

-maintain the autonomous status of the SCA with no involvement in seed production and marketing;

GOVERNANCE MEASURES TO IMPROVE SEED SUPPLY SYSTEMS

•Develop a long-term national policy, for example a national seed policy outlining a framework for investment of resources, capacity development, incentives for private sector investment, pricing and procurement, collaboration between

public and private sector, support for research and development;

•Upgrade the regulatory framework (seed laws, rules, acts, etc.)

a. standardizing seed production and import in the formal seed sector;
b. exercising additional oversight on import and local production of hybrid seeds and their quality control;
c. facilitating greater private sector involvement in seed sector;
d. eliminating trust deficit between public and private sectors;
e. protecting farmers against fraud, adulteration, and mislabeling in their access to marketed seeds;
f. protecting farmers' rights over their own PGR and seed systems particularly their right to saving a portion of harvest for use as seed;
g. balancing interests of resource-limited smallholder farmers with those of corporate breeding and seed sector in the framework of intellectual property protection through such instruments as PVR, UPOV, etc.

•eliminate bureaucratic red tape in the administrative procedure to expedite variety release, acceptance, registration and seed multiplication processes;

•build capacity to engage a broad range of stakeholders (farmer groups, private sectors, NGOs, community-based organizations, women's organizations, etc.) and feed the inputs of the consultative procedures into research programmes planning and priority setting to ensure relevance and utility of new varieties and their faster uptake by farmers;

•make breeding research more decentralized with a renewed focus on farmers' participation at different stages in the variety development process and create effective institutional mechanisms for mainstreaming farmer-participatory breeding in the conventional model of crop improvement;

•build capacity in the informal seed sector with due recognition of its potential to support sustainable crop production in smallholder-dominated farming through:

a. organizing on-farm seed production using farmer groups, cooperatives, NGOs, etc.;
b. provide technical training to farmers to improve quality of saved seeds through pre-harvest selection, grading, drying, and post-harvest storage;
c. undertaking farmer participatory breeding and seed selection with active involvement of local units of public sector research and extension organizations and NGOs; and
d. better networking through farmer-to-farmer seed exchange systems.

GOVERNANCE MEASURES FOR THE TRANSGENIC SEED SECTOR

• Increase effectiveness and efficiency of the biodiversity regulatory systems through:

- establishing adequate modern laboratories with trained staff in reputed public and private sectors institutions

- accrediting these laboratories to boost public confidence in fool proof capability of the regulatory system to provide food safety; and

-establishing accredited laboratories for seed testing of GMO crops

•Undertake far-reaching multipronged concerted efforts toward the most difficult task of consensus-building in the society around the need for accepting modern biotechnology tools (that allow manipulation with native as well as transgenes) as some of the most promising tools for achieving unprecedented increases in yield and productivity of key food crops. This can be achieved by:

- initiating a systematic campaign of educating and awareness building around the pros and cons of GM technology

-public perceptions of GM technology are often not based on scientific facts. The information communication system, including public extension and awareness services, need to be considerably improved in order to effectively deliver correct and unbiased information to farmers and the general public. Also, there is an urgent need to properly inform and educate people at all levels, including policy-makers and planners, farmers, consumers and other stakeholders on all aspects of agricultural biotechnology and biosafety. Required communication must be used for effective delivery of knowledge

- devising a variety of PPPs with the involvement of smallholder farmers in biotechnology projects to ensure the flow of unbiased information and cross-breeding of scientifically valid ideas eventually contributing to building an atmosphere of trust and consensus building.

•Bolster institutional capacity, especially in areas of biosafety rehears, regulatory systems (including legal aspects). Communication tools and IPR issues since they are all critical for scaling out innovations for greater impacts. ■

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