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Kurukshetra seeks to carry the message of Rural Development to all people. It serves as a forum for free, frank and serious discussion on the problems of Rural Development with special focus on Rural Uplift.

Editorial

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DOUBLING FARMERS' INCOME

Naresh Sirohi

Agriculture is very important for Indian economy and society both. It is the means of livelihood for half of the population, if we also count in the ancillary activities. Apart from meeting the food security requirements of the country as well as providing additional produce for export, it also provides most of the raw material for the industry sector. According to the Socio- Economic and Caste Census, SECC in 2011, out of 24.39 crore households in the country, 17.9 million households live in villages and are mostly dependent on agriculture. But when we look at the condition of Indian farmers, picture does not look very encouraging, and main reason for this being that the focus of our economic policies so far has been on increasing the farm production rather than the farmer himself.

Agriculture is very important for Indian economy and society both. It is the means of livelihood for half of the population, if we also count in the ancillary activities. Apart from meeting the food security requirements of the country as well as providing additional produce for export, it also provides most of the raw material for the industry sector. According to the Socio- Economic and Caste Census, SECC in 2011, out of 24.39 crore households in the country, 17.9 million households live in villages and are mostly dependent on agriculture. But when we look at the condition of Indian farmers, picture does not look very encouraging, and main reason for this being that the focus of our economic policies so far has been on increasing the farm production rather than the farmer himself.

Shri Narendra Modi is the first Prime Minister of the country whose economic policy has the farmer at its core. Until now, our economic policies revolved around agricultural and industrial production rather than the farmer as the focal point. Prime Minister has declared the goal of doubling the farmer's income instead of increasing the agricultural production. With the increase in farmer's income, the society around him will be benefitted first. This announcement of the Prime Minister should not be considered merely as a government announcement. Prime Minister is the head of the country and his declaration should be taken as a national resolution. In fulfilling this resolution, not only should our entire government system be mobilized but all the citizens of the country including the farmers should be made partners. Prime Minister has made this announcement quite some time back but it does not seem that we have been able to make any headway in respect of farmer-centric agriculture. Yes, a new class of committed farmers has emerged, which has begun to give a new direction to agriculture by assimilating the traditional methods of farming and wisdom. In farming, the farmer has close association with soil, water, cattle, seed, season cycle and the surrounding society and geography. The agricultural experts neglected this relationship and developed new farming methods with the help of technology resulting in loss of soil fertility to farmers' suicides which the country has witnessed. The basic objective of agriculture in our traditional wisdom was not only to feed ourselves and other people of the society, but also to nurture. We have to produce for our society and not for the market. Therefore, the objective of our farming should not be merely abundance but completeness also. The objective should be to make available the whole society nutritional and adequate food.

This is the second time after independence when there is going to be a big transformation in

Seven-point strategy by PM for 'Doubling Farmers' Income'

The Prime Minister, Shri Narendra Modi breaks ground for resilient rice field laboratory, at the International Rice Research Institute (IRRI), in Los Banos, Philippines on November 13, 2017.

Prime Minister has set a target to double the farmers' income by 2022. And to achieve this target, he has advocated a seven-point strategy:

1. Special focus on irrigation with the aim of "Per Drop More Crop".
2. Provision of quality seeds and nutrients based on soil health of each field.
3. Large investments in Warehousing and Cold Chains to prevent post-harvest crop losses.
4. Promotion of value addition through food processing.
5. Creation of a National Agriculture Market,
6. Introduction of a new crop insurance scheme- 'PM Fasal Bima Yojana' to mitigate risks at an affordable cost.
7. Promotion of ancillary activities like poultry, beekeeping, and fisheries.

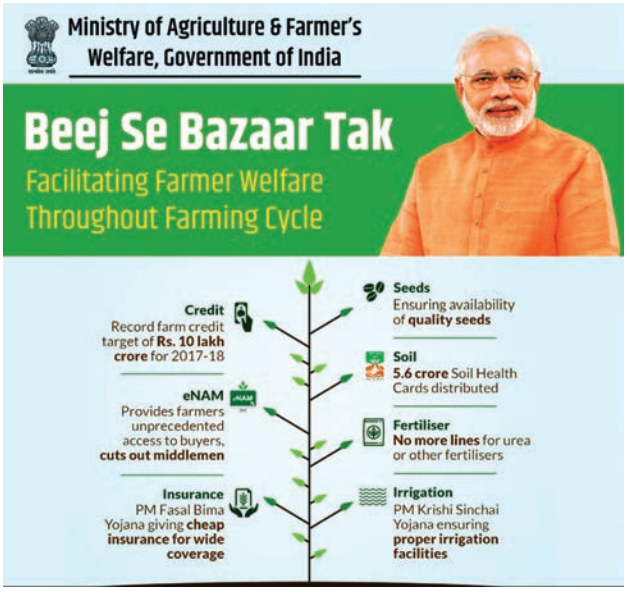
the system in respect to agriculture and farmers. The country struggling with food shortage in the sixties was made self-reliant through the Green Revolution and now the Prime Minister is striving to double the income of the debt ridden farmers and raise their living standards. Prime Minister Shri Narendra Modi has prepared a seven- point plan for this.

Looking at the current scenario of agriculture in India, 69% of the farmer families have less land than one hectare land. 17% of the families have land between one to two hectares. According to the National Sample Survey Organization (NSSO), 36 per,cent of the farmers are landless. Economic Survey of 2015-16 states that 48.9 per cent of the total workforce population is contributing only 17 per cent to GDP (Gross Domestic Product). And in the current financial year, the growth rate of agriculture and allied sectors is expected at 2.1 per cent.

The Prime Minister's goal of doubling the income of farmers by 2022 is commendable and full of challenges but not impossible. Before taking steps towards the goal of doubling the income, it is essential to know the income of the farmer in the current fiscal 2016-17, as according to the available NSSO data for 2012-13, the average monthly income of the country's farmer is Rs. 6426. In the resolution of doubling the earnings, it also needs to be clarified whether we want to double the amount of the minimum income or actual income (actual income is the estimated reduced minimum income by taking into account appropriate inflation factors). It is to be noted that the minimum income doubles automatically in six to seven years, whereas it takes about 20 years to double the actual income. In such a situation, doubling the actual income by 2022 would require three times the current momentum of ongoing efforts.

In the sixties, the country had initiated the first change in the condition of farmers and the agricultural system through the Green Revolution, but despite the increase in production triggered by the Green Revolution, the socio-economic impact was not very encouraging, due to which ill effects on soil, water, environment as well as on human health could be seen. The cost of farming *vis a vis* production value led to farmers in heavy debt. As per the 2013 survey, about 52 to 56 per cent of the farming families in the country are under debt burden. And the debt amount on each family was about Rs. 48000.

Today, it is necessary to analyze the current agricultural scenario and policies before making a new action plan for addressing the grey areas. The well being of a community depends on how they get the value of their produce. If the government pricing policy is unfair, then the community can never thrive. The government declares the minimum support price for 24 agricultural commodities, but there is huge discrepancy in the way the Commission for Agricultural Costs & Prices (CACP) determines the price of crops. In



fact, it calculates the minimum support price by reducing the actual cost of crops according to the name and suggests buying only on reduced price. The cost value estimated by CACP is based on all-India level average. Often MSP is less than the cost price of farmers. Therefore, the price of crops should be determined by the CACP in proportion to the increase in the value of other commodities and services in any previous year as base year. Secondly, it also needs to be ensured by the government that the prices of all such commodities in the markets do not go below the MSP and purchase should be guaranteed because currently, only six per cent of the crops are purchased on MSP. Remaining agricultural commodities fetch 10-30% less price in the market. The country produces more than 28 crore tonne horticulture crops (fruits and vegetables) and thus, the second largest producer country in the world. But due to the lack of adequate food processing industry and technology, farmers get only 20 to 30 per cent of the consumer purchase price.

The life of the Indian farmer is full of uncertainties and plight. The crop which remains intact after the onslaughts of rising costs, bad weather, pest attacks, is his biggest hope. But the transmission from the fields to markets is also not easy. Contrary to the expectations of farmers, the basic structure of moneylenders, middlemen and government procurement centres is exploitative. It serves the interest of middlemen rather than farmers and consumers. The Central Government had sent a proposal to the State Governments in 2003 to implement the Model APMC Act. Its objective was to do away with the regulations and control of mandis, assist in direct purchasing, eliminate the nexus of local traders in the market, and infuse competition and investment in agricultural markets. But due to pressure from local traders on state governments, the model APMC Act was neither properly accepted nor implemented. Government of India has started taking steps to bring about a radical change in agricultural marketing in the year 2016. There is a provision to integrate 585 mandis of the country through Integrated National Agricultural Market (e-NAM). Central Government provides financial assistance to the tune of Rs 75 lakhs to each market under e-NAM.

The Ministry issued a Model Marketing Act on 24th April, 2017, which was named "Agricultural Produce and Livestock Marketing (Facilitation and Promotion Act 2017)". After adoption by the states, this Act will provide diverse marketing channels and end the APMC's monopoly. Its purpose is to increase competition and provide options to farmers so that they can take advantage of the competitive price of their produce. In such a situation, the reform in the agricultural marketing system would provide increased purchase price to the farmers. Along with reforming the domestic marketing system, there is a need to set right the import-export policy as the changes brought about in policies after liberalization have neglected the interests of the farmers of the country. Therefore, during the harvesting of the crops, such

Sl No.	Crop	Yield (per hectare)		
		In India	Average yield in the world	In other countries
1.	Rice	3.62 tonnes	4.53 tonnes	China 6.74 tonnes
2.	Wheat	3.03 tonnes	3.27 tonnes	France 7.36 tonnes
3.	Maize	2.75 tonnes	5.57 tonnes	USA 10.73 tonnes
4.	Pulses	6.54 quintals	9.06 quintals	Canada 20.30 quintals

agricultural commodities should not be imported and it should also be ensured that they should not be imported at the prices below minimum support price declared by the government. Apart from this, agricultural exports should also be promoted so that the price of agricultural commodities will not go down in the local markets and farmers will continue to get remunerative prices.

As regards crop productivity, by 2030, the population of India is estimated to touch 150 crore mark and the requirement of food grains will reach 35 crore tonnes. Therefore, it is necessary to increase yield per hectare. As compared to the year 1950, the crop productivity in India has improved significantly. But in comparison to the international level, it is found that there is widespread possibility of increasing the average yield of major crops in the country.

But the role of three factors in augmenting production per hectare in fields is very important, one-climate, second-knowledge level of farmer and third-investment. India has 127 agro-climatic zones in terms of climate. Out of 64 soil types found across the globe, 46 soil types are found in the country. In addition to adequate rain water, there are 445 rivers in India whose length is more than two lakh kilometres. We are the world's most prosperous country in terms of water and biodiversity. But in the field of agricultural education, India is counted among very backward countries. In India, 12 per cent of students enrol in science-based graduate courses out of which only 0.65 percent students enrol in agricultural science. Due to such gross neglect, the field of agricultural research and agriculture extension is in bad shape. In such a situation, one can understand the level of education of a common farmer. Third, the investment- the monthly average income of the country's farmer and average monthly consumption expenditure leaves him with nothing to invest in quality seeds, fertilizers, insecticides, high value crops, irrigation, agricultural machinery and technology. To sow the next crop, farmers depend on banks and co-operative organisations for loans and landless farmers are forced to borrow only from the moneylenders at a higher interest rate. In fact, the gap in potential and achievements is only because agriculture has been neglected and farmers have been treated unjustly.

The government gives subsidies on fertilizers, irrigation and electricity directly to increase crop yields. Banks and other institutions help farmers by giving subsidy indirectly in the form of cheap loans or reduced interest rates. The subsidy of fertilizers alone has increased five times in the last ten years. It has increased from Rs 12,995 crore in 2001-02 to Rs 67,971 crore in 2014. The government has made a provision of Rs 73,000 crore as subsidy in the budget for 2015-16 which is 0.5 per cent of the total GDP. Subsidy to the tune of about Rs 15,000 crore is also given on the interest of the banks.

Despite the investment in irrigation so far, more than half of the agriculture sector does not have irrigation facilities which directly affects the income and nutrition of the farmers of the un-irrigated areas and the country's food security. The average yield of foodgrains in the irrigated agricultural areas of the country is 4.00 tonnes per hectare, while in the rainfall dependent areas it is only 1.2 tonnes per hectare. Apart from food grain yield ,the impact of lack of irrigation is also on the production of horticulture and animal husbandry sectors.

There is a need to invest in the irrigation sector to increase farm yield as well as to provide better nutrition to farmers and increase their income. In

the Twelfth Five Year Plan (2012-2017), instead of about 4.25 lakh crore rupees required to complete 337 small and big irrigation projects, only 20,000 crore rupees was given per year. The government has increased the long term agricultural irrigation funds by 100 per cent to Rs 40,000 crore in 2017-18. Besides, to achieve the goal of "more crop per drop", a dedicated micro irrigation fund of 5000 crores has been set up and the budget of the Pradhan Mantri Krishi Sinchai Yojana has been increased to Rs. 7377 crores.

Apart from agriculture, the importance of animal husbandry can be understood from the fact that in the gross domestic agricultural production, the contribution of animal husbandry is 28-30% and in the average monthly income of farmers, it is 11.9% which is commendable. There are 86 per cent small and marginal farmers in the country who hold thirty per cent of the total land. Seventy per cent of the farmers are involved in animal husbandry businesses who possess around 80 per cent of the total livestock. It is noticeable that for landless farmers, who do not have resources to grow crops and raise big cattle, small animals such as sheep, goats, pigs and poultry etc. are the means of livelihood and dealing with poverty. If people show more interest in animal husbandry and take advantage of the positive initiative of the government, their income will definitely increase. Recently the Central Government has launched schemes viz. "Rashtriya Gokul Mission" and "Kamdhenu Prajanan Kendras" for the conservation and development of the indigenous breeds of cow. This will lead to the development of indigenous breeds and production of high quality A2 milk in view of climate change.

"World Food India 2017" was organized by the Food Processing Industry Ministry to double the income of the farmers and make Food Processing Industry attractive for investment. In this event more than 5000 entrepreneurs and companies from more than 60 countries and 27 states including north-east states have participated. The ministry says that in the next three years, there will be an investment to the tune of more than 65 thousand crore rupees in the country and more than one million employment opportunities will be available. Along with this, wastage of huge quantities of horticultural crops can also be prevented. The point to ponder here is that the

farmer will remain the raw material producer only and the entire profit of value addition will be pocketed by the companies. Secondly, the crop pattern according to the geographical conditions would end diversity of food and taste. Unemployment crisis will loom in front of the people engaged in small and cottage industries. The food processing companies use millions of tonnes of plastic in packaging of water and cold drink bottles, milk, chips, snacks etc. which turns the soil barren and poison the ground water. In addition to generating raw material, if the farmer is engaged in the work of value addition through co-operatives, he will get additional employment and profit making opportunities.

The rising population in the country and fields getting smaller have become a curse for the farming families. As per the Indian agricultural situation, for livelihood of a farming family less than two hectare land and more than ten hectare land to maintain optimum productivity per hectare is considered to be non-profitable whereas today, almost 70 per cent of the farmland is less than one hectare in the country. Therefore, it is utmost important to increase the size of the farmland and reduce the burden of the population dependent on the farm to boost the income of farmers and make their livelihood better. Therefore, the NITI Aayog has prepared the "Model Agricultural Land Leasing Act 2016". The Government believes that it will lead to lessen the burden of population on farming, increase productivity, promote equality

and help in reducing poverty. Due to the land lease system getting legalized, the fear among land owners of losing ownership on the leased land will be over. The lessee will also be able to get easily all the facilities available for farming including the government's crop loan, crop insurance. The workforce involved in farming would get the opportunity to shift to the non-agricultural sector. National Skill Development Council has also set a target of decreasing the number of the work force in agriculture from 57% to 38% by 2022 i.e. about 20% people will have to find employment avenues in non-agricultural sector.

Before implementing suggestions from the NITI Aayog, NABARD, agricultural scientists, agricultural economists and all experts to attain the goal of increasing the income of the farmers, it is necessary to analyze the agricultural scenario of Punjab , condition of farmers and all those factors due to which in Punjab despite world class yields, the most irrigated fertile land, new seeds, fertilizer, pesticides , mechanization and animal husbandry, the agricultural situation deteriorated and the farmer is on the verge of suicide rather than be affluent. On the other hand, rain-dependent areas of low productivity riddled with poverty and deprivation the farmers are not affected from situations like suicide.

There is a need to make sweeping changes in policies and clarity in the approach to fulfil the commitment of the Prime Minister to double the income of farmers and to free the country from malnutrition. To improve the agricultural conditions, there is a need to adopt such crop cycle in the agricultural system, which would focus on the local agriculture, geographical area and village and capable of providing self-sufficiency in food security and wiping away malnutrition. It would be able to provide grains, pulses, oilseeds, vegetables, fruits, sugarcane (jaggery, cane sugar, molasses and unrefined sugar etc.), cotton for clothing and nutritious fodder for livestock so that entire rural population becomes self reliant and free from dependence on markets. Under conventional farming system, there is a natural bio-mechanism which is beyond chemical fertilizers and pesticides in which ensures all the nutrition requirements. Active micro-organisms in the soil, through biological activity, provide easy access to unused nutrients. Thus, nutrients are easily available in natural farming. Now the pulse based mixed crop system in natural farming is the best method, which along with easy nutrition providing system is capable of keeping the soil soft and airy and also maintains its fertility and health. In this system, due to moisture in soil, the consumption of ground water is also reduced to half the required amount. In addition, this method is fully capable of coping with the effects of changes in weather. Indeed, the Indian agricultural system based on eternal Vedic tradition is fully developed in philosophical, scientific and practical terms. In it, all the natural laws have been followed which ensure

sustenance of all the organisms. The food derived from this method provides satiation to not only the physical form of human being, but also to its subtle form i.e. the mind and the soul.

Conventional farming system would reduce the subsidy given in the name of fertilizers and food security and thus reduce the fiscal deficit. This will further reduce the expenditure on health and control inflation too. Besides government efforts, the farmers have to set up, in addition to biological or high quality production, value addition activities and marketing network to reform their economic condition. I know many farmers, farmers' productivity confederations, co-operatives and non-governmental organizations who, according to their economic status, geographical conditions have introduced innovations in farming methods, created value additions and set up local distribution mechanism to sell and purchase directly with rural and urban consumers. Jaivir Singh (MSc Agriculture) of Sehra Village (Bulandshahar, Uttar Pradesh) is a well-educated and enlightened farmer. He has reduced the cost of farming to half. He has increased the fertility of soil and reduced the consumption of water to half. He has adopted crop planning i.e. which crop is to be sown in what acreage of land. He has also opted for inter cropping i.e. mixed crop farming which, along with the production of many crops, has also reduced the risk of farming. He has also increased the yield per hectare to one and a half times more as compared to the normal yield. Another outstanding fact is that he also provides training to the farmers around them.

Shri Adrishya Kand Sidheshwar Swamy of Kaneri Math (Kolhapur, Maharashtra) has developed a wonderful model of cow dung based *lakhtakia* farming in one acre. Kan Singh Nirvana of Jor ki Dhani, Godham (Katrathal Sikar, Rajasthan) is engaged in promoting rural tourism along with natural farming. Kamdhenu Gaushala, Noormahal, Punjab has also made unique experiments in improving the breeds of indigenous cow as well as in natural farming. Vrindavan Tharparkar Club, Pune, has not only improved the indigenous Tharparkar cow breeds and developed products of dung and cow urine of the international standards, but has also set up centre for Panchgavya medicine. Vanrai Institute, Pune, founded by the famous politician and social worker of the country late Mohan Dharia, has also carried out successful experiments in rural development. Jaiprakash Singh of Varanasi is engaged in developing variety of high yielding seeds to aid in increasing the income as well as paving new avenues of employment for the people. Syed Ghani Khan, educated at Mandiya, Karnataka, is contributing to the conservation and promotion of biodiversity by cultivating fruit, vegetables and spices and indigenous variety of paddy. There are many illustrious examples in the country such as Umendra Datta of Kheti Virasat (Punjab), Anupam Paul of West Bengal, Dev Baldev of Odisha who are setting up a roadmap for other farmers as well as the government.

Certain things are very important for any governance system. It should ensure people's participation in all decisions affecting the common man. It should follow a top-down approach for fixing accountability and a bottom up approach while distributing the national resources and fruits of the development. We have to think about the all-round development of farmers and agriculture by placing our farmers at the centre. For doubling the income of the farmer if the attention is given to develop the whole country as a large market system, then we will repeat the same mistake which happened during the Green Revolution. The benefits of Green Revolution were passed on to industries, large business houses of agriculture sector and big farmers in this sequence which resulted in end of crop diversification and increase in mono cropping pattern. This has greatly reduced the quality of food of common Indian people. The hurry of converting the entire country a big market at the outset will take us in this direction. It should be kept in mind that our system should develop not from top to bottom, but from the bottom upwards. It should begin from the village, and then the village aggregate by making towns as centre point followed by district, then the province and finally the system of the country should be developed above it. Strong villages only can make a strong nation. If the system of the village remains undeveloped, then the nation system will exploit it. We have to develop agriculture system in such a way that our most skilled and talented people can also get a glimpse of good, natural and prosperous life. Agriculture should become a glorious business again and farmers earn respect in society as it was before.

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EVERGREEN REVOLUTION

Surinder Sud

The success of the efforts to transform the green revolution into an evergreen or an ever- enduring revolution would depend largely on how well the mooted programmes and schemes are implemented. There are already indications that the focus of agriculture development is gradually shifting from production to income which will essentially need pointed attention to all the links in the agriculture development chain from farm to fork. Technology-driven efficiency and precision would, therefore, have to be the byword for every farm operation to transform green revolution into an evergreen revolution.

The concept of evergreen revolution is, indeed, a sequel to the green revolution of the 1960s which made the country self-sufficient in foodgrains and ended its precarious dependence on food aid and grain imports. Triggered by the use of high-yielding crop varieties which required liberal use of water, fertilisers and plant protection chemicals, this revolution did not prove an unmixed blessing. It also caused some distortions in the cropping pattern and led to some unwarranted ecological ramifications in terms of degradation of natural resources like soil and water and emergence of new kinds of pests, diseases and weeds. However, thanks to its gains outweighing the adverse consequences, a need is being urgently felt to perpetuate it as an everlasting or evergreen revolution but without its harmful upshots. The prime objective of transforming the Green Revolution into an evergreen revolution, therefore, is to expand it to all crops and all regions with minimal unhealthy consequences.

This kind of an environment-friendly and natural resources-compatible evergreen revolution, covering all gamuts of agriculture and its allied fields and spanning all across the country, is deemed imperative for several other pressing reasons as well. Despite the spectacular advances in the production and per-hectare yields of some crops, the overall productivity of Indian agriculture still remains low compared to that in many other agriculturally advanced countries. Besides, reliance of the Indian agriculture on the monsoon is still quite high. The capability of this sector to withstand the climate change-induced more frequent extreme weather events and natural disasters remains fairly meagre. The scope for expanding cropland has dried up. Landholdings are getting smaller and fragmented, adversely affecting the viability of farming. Agricultural marketing continues to suffer from some formidable disabilities. The marketing network is neither adequate nor efficient to ensure reasonable returns to farmers for their produce. Moreover, rural labour is turning scarce and costly. The combination of all these factors is causing agrarian distress which is reflected

in farmers' suicides and widespread rural unrest that, at times, tends even to turn violent. The green revolution should, therefore, be treated as incomplete unless it becomes an all round and all encompassing evergreen revolution that leads to copious production and rural prosperity. This will require simultaneous action on several fronts and not remain confined to a few commodities.

The noted agricultural scientist, Dr M. S. Swaminathan, who spearheaded the advent of the green revolution, was also the first to sound the note of caution about the adverse, even if inadvertent, fallout of the exhaustive high-yielding crop production technology. He also voiced the need for transforming it into the ecologically-sound and sustainable evergreen revolution. In his presidential address to the Indian Science Congress way back in 1968, Dr Swaminathan warned against practicing exploitative agriculture for short-term gains. He specifically mentioned the harmful consequences of excessive application of chemical fertilisers, pesticides and groundwater irrigation without adequate drainage on the physical and chemical health of the soils. He suggested adherence to scientific principles of soil and plant health management in order to perpetuate the benefits of the enhanced productivity over the longer run. The need, therefore, is to produce more from less land and with less water and less cost-intensive inputs. Such an approach is considered essential to preserve not only the livelihood security of the large agriculture-dependent population, but also ecological security to sustain the green revolution. Dr Swaminathan's recipe for the evergreen revolution, therefore, boils down to perpetuating the increase in land and crop productivity without causing any ecological harm.

The Prime Minister has also been stressing the need for an evergreen revolution instead of using the terms like first green revolution and the second green revolution. He misses no opportunity to elaborate his concept of the evergreen revolution which is focused sharply on producing more from less land and with lower use of water and at reduced overall costs. This may be possible by integrating traditional systems of farming with the modern and scientific ways of agriculture. The use of chemical fertilisers should be strictly need-based as determined by the requirement of the crop and land fertility. Supplementing the fertilisers with organic manures would help safeguard soils' physical, chemical as well as microbial health. "More crop per drop" is his mantra for the evergreen revolution. He also intends to expand the concept of food security to nutrition security to tackle the menace of malnutrition.

One of our PM's suggestions that merit special consideration relates to creation of agriculture clusters on the pattern of the industrial clusters. Different areas could be identified for growing particular crops suited to the agro-climatic conditions. This would help in streamlining transportation, storage and processing facilities for different crops taking care of their specific needs.

The official think tank, the NITI Aayog, has taken due note of the fact that the farm sector has, by and large, been side-stepped in the process of economic reforms that began in 1991. To address this lapse, the Aayog is working ceaselessly on crafting strategies for raising the farmers income through evergreen revolution. It is regularly coming out with ideas which can help the government to reform and transform agriculture into a sustainable and lucrative business occupation that can contribute to the country's overall economic development. The principal goal of the recipes being suggested by the Aayog from time to time through policy briefs, working papers and other documents is to restore profitability of agriculture as a prerequisite to an evergreen revolution.

The NITI Aayog has, therefore, put forth a multi-pronged agenda for agricultural development. It involves increasing productivity of crops, boosting production of livestock, enhancing input-use efficiency to reduce costs, increasing crop intensity by taking more crops from the same piece of land and with the most economical use of water, judicious use of chemicals, diversification of agriculture towards high-value crops and other ventures, higher price realisation by farmers, creation of additional employment opportunities for cultivators in the non-farm rural sector to supplement the income of farm households, and several other well-chosen reforms-oriented measures. Special emphasis is being laid on taking forward the ongoing agricultural marketing reforms to facilitate and incentivise the private sector investment in setting up rural markets and farm-related logistics infrastructure, including cold chains.

In one of the documents, the NITI Aayog has shortlisted five broad aspects of agriculture that need immediate attention to lift the economic status of millions of farm families. These are also the basic issues which need to be addressed to prepare the ground for an evergreen revolution.

The first point deals with productivity in terms of per hectare output of farm ventures. The present average productivity, despite remarkable spurt since the green revolution, compares poorly with that in many other countries. Besides, there are also large regional variations in the crop yields within the country. Bridging these gaps can go a long way in laying the foundation of the evergreen revolution. This requires development of new cost-effective technology and transferring it to the poor farmers, besides empowering them financially to put this into practice.

Secondly, most farmers at present do not get remunerative prices for the crops due to the limited reach of the minimum support prices (MSPs) mechanism across the farm community in different parts of the country. The procurement-based market intervention to provide price support has remained confined to a few crops – notably wheat, rice and, occasionally, some other crops – and in a handful of states, though this system has been in operation since the mid-1960s. Elsewhere, the existing agricultural marketing network is highly inadequate, besides being inefficient and non-transparent. It manages to deliver only a small fraction of the final price to the actual producers. The huge gap between the prices received by the growers and those paid by the consumers bears this out. Clearly, a sizable chunk of the money spent by the customers is cornered by the large number of intermediaries in the marketing chain.

Thirdly, the size of the farm holdings of the majority of agricultural households has shrunk to unviable level, nudging farmers to leave farming and look for jobs elsewhere. Over 85 per cent of the farm holdings are smaller than 1.5 hectares in size. Many of them are economically unviable. Since the currently prevalent land leasing systems lack legal sanctity in most states and the land owners find it risky to lease land to others for tilling, large chunks of productive land is being left uncultivated. Amendment of land leasing laws to legalise land leasing without the fear of losing its ownership may, therefore, help in consolidation of land holdings at operational level and to attract fresh investment in farming. This can also bring under cultivation the land belonging to absentee land lords most of which now remains unutilised. More importantly, this can make the tenant cultivators eligible for loans and other benefits of government programmes.

Fourthly, the present measures for relief and loss reimbursement to the farmers at the time of natural disasters are inadequate and suffer from procedural inefficiencies and delays. The risk adaptation measures, too, are poorly executed and have not worked effectively. This situation needs to be rectified.

Fifthly, the agricultural potential of the eastern region is grossly underexploited. This region has

unique agro-climatic conditions for the production of several products. This potential needs to be optimally tapped. This would, of course, require institutional support and investment in technology innovations besides creation of supportive infrastructure of rural connectivity, transportation, storage and marketing.

With these broad imperatives in view, the NITI Aayog has already chalked out detailed action plans for at least three areas which can ultimately form part of the overall plan of action for doubling farmers' income and ushering in an evergreen revolution. For one, it proposes greater involvement of the National Food Security Mission for boosting the production of pulses which, despite being the major protein source for millions of people, have to be imported in large quantities to meet the domestic requirement. This Mission is already operating several schemes, including cluster demonstrations on promotion of improved package of practices for pulses cultivation, to optimise yields. Its recent initiatives for ensuring adequate availability of seeds of high-yielding varieties of pulses can be of great help in raising pulses productivity and production to make the country self-sufficient in this important component of food and nutrition security which is an important objective of the evergreen revolution. To upgrade the quality of seeds, especially of the farmers' self-produced and saved seeds, the government is already running a seed village programme. Under this, financial assistance, by way of 50 to 75 per cent subsidy, is provided on foundation and certified seeds of various crops like pulses, oilseeds and fodders to small and marginal land holders.

In another significant move aimed at ensuring better quality of agricultural products and providing assured marketing at pre-negotiated prices, the NITI Aayog has helped the agriculture ministry to prepare a Model Contract Farming Act for the guidance of the state governments. If the states enact their contract farming laws on the lines of the Centre's Model Act, it can help popularise this system of farming which facilitates direct linkage between the growers and the end-users of different crops. Elimination of middlemen and freedom from routing the output through the regular mandis can substantially reduce the marketing costs, including market levies, for the benefit of both producers and consumers.

On the other hand, the Ministry of Agriculture and Farmers Welfare, too, has prepared a roadmap for ushering in an evergreen revolution and doubling farmers' income by 2022. The new initiatives envisaged under this plan include the use of cutting-edge technology to lift farm productivity, launching a nation-wide programme to tap the advantages of space technology in agriculture, and consolidation of online trading and inter-market transactions to enhance the farmers' price realisation in an efficient and transparent manner. Besides, it also stipulates setting up of seed production and processing units at Panchayat level to make good quality seeds of high-yielding and disease and pest resistant varieties to the farmers. A noteworthy feature of this plan is to utilise about a million hectares of rice fallows, the land left untilled after harvesting rainfed paddy, for producing pulses and oilseeds.

Going a step further, the Agriculture Ministry's plan of action seeks to promote the agriculture's allied activities which can supplement farm incomes and contribute to strengthening food and nutrition security. For this, it intends to promote rearing of indigenous breeds of cows and buffaloes which are strong and sturdy enough to withstand the challenges of climate change, apart from popularising fisheries. Deep sea fishing is sought to be promoted to increase overall production and availability of fish for domestic consumption and exports. The ministry is confident that such initiatives would push the country towards an evergreen revolution besides leading to greater economic well being in rural areas.

The success of the efforts to transform the green revolution into an evergreen or an ever-enduring revolution would depend largely on how well the mooted programmes and schemes are implemented. There are already indications that the focus of agriculture development is gradually shifting from production to income which will essentially need pointed attention to all the links in the agriculture development chain from farm to fork. Technology-driven efficiency and precision would, therefore, have to be the byword for every farm operation to transform green revolution into an evergreen revolution.

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PRADHAN MANTRI KRISHI SINCHAI YOJANA (PMKSY)

Pankaj Tyagi and Team

Government of India is committed to accord high priority to water conservation and its management. To this effect Pradhan Mantri Krishi Sinchai Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation 'Har Khet ko pani' and improving water use efficiency 'Per Drop More crop' in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities. The Cabinet Committee on Economic Affairs chaired by Hon'ble Prime Minister has accorded approval of Pradhan Mantri Krishi Sinchai Yojana (PMKSY) in its meeting held on 1st July, 2015.

The Pradhan Mantri Krishi Sinchayee Yojana was launched on 1st July, 2015 with the motto of 'Har Khet Ko Paani' for providing end-to end solutions in irrigation supply chain, viz. water sources, distribution network and farm level applications. PMKSY not only focuses on creating sources for assured irrigation, but also creating protective irrigation by harnessing rain water at micro level through 'Jal Sanchay' and 'Jal Sinchan'.

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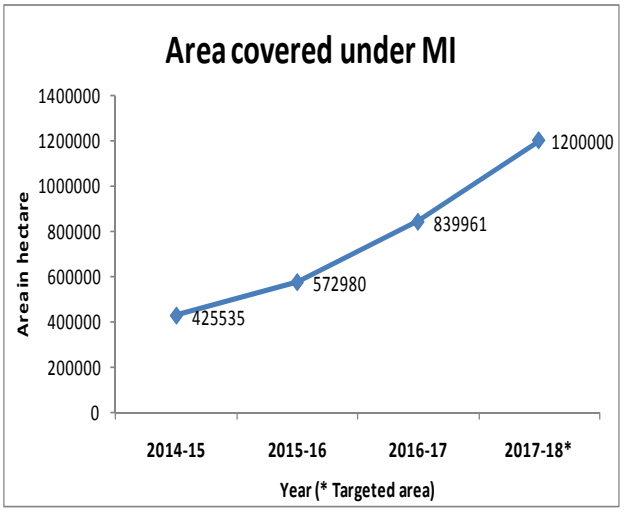
Objectives of PMKSY:

The major objective of PMKSY is to achieve convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on-farm water use efficiency to reduce wastage of water, enhance the adoption of precision-irrigation and other water saving technologies (Per Drop More crop), enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal waste water for peri-urban agriculture and attract greater private investment in precision irrigation system.

Structure of the Scheme:

PMKSY has been conceived amalgamating ongoing schemes viz. Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR,RD&GR), Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DoLR) and the On Farm Water Management (OFWM) of Department of Agriculture and Cooperation (DAC). The scheme is being implemented by Ministries of Agriculture, Water Resources and Rural Development. Ministry of Rural Development mainly undertakes watershed development, under which rain water conservation, construction of farm pond, water harvesting structures, small check dams and contour bunding etc. are taken up. MoWR, RD &GR, undertakes construction major & minor (AIBP) for creation of assured irrigation source, command area development and minor irrigation (HKKP) Ministry of Agriculture will promote efficient water conveyance

and precision water application devices like drips, sprinklers, pivots, rain-guns in the farm "(Jal Sinchan)", construction of micro-irrigation structures to supplement source creation activities, extension activities for promotion of scientific moisture conservation and agronomic measures.



PMKSY Components:

The Major Components of PMKSY are:

1. Accelerated Benefits Programme (AIBP)
2 Har Khet Ko Pani
3. Per Drop More Crop
4. Watershed Development

Strategy:

Programme architecture of PMKSY has been adopted a 'decentralized State level planning and projectile execution' structure that allows States to draw up their own irrigation development plans based on District Irrigation Plan (DIP) and State Irrigation Plan (SIP). It serves as convergence platform for all water sector activities including drinking water & sanitation, MGNREGA, application of science & technology etc. through comprehensive plan. State Level Sanctioning Committee (SLSC) chaired by the Chief Secretary of the State is vested with the authority to oversee its implementation and sanction projects.

PMKSY Mission:

Union Cabinet in its meeting dated 26.07.2016, has approved for Mission mode implementation of the programme with the Mission being headed by MoWR,RD&GR with an objective for completion of the identified 99 medium/ major irrigation projects including development of their command area by Dec. 2019 and to promote pressurized pipe system wherever feasible, drip/sprinklers, water use efficiency, participatory irrigation management formation of water user association (WUA), involvement of NGOs to Promote convergence under various schemes and Provide platform to share best Practices.

Per Drop More Crop:

Ministry of Agriculture & Farmer's Welfare, Department of Agriculture Cooperation & Farmer's Welfare is implementing 'Per Drop More Crop' component of PMKSY. Per Drop More Crop mainly focuses on water use efficiency at farm level through precision/micro irrigation (Drip and Sprinkler Irrigation). Besides promoting precision irrigation and better on-farm water management practices to optimize the use of available water resources, this component also supports gap filling interventions like micro level water storage or water conservation/ management activities as to complement and supplement the works under taken through various national/state level programmes for drought proofing measures.

Significant Growth in adoption of Micro Irrigation in last 6-7 years from 2010-11 to 2016-17, Compounded Annual Growth Rate (CAGR) of Micro Irrigation, coverage is 12.7%.

During 2016-17, an area of around 8.4 lakh ha was brought under Micro Irrigation, which is the highest coverage achieved in a calendar year.

Under Centrally sponsored scheme Micro Irrigation scheme, an area of 6.2 mha has been covered.

Under PMKSY-PDMC other Intervention scheme 97359 number of water harvesting having potential for protective irrigation of 1.8 lakh ha has been created since 2015-16.

Benefits of Micro Irrigation:

1. Reduction in input costs and significant cost savings observed for irrigation in all surveyed states. Irrigation cost reduced by 20% to 50% with average of 32.3%.
2. Labour savings on account of irrigation, weeding, fertilizer and other operations. Use of human labour decreased significantly and ranged from 7.41% to 18.75% in pre-harvest operations. However, labour use increased in post-harvest operations for harvesting, assembling & grading, handling, transportation and disposal of produce.
3. Electricity consumption reduced after installation of micro irrigation system by about 31%.
4. Saving of fertilizers with average reduction of about 28% in total fertilizer consumption in all surveyed states. Fertilizer saving vary from 7% to 42%.
5. Irrigated area increased in all surveyed states (13 states, 64 districts) after introduction of NMMI scheme by an average of 8.41% from same source of water. Maharashtra topped the list with 22.28% growth in irrigation area followed by Chhattisgarh.
6. Increase in area under horticulture crops after adoption of micro irrigation by farmers.
7. Average productivity of fruits and vegetables increased by about 42.3% and 52.8% respectively mainly because of crop spacing, judicious use of water and other inputs etc.
8. Overall benefits accrued from micro irrigation reflect in income enhancement of farmers. Farmer's income increased in the range of 20% to 68% with average of 48.5%.
9. Benefit cost (BC) ratio of micro irrigation is greater than "1" across states and crops which signify importance of micro irrigation in net income enhancement of farmers.
10. Positive outcomes of micro irrigation has made food security effective due to increase in production and productivity of different crops and increased area under irrigation from same source of water.

An impact evaluation study for Micro Irrigation was carried out in the year 2014 and major findings of the study are:

- Irrigation cost reduced by 20% to 50% with average of 32.3%.
- Electricity consumption reduced by about 31%.
- Saving of fertilizers vary from 7% to 42%.
- Average productivity of fruits and vegetables increased by about 42.3% and 52.8%.
- Overall income enhancement of farmers in the range of 20% to 68% with average of 48.5%

Conclusion:

The Successful implementation of the PMKSY serves in the rapid development and growth of agricultural systems, since the farmers can invest in the agricultural activities readily with enhance confidence of returns on investments in availability of proper water sources & technologies for its efficient application. The enhanced coverage of irrigation facilities can efficiently reduce the income disparity among the different areas furthering the equality among the communities. Efficient systems such as drip enhance productivity & quality of produce rendering the additional income to farmers. With availability of water, the farmers can diversify the cropping for horticulture based farming which is more beneficial to them. The ultimate medium term objective of the Government for "Doubling of Farmers Income" will be ably supported by the programmme.

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NATIONAL AGRICULTURE MARKET: ONE INDIA, ONE MARKET

Subhash Sharma

The Cabinet Committee on Economic Affairs approved the Central Sector Scheme for promotion of National Agriculture Market through Agri-Tech Infrastructure Fund (ATIF) for implementation during 2015-16 to 2017-18 on 1st July 2015. The CCA gave its approval for Implementation of the National Agriculture Market by Department of Agriculture, Cooperation and Farmers' Welfare through Small Farmers Agribusiness Consortium by creation of a common electronic platform deployable in selected regulated markets across the country.

The agriculture sector continues to be a critical segment of India's economy in terms of employment and income generation. The majority of India's population is engaged in agriculture and allied sectors. Government of India is committed to the welfare of the farmers and the Budget 2016-17 makes an explicit announcement to double the income of the farmers in the country by the year 2021-22. Agriculture being primarily a state subject, Government of India believes that both the Centre and States need to work together to realize this goal.

Since the launch of Green Revolution in mid 1960s, India has made good progress and has achieved food security. This has largely come about by new technology introduced on the production front. Now, it is time for addressing issues relating to the post-production activities including food processing and marketing.

The Ministry of Agriculture and Farmers' Welfare believes that the next phase of transformation of India's agriculture will need reforms in agricultural marketing system. If the farmers are to be rewarded with remunerative prices for their produce, reforming the existing marketing system in the country is essential.

The post-harvest management including agricultural marketing has not kept pace with the changes in economy, particularly relating to setting up of an efficient supply chain. We are therefore, faced with new challenges in terms of finding an efficient market for the marketable surplus. There is enormous concern over several aspects of our agricultural marketing system. For one, agriculture marketing is administered by the States as per their agri-marketing regulations under which State is divided into several market areas, each of which is administered by a separate Agricultural Produce Marketing Committee (APMC) which imposes its own marketing regulation (including fees). As a consequence, this fragmentation of markets, even within the State hinders free flow of agri commodities from one market area to another and multiple handling of agri-produce and multiple levels of mandi charges end up escalating the prices for the consumers without commensurate benefit to the farmer. The need to unify markets both at State and National level is, therefore, clearly the requirement of time. Backed by these reforms, a pan India online trading platform is expected to promote uniformity and streamlining of procedures across the integrated markets, remove information asymmetry between buyers and sellers and promote real time price discovery based on actual demand and supply, promote transparency in auction process, and access to a nationwide market for the farmer, prices commensurate with quality of his produce and online payment and availability of better quality produce and at more reasonable prices to the consumer.

NAM is a pan-India electronic trading portal which seeks to network the existing APMC and other market yards to create a unified national market for agricultural commodities. NAM is a "virtual" market but it has a physical market (mandi) at the back end. The NAM Portal will provide a single window service for all APMC related information and services. This will include commodity arrivals & prices, buy & sell trade offers, provision to respond to trade offers, among other services. While material flow (agriculture produce) shall continue to happen through mandis, an online market would reduce transaction costs and information asymmetry.

Scheme Design:

It is with the objective to usher in reform of the agri marketing system and to provide farmers / producers with access to markets across the country that the National Agriculture Market (NAM) was conceived and approved by the Cabinet Committee on Economic affairs (CCEA) on 1ST July, 2015. The scheme envisages implementation of the NAM by setting up of an appropriate common e-market platform that would be deployable in selected 585 regulated wholesale markets in States / UTs desirous of joining the e-platform in the first phase. Small Farmers Agribusiness Consortium (SFAC) is implementing the national e-platform. Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW) is providing for the expenses on development of software and its customisation free of cost to the States and Union Territories (UTs). DAC&FW is also giving grant as one time fixed cost subject to the ceiling of Rs.30.00 lakhs per selected mandi for IT and Quality assaying related equipment / infrastructure in 585 regulated mandis, for installation of the e-market platform. This assistance is further increased to Rs 75 Lakh per mandi to include setting up of Sorting/Grading/Cleaning and packaging units and Compost unit in e-NAM mandis in the budget announcement of 2017-18. State Governments are required to propose requirement and names of APMCs where this project would be initiated.

Marketing Reforms Mandatory for Joining e-NAM:

The Scheme being linked to agricultural marketing reforms, the States/Union Territories (UTs) need to undertake mandatory reforms in their Agriculture Produce Market Committee (APMC) Act in respect of following three areas to avail the assistance under the Scheme.

i) Provision of single trading license to be valid across the State:

The State / UT must provide, through appropriate legislation in consonance with the concerned APMC Act/regulation, for issue of single trade license to any eligible person from across India irrespective of one's domicile to enable one to trade through e-NAM portal in the markets across the State /UT.

Further, State/UT must provide for a liberal process of single trade license for wholesale traders/buyers for the entire State & ensure that there are no barriers like prohibitively high security deposits or stipulations regarding minimum quantities to be transacted or requirements of establishment of purchase centre/premise' etc.

ii) Provision of single point levy of market fee across the State :

State/UT must provide, through appropriate legislation/executive order in consonance with the concerned APMC Act/regulation for single point levy of market fee for wholesale trading of same produce across the State i.e., levy of market fee/cess at point of first transaction only in the State. No further market fee / cess / service charge, or by whatever name it is called, should be leviable on subsequent wholesale transaction (s) of the same produce.

iii) Provision for e-auction/e-trading as a mode of price discovery to be facilitated by the State Agriculture Marketing Department/Board/ APMCs/Regulated Market Committees (RMCs) as the case may be:

State / UT must provide, through appropriate legislation / executive order in consonance with the concerned APMC Act / regulation, that State Agricultural Marketing Department / Directorate / Board , as the case may be , and concerned APMC /RMC shall provide necessary legal framework therefor and required infrastructure connected thereto to promote National Agriculture Market (e-NAM).

Objectives:

The main objectives of the Scheme are-

(i) To integrate markets first at the level of the States and eventually across the country through a common online market platform, to facilitate pan- India trade in agricultural commodities;

Status of Mandatory Marketing Reforms:

Status	States / UTs
States which have carried out mandatory reforms and have joined e-NAM	Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Telangana, Uttar Pradesh, Uttarakhand, Tamil Nadu and (15)
States which have carried out reforms but not joined e-NAM	Karnataka and Goa (02)
States/ Uts which have submitted proposal for joining e-NAM and reforms are under process	Chandigarh and Puducherry and West Bengal (03)
States / UTs yet to carry out reforms mandatory for joining e-NAM	Arunachal Pradesh, Delhi, Meghalaya, Assam, Mizoram, Nagaland and Tripura. (07)
States with non-functional APMC Act	Sikkim and J&K. (02)
States / UTs with no APMC Act.	Bihar, Kerala, Manipur, Andaman and Nicobar, Daman and Diu, Dadra and Nagar Haveli and Lakshadweep (07)

(ii) To streamline marketing/transaction procedures and make them uniform across all markets to promote efficient functioning of the markets;

(iii) To promote better marketing opportunities for farmers / sellers through online access to more buyers / markets, removal of information asymmetry between farmer and trader, better and real-time price discovery based on actual demand and supply of agri-commodities, transparency in auction process, prices commensurate with quality of produce, online payment etc. that contribute to marketing efficiency;

(iv) To establish quality assaying systems for quality assurance to promote informed bidding by buyers; and

(v) To promote stable prices and availability of quality produce to consumers.

Components of NAM:

NAM has the following components:

- A National e-market platform for transparent sale transactions and price discovery in regulated markets, kissan mandis, warehouses and private markets. Willing States to accordingly enact provision for e-trading in their APMC Act.
- Liberal Licensing of traders/buyers and commission agents by State authorities without any pre-condition of physical presence or possession of shop/premises in the market yard.
- One license for a trader valid across all markets in the state.
- Harmonization of quality standards of agricultural produce and provisions of assaying (quality testing) infrastructure in every market to enable informed bidding by buyers.
- Restriction of agriculture Produce Marketing Committee's (APMC) jurisdiction to within the APMC market yard / sub yard instead of a geographical area (the market area) at present
- Single point levy of market fees. i.e. on the first wholesale purchase from the farmer

Implementation Strategy:

Ministry of Agriculture, Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) have mandated Small Farmers' Agribusiness Consortium (SFAC) to act as the Lead Implementing Agency for NAM.

Role of the selected Strategic Partner is comprehensive and includes:

- Design, develop, test, implement, maintain, manage, enhance and modify the set of applications and modules forming the National Agriculture Market (NAM) .
- Provide ground level support to integrated mandis by deploying support staff for one year, provide training to various users and organize awareness creation camps in mandis.
- Set up a help desk that will answer queries and handle/escalate issues reported by the users during business hours.
- Marketing and usage of the portal: SP shall carry out appropriate promotion and marketing activities to enhance acceptability and usage of e-NAM portal amongst various stakeholders;

- Generation of MIS reports: SP shall make suitable provisions in the e-NAM for generation of MIS reports.

Process Flow:

Farmers can showcase their produce online from their nearest e-NAM Market and traders can quote price from anywhere online which would result in the increased number of traders and greater competition ensuring open price discovery & better return to farmer.

Clearing and Settlement:

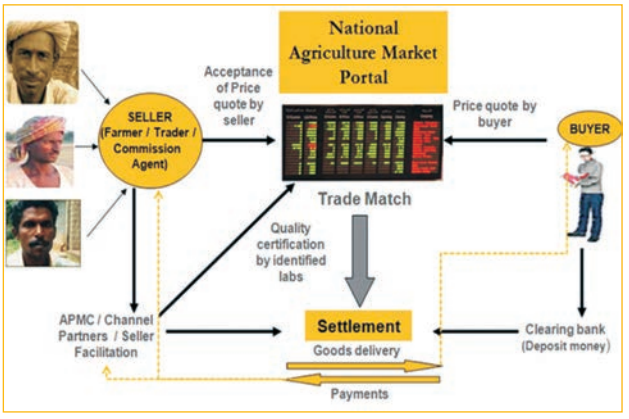
Once the trade has been confirmed, primary invoice will be generated automatically by e-NAM software which can be accessed by the traders from the respective dashboard or from the one sent to the winning bidder on email / SMS or manually etc . The winning bidder will deposit the amount calculated as per the sale agreement , which will include market fee, commission agent's charges, loading / unloading / packaging charges etc., as applicable. Winning bidder will be able to deposit the amount on-line into an settlement account using RTGS /NEFT or through on-line payment gateway provided on e-NAM. Once the funds are received by e-NAM, a confirmation message will be sent to the Farmer- Seller / Commission Agent. Depending on the terms of delivery, the winning bidder will be required to take the delivery of goods at the APMC market either by himself or through an authorized agent or logistics provider. Buyer can also request the Commission Agent / Seller to dispatch the goods through a transporter identified by him on "Freight to Pay" basis at his own risk and cost Freight, insurance charges etc. to be paid by the buyer. Funds due to be paid to the Farmer- Seller / Commission Agent and other beneficiaries like APMC, service providers etc. will be transferred to their respective bank accounts registered with e-NAM after acceptance of delivery by the buyer or his representative within 1 (one) business day by the bank operating the e-NAM account upon on-line approval from concerned APMC.

Pilot Launch:

Pilot of National Agriculture Market was launched on 14th April 2016 by Hon'ble Prime Minister in 21 mandis across 08 States. As of now e-NAM is rolled out in 470 mandis across 14 States.

Progress of Implementation:

579 mandis across 16 States and 02 Union Territories had been approved by the Government of India for integration with e-NAM, out of which, 470 mandis across 14 States has been already integrated. Besides English and Hindi, e-NAM portal is available in regional Languages like Gujarati, Telugu, Marathi and Bengali. Website of e-NAM is also available in



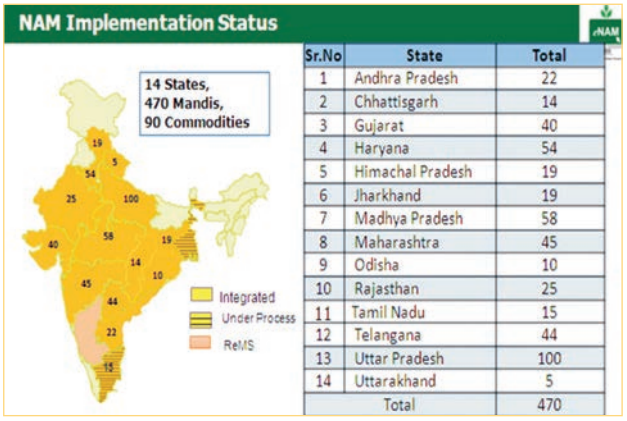
regional languages like Gujarati, Telugu, Marathi and Bengali, Tamil and Odia besides English and Hindi.

Mobile application:

A mobile application for e-bidding is launched which can be downloaded from Google Play Store (play.google.com) App is available in English and Hindi. E-NAM mobile app provides the facility of viewing the mandi wise arrival and price information to farmers and facility of bidding using their mobile from anywhere to Traders.

Progress so far:

Mandis are integrated as per the pre-decided targets Coverage of National Agriculture Market (eNAM) in various states/UTs is as under:



Sr.No	State	Total
1	Andhra Pradesh	22
2	Chhattisgarh	14
3	Gujarat	40
4	Haryana	54
5	Himachal Pradesh	19
6	Jharkhand	19
7	Madhya Pradesh	58
8	Maharashtra	45
9	Odisha	10
10	Rajasthan	25
11	Tamil Nadu	15
12	Telangana	44
13	Uttar Pradesh	100
14	Uttarakhand	5
	Total	470

A) Performance at a glance (till 31ST Dec., 2017):

- No. of farmers Registered on eNAM : 63.82 lakhs
- No. of traders Registered : 99,531
- No. of Commission Agents Registered : 52,768
- Total Traded Quantity : 1.37 crore MT
- Value (in Rs.Crores) : 32425
- Tradable parameters notified : 90 commodities

B) Hon'ble Prime Minister bestowed the Excellence Award to Solan (Himachal Pradesh) & Nizamabad (Telangana) Mandis for Excellent performance on implementation eNAM on the occasion of Civil Services Day (21.04.2017)

(c) Training and Awareness:

Training and awareness camps are being organized for Farmers, Traders, Commission Agents, mandi functionaries and other stakeholders in each e-NAM mandi associated with registration desk for on the spot registration of farmers. So far such camps had been organized in 200 mandis. Feedback of the participants is being captured in a prescribed format and is being analyzed for further improvement.

Challenges Faced:

1. Non-uniform Quality standards across various States specifically in case of Horticulture produce is a hindrance in promotion of inter-mandi and inter-State trade. The harmonization of Quality standards across the States is need of the time. SFAC as a lead implementing agency is exploring the possibilities of bringing uniformity in the quality standards with the help of Directorate of Marketing and Inspection (DMI) an associated office of DAC&FW. In the process, the quality assaying parameters for 90 commodities have been prepared and notified for all e-NAM mandis to follow.
2. States are required to establish the appropriate quality testing facilities equipped with the trained manpower and suitable assaying equipments. DMI is providing the required training to the staff of e-NAM mandis for quality assaying through their regional Agmark Laboratories.
3. In order to promote the inter-MANDI AND Inter State trade, States are required to promote the issue of Unified trade licenses in sufficient numbers to the traders. Till date, very few traders have applied for unified licenses.

Online payment directly to the farmer's bank account by the buyers is another area of concern where the progress is quite slow. This involves the change management as traditionally Commission agents are making payments to the farmers and providing credit to the sellers, while e-NAM envisages the direct payment by buyers to farmers on the lines of Direct Benefit Transfer (DBT) policy of Government of India.

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PM FASAL BIMA YOJANA: ENSURING FARMERS' PROSPERITY

Sandip Das

In a bid to protect farmers against losses occurred because of frequent changes in weather patterns, the Pradhan Mantri Fasal Bima Yojana (PMFBY) was launched by Prime Minister Narendra Modi on 18 February 2016. The scheme, a first of its kind in the country, seeks to provide farmers with uniformly low premium that would help them sustain agriculture in case of crop losses arising out change in climate.

The Close to two years after the launch of Pradhan Mantri Fasal Bima Yojana, the farmers are gradually taking up crop insurance scheme for protection against natural calamity.

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The crop insurance schemes have been in operations in the country close to last two decades or so. The government formulated the PMFBY mainly to plug the holes in the older crop insurance schemes, the National Agriculture Insurance scheme (NAIS) introduced in 1999 and the Modified NAIS (MNAIS) initiated in 2011.Prior to launch of PMFBY, only 20 million of an estimated 140 million farmers in the country, earning for a population four to five times as many, had crop insurance cover in 2014-15. The scheme was only against the cost of cultivation and barely provided any income protection to farmers. According to Agriculture Ministry data, most of the farmers who took crop insurance were in Rajasthan, Bihar, Uttar Pradesh, Maharashtra, Karnataka and Andhra Pradesh.

About the scheme:

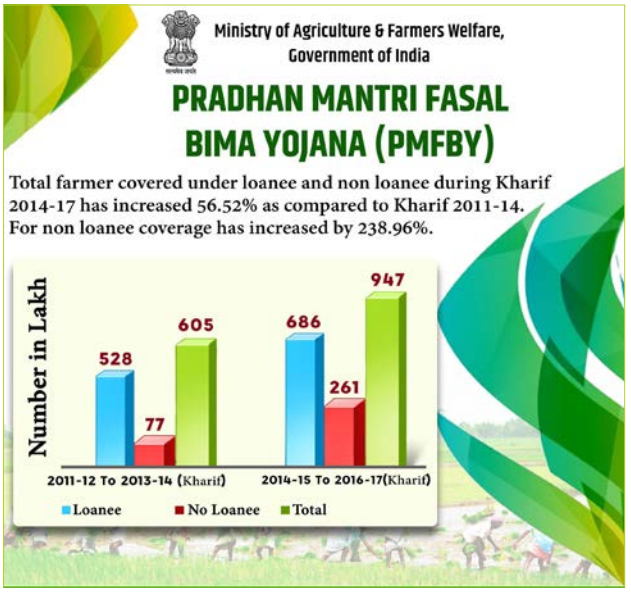
Under the new scheme which was implemented since kharif season of 2016, the premium paid by farmers had been reduced to 2% of the insured value for the more rain-dependent Kharif crop and 1.5% for the Rabi season, compared with 3.5-8% charged for the two earlier schemes, NAIS and MNAIS. In case of horticultural crops, farmers' premium burden had been fixed at 5% of the sum assured or 50% of the total premium.

NAIS and MNAIS have been discontinued from Kharif 2016, but the Weather Based Crop Insurance Scheme (WBCIS) and Coconut Palm Insurance Scheme would continue to operate while premium to be paid under WBCIS has been brought on a par with PMFBY.

While unveiling the operational guidelines for the PMFBY at a massive farmers' rally in Sehore in Madhya Pradesh in February 2016, Prime Minister had noted that the crop insurance scheme would provide a solution for the farmers problems, in times of difficulty. He said care had been taken to eliminate the shortcomings of previous crop insurance schemes, and create trust among farmers with regard to crop insurance. He said technology would be used extensively with this scheme to ensure early settlement of claims, and exhorted farmers to take benefit of this scheme.

PMFBY aims at supporting sustainable production in agriculture sector by way of :

- Providing financial support to farmers suffering crop loss or damage arising out of unforeseen events.



- Stabilizing the income of farmers to ensure their continuance in farming.
- Encouraging farmers to adopt innovative and modern agricultural practices.
- Ensuring flow of credit to the agriculture sector, which will contribute to food security, crop diversification and enhancing growth and competitiveness of agriculture sector besides protecting farmers from production risks.

Another unique feature of PMFBY has been that there would be no upper limit on government subsidy provided by centre and state governments. "Even if the balance premium (after farmers' contribution) is 90%, it will be borne by the government," according to an agriculture ministry statement.In the earlier crop insurance schemes, there was a provision of capping the premium rate which resulted in low claims being paid to farmers. This capping on premium was done to limit the government outgo on the premium subsidy. "This capping has now been removed and farmers get claim against full sum insured without any reduction.

This has ensured that farmers get the full sum insured without any reduction or hassles from the designated insurance companies if natural calamities ravage their crops. Officials said that the following roll out of PMFBY, the crop insurance coverage is set to rise from 45 million hectares or 23 per cent of the area under cultivation in 2015-16 to 50 per cent of the crop area by 2018-19.

Another benefit to farmers under the new crop insurance scheme was that losses incurred by them at any stage of the farming activity, from the sowing to the post-harvest season, is being covered. Earlier, only post-harvest losses can be offset by the insurance facility under the two existing schemes. Also, even those farmers who haven't taken bank loans/credit have been made eligible for insurance cover under PMFBY. The scheme also provide insurance cover at individual farm level to crop losses due to occurrence of localized calamities such as landslides, hailstorm and inundation affecting part of a notified unit or a plot.

The Agriculture Ministry had empanelled state-owned Agriculture Insurance Company of India (AIC) and private companies for implementation of the mega scheme. In the first year of implementation of PMFBY/RWBCIS, 23 States implemented the schemes during kharif 2016 and 25 States and 3 Union Territories during rabi 2016-17.

Progress so far:

According to official data, during 2016-17, 30% of Gross Cropped Area has been covered under PMFBY in comparison to 23% crop area covered in 2015-16. In the last financial year, a total of 5.74 crore farmers were covered, including 1.35 crore non-loanees (who have not availed crop loan from banks) under the crop insurance scheme. There was an increase of 0.89 crore in total coverage of farmers in 2016-17, an increase of more than 18% in comparison to the previous year. Coverage of non-loanees has increased by 123.50% comparison to 2015-16. During 2016-17, 518.11 lakh hectare was insured which is 56.56 lakh hectare more than the previous year, with an increase of 10.78%.

Increase in Sum Insured:

Due to capping of premium under earlier crop insurance schemes, the sum insured was consequentially reduced, as a result of which the farmers were denied the expected benefits and complete compensation for their crop loss. However, under PMFBY, in order to provide maximum risk coverage to farmers, sum insured has been equated to Scale of Finance (SOF). "As a result, the farmers now get timely settlement of claims for entire sum insured, without any deduction and are being compensated for entire crop loss," according to an agriculture ministry note.

In 2016-17, the total area covered has been insured for a sum of Rs. 20,47,79 crore, which is 78.14% more than that of Rs 11,49,51 crore in 2015-16. Sum insured per hectare in kharif 2015 was Rs 20,498 which increased to Rs 34,574 in kharif 2016 and in rabi 2015-16, it was Rs 8733 which increased to Rs 39,358 in rabi 2016-17.

Rise Risk Coverage:

Under PMFBY, comprehensive coverage has been provided against non-preventable natural risks from pre-sowing to post-harvest losses. In addition, losses due to localised risks are estimated at the individual farm level for claim settlement. On account of coverage of losses due to prevented sowing in 2016-17, Tamil Nadu's claims worth of Rs. 27.61 crore (upto 25% of sum insured) were settled due to prevented sowing on account of inclement weather.

Similarly, 25% advance relief due to mid-season adversity has been provided to states. In 2016-17, due to adverse climatic conditions such as floods, drought spell, severe drought, unseasonal rains etc. the payments were made to the tune of Rs 32 crore in Uttar Pradesh, Rs 11 crore in Chhatisgarh, Rs 11.19 crore in Maharashtra and Rs. 9.42 crore in Madhya Pradesh.

Coverage of localised claims:

In 2016-17, due to localised calamities such as hailstorm, inundation and landslides, claims worth of Rs 0.11 crore in Andhra Pradesh, Rs. 0.09 crore in Chhatisgarh, Rs. 4.04 crore in Haryana, Rs. 1.55 crore in Maharashtra, Rs. 0.32 crore in Rajasthan and Rs. 0.80 crore in Uttar Pradesh were settled expeditiously prior to the commencement of crop cutting experiments.

Coverage of Post-Harvest Losses:

In 2016-17, claims on this account worth Rs. 0.11 crore in Andhra Pradesh, Rs. 0.66 crore in Manipur and Rs. 16.51 crore in Rajasthan were settled.

Settlement of claims and allocation for the scheme by the Centre:

During 2016-17 (kharif 2016 and rabi 2016-17), on account of a 'normal' monsoon rains, against the gross premium of Rs. 22,344 crore, total claims by farmers have been estimated at about Rs. 15,100 crore 68% of the premium paid. In comparison under actuarial premium based erstwhile schemes during 2011-12, which was also 'normal' monsoon year, claims settled were only Rs. 1357 crore against the premium paid of Rs. 2131 crore, or around 64% of the total premium paid by the farmers.

Similarly, during 2015-16, against the gross premium of Rs 3076 crore claims were to the tune of Rs. 4155 crore or around 134% of the gross premium because of deficient monsoon received in the country. During 2016-17, Rs. 11054 crore was utilized for crop insurance scheme. The Finance Minister has made a provision of Rs. 9000 crore for PMFBY as centre's share in the under budget (2017-18).

For promoting transparency in the implementation of crop insurance scheme, Central Crop Insurance Portal has been developed which integrates farmers and other stakeholders and also provides for online registration of farmers. "All possible farmer friendly administrative initiatives

and technology have been put in place to increase the coverage of non-laonee farmers including sharecroppers," according to an agriculture ministry note. The Common Service Centre(CSC) has been engaged to facilitate enrolment of non-loanee farmers from Kharif 2017. Direct Benefit Transfer (DBT) has been initiated to facilitate transmission of claims amount directly to the farmers account. Provision has been made for use of advanced technology such as drone, remote sensing etc. for promoting transparency and immediate settlement of insurance claims.

Challenges in terms of Implementation:

In the earlier crop insurance schemes due to non- adoption of improved technology, there was considerable delay in settlement of claims of the farmers. Under PMFBY, the States are required to give Crop Cutting Experiment (CCE) data to insurance companies within one month of harvest and the companies have to settle the claims within three weeks of receiving the CCE data. Under earlier schemes, estimation of yield data was done without using technology through manual means, due to which there was a huge delay in obtaining CCE data. Due to this, the claim settlement, on an average took six months to one year.

To eliminate this delay and to promote transparency, the government has made mandatory to use smartphones or CCE Agri App for capture and transmission of yield data to the crop insurance portal. Recently in a circular, the agriculture ministry has also asked states to use technologies such as remote sensing, satellites and drones to deal with frequent reports of discrepancies, such as the area insured was more than the area sown for a particular crop in many states.Experts say that PMFBY if implemented properly across the country would mitigate farm distress to a large extent especially when the erratic climates have become a norm rather than exception.

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The President of India felicitates exceptional women achievers at Rashtrapati Bhawan

The President of India, Shri Ram Nath Kovind felicitated a group of exceptional women, the first to set a milestone in their respective fields at Rashtrapati Bhawan on 20th January, 2017. These women had been selected by the Union Ministry of Women and Child Development with the aim of felicitating extraordinary achievers who had defeated stereotypes and broken glass ceilings.

The President of India, Shri Ram Nath Kovind with the group of exceptional women in their respective fields at Rashtrapati Bhawan on 20th January, 2017.

Addressing the gathering, the President said that progress of women is a barometer for progress in any country or society. We are witnessing positive change in participation of women in our country. He said the pace at which women are empowered will determine how fast we move towards a more sensitive and equitable society.

The women who have been felicitated are those who have been the first in any field like the first woman judge, first woman porter, first woman to head a missile project, first para-trooper, first Olympian among others.

http://164.100.117.97/WriteReadData/userfiles/Bio-112_First%20Ladies.pdf

Institutional Credit for Small Farmers

The Government has increased accessibility of credit for farmers with a record credit target of Rs 10 lakh crore. It has also taken several measures to increase institutional credit flow and to bring more and more farmers including small and marginal farmers within the institutional credit fold. Some of these measures are detailed below:

- **Interest Subvention Scheme-** Under the Interest Subvention Scheme (ISS), Short Term Crop loans upto Rs.3 lakh are extended to farmers at a subvented interest rate of 7 per cent per annum for a period up to one year. In case of prompt repayment, the farmers can avail a prompt repayment incentive of 3 per cent per annum and thus the effective rate of interest on such loans is only 4 per cent.
- **Priority Sector Lending Guidelines-** which mandate all Domestic Scheduled Commercial Banks to earmark 18 per cent of their Adjusted Net Bank Credit (ANBC) for lending to Agriculture.
- **Kisan Credit Card -** aimed at providing adequate and timely credit support from the banking system under a single window to the farmers for their cultivation and other needs. All the banks have been advised to implement the scheme.
- **Joint Liability Groups -** To bring small, marginal, tenant farmers, oral lessees, etc. taking up farm activities, off-farm activities and non-farm activities, into the fold of institutional credit, Joint Liability Groups (JLGs) have been promoted by banks.
- **Relief measures during natural calamities** – these include, restructuring/rescheduling of existing crop loans and term loans, extending fresh loans, relaxed security and margin norms, moratorium, etc.

Steps for Fertilizer Availability Round the year

Fertilizers are an important input for agriculture and have played a major role in increasing farm productivity since Green Revolution. But Indian farmers have often faced the difficulties due to shortage of fertilizers in past. So, the Government, giving high priority to farmers' welfare, has taken a number of initiatives to ensure supply of fertilizers round the year. Some of these steps are:

(1) **Urea Pricing Policy – 2015 -** New Urea Policy – 2015 was notified on 25th May, 2015 to maximize indigenous urea production; to promote energy efficiency in the urea units; and to rationalize the subsidy burden on the Government.

(2) **Neem coating of urea-** 100 per cent of Neem coating achieved.

(3) **Introduction of 45 kg. urea bags replacing the existing 50 kg. bags**

(4) **Reduction in the rates of P&K fertilizers -** The Government had encouraged the Fertilizer companies to reduce the rates of P&K fertilizers which resulted in reduction in the MRP of DAP, MOP and Complex fertilizers.

(5) **Removal of the minimum annual production** - It has been decided to do away with the provision of mandatory 50 per cent capacity utilization or minimum production of 40000 MT for SSP units to be eligible for subsidy.

(6) **Revival of Sindri & Gorakhpur units of FCIL and Barauni unit of HFCL**

(7) **Model fertilizer retail shop -** In the Budget 2016-17, announcement was made for opening up of 2000 Model Fertilizers Retail Shop over a period of three years. It will provide mandatory services like selling of quality fertilizers at genuine rates, soil testing, seed testing, promotion of balanced use of nutrients etc.

(8) **Policy on promotion of city compost –** Policy for promotion of City Compost has been notified by the Department of Fertilizers on 10.2.2016 wherein Market Development Assistance (MDA) of Rs. 1500/ MT has been provided for scaling up production and consumption of City Compost. Manufacturing companies are allowed to undertake direct sale of city compost to farmers.

(9) Pilot projects are underway for Direct Benefit Transfer scheme in fertilizer subsidy scheme.

PRESERVING SOIL HEALTH FOR SUSTAINABLE PRODUCTION

Anjani Kumar and Ranjan Kumar Mohanta

The Governments active involvement in acknowledging the importance of managing soil health has created a major impetus for restoring and maintaining soil health. An enthusiasm has been generated and awareness is being created by mass awareness activities on World Soil Day (December 5) every year. Soil health cards are being distributed and location and crop-specific sustainable soil management practices are being popularized among the farmers for maintenance of soil health. Integration of Governmental policies, research institutes and extension agencies are needed for successful implementation of the soil health restoration and preservation initiatives.

Soil is a dynamic system, consisting of organic and mineral matters, air, water and living organisms along with their interactive processes. Soil is formed through a complex process which takes thousands of years to make an inch of soil. But it can easily be contaminated, eroded and destroyed in a very short span of time, if managed unscientifically. Increasing population and shrinking land resources for agriculture is tremendously increasing pressure on soil beyond the boundaries of sustainability. Our consumerism attitude or greed results in indiscriminate use of fertilizers, pesticides and land resource, which disturbs the harmony existing within the soil thereby affecting the physico-chemical properties of the soil system. Thus, there is a need to understand the soil health and the systems that affect it, so as to devise strategies for its sustainable use for providingthe human needs in the future.

Soil Health:

Soil health and soil quality are considered synonymous and can be used interchangeably. However, one key distinction is that soil quality includes both inherent and dynamic quality. The Soil Science Society of America defines soil health 'as the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation'.Soil health is like animal health where the soil sustains production depending upon the status of soil health attributes.

Soil health concept involves integration of physical, chemical and biological properties of a soil and role of this harmonious blend in sustaining growth, productivity and environmental security. Thus, soil is an ecosystem full of life that needs to be carefully managed to regain and maintain the ability to function optimally.

What is a Healthy Soil?

A soil that is able to optimally sustain its native/acquired productivity potential and render ecological services is said to be in good health. A healthy soil has the following characteristics.

- It has good soil tilt, i.e. crumbly, well structured, dark with good amount of organic matter, and possesses no hard pans.
- It has sufficient depth through which roots can grow to find water and available nutrients.
- It has good water storage and good drainage capabilities, e.g. it retains more water, but will also allow excess water to drain out from soil in case of heavy rain.
- It has sufficient nutrient supply, but not imbalanced or excess of nutrients to achieve optimal production and also for balanced cycling of nutrients within the ecosystem.

- It should contain abundant population of beneficial organisms that help in cycling of nutrients, decomposition of organic matter, maintenance of soil structure, biologically suppressing plant pests, etc.
- It should be free of potentially harmful chemicals and toxins.

Some of the common indicators used to determine the status of soil health are listed in Table 1.

Table 1. Common Indicators of Soil Health

Chemical Indicators	Physical Indicators	Biological Indicators
Soil pH	Soil texture	Microbial biomass
Soil electrical conductivity	Soil particle and bulk density	Population of soil micro and macro organisms
Organic matter content	Penetration resistance of soil	Soil enzyme activities
Total carbon and nitrogen	Aggregate stability	Pollutant detoxification
Cation exchange capacity	Soil water holdingcapacity	Soil respiration
Soil essential nutrient	Soil aeration and porosity	Soil pathogens
Heavy and toxic metals	Soil infiltration rate	

Current Status of Soil Health in India:

In India, about 18 and 15% of world's human and livestock population have to be supported by 2% of world's geographical area and 1.5% of forest and pasture land, respectively. This pressure has resulted in intensive agriculture, which in turn resulted in reduced soil fertility, low farm organic carbon content, deficiencies of nutrients, reduction in quality and availability of water, soil erosion and degradation leading to deterioration of soil health.

According to National Academy of Agriculture Sciences, out of a total of 142 Mha net sown area of India (2010) around 105 Mha farm land has been degraded by various factors like soil erosion

(85.7 Mha) out of which 73.3 Mha by water erosion and 12.4 Mha by wind erosion, followed by soil acidity, soil alkalinity/sodicity, soil salinity and water logging etc. In 2013-14, India has used 16.75 million tons of nitrogen, 5.63 million tons of phosphorus and 2.10 million tons of potash, but the crops still removed around 10 million tons of plant nutrients from the soil, thereby affecting soil health. Thus, adequate amount of organic and inorganic nutrients must be applied to the soil to maintain soil health.

Soil Health: Causes of Deterioration

A healthy soil promotes sustainable root-growth, ensures adequate retention and release of water and nutrients for crop growth, maintains soil biotic habitat and responds favorably to soil management/ agronomic practices. The principal reasons promoting soil health degradation are:-

Population pressure: Due to high population, the soils have to be exploited beyond carrying capacity to feed the proliferating humans and also for production of clothing material. In many cases, the fertile lands are also used to build houses, roads and other infrastructures. Typically, in developing countries like India where the population pressure is high and proportion of nutrient stress-free soils is low, native fertility is being mined more than it is being renewed causing impaired soil health.

Decline in forest and tree cover: Forest and tree cover prevent erosion, helps in soaking of precipitation/ rainfall and building the soil fertility. Therefore, the decline in forest and tree cover is leading to erosion of fertile soil layer, which causes loss of soil productivity.

Intensive soil farming: Intensive cropping system requires exhaustive tillage which breaks down soil organic carbon (SOC) to carbon dioxide and removes plant cover; this exposes the organic rich top soil to erosion by wind or water. Diminished level of SOC adversely affects soil physical condition and fertility. Indiscriminate and imbalanced use of chemical fertilizers and falling use of organic manures further hastens the processes of soil quality degradation.

Mounting use of pesticides: Intensification of agriculture is resulting in indiscriminate use of pesticide. These pesticides persist in the soil and residues influence the natural nutrient cycles due to deadening effect on soil organisms. Decline in soil organisms results in decreased organic matter dynamics, soil fertility and maintenance of air and food quality.

Strategies of Soil Health Management:

1. Conservation agriculture approaches:

- **Diversified crop rotations**: Use of different crops in crop rotations, particularly cereal-pulses system increases soil organic matter, nutrients and biodiversity in the soil. It also improves nutrient use efficiency, improves water quality and conserves soil water.
- **No tillage/Minimum soil disturbance**: As too much plowing helps in nutrient loss and causes soil erosion, no or minimum tillage is used for growing crops without disturbing the soil. It conserves water and improves water use efficiency. It increases soil organic matter and reduces soil erosion.
- **Residue retention/incorporation**: Applying plant residues to the soil surface to compensate for loss of residue due to excessive tillage. It increases soil organic matter, moderates soil temperature, conserves soil moisture and reduces erosion from soil and wind.

2. Nutrient management approaches:

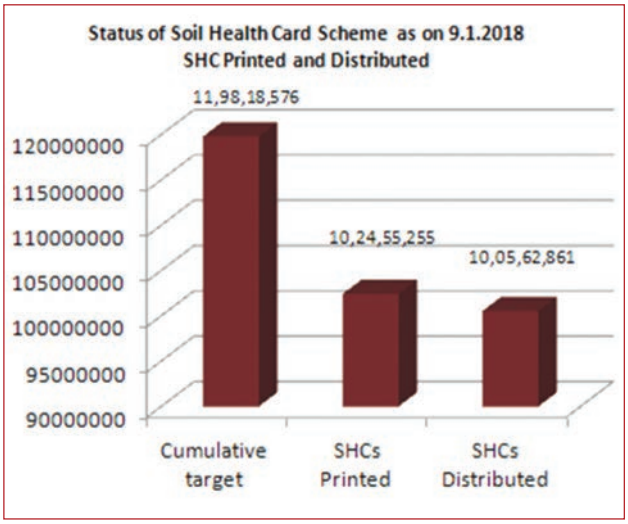
- **Balanced use of fertilizers**: Use of fertilizer has to be based on 4R principle: Right time, Right place, Right dose and Right source. Balanced use of fertilizers is defined as the timely application of all essential plant nutrients (primary, secondary and micronutrients) in readily available form, in optimum quantities and in the right proportion, through the correct method, suitable for specific soil/crop conditions. Balanced fertilization includes application of chemical fertilizers in conjunction with organic manures and bio-fertilizers. Appropriate soil amendments for acidic/alkaline soils need to be timely applied to improve soil health, thereby ensuring adequate availability of nutrients to plants at critical stages of growth.
- **Soil-test-based fertilizer recommendation**: It reduces the overuse of fertilizers and increases the fertilizer use efficiency. The right amount of fertilizer is calculated based on the soil test values and then it is applied in the right form.
- **Application of biofertilizers**: It helps in nitrogen fixing, phosphate solubilizing and mobilizing microbes or the microbial consortium to the crop plants has beneficial effect on crop growth, yield and soil fertility and sustainability in natural soil ecosystem.

Soil Health Card vis-à-vis Soil Health:

To combat excessive use of chemical fertilizers, Government of India has launched the Soil Health Management(SHM) Scheme under National Mission for Sustainable Agriculture with effect from 1st April 2014. It aims at promoting Integrated Nutrient Management (INM) through judicious use of chemical fertilizers including secondary and micro nutrients in conjunction with organic manures and bio-fertilizers for improving soil health and its productivity, strengthening of soil and fertilizer testing facilities to provide soil test based recommendations to farmers for improving soil fertility, ensuring quality control requirements of fertilizers, bio-fertilizers and organic fertilizers; upgradation of skill and knowledge of soil testing laboratory staff, extension staff and farmers through training and demonstrations; promoting organic farming practices etc.

Soil health card (SHC) is a practical report that can enable anyone interested in their soil to monitor soil health. It gives information on the status of soil with respect to 12 parameters, namely N,P,K (Macro-nutrients) ; S (Secondary-nutrient) ; Zn, Fe, Cu, Mn, Bo (Micro - nutrients) ; and pH, EC, OC (Physical parameters). Based on this, the SHC indicates fertilizer recommendations and soil amendment needed to maintain soil health in the long run. SHCs are producer friendly, quick, and require only basic tools. Results are obtained immediately, allowing the user to evaluate numerous fields quickly. National Informatics Centre has designed and developed the Soil Health Card Portal for generation of Soil Health Cards along with Fertilizers Recommendations (Refer http://www.soilhealth.dac.gov.in/).

Fig 1



(Source: http://www.soilhealth.dac.gov.in/Content/blue/soil/index.html)

Long term imbalance use of chemical fertilizer has resulted in skewed N:P:K use ratio. The ideal ratio of N:P:K in Indian context should be 4:2:1, but in 2013-14, it was reported to be 8.0:2.7:1.0. Due to boot polishing effects of urea or any nitrogenous fertilizers, farmers are tempted to use excessive urea, which is not required at all. This indiscriminate use of urea leads to ecological imbalance and is detrimental both to plant and human health. Site specific nutrient recommendation involving soil test based application of fertilizers is critical to enhance fertilizer use efficiency. Soil health card displays the nutrient status of a particular field. Recommendation of fertilizer based on SHC is both economically and environmentally beneficial, particularly for the nutrients like nitrogen whose use efficiency is very low. With the help of SHCs, we can optimize the dose of nitrogenous fertilizer and can curtail its overuse.

The GoI has taken a big initiative to issue soil health card for each of the farm holdings of the country (Fig 1).

The proper implementation of the SHC scheme will increase significantly the efficiency of costly and heavily subsidized fertilizers. It is the right time for the policy makers and the agricultural scientists to come forward and join hands to serve for the successful implementation of the programme. The importance of soil health and application of fertilizer based on soil health card is well understood. Accordingly, farmers are to be sensitized for the use of SHCs through elaborate outreach activities.

The Way Forward:

The Governments active involvement in acknowledging the importance of managing soil health has created a major impetus for restoring and maintaining soil health. An enthusiasm has been generated and awareness is being created by mass awareness activities on World Soil Day (December 5) every year. Soil health cards are being distributed, and location and crop-specific sustainable soil management practices are being popularized among the farmers for maintenance of soil health. Integration of Governmental policies, research institutes and extension agencies are needed for successful implementation of the soil health restoration and preservation initiatives.

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INTEGRATED FARMING SYSTEMS: A NEW APPROACH

N. Ravisankar and A.S. Panwar

Holistic and innovative approaches of Integrated Farming Systems (IFS) provides ample opportunities for the farmers especially small land holders to produce the multiple commodities for the household & market, on-farm generation of employment, balanced nutrition for the family, round the year income & employment, reduction of weather and market related risks. It also reduces the market dependency of farms for inputs.

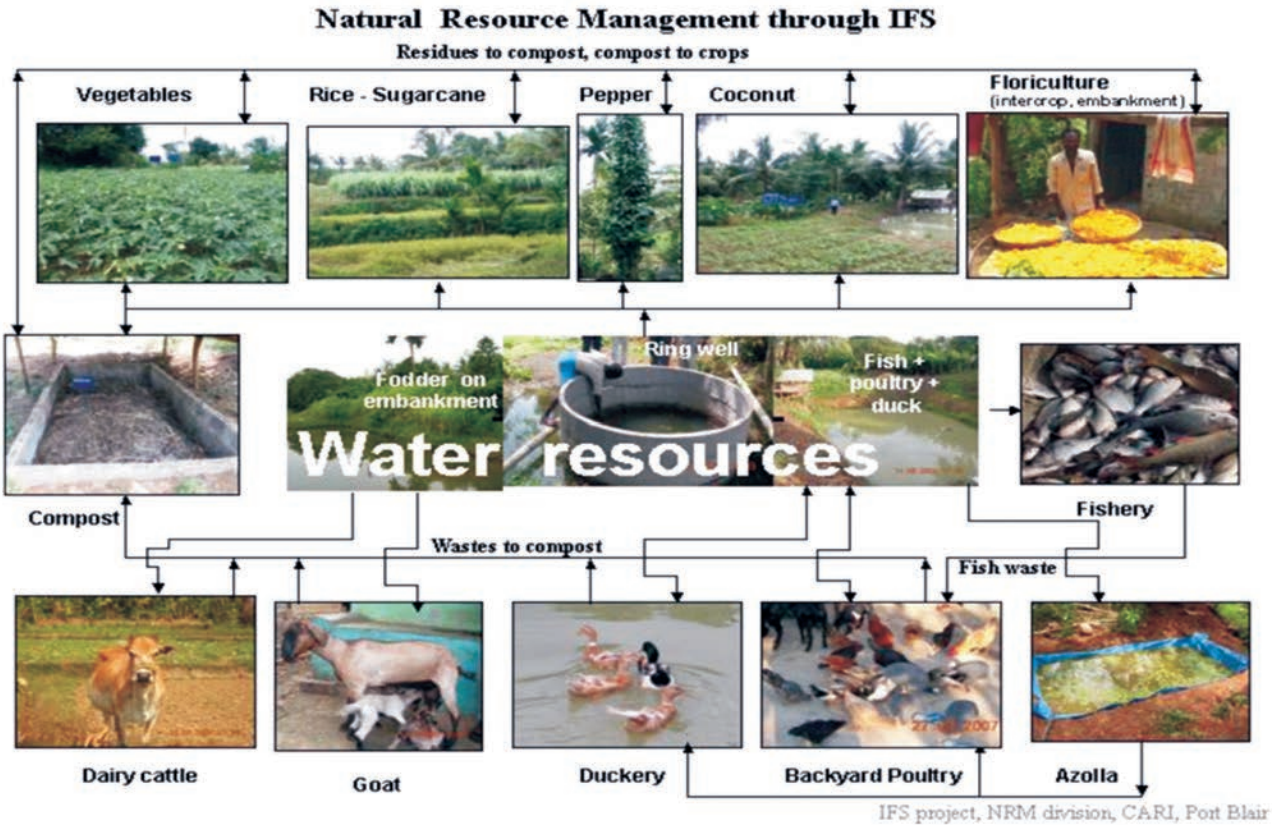
Small farm agriculture (up to 2 ha) holds the key to ensuring food and nutritional security of India and nurturing them in right perspective with sustainable farming systems are essential for rural prosperity. These farms are characterized by low income (at all-India level, average monthly income per agricultural household during the agricultural year July 2012- June 2013 was estimated as Rs.6426), leading to smaller re-investment in farm development, seasonal employment, higher dependency for market inputs especially for seeds, fertilizers, pesticides and large machineries like mechanical harvesters, distress sale due to low storage capacity & market price. These farms are also more vulnerable to weather vagaries like flood, drought and other natural calamities and farming remains risky compared to large size farms. To change the status of these farmer categories, it is essential to enhance the income and employment opportunities within their household (land less) and farm (marginal & small) by promotion and adoption of efficient secondary/ tertiary enterprises like animal husbandry, horticulture (vegetables/ fruits/ flowers/ medicinal and aromatic plants), apiary, mushroom cultivation, fisheries etc.

What is IFS approach?

"A judicious mix of two or more components using cardinal principles of minimum competition and maximum complementarity with advanced agronomic management tools aiming for sustainable and environment friendly improvement of farm income, family nutrition and ecosystem services". Preservation of bio-diversity, diversification of cropping/farming system and maximum recycling is the base for success of the farming systems approach (Singh and Ravisankar, 2015).

The essential components of integrated farming systems are keeping the soil alive and provide sustainable support to farm and family through effective management of natural resources. They are as follows

- **Enrichment of soil:** Need based use of chemicals, use of crop residue as mulch, use of organic and biological fertilizers, adopt crop rotation and multiple cropping, avoid excessive tilling and keep soil covered with green cover or biological mulch.
- **Management of temperature:** Keep soil covered, plant trees, orchards and bushes on bund
- **Conservation of soil and rain water:** Create percolation tanks, maintain contour bunds in sloppy land & adopt contour row cultivation, Create farm ponds, maintain low height plantation on bunds.
- **Harvesting of sun energy:** Maintain green stand throughout the year through combination of different cropping systems and other plantations.
- **Self-reliance in inputs:** Develop own seed to the maximum extend, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts
- **Maintenance of life forms:** Develop habitat for sustenance of life forms, minimal use of permitted chemicals and create enough diversity.
- **Integration of animals:** Animals are important components of farm management and not



only provide animal products but also provide enough dung and urine for use in soil.

- **Use of renewable energy:** Use solar energy, bio-gas and other eco-friendly machines.
- **Recycling:** On-farm recycling of wastes as input to other enterprises
- **Meeting the basic needs of family:** Create and integrate components for meeting the family needs such as food, fodder, feed, fibre, fuel and fertilizer (6Fs) to maximum extent with in the farm boundaries in a sustainable way.
- **Round the year income for meeting social needs:** Create marketable surplus and integrateallied activities such as bee keeping, mushroom production, on-farm processing & value addition, tailoring, carpeting etc to get round the year income for the family to meet social needs such as education and family functions besides health.

The Food and Agriculture Organization[3] (FAO) classified the integrated farming systems as natural and intentional integrated systems. The natural integrated systems are one which is practiced by farmers where in linkage among components / enterprises of the systems often do not exist. The intentional integrated systems are one which addresses the multiple objectives of increased production, profit, cost reduction through recycling, family nutrition, sustainability, ecological security, employment generation, economic efficiency and social equity.

Holistic and Innovative approaches of Farming System:

Two approaches namely holistic and innovative are used in farming systems. The holistic approach involves identification of constraints using Participatory Rural Appraisal (PRA) and other techniques and addressing them through scientific approach for improving the productivity, income, cost reduction, environmental benefits etc from the existing components of a farming system. The other approach, i.e innovative approach encompasses the holistic improvement of existing systems besides diversification of existing components by way of introducing new components/enterprises/modules in to the system. In this, diversification aims to provide the alternative avenues available for enhancing the income in a sustainable way and it is good alternative to improve system yield with enhanced profitability. Modules comprising of cropping system diversification

(most efficient cropping systems keeping in view of the farmers resources, perception, willingness, market and requirement of other components in the system), livestock diversification (introduction of location specific low cost livestock components viz., backyard poultry, duckery, piggery, goat etc), product diversification (both physical change of product and process of production like from inorganic to organic production) and capacity building (training of farm households on farming systems including post-harvest and value addition and assessing its impact) can be implemented to get desired changes in the farm households.

Need for Farming System Diversification:

Spatial and temporal expansion in small farms is possible by integrating appropriate farming system components requiring less space and time and it can ensure diversified options of food and nutrition to the rural mass besides providing insulation against market price fluctuations, weather vagaries, reducing dependency on market for inputs, ensuring periodic income and employment to the farmers. Analysis of farming systems of marginal households across the different zones indicates though, the mean holding and family size of marginal households having up to 2 components and more than 2 components remains almost same (0.82 ha with 5 no's in 2 component category and 0.84 ha with 5 no's in > 2 component category), the mean income level is much higher (Rs 1.61lakhs)inthefarmshavingmorethan2components (e.g. crop+dairy+goat; crop+dairy+goat+poultry; crop+dairy+goat+poultry+fish etc.) than with farms having 2 or less components (Rs 0.57 lakhs only in crop alone, dairy alone, crop + dairy, crop + goat etc.). Diversification of one and two component systems (crop alone, dairy alone, crop+dairy, crop+pig, crop+poultry, crop+fisheries, crop+horticulture, crop+goat, dairy+goat) in the 59 % marginal household is essential to augment the per capita income.

Multiple Benefits of Integrated Farming System Approach:

Productivity enhancement: Farming system provides an opportunity to increase the yield and economics/unit time by virtue of intensification of crop and allied enterprises. Many studies from India have shown significant improvement in livelihood of small and marginal farmers through IFS approaches. The results of study conducted at Andaman and Nicobar Islands reveals that integration of crop with fish + poultry and cattle resulted in higher productivity than cropping alone. The animal component yielded 25 t of manure, each cow yielded 5250 litres / lactation, each bird laid about 150 eggs / bird / annum apart from the manure for fish pond which are additional contributors for the system productivity. Though fish yield was recorded only 60 kg / year from 0.036 ha, it ensured the supplementation of protein for the household.

Income enhancement: Integrated farming system as a whole provides opportunity to make use of recyclable waste material of one component as input for other at the least or no cost at farm level. Thus there is a possibility for reduction of production cost of enterprises from one to another and finally the return per rupee invested is very much enhanced. Recycling also reduces market dependency for inputs. The homestead model developed for 0.2 ha area under Kerala situation comprising of cropping systems (80 % area)+ dairy (1cow+1 buffalo)+duck (150 nos.) + fishery (20 % area) + vermicompost (1 % area) gave net return of Rs 0.60 lakhs in 0.20 ha area/year.

On-farm employment generation: Integration of other components with cropping increases the labour requirement and thus provides scope to employ family labour round the year without much lean and peak demand for labour. The employment generation can be increased to 221mandays/ha/year by way of integrating fish cum poultry and cattle rearing with cropping compared with cropping alone

Utilization of homestead area for vegetable production at 24 South Paragnas (West Bengal)

(58 mandays /ha/year). An additional employment of 15 man days from poultry and 15 mandays from fishery could be generated by diversifying the existing farming systems.Floriculture, bee keeping, processing also gives additional employment for the family.

Meeting the household food and nutrition and reducing market dependency: The present average monthly consumption expenditure per agricultural household ranges from Rs 5108 (<0.01 ha) to 6457 (1.01-2.00 ha).

Every farm household should be self-reliant in 6F's (Food, Fodder, Feed, Fuel, Fibre and Fertilizer). Diversified farming systems having cropping systems + livestock + fisheries + horticulture + boundary plantations can produce sufficient quantity of cereals, pulses, oilseeds, vegetables, fruits, milk and fish per annum as per ICMR standards to meet the nutritional requirement with in the farm. Apart from this, these type models also ensures sufficient availability of green fodder throughout the year thus improving the health of the animals also. Due to the on-farm production of multiple commodities with in the farm, market dependency is reduced besides meeting the nutrition which results in additional saving for the family.

Soil health improvement throughrecycling: Residue recycling is an integral part of the farming systems which is one of the most promising approaches of recycling agriculture residues for sustainable development, the adoption of

Boundary plantation of Ardu in farming system model at SK Nagar (Gujarat) (Source: AICRP-IFS centre, SDAU, SK Nagar, Gujarat)

Small scale mushroom production for diet diversification

which paves way for higher input use efficiency. Considerable quantity of nitrogen, phosphorus and potassium besides micro nutrients can be generated within the farm through recycling.

Multiple uses of resources: Multiple use of the resources such as land and water are essential to enhance the system productivity and profitability. Multiple uses of water for household (washing), irrigation, dairy, poultry, duckery and fish rearing is the best example. Small and medium size water bodies can be brought under multi-component production systems using in and around areas which will ultimately lead to improved income, nutrition and livelihood of small farm holdings. Integration of proper waste resource recycling in the small and marginal farmers holding will pave way for reduced fertilizer usage which in turn will have positive effect. For example, the egg laying khaki cambell duck produces more than 60 kg of manure per bird on wet basis. The duck droppings provide essential

Pond based integrated farming systems involving crops on embankments + poultry + duckery + fishery

nutrients such as carbon, nitrogen and phosphorus in the aquatic environment which stimulates natural food for fish. Besides this, 10 to 20 % of duck feed (23 to 30 g/day) are lost in the normal circumstances of feeding ducks. In the farming systems mode, feed given to ducks were also partially utilized by fish while washing the shed.

Risk reduction: IFSapproach also helps to reduce the risks involved in farming especially due to market price crash as well as natural calamities. Due to the presence of multiple components at a time, price crash of one or two crop produce may not affect the economy of the household. Further, it also protects against weather related risks. For example, Phailin, a monster cyclone had hit Odisha during October, 2013. It was packed with heavy rains and destructive winds. Being a coastal district, Kendrapara was also affected by the cyclonic storm. Generally, the district gets an average rainfall of 183.7 mm during October. But during the said year, the district received 95.67 mm on 13 October, 2013 and again 163.67 mm on 25 October 13 and 51.44 mm on 26 October, 2013.The paddy crop that were at either at flowering stage or in low lying tracts were affected. In the households practicing the farming system approach comprising of advanced agronomic management tools coupled with livestock, jute, fishery, theper cent loss was ranging from 8 to 28% only while the farmers who have not had the components of farming systems had complete loss of crop.

IFS approach based Production Systems:

Under AICRP on Integrated Farming Systems and Network Project on Organic Farming, IFS approach is used in on-station and on-farm research programmes. The models developed at on-station (research farm) and on-farm (farmer participatory) for different states demonstrates that IFS approach can empower the marginal and small households by generating sustainable livelihoods.

Family Farming Model for nutrition & round the year income : A one hectare area with 5 member family farming model comprising of diversified cropping systems (0.78 ha) + horticulture (0.14 ha)+ dairy (2 cows) + goat (11 no's) + fish (0.1 ha) + ducks (25 no's) + boundary plantation (subabul, 225 plants &Moringa, 50 plants) developed for the South Bihar Alluvial Plain zone in Middle Gangetic Plains region provides round the year income which ranges between Rs 13,160 (September) to 51,950 (April)/ha/ month (Fig 1). The diversified cropping systems [rice - wheat - greengram (grain +residue incorporation), rice - maize + potato - cowpea (fodder), rice - mustard - maize (grain) + cowpea (fodder), sorghum + rice bean – berseem /oat- maize + cowpea (fodder) and seasonal vegetables (brinjal, tomato, cauliflower, cabbage, vegetable pea, okra, lettuce) grown in 0.78 ha area could meet the full family requirement of cereals, pulses, oilseeds, fruits (guava & papaya) and vegetables and livestock requirement of green and dry fodder per annum. The model also meets the milk, egg and fish requirement of 550 litres, 900 no's and 120 kg respectively. Besides meeting the family and livestock requirement, the model produced marketable surplus of 4810, 986 and 35 kg of cereals, vegetables and fruits with surplus of milk, egg and fish of 4243 litres, 950 numbers & 124 kg respectively which resulted in round the year income. The model also ensured fuel wood availability of 4 t/year for the family and could add 4 t of enriched vermicompost and 2.3 t of manure to improve the soil health. A total net return of Rs 3.14 lakhs which is 3.2 times higher than existing pre-dominant crop+dairy system of the zone was observed.

Organic Farming System model for improving productivity and livelihood of tribal areas: Promotion of organic farming in niche locations especially low nutrient consuming tribal areas have great scope to enhance soil and crop productivity along with

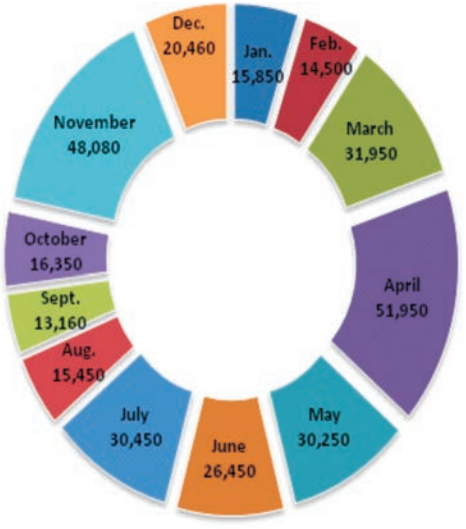


Fig 1. Round the year net income (Rs/ha) for the family from crop (0.78 ha) + horticulture (0.14 ha) + dairy (2 cows) + goat (11 no's) + fish (0.1 ha) + ducks (25 no's) + boundary plantation (subabul&moringa) farming system model at Sabour (Bihar)

livelihood for the people. A 0.43 ha organic farming system model comprising of cereals viz. rice and maize, pulses and oilseeds viz. soybean, lentil and pea, vegetable crops viz.french bean, tomato, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chilli, coriander, fodder, fruits viz. Assam lemon and papaya, dairy (1 cow + 1 calf) and a farm pond of 0.04 ha with depth of 1.5 m for life saving irrigation and fisheries developed at Umiam under Network Project on Organic Farming (NPOF) could able to meet the nutrient requirement of all the crops.

Land configuration based farming systems: Raised and Sunken Bed (RSB) system also known as Broad Bed and Furrow (BBF) system in Andaman and Nicobar Islands can serve as climate proof technology in the rice based farming systems especially in the coastal areas where in inundation of rice fields are expected due to the sea level rise. It is a technique of land manipulation to grow vegetables, fish and fodder right in the midst of rice fields. The technology involves making of broad bed and furrow alternatively. In the BBF, depressed area is used for rice cultivation and the raised broad bed area, which is above the water level of the paddy field, are used for cultivating of seasonal vegetable or fodder crop during monsoon season. Because of the long term sustainability, easy to adopt and efficient utilization of land area, this techniques is having lot of potential especially for the coastal areas. This type of system gives scope for producing multiple commodities. These types of models have been tested in West Bengal also and found successful.

Organic Farming System model (Source: ICAR-RC-NEH, Umiam, Meghalaya)

Land configuration based farming systems for water logged areas to produce rice, vegetables, fish and fodder together

Farmer participatory refinement and improvement of farming systems: Innovative approach of farming systems employed for enhancing the income of marginal households indicates addition of components especially small ruminant (goat) and poultry to the existing system improves the income and employment considerably. The additional income and employment generated will help to increase the livelihood status of marginal farmers.

Comparative performance of Systems:

Comparative performance of mono-cropping with that of farming systems evaluated in Andaman and Nicobar Islands is given in Fig 2 clearly indicates integrated farming systems and land shaping based interventions (Broad Bed and Furrow system) are much better in terms of net returns and B:C ratio.

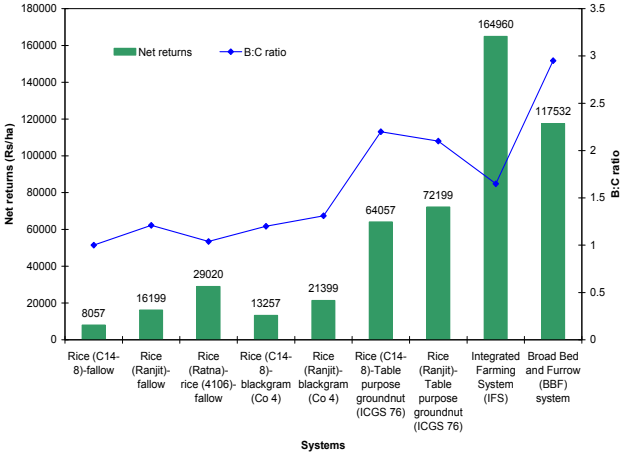


Fig 2.Comparative performance of various systems in terms of net return and B:C ratio in A&N Islands

Way Forward:

Diversification of existing farming systems with change in crop (s), cropping systems, addition and improvement of livestock components, inclusion of horticulture, kitchen garden, primary and secondary processing, boundary plantations are essential to improve the on-farm income of small holders in India. This also paves way for meeting the household demand of balanced food, improved recycling of nutrients and water besides increasing the on-farm employment for family. Diversification of existing farming systems clearly demonstrates the advantages. It has been observed that productivity and profitability gain of 2 times is possible with improved systems. Further, resource saving of 40 to 50 % can also be ensured besides providing round the year income. The following steps are essentially required for up-scaling of science based integrated farming systems.

1. Focus should be given mainly on market-oriented diversification and livelihood improvement by considering the options of alternative cropping, novel livestock systems and adding of value to primary (raw) products.
2. Initiation of National Mission on Integrated Farming Systems by converging the schemes of crops, horticulture, livestock and fisheries to give impetus in promoting integrated farming systems approach.
3. Large scale spread of IFS concepts through front line demonstrations in farming systems perspective will help to improve the households in holistic way.
4. There is a need to move from soil health card (SHC) to Farm or Farming System health card comprising the health components of soil, plant, livestock and human at household level.
5. Capacity building of stake holders (farmers & extension functionaries) including skill development supplemented with physical and technology inputs.
6. Crop and forage rotation: includes crops, forages and high value crop options including vegetables, fruit trees, medicinal and aromatic plants, orchards.
7. Introduction of farmer perception based location specific livestock components especially small ruminants such as goats, sheep & poultry, pig with component technologies
8. Improving/ ensuring monthly income flows through product diversification (both in terms of process and physical change of products)
9. Integration of less land requiring activities such as mushroom farming, bee keeping etc in the existing systems.

Footnotes:

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TECHNOLOGICAL INNOVATIONS FOR AGRICULTURE

Dr Y S Shivay and Dr Teekam Singh

Recently, there have been enormous innovations in agricultural production, not only improving productivity, but just as importantly, safeguarding the environment. Several systems-research tools relating to information technology have become available for fertilizer management. With the introduction of geographic information systems (GIS), global positioning systems (GPS) and remote sensing (RS), farmers can now refine nutrient recommendation and water management models to the site-specific conditions of each field.

The global population is projected to be nine billion by 2050 which need to be almost doubled to meet the global food and fibre demand. Doubling food and fibre production and sustaining the production at that level are the major challenges. Intensification of agriculture using high-yielding crop varieties, fertilization, irrigation and crop protection remain the most likely options to combat these challenges. In the past, the emphasis was on improving potential yield, but today, there is increased emphasis on improving the nutritional value of foods (e.g., protein content in grain, essential amino acids, content of other minerals, etc.), reducing post-harvest losses, improving stress tolerance and reducing reliance on chemical crop protection products. Recently, there have been enormous innovations in agricultural production, not only improving productivity, but just as importantly, safeguarding the environment. Several systems-research tools relating to information technology have become available for fertilizer management. With the introduction of geographic information systems (GIS), global positioning systems (GPS) and remote sensing (RS), farmers can now refine nutrient recommendation and water management models to the site-specific conditions of each field.

Technological Innovations for Water Management:

Water is the most critical natural resource for human survival and sustainable development as its availability is decreasing day by day. The total projected demand of water for irrigation sector will be more than the present level so there will be three major challenges viz. (i) "more crop per drop of water" by efficient and productive use of available water resources in irrigated areas, (ii) increased productivity of sub-productive challenged ecosystems, i.e., rainfed and waterlogged areas, and (iii) making use of grey water (waste water) for agriculture production. It is possible only through efficient irrigation management and drainage network development with combined approach of engineering, crop selection, crop management and aquaculture practices in location specific areas. There are following practices which will save precious water resources and enhance the productivity.

Deficit Irrigation Supplies: Under limited water availability condition, irrigation strategies based on meeting the partial crop water requirements should be adopted for more effective and rational use of water. The adoption of deficit irrigation such as regulated deficit irrigation and controlled late-season deficit irrigation are becoming an accepted strategy for water conservation and to reduce the amount of water used for crop production.

Reducing Crop Water Demand: The reduction in crop water demand can be done by promoting innovative techniques and uses such as conjunctive use of surface and groundwater, promoting precision irrigation and water-saving crop-production technologies, rationalization of subsidizing electricity

Bicycle Weeder

for irrigation including system of pricing and incentives for groundwater use, use of hydrogel, appropriate policies regulatory mechanism and governance.

Pressurized Irrigation System: The water-use efficiency under conventional flood irrigation, which is predominantly practiced in Indian agriculture, is very low due to substantial conveyance and distribution losses. Pressurized irrigation system, which includes both drip and sprinkler irrigation is proved to be an efficient method in saving water and increasing water-use efficiency as compared to the conventional surface method of irrigation, where water-use efficiency is only about 35– 40 per cent. The field experiments conducted across the country under All India Coordinated Research Project on Water Management have indicated that the saving of irrigation water depending on the soil type ranges from 30–60 per cent and 1.5 to 2.6 times area can be brought under irrigation. This indicated that the drip irrigation was more effective in the soil with poor water retention and higher drainage rate. Drip irrigation along with fertilizer (fertigation) reduces the wastage of water and chemical fertilizers, and subsequently, optimizes the nutrient use by applying them at proper place and time, which finally increases the water and nutrient-use efficiency.

Subsurface Drip Irrigation: Subsurface drip is a highly efficient irrigation system that uses buried drip tubes or drip tape to meet crop water needs. Since the water is applied below the soil surface (as opposed to surface irrigation or traditional drip irrigation), the effects of surface infiltration, such as crusting, saturated condition of ponding water, and water losses via evaporation and surface runoff (including soil erosion) are eliminated. With an appropriately sized and well-maintained subsurface drip irrigation system, water application is highly efficient and uniform. Wetting occurs around the tube and water moves out in all directions. Moreover, water is applied directly to the root zone of the crop as opposed to the soil surface where most weed seeds hibernate. As a result, germination of annual weed is reduced. This lowers the pressure on valuable crops. Furthermore, some crops may benefit from the additional heat provided by dry surface conditions, and produce more biomass. When managed properly, the application of fertiliser can be optimised. Fields can still be worked when irrigation systems are installed.

Resource Conservation Technologies: In the post-green revolution era, the issues of conservation have assumed greater importance in view of widespread resource degradation problems and the need to reduce production costs, increase profitability and make agriculture more competitive. The new challenges demand efficient resource use and conservation should receive high priority to ensure that earlier gains are sustained and further enhanced to meet the emerging needs. There are many resource conservation technologies like zero tillage, bed planting etc. which have shown promise

Table 1: *In-situ* soil-and water-conservation measures for various rainfall zones

Seasonal rainfall (mm)			
<500	500–700	750–1,000	>1,000
• Contour cultivation with conservation furrows	• Contour cultivation with conservation furrows	• Broad bed & furrow (Vertisol)	• Broad bed & furrow (Vertisol)
• Ridging	• Ridging	• Sowing across slopes	• Field bunds
• Sowing across slopes	• Sowing across slopes	• Tillage	• Vegetative bunds
• Mulching	• Scoops	• Lock and spill drains	• Graded bunds
• Scoops	• Tide ridges	• Small basins	• Level terraces
• Tied ridges	• Mulching	• Field bunds	
• Off-season tillage	• Zingg terrace	• Vegetative bunds	
• Inter-row water harvesting	• Off-season tillage	• Graded bunds	
• Small basins	• Broad bed and furrow	• Zingg terrace	
• Contour bunds	•Inter-row water harvesting		
• Field bunds	• Small basins		
	•Modified contour bunds		
	• Field bunds		

in enhancing water productivity. No tillage wheat after harvesting of rice is the most effective RCT in the Indo-Gangetic plains in India, and saves irrigation water by about 25 per cent due to faster flow across the non-tilled fields and less soil water evaporation loss compared to tilled soil.

On-Farm Reservoir (OFR): Rainwater harvesting, and efficient water use are inevitable options to sustain rainfed agriculture in future. Different states have initiated special programmes for OFR to ensure the sustainability and to improve livelihoods of people. Despite these experiences, the adoption of OFR at the individual farm level has been very low, particularly for drought proofing through life saving irrigation of rainy (*kharif*) season crops. Renovation of old and silted community ponds for water conservation as well as groundwater recharge and monitoring of the effectiveness of OFR constructed under various watershed development programmes will be helpful to strengthen rainwater conservation in the country.

Tank-cum-well system: A tank-cum-well system was conceptualized for micro-level water resources development on watershed basis for plateau areas with slope of 2 to 5%. This involves construction of tanks and wells in series along the drainage line in a watershed. The excess runoff water is stored in the tank and this can be used for meeting the irrigation requirement in the post-monsoon season and supplemental irrigation requirement in the monsoon season.

Other soil and water conservation techniques: Some of the conservation practices listed above are temporary in nature and can be implemented by the farmers every year before the onset of monsoon, cost being nominal. Few measures such as contour and graded bunding, continuous, contour or staggered trenches, water harvesting structures and drainage line treatment are covered under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).

Agro-forestry systems:

Substantial number of tree-based systems were developed based on rigorous experimentation after the initiation of systematic research at the National Research Centre for Agroforestry, Jhansi and at All India Coordinated Research Project on Dryland Agriculture (AICRPDA), Hyderabad. The experimental results were also field tested and the proven systems are being scaled up through developmental programmes such as Integrated Watershed Development Programme, Mahatma Gandhi National Rural Employment Generation Programme, National Horticulture Mission, etc. Owing to the multifarious advantages associated with the tree systems, the acceptance of these systems is observed and the area under these systems is gradually expanding. The total area under agroforestry in India is reported to be about 25.32 million ha out of which 7 million ha in irrigated regions and 13 million ha in rainfed regions.

Integrated Farming Systems:

One of the best approach is building farm resilience through spreading risks and creating buffers, i.e. not putting 'all eggs in one basket'. The farming systems approach is considered as important and relevant, especially for the small and marginal farmers as location-specific IFS will be more resilient and adaptive to climate variability. Integration of livestock rearing with crop production gave higher economic returns compared to crop production alone for both marginal and small farmers. On-station and on-farm research in different regions of the country has resulted in identification of many sustainable and profitable IFS models for rainfed areas. In general, in regions with rainfall of 500 to 700 mm, the farming systems should be based on livestock with promotion of low-water requiring grasses, trees and bushes to meet fodder, fuel and timber requirements of the farmers. In 700 to 1,100 mm rainfall regions, crops, horticulture and livestock-based farming systems can be adopted depending on the soil type and the marketability factors. Runoff harvesting is a major component in this region in the watershed-based farming system. In areas where the rainfall is more than 1,100 mm, IFS module integrating paddy with fisheries is ideal. Under irrigated areas, the following IFS models are most suitable to maintain soil fertility and productivity.

- Intensification and diversification of crop component of farming system.
- Diversification of other components of farming system for higher income.

Small-farm Mechanization:

Timeliness of operations has a significant role for increased germination and required plant population, good crop stand and sustained

productivity of crops. Large areas remain fallow or planted late due to poor access to farm machinery which results in low crop productivity. Hence, improved access to the farm machinery for sowing, harvesting etc. and other operations is an important adaptation strategy to deal with climatic variability such as late onset of monsoon, mid-season and terminal droughts and contributes to timely sowing of post-rainy crops. Many efficient low-cost farm implements were designed for various operations. This reduced 20–59 per cent of the operation cost, saved 45–64 per cent in operation time, saved 31–38% seed and fertilizer, and increased productivity of dryland crops by 18–53%. In the recent past, custom-hiring of agricultural machinery is an appropriate institutional arrangement which can promote mechanization of agricultural operations on small farms. For the first time, a systematic attempt has been made under the National Innovations on Climate Resilient Agriculture (NICRA) to set up 1 custom-hiring centre each at the 130 climatically vulnerable villages across the country.

Precise Nutrient Management:

Substantial variations in soil properties and nutrient availability exist across the fields. Thus, the ability to apply site-specific nutrient to match spatially and temporally variable conditions can increase application efficiencies, reduce environmental impacts, while improving yields. Precision farming technologies have now been developed to spatially vary nutrients within a field based on various information sources (soil properties maps, terrain attributes, remote sensing, yield maps, etc.). Precision agriculture involves the integration of the modern technologies (including GIS, GPS and RS) to allow farm producers to manage within field variability to maximize the benefit-cost ratio. Variable rate technology (VRT) available with farm implements, such as fertilizer applicators and yield monitors, has evolved rapidly and has fostered the growth of precision agriculture. For example, chlorophyll meters, a recent development in agriculture, are used for corrective nitrogen (N) management where N fertilizers are applied based only on crop needs to ensure increases in fertilizer use efficiency and return on fertilizer investment.The following nutrient management strategies are the most efficient methods to enhanced nutrient use efficiency.

- Optimal use of on-farm nutrient input sources such as crop residues.
- Application of NPK fertilizers is adjusted to the location and time specific as per the needs of the crop plant.
- Leaf colour chart (LCC), Chlorophyll meters and Green-seeker based nitrogen management which ensures that nitrogen is applied at the right time and right amount needed by the crop plants which reduces wastage of N-fertilizer.
- Use of nitrogen omission plots techniques to ensure that phosphorous and potassium is applied in the ratio required by the crop.
- Local randomization for fertilizer application of zinc, sulphur and micronutrients are followed.
- Selection of most efficient and economic combination of available fertilizer sources.
- Integration with other integrated crop management (ICM) practices such as the use of quality seeds, optimum plant population, IPM practices and efficient water management.
- Use of software based skills like- Nutrient Experts, Crop manager, Geographical Information System (GIS) and Global Positioning System (GPS) in monitoring and application of nutrients.

Conservation Agriculture (CA):

Conservation agriculture refers to the system of raising crops without tilling the soil while retaining crop residues on the soil surface. Land preparation through precision land levelling and bed and furrow configuration for planting crops further enables improved resource management. Conservation agriculture permits management of soils for agricultural production without excessively disturbing the soil, while protecting it from the processes that contribute to degradation, e.g. erosion, compaction, aggregate breakdown, loss in organic matter, leaching of nutrients etc. Thus, CA is a concept for optimizing crop yield, economics and environmental benefits. Three key features of conservation agriculture are: i) minimum soil disturbance by adopting no-tillage and reduced traffic for agricultural operations, ii) maximum soil cover by leaving and managing the crop residues on the soil surface, as cover/mulch and iii) adopt spatial and temporal crop sequencing/crop rotation to derive maximum benefits from inputs and

minimize adverse environmental impacts. The main advantages of CA are reduction in cost of production, reduced incidence of weeds, saving in water and nutrients, increased yields, environmental benefits, crop diversification opportunities, improvement in resource-use efficiency, etc. The CA practices include laser land levelling, conservation tillage, bed planting, direct-seeded rice, brown manuring with Sesbania, crop residue management and crop diversification.

Climate Smart Cropping:

In changing climate scenario, developing cultivars resistant to climate change may become important adaptive mechanism for maximizing resource-use efficiency. For example, crop varieties that are resistant to lodging (e.g., short rice cultivars), may withstand strong winds during the sensitive stage of crop growth, are viable alternative. Similarly, change of planting dates to minimize the effect of temperature increase and reducing spikelet sterility can be used to enhance yield stability, by avoiding the flowering period to coincide with the hottest period. Such adaptation measures like change in crop calendar to reduce the negative effects of increased climatic variability in arid and semi-arid tropics proved advantageous to avoid extreme weather events (e.g. typhoons and storms) during the growing season.

Integrated Crop Management (ICM): ICM suggests the use of good agricultural practices (GAP) which is an alternative system of crop production, which conserves and enhances natural resources while producing quality food on an economically viable and sustainable foundation. It combines the best of traditional methods with appropriate modern technology for balancing the economic production of crops with positive environmental management. ICM is particularly beneficial for small and marginal farmers because it aims to minimize dependence on purchased inputs while utilizing on-farm resources.

Innovations in Agriculture to improve Nutrition:

Recently,significant efforts have been made to identify the practices that can improve both food and nutritional security. Many interventions in agriculture have been designed to have an impact on nutritional outcomes. Progress has been made to enhance protein, vitamin A, iron, and zinc nutrients in food through biofortification. Scientific evidence shows this is technically feasible without compromising agronomic productivity.

Biofortified Rice: The ICAR-National Rice Research Institute, Cuttack has developed a high protein rice variety CR Dhan 310 with an average 10.3% protein in milled rice, by improving the popular high yielding variety Naveen. Popular varieties of rice usually contain about 7% protein, but the variety developed by NRRI contains 11 to 12%.The protein-rich rice makes the cereal more nutritious and help in solving the problem of malnutrition to a great extent. Rice biofortified with zinc DRR Dhan 45 was released by ICAR-Indian Institute of Rice Research to farmers containing zinc 22 ppm in milled rice. It could contribute significantly to meeting protein and zinc requirement where the poor consume substantial amounts of rice daily and often sacrifice the consumption of other more nutrient-rich foods.

Biofortified Maize: Quality protein maize and maize with high beta-carotene traits have been shown to be good supplement of protein and vitamin A.

Biofortified Pearl-Millet: Pearl-millet has been biofortified to improve its iron and zinc nutrients to target hidden hunger of undernourished and malnourished people, especially the poor who are not able to meet micronutrient requirements from the food they eat. Biofortified pearl millet, with higher iron and zinc content, is already being grown widely in Maharashtra.

Iron Rich Bean: High-iron bean varieties having a higher iron content than traditional varieties, preliminary evidence shows that biofortified beans can improve iron status in women. Acceptability and uptake by farmers exposed to the new varieties have been good.

Vitamin A rich Sweet Potato: Orange flesh sweet potato contains elevated levels of beta-carotene which is building block for vitamin A. Tests show that 75 per cent of the beta-carotene is retained in the sweet potato even after boiling in preparation for a meal.

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VALUE ADDITION THROUGH FOOD PROCESSING

N. Chandrasekhara Rao

Our country reached the status of 'lower middle-income' among the countries in the world and therefore, the share of processed food in the food basket of our population is bound to go up. Diversification of diets, globalisation of diets, urbanisation, rising share of women in work force, nuclear families juxtaposed with supply-side factors like changing policy perspectives including digitalisation and export opportunities propel growth of food processing sector in India.

Food processing is where agriculture meets industry. In the increasingly rising share of non-agriculture activities of contemporary rural India, processing industries can play a vital role in achieving the avowed objective of 'doubling farm income'. The consumption of processed foods is synchronous with the rise in incomes as income elasticity of these foods is very high. It is worth noting that our country reached the status of 'lower middle-income' among the countries in the world and therefore, the share of processed food in the food basket of our population is bound to go up. Diversification of diets, globalisation of diets, urbanisation, rising share of women in work force, nuclear families juxtaposed with supply-side factors like changing policy perspectives including digitalisation and export opportunities propel growth of food processing sector in India.

Innovations in midstream of the value chain can have significant impacts on agricultural performance, and might potentially benefit producers and consumers alike, they have received less attention in the literature and policy discussions on agriculture (Rao et al., 2017). India is no exception to this general trend and in fact, the situation is rather grim with perverse incentive structure. Processed foods were considered rich people food for a long time and suffered heavy taxation, riddled with so many taxes including steep taxes for packaged products. This has been gradually changed with successive reduction in excise duties and state taxes to benefit farmers (Rao, 2009; Rao and Dasgupta, 2009). Concept of cold chain was non-existent until the late nineties and post-harvest losses were very high with poor infrastructure. Transport costs are relatively high leading scholars to conclude that importing from other countries is cheaper than transporting from one part of the country to another. Standards and protocols for food safety and laws for food safety were absent until recently (Dev and Rao, 2005).

The food policy in India has mainly focused on increasing the production with a view to substitute imports which became a common feature during the immediate post-independence years until the eighties. Therefore, the issue of processing the food did not arise as a policy question until the eighties. On the other hand, the industrial policy since the second five year plan concentrated on the heavy industries required to build up the necessary infrastructure for the industrial development. Though there were some food processing industries in the organized sector, they were part of small and village industries and have no separate identity.

The consistent rise in per capita incomes and the shifting of the incomes after 1981 to a higher growth path led to the rise in middle classes, who have the purchasing power to buy the processed foods. The growth of manufacturing industry also necessitated encouraging food processing sector. The central government, in view of these changes, has

started attempts to invigorate the sector by forming a separate ministry for food processing industries in 1988. This is to bring out the fact that India is a late entrant into the food processing sector and international market. Though some measures are initiated after the formation of the ministry for the speedy development of the sector, it is only after the country embarked on full scale liberalization in 1991 that the food processing sector got real impetus. Several policy initiatives for freeing the licensing system, foreign investment etc., are taken during this time for encouraging the sector.

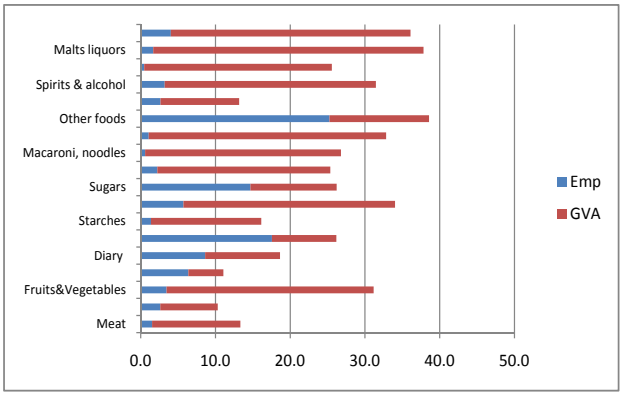
The entire sector was deregulated and no license is required except in case of items reserved for small-scale sector and alcoholic beverages. Automatic approval for foreign investment up to 100 per cent equity in food processing industries is available except in a few cases. Hundred per cent export oriented units are permitted to import raw material and capital goods free of duty. The excise duty on food processing items was removed in 1991 and again imposed in 1997. This excise duty of 16 per cent was again removed in 2001. The concept of food parks, agri-export zones, mega food parks, cold chains and human resource development have been initiated besides several incentive schemes during this period. The central government has released a food processing policy in 2001 and again in 2005. The new agro-processing industries set up to process, preserve and package fruits and vegetables are allowed under Income tax Act, a deduction of 100 per cent for five years and 25 per cent of profits for the next five years since 2004-05. However, the role of state is considered to be vital. Hence, the centre has urged the state governments to allow exemption for this sector from sales tax and other local taxes. Several state governments have also announced food processing policies. Most recently, centre has allowed 100% FDI in trading of food products including through e-commerce to boost growth of the sector. 42 food parks sanctioned with a total investment of 2100 crores and expected a total investment of 4500 crores and additional investment of around the same amount for setting up of processing units.

Table 1: Salient Features of Organised Food Processing Industries in 2013-14

NIC, 2008 4-digit	Type of processing	No.of factories	No.of persons	Total output	Fixed capital	GVA	FC per factory	GVA %	Emp. Per crore
1010	Processing and preserving of meat	148	25607	27520	2298	2907	15.53	11.81	11.14
1020	Processing and preserving of fish, crustaceans andmolluscs and products thereof	466	44178	27061	2460	1932	5.28	7.69	17.96
1030	Processing and preserving of fruit and vegetables	1101	58331	13893	6571	3015	5.97	27.71	8.88
1040	Manufacture of vegetable oils and animal fats	3300	107623	157001	14056	7015	4.26	4.68	7.66
1050	Manufacture of dairy products	1753	145601	110656	12039	10068	6.87	10.01	12.09
1061	Manufacture of grain mill products	18272	296548	175746	17951	13941	0.98	8.62	16.52
1062	Manufacture of starches and starch products	744	23111	10336	3644	1329	4.9	14.76	6.34
1071	Manufacture of bakery products	1498	96561	20484	4963	4518	3.31	28.30	19.45
1072	Manufacture of sugar	791	247953	85884	47755	8880	60.37	11.53	5.19

NIC, 2008 4-digit	Type of processing	No.of factories	No.of persons	Total output	Fixed capital	GVA	FC per factory	GVA %	Emp. Per crore
1073	Manufacture of cocoa, chocolate and sugar confectionery	505	37469	14750	5842	2772	11.57	23.15	6.41
1074	Manufacture of macaroni, noodles, couscous and similar farinaceous products	105	9948	3973	1497	825	14.26	26.2	6.65
1075	Manufacture of prepared meals and dishes	298	18153	2765	933	666	3.13	31.75	19.46
1079	Manufacture of other food product n.e.c	5546	426659	86271	17546	10135	3.16	13.31	24.32
1080	Manufacture of prepared animal feeds	820	44786	37166	4093	3534	4.99	10.51	10.94
1101	Distilling, rectifying and blending of spirits, ethuyl alcohol production from fermented materials	369	54226	24854	10078	5474	27.31	28.25	5.38
1102	Manufacture of wines	71	7859	2947	738	591	10.39	25.10	10.65
1103	Manufacture of malt liquors and malt	143	28302	11740	5709	3117	39.92	36.15	4.96
1104	Manufacture of soft drinks, production of mineral waters and other bottled waters	1520	68120	21548	10228	5231	6.73	32.06	6.66
	All food processing industries	**37175**	**168917**	**834597**	**168401**	**85952**	**4.50**	**11.48**	**10.03**

Figure 1: Level of GVA and Share of Employment in Food Processing Industries in 2013-14



The scourge of organised food processing sector continues to be very low value added at just 12% in 2013-14 and much less in some of the important industries like vegetable oils and fats (5%), dairy products (10%), grain mill products (8.6%) and fish products (7.7%) (Table 1). Leading industries in terms of gross value added malt liquors (36.2%), soft drinks (32.1%), and spirits and alcohol (28.3%) (Figure 1). In regard to employment, leading industries changes to other food products (25.3%), grain mill products (18%), and sugars (15.4%).

The main paradox in food processing industries is the dichotomy between organised and unorganised segment in regard to output and employment. While output and value added are higher in the organised segment, unorganised segment with one-fifth of output employs three times higher employment. Employment in unorganised segment was 47.93 lakhs in 2010-11 (from 37.08 lakhs in 2000-01), while organised segment employed 16.89 lakhs in

2013-14 making the total to 64.82 lakhs in a ratio of 74% in the unorganised segment. While the output was in the ratio of 78% and 22% in the organised and unorganised sector. The fixed capital per firm and output per person are lower in organised segment itself relative to total manufacturing Food processing industries operate at just 45% of the fixed capital per enterprise relative to the average of all manufacturing industries and produce 82% of output/ person compared to manufacturing average. This is the major problem in this sector leading to low productivity of persons engaged in this work (Chadha and Sahu, 2003). While this is the situation on the average, some of the industries like grain mill products, tobacco industries, macaroni, noodles and other products, and several others perform poorly with low capital per enterprise as well as output except spirits, and vegetable oils and fats.

The sector witnessed an impressive growth of 12% per annum from 2004-09 compared to just 6% in the previous two decades before that. However, the growth momentum was lost after 2011 and had been showing signs of recovery in the past few years. In terms of share of this sub-sector in the manufacturing sector in regard to both output and employment was declining. Share of organised food processing plummeted from 17.31% in 2005-06 to 11.59% in 2013-14, while employment during the same period went down from 17.12% to 12.8%. Similarly, share of employment in unorganised segment declined from 17.41% to 13.74% in 2010-11. While unorganised food segment added one million jobs from 2000-01 to 2010-11, organised segment stagnated at around 16 lakh jobs since 2009. It needs further analysis to understand the underlying causes for this decline of share in manufacturing. It needs to be underlined here that the sector has been growing share of organised segment in output and value added has been going up showing the consolidation in the sector.

Table 3: Cold-Chain Infrastructure Gap in India in 2015

Type of infra-structure	Infrastruc-ture require-ment *(A)*	Infrastruc-ture created *(B)*	All-India gap *(A-B)*
Pack-house	70, 080	249	69,831
Cold-storage (Bulk) in million metric tones	341.64	318.24	3.28
Cold storage (Hub) in million metric tones	0.94		
Reefer vehicles in numbers	61826	9000	52826
Ripening chambers in numbers	9131	812	8319

(Source: NCCD (2015)

On the other hand, the growth of exports and inflow of FDI into the sector were impressive. Foreign direct investment, which was just 11,759 crores or 2.62 billion US dollars from 2005-2011, has accelerated to 5.3 billion from April 2012 to December 2015. In fact, the sector received a total of 4 billion dollars in 2013-14 alone. Exports worth Rs.36,172 for processed foods and Rs.33,442 crores of marine products coming to a total of 69,614 crores out of a total of Rs.1,31,000 crores of agricultural exports constituted 53% of all exports.

The growth of food processing and increasing exports from this segment of value chain has been increasing its interactions with other segments like farmers for sourcing of raw materials either directly through contract farming or through wholesalers and other means. Large number of studies found higher incomes and inclusiveness with contract farming in the country (Dev and Rao, 2005; Rao et al., 2017). Few studies however, show small farmers are excluded. On the question of state intermediation in contract farming between agri-business firms and farming community, a study in Punjab found state mediation in contract farming might help only powerful large farmers, while direct links between agribusiness firms and farmers help in the contract farming to be more inclusive and positive outcomes. In a study on fishery

value chains in Kerala in a value chain framework, it was found that concentration and consolidation are taking place at the processing node of the chain, wherein the number of exporters has come down and professional players are upgrading their positions in the value chains. The pre-processing node of the chain is getting integrated to the processing sector, causing a major transformation of the existing value chain.

Cold Chain and Value Chains: Lack of awareness on building cold chain as a way of reducing losses and improving efficiency and farmer profitability has been costing the farming community for a long time in the country. Efforts over the last two decades centred around building up huge cold storages to the relative exclusive of other players in the cold chain . Now, it is realised that bulk and hub storage requirements reached nearly 90% and necessity to focus on pre-cooling pack houses, refrigerated vans, and ripening chambers, as shown in Table 3 (NCCD, 2015). The increasing availability of modern cold storages has led to important changes in potato value chains, with significant implications for smallholders. All potato farmers, small and large, participate in cold storage and the availability of cold storages is associated with improved efficiency in value chains because of lower wastages even as a number of these storages become involved in input, output and especially credit markets.

Way Forward: Food processing is the sector with the largest share of employment in the organised segment and third largest in the unorganised segment even with a very low value added in comparison with manufacturing as a whole. The productivity of these sectors needs improvement though studies show that there has been improvement after 2000s (Bathla, 2018). There is a need to infuse more technology in both the organised and unorganised segments with liberal provision of credit. Value of land poses the biggest threat to unorganised manufacturing in general and food processing in particular, and needs attention of the policy makers. Some of the tax slabs in GST also can have negative impact on this sector. The recent spurt in the inflow of foreign direct investment is encouraging and augurs well for the sector. Recent initiatives like mega food parks, and cold chain schemes are well conceived and showing signs of positive impact. The government needs to move fast to leverage the advantages of this segment for employment, growth of value added and exports by taking appropriate measures on the issues highlighted.

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ORGANIC FARMING PRACTICES IN INDIA

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Adoption of organic agriculture in India can brings greater economic benefits to farmers and environmental growth for the nation that emphasize on more sustainable production system crucial for achieving food security apart from maintaining natural resources. Application of scientific approaches to organic farming practices maintain and in some cases, increase the yield in the long run.

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasis the use of management practices in preference to the use of on-farm inputs, taking in to account regional conditions require locally adopted systems. This is accomplished by using, where possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials to fulfill any specific function within the system. Since organic farming address soil health, human health and environmental health and is eco-friendly, it is one of the best options for sustainable crop production and crop yields.

Adoption of organic agriculture in India can brings greater economic benefits to farmers and environmental growth for the nation that emphasize on more sustainable production system crucial for achieving food security apart from maintaining natural resources. Application of scientific approaches to organic farming practices maintain and in some cases, increase the yield in the long run. It sustains bio-diversity, soil fertility and natural ecosystem processes and other services that underpin the agriculture. It allows the farmers to overcome the risk of crop failures and increased cost of production, encourages production of healthy food and fiber of high quality. It also enhances the quality of agro-ecosystem and soil, the health of crops, animals and people maintained through biological processes. Local resources are used in a way that minimizes losses of nutrients, biomass and energy resources.

There are three categories of organic farmers in India. The first category of organic farmers are those who are in 'no-input or low-input' use zones, for them organics is a way of life and they practise it as a tradition. Second category of farmers is those who have recently adopted the organics in the wake of ill effects of conventional agriculture. The third category comprise of farmers and entrepreneurs who have systematically adopted the commercial

organic agriculture to capture the emerging market opportunities and premium prices.

The area under organic cultivation in India is about 5.71 million hectares (2015-16) including cultivable area of 1.49 million hectares (26%) and rest 4.22 million hectares (74%) under forest and wild area harvest. Madhya Pradesh has the highest area under organic farming in India followed by Maharashtra and Rajasthan. Besides these states, Meghalaya has committed to have two lakh hectares of certified organic land by 2020 and Sikkim is aiming to become 100 per cent organic which was an official announcement during 2016.

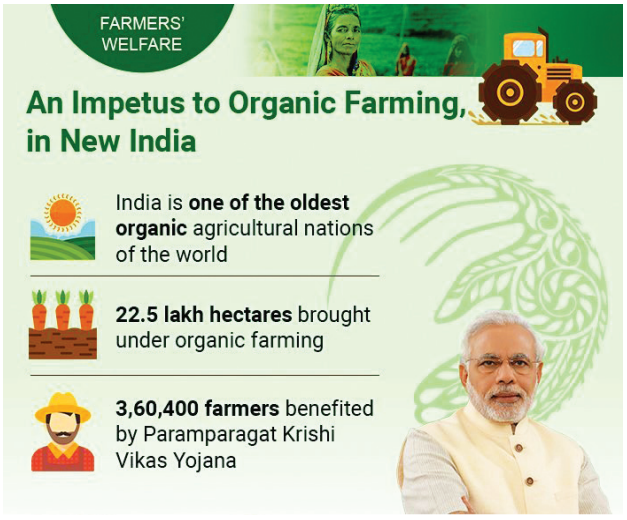
The soils for organic farming should be friable and must have the sufficient organic matter content with an ideal pH of 6.5 and 7.5 to help the microbial activity, called as living soil. The soil health in terms of soil organic matter or humus content and microbial activity can be improved through application of organic manures every year. The manures for organic farming should have a minimum of 12 per cent organic carbon, 0.8 per cent nitrogen, 0.4 per cent phosphorus and 0.4 per cent potash, Carbon to Nitrogen ratio of 20:1 and pH between 6.5 and 7.5. Farm yard manure (FYM), poultry manure, cow dung slurry, animal urine, crop residues, green manures and green leaf manures are permitted in organic farming. The inputs under restricted use such as blood meal, bone meal, compost, fish meal, urban wastes, vermicompost etc are allowed after confirming the absence of chemical impurities. Organic manures improve the physical, chemical and biological properties of the soil which in turn, leads to better crop productivity. In India, there is sufficient availability of organic manures like farm yard manure (791.6 million tons) crop residues (603.05 million tons), green manures (4.5 million ha), rural compost (148.3 million tons), urban compost (1.22 million tons) and bio fertilizer (0.41 million tons) and these may become a good substitute of chemical fertilizers. Recycling of organic wastes is not only an ecological necessity, but in a country like India, it is a compulsion.

The choice of organic manure application in organic farming is based on availability of the manure and soil test reports. In general, it is applied based on nitrogen equivalent to recommended dose of inorganic fertilizers of the crops. Enriched farm yard manure (EFYM) @ 1ton per ha is also recommended as low cost effective nutrient material in organic farming. For preparation of EFYM mix 10 kg of rock phosphate, 10 kg of nitrogen fixing biofertilizer *(Azospirillum/Rhizobium/Acetobacter)* and 10 kg of phosphobacteria in one ton of well decomposed FYM. Heap this under shade for 30-45 days with 65-70 per cent moisture content under shade and apply to the field as basal. Sunnhemp, Diancha, Sesbania, Tephrosia, Cowpea and Phillipesara are the some of the commonly grown green manure crops grown on the farm and incorporated 10 days before planting / sowing for paddy cultivation and 15-20 days before planting / sowing for garden land crops. Subabul, Glyricidia, Neem, Pungam etc are considered as green leaf manure crops grown outside the farms or along the fence and their leaves are used for enriching the soil. Rotovator is used for incorporation of green manures and green leaf manures in to the soil.

The non-edible oil cakes like neem, pungam, mahua and castor have low carbon nitrogen ratio and applied as organic manures which helps in quick releasing of the nutrients. The oil cakes also help in reduction of insect pests damages, soil borne root diseases and nematodes infestation. Use of crop residues after decomposition is essential in organic crop production, which increases the soil organic matter content, maintains soil fertility status of the soil. Leguminous crop like beans, greengram, blackgram, soybean, lablab, peas and cowpea are raised on a crop rotation basis with cereal crops to improve the soil fertility status of the soil. It was reported that up to 35 per cent yield shows improvement in succeeding crop through crop rotation cereal crops with root nodulating leguminous crops.

Vermicompost is a digested material of the organic wastes by earthworms, used as a quality manure in organic farming, recommended for basal as well as top dressing application. It is rich in plant nutrients *viz.,* NPK (macro elements), Ca, Mg, S (Secondary nutrients), Fe, Zn, Cu, Mo, B (micronutrients), beneficial for micro flora, antibiotics and plant growth promoters. The C:N ratio of vermicompost varies from 7.93:1 to 12.5:1 easily and the nutrients are in easily available from. Vermiwash is one of the crop boosters from earthworms used as foliar spray @ 5 per cent.

Bio-fertilizer is another important source of nutrients. Rhizobium is a bacterium lives in the root nodules of leguminous plants and fixes atmospheric nitrogen in crops like redgram, greengram, blackgram, bengalgram, groundnut and soybean. It fixes 50-100 kg of nitrogen per hectare per season. The bio-fertilizers like blue green algae, azolla, azatobacter and



azospirillum which can also fix atmospheric nitrogen. Apart from this, vesicular arbuscular mycorrhiza is used to improve the availability of phosphorous, zinc, copper and sulphur. The phosphorous fixed in the soil are unavailable to the crop plants at high or low pH level. To alleviate this problem, the phosphorous solubilizing bacteria like phosphobacteria is in use and it can release up to 30 kg of phosphorous per hectare per season. Potash releasing bacteria helps in potassium nutrient available to the crop plants. Pink pigmented facultative methanogens (PPFM) provides drought resistance to the crops in addition to its growth promoting ability.

Panchagavya, an organic product has the potential to play the role of promoting growth of the plant and providing immunity in plant system. It consists of five products of cow *viz.,* cow dung, cow urine, milk, curd and ghee. In addition to this country jaggery, banana, tender coconut and water are added. It is applied @ 3 per cent as foliar spray for all the crops twice at 15 days intervals. Mix cow dung (7 kg) and cow ghee (1kg) thoroughly both in morning and evening hours and keep it for 3 days. After 3 days mix cow urine (10 lit.) and water (10 lit.) and keep it for 15 days with regular mixing both in morning and evening hours. After 15 days, mix cow milk (3 lit.), cow curd (2 lit.), tender coconut water (3 lit.), country jaggery (3 kg), and well ripened poovan banana (12 nos.) and panchagavya will be ready after 30 days. All the above items can be added to a wide mouthed mud pot, concrete tank or plastic can as per the above order. The content is to be stirred gently twice a day both in morning and evening. The *Panchagavya* stock solution will be ready after 30 days. It should be kept in the shade and covered with a wire mesh or plastic mosquito net to prevent Dipteran flies from laying eggs and the formation of maggots in the solution. If country jaggery is not available, add 3 l. of sugarcane juice.

Jeevamrutham is one of the cheapest source nutrient applied through irrigation water during the critical stages of the crop @ 200l/ac. It is a fermented product of cow dung (10kg), cow urine (10 lit.), country jaggery (2 kg), gram flour (2 kg) and handful of native soil. All the constituents are dissolved in 200 lit. a plastic drum with water and allowed for fermentation for 3 days with gentle stirred twice a day both in morning and evening, apply within a week period.

The careful use of water is as much a part of organic growing as any other technique. Excess irrigation leads to the depletion of nutrients apart from wastage of water. Salts in the deeper layers of alkaline soils come to upper layer due to excessive irrigation and makes the soil saline and make the soil unsuitable for crop production. Micro or sprinkler irrigation is better in organic farming to maintain humid micro climate and for better decomposition of organic matter.

In organic farming systems, the weed controls are achieved through *in-situ* incorporation with rotovator. Stale seedbed technique is one of the important non-chemical weed management tactics followed in organic farming, in which the field is irrigated once before sowing, after germination of weed seeds, it is ploughed and incorporated. Crop rotations, hoeing, mulching, hand-weeding, mechanical weeding, cover cropping and poly cropping also helps in weed control in organics. Rice bran, tamarind seed powder, corn flour gluten and sunflower stalk extracts are used in organic weed management.

Agro forestry is one of the important components of organic farming. Green manures, fodder species and pest repellant plant species are better choice for agro forestry. It provides food and shelter for honeybees and bugs, hence it enriches the biodiversity of the farm. Live fence is also useful as wind breakers.

Pest management in organic farming is possible through agronomic practices selection of resistant crop varieties, timely planting, crop rotation with non-host crops, inter and mixed cropping techniques. Timely earthing up, mulching with crop residues reduces the infestation of pest and diseases affecting stems at collar regions of the plants. Trap cropping techniques is effective for the management of

Helicoverpha armigera (marigold) in cotton, pulses, bhendi and tomato, *Spodoptera litura* (castor) in tobacco, groundnut and chillies and *Plutella xylostella* (mustard) in cabbage, cauliflower, knolkhol and radish. Habitat manipulation with growing of nectar yielding flowering plants in borders enhances the natural enemy's populations of the pests. Push and pull strategy is a method in which repellant plants (onion) are grown in the field along with the main crop (cabbage/cauliflower) and attractant crop (mustard) is grown along the borders to manage the insect pest (diamond back moth).

Light traps are a mechanical device used to monitor the prescience of an insect pest in organic farms. It should be used 6.30-11.30pm only to safeguard the natural enemies in organic ecosystem. Sticky traps attract and kill sucking pests in organics. Yellow sticky traps are used for whiteflies, aphids and leaf miners and the violet sticky traps are used for thrips and lice. Nowadays, pheromone traps are effective in monitoring and control of insect pests in organic farming. Pheromones are the biological substances released by female insects to attract the males. Aggregation pheromones attract both the sexes of the insects. The pheromone traps are also used as a monitoring and controlling tool for insets pests in organic agriculture.

Border cropping technique is one in which the taller and dense foliage producing crops like maize, sorghum are planted in 3-5 rows around the primary crops like vegetables and pulses to restrict the movement of insects into the cropped area. Through vector control,the occurrence and transmission of viral is also contained by this technique.

Utilization of botanicals in pest management is popular among organic farmers in India. Nearly 2400 plant species have been identified in their toxic effects against insect pests. Among them, around 250 plants have been screened for pest management in crop plants. Some of the commonly available herbal insect repellant plant species are neem, pumgam, notchi, adathoda, nerium, calotrophis, castor, clerodendron, proposes, abutilon, ailanthus, lantana, cassia, custard apple, tulsi, basilicum, alove, hibiscus, curcuma, acorus, allium, ginger, chilli, pepper, marigold, morinda, citrus, ipomea, wild snake root, papaya, cycas, tephrosia, jatropha, simaruba etc. Five leaf herbal extract is popular among organic farmers in which five different kinds of plant species locally available are selected based on bitterness, non preference by the cattle and goats, latex exudation property. Five kinds of herbal leaves @ 500g in each are ground with cow urine (1:5) and allow for 15 days. Filtered and apply as foliar spray @ 5-10 per cent based on the type of pests and stages of the crop. Neem, a unique plant has been utilized as pest repellant, disease management and nematode control. Neem cake, neem oil and neem seed kernel extract (NSKE) are commonly used in organic pest management. NSKE is prepared by overnight soaking 5 kg of neem seed kernel powder in 100 lit. of water. Neem oil @ 2-3 per cent is recommended in pest management. Organic emulsifier is utilized for mixing neem oils with water @ 3 and 10 ml per liter of water respectively, for NSKE and neem oil. Like neem oil pungam and mahua oils are also used for pest management in organics.

Predators and parasites are effective bio-control agents in organic crop protection. *Trichogramma* is an egg parasitoid and is recommended for the management of various lepidoptrean pests in paddy, sugarcane, cotton, maize, sorghum, castor, groundnut, bengalgram, redgram, green gram, blackgram, brinjal, bhendi, tomato, cabbage, lablab etc. *Bracon,* a larval parasitoid is used for the management of black headed caterpillars in coconut, arecanut and oil palms. *Acerophagus papaya* parasitoid is used for the management of papaya mealybugs in papaya, brinjal, cotton, tapioca, cocoa, mulberry etc. The green lace wing predator is used for the management of sucking pests like aphids, whiteflies and leaf hoppers. The *Cryptolemus* lady bird beetle predator is used for the management of mealy bugs in various crops.

Disease management in organics is achieved through bio-control agents like *Trihoderma vividi, Pseudomonas fluroscens* and *Bacillus subtilis.* The *Trihoderma vividi* is used as for the management of root rot and root wilt diseases in crop plants. It is used as seed treatment (4g/kg), soil application (2.5kg/ha) and foliar spray (2g / lit.). *Pseudomonas fluroscens* is used for the management of soil and air borne diseases, is available in talk and liquid based formulations, applied for seed treatment (7g/kg), soil application (2.5kg/ha) and foliar spray (2ml/lit.). The bacterium *Bacillus subtilis* is recommended for the management of root wilt diseases in coconut, arecanut and fruit crops.

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INCREASING PULSES PRODUCTION IN INDIA

J.S. Sandhu and S.K. Chaturvedi

Pulses are important ingredient of largely vegetarian diet in Indian Sub-continent and their role in improving soils and sustaining agricultural production are well known and documented. More than a dozen pulse crops are grown in India on about 25-26 million ha (m ha) area producing 18-19 million tonnes (m t) of the pulse grains annually. India is the largest producer, importer (5-6 MT) and consumer (25-26 MT) of pulses globally. Continuing research and development efforts ensured tremendous progress in pulses productivity and production during last three consecutive Plan periods (2002 to 2017). There is scope to popularize pulses as 'Health Food' or 'Nutri-Rich Food' to improve protein malnutrition of the general masses and of poor in particular who cannot afford inclusion of other sources of protein in diet. With the availability of high yielding varieties, their quality seeds, matching crop raising technologies, and present enabling policy environment for promotion of pulses, country is marching ahead towards attaining self sufficiency in pulses production.

The rising import of pulses to the tune of 5.797 million tonnes (MT) during 2015-16 and further import of 6.60 MT pulses during 2016-17 warranted the Government of India to implement planned strategies effectively taking all stakeholders on board. Since, India could produce 6.60 MT of additional pulses during 2016-17 and almost similar quantity of pulses (6.60 MT) was imported by various agencies in the same year, price of pulses in domestic market crashed for almost all pulses excluding chickpea and up to some extent lentil. Since, research and development machinery of Government of India was vigilant on the issue of pulses; scheme for procurement of pulses directly from farmers was implemented immediately without time lapse. This resulted in procurement of about 2 MT of the pulses by the Government using price stabilization funds to maintain buffer stock. This initiative of Government of India along with other strategies like ensuring timely availability of quality seeds of high yielding varieties, large scale demonstrations on newer and high yielding varieties and matching production and protection technologies has encouraged farmers to grow more pulses which is evident from marginal increase in area under rabi pulses over 2016-17 which was ever maximum in history of pulse cultivation in India. Considering the increase in area during 2017-18 and expecting higher production of chickpea and lentil, Government of India has imposed 30 per cent import duty on chickpea and lentil and kept 50 per cent import duty on yellow pea (fieldpea) to protect interest of Indian farmers and encourage them to grow more pulses domestically. India has potential not only to sustain current level of production but to attain self sufficiency in pulses production. The record sowing in current rabi pulses (16.91 m ha) has set tone for harvesting more pulses during 2017-18, and to be closer to attaining self-sufficiency in pulses production in India.

Trends in Area, Production and productivity of Pulse:

Indian farmers grow variety of food crops and have produced 275.68 MT (2016-17) of food grain which is higher by 10.64 MT (4.01 per cent) than the previous record production (265.04 MT) achieved during 2013-14. India, pulse production also attained highest peak of 22.95 MT breaking previous record of 19.78 MT (2013-14). Among pulses, contribution of chickpea in total pulses production was more than 40.65 per cent followed by pigeonpea (20.82 per cent) and urdbean (12.20 per cent). During last three consecutive Plan periods (2002-2017) pulses area, production and productivity has shown continuous increase (Fig. 1a-c and Fig.2) though during last five years (2012-2017) ups and down in pulses area and production have been observed (Fig. 3).

The record production (22.95 MT) of pulses during 2016-17 was mainly due to higher prices of pulses during previous year, good agronomic practices and quality seed of newer varieties, use of phosphoric fertilizers and agro-chemicals, favourable weather, policy support in terms of minimum support price (MSP), procurement of pulses at MSP, Pradhan Mantri Fasal Bima Yojana (PMFBY) and Pradhan Mantri Krishi Sinchai Yojana (PMKSY) etc.

In India, Madhya Pradesh is the largest producer of pulses followed by Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh and Odisha. These seven states shared more than 80 per cent pulse area and contributed about 78 per cent of the total pulses production during 2015-16. There is ample scope in states like Tamil Nadu, Jharkhand, Chhattisgarh, Odisha, Bihar and West Bengal for expansion of pulses cultivation.

Demand and Supply of Pulses: India is the largest consumer of pulses and demand of pulses is likely to increase further as more and more people are becoming health cautious. Government of India is fully aware of its responsibility of ensuring nutritional security through pulses. Recently, the Government has launched number of schemes to promote indigenous production of pulse cultivation so that much needed self sufficiency in pulses can be achieved and precious foreign exchange can be saved. The estimated demand suggests that India need to manage 26.50 MT of pulses to fulfil the pulse demand by 2020 which may further go up in subsequent years. This will help in maintaining present level of protein availability @38g per capita per day for human consumption and demand for

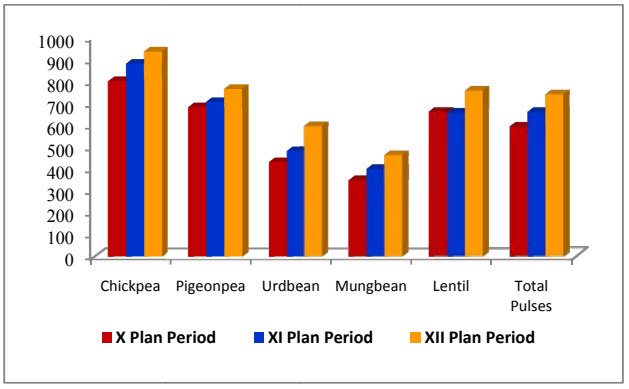

Fig.1c. Productivity (kg/ha) of pulses during 3 consecutive Plans

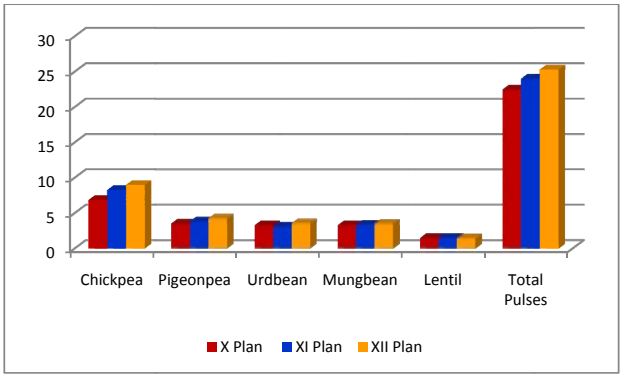

Fig.1a. Area (m ha) of pulses during three consecutive Plan periods

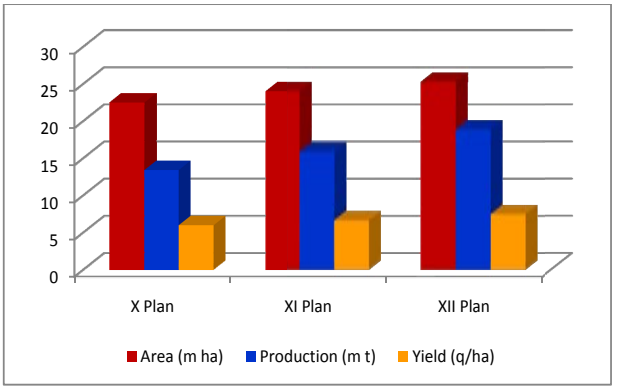

Fig.2. Area, production and yield of total pulses during 3 consecutive Plans

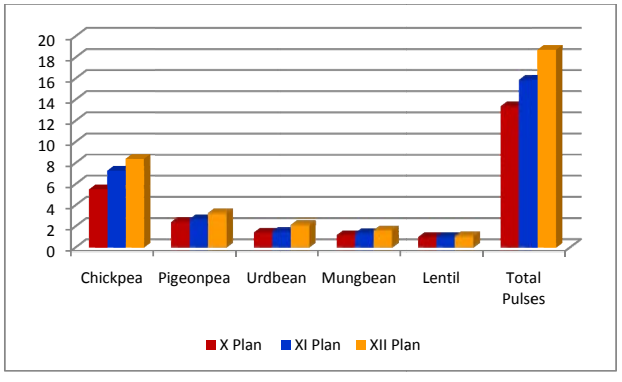

Fig.1b. Production (MT) of pulses during three consecutive Plan periods

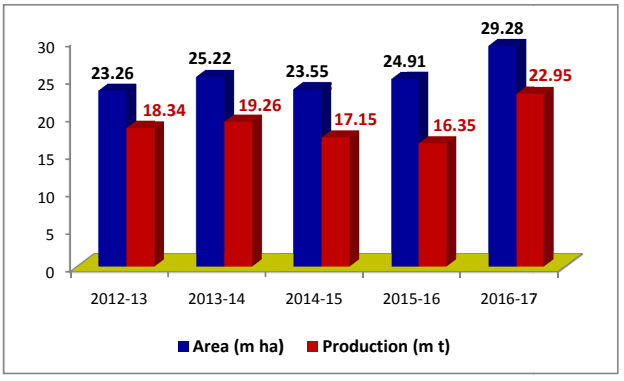

Fig.3. Area and production of total pulses during last 5 years

seed and other uses. Further, the pulses demand has been projected to the tune of 26.5 MT by 2020, 32 MT by the year 2030 and 39 MT by 2050. If present level of area under cultivation can be sustained with even marginal increase in productivity which is not difficult task, country can achieve self sufficiency in pulses production in near future. However, there will be need of good investments for generation of new varieties, integrated pulse production and protection technologies, accelerated quality seed production, farmers' centric policies, empowerment of growers through training, efficient transfer of technologies network, market, remunerative minimum support price and procurement, bringing pulses in mid-day meals and public distribution system and other social schemes, etc. so that required annual growth rate can be achieved for attaining self sufficiency in pulses production.

Research network and infrastructure: Under the aegis of Indian Council of Agricultural Research (ICAR), Department of Agricultural Research and Education (DARE), wide research network comprising Institutes and All India Coordinated Research Projects (AICRPs) centres located in different State/ Central Agricultural Universities are working for the improvement in pulse crops (http://www.iipr.res.in). Considering the area shift and regional importance of pulses in different parts of the country, ICAR-Indian Institute Pulses Research (IIPR) has established two regional stations, Regional Research Centre, Bhopal and Regional Centre-cum-Offseason Nursery, Dharwad to conduct intensive research on pulse crops during the last decade. Recently ICAR has approved establishment of two more Regional Stations of IIPR, one each in western India (Bikaner) and eastern India (Bhubaneswar). In addition, other ICAR Institutes are also contributing to pulse research. The role of private sector in research and development is needed to fill up the gaps in technology and quality seed production.

Major Research Achievements: Concerted efforts led to the development of more than 510 high yielding varieties of different pulses, insulated against major biotic and abiotic stresses along with matching integrated crop management technologies. These technologies have great potential to improve pulse production substantially as evident from front line demonstrations.

- **Good agronomic practices:** Besides, improved seeds, integrated crop production technologies have definite role to play. Several crop production technologies developed in past need to be integrated with newer ones to increase profitability from per unit area of pulses cultivation. These technologies include integrated nutrient management, micro-irrigation including dry sowing followed by light irrigation, seed priming, pre- and post-emergence herbicides application for effective weed management, etc. Some of important technologies well accepted are: Ridge planting and Application of micronutrients.
- **Integrated Diseases Management (IPM):** Diseases management following IPM approach is the most economical way to minimize losses likely to be caused by diseases prevalent in particular area. The best strategy to minimize diseases incidence due to soil borne pathogens rests in exploitation of host plant resistance and development of diseases resistant varieties as control for soil borne diseases (wilt and root rots) through use of fungicides at different crop growth stages is neither economical nor feasible at farmers' fields.
- **Integrated Insect Pest Management:** Gram pod borer (*Helicoverpa armigera* Hubner) is the most important and dreaded pest infesting chickpea and pigeonpea crop. IPM modules developed have helped in minimizing damage due to *Helicoverpa armigera*.
- **Processing and small scale milling:** Huge losses are incurred during storage of pulses as grain. Storage of pulses after splitting as *dal* or value addition is comparatively safe. ICAR-IIPR, Kanpur; CFTRI, Mysuru, ICAR-CIAE and some of the private companies have developed small

scale pulse processing machinery capable of making *dal* from all types of pulse grains. More efforts are required in development of efficient machinery for processing and milling of pulses at community level.

Biotechnological interventions:

- **Exploitation of genomic tools in breeding varieties:** Molecular marker technology that facilitates transfer and tracking of gene(s) needs to be exploited in routine breeding programs. This can reduce time taken to release a variety. The information on genome sequences of *desi* and *kabuli* chickpea and pigeonpea are in public domain hence can be utilized for development of trait linked markers. The genome of pigeonpea and chickpea is decoded and the draft genome sequence of mungbean and lentil will be available possibly within this year. It will help in more precise and targeted technology development.
- **Issues and strategies**: A large number of issues relating to low productivity of pulses can be summarised as those relating to research, development and policy issues. Pulses are largely grown under rainfed and residual moisture which is one of major reasons for low yield. If appropriate measures are taken, most of these can be addressed for increasing indigenous production of pulses. The major issues relating to research are detailed below:

- **Issues:** Pulses are protein rich crops therefore more prone to biotic and abiotic stresses There is need to develop multi-adversities (Table 2) resistant varieties following integrated breeding approaches.

  Considering the demand, global market, companion crops' competitions, climate change etc., there is need to reprioritize pulses improvement research programs so that desired level of improvement can be ensured for all the pulse growing areas.
- **Strategies:** Integrated breeding exploiting genomic tools (molecular markers) for transferring genes/QTLs of interest. Multidisciplinary team

Table 2. Major biotic and abiotic stresses affecting pulse crops

Crop	Biotic		Abiotic stresses
	Diseases	Insect pests	
Chickpea	*Fusarium* wilt, dry root rot, wet root rots, collar rot, *Ascochyta* blight, *Botrytis* grey mould	Gram pod borer, cut worm, termite	Terminal drought and high temperature (late sown crop), cold (at reproductive stage in timely sown and at vegetative stage in late sown crop), and salinity
Lentil	*Fusarium* wilt, dry root rot, collar rot and rust	Aphids, pod borer	Terminal drought (rainfed crop), terminal heat(late sown crop), soil salinity/acidity
Fieldpea	Powdery mildew, rust and root rots	Stem fly	Frost (at all stages), high temperature (late sown crop)
Rajmash	Yellow mosaic, leaf curl, anthracnose	Thrips	Frost and low temperature during rabi season
Lathyrus	Powdery mildew and rust	Stem fly	Drought and soil acidity
Pigeonpea	Fusarium wilt, sterility mosaic disease, *Phytophthora* stem blight	*Helicoverpa* pod borer, pod fly, termite	Terminal drought and heat, frost and reproductive stage cold (in northern and central India), and waterlogging
Mungbean, and Urdbean	Yellow mosaic, *Cercospora* leaf spot, Anthracnose, leaf crinkle, *Macrophomina* blight, web blight	Thrips, Bihar hairy cater pillar	Drought, heat and pre-harvest, sprouting due to continuous rains. Heat stress is more important in urdbean

of scientists need to be deployed for pulse improvement programs. Integration of molecular marker technology for increasing efficiency of selection has to be key tool to speed up to technology development. Need based alternative technology of transgenic development and gene editing technologies will be deployed to solve problems those are cannot be easible with conventional means. The ongoing research on exploitation of heterosis in pigeonpea needs further strengthening.

Strategies for Enhancing Pulses production:

Production of pulses can be enhanced substantially in India following two approaches i.e. horizontal expansion by bringing additional area, and vertical expansion by increasing production per unit area of pulse cultivation.

Horizontal Expansion: Large areas remain fellow in eastern India and can be brought under pulses cultivation in phased manner to bring regional self – sufficiency in pulses as well. Secondly, non-traditional regions/alternative seasons can be used for pulses production and also to augment seed production.

Productivity Enhancement: Popularization of high yielding varieties and matching production technologies for different pulse crops will certainly help in enhancing yield from per unit area of cultivation. Good agronomic practices (GAP) including recommended IPM modules an indicated earlier have potential to increase productivity to the tune of 20-30 per cent.

Farm Mechanization: Increased farm mechanization helps in reducing cost of cultivation and save farm labourers for non-agricultural work. The mechanisation will be a great help for timely planting and harvesting pulse crops.

Making Quality seed available: Seed is the vital component for harvesting good yields from any crop by way of ensuring optimum plant population, proper crop health and growth. In case of pulses, quality seed supplies always remain a major production and productivity constraint. Recently, area under pulses has gone up by 3-4 m ha therefore demand for additional quality seed is expected to grow. To cover 30 per cent of the pulse area with quality seeds about 30-35 lakh quintals of quality seed will be required annually. Considering importance of the quality seed, Department of Agriculture, Cooperation ad Farmers Welfare (DAC&FW), Ministry of Agriculture and Farmers Welfare, Government of India has approved an ICAR project **"Creation of seed hubs for increasing indigenous production of pulses in India**" to establish 150 Seed-Hubs in 24 states with a total out lay of Rs. **Rs. 22531.08 lakh.** This project has been implemented through ICAR-Indian Institute of Pulses Research (ICAR-IIPR), Kanpur. 9 ICAR Institutes, 44 AICRPs located in different SAUs/CAUs; and 97 Krishi Vigyan Kendras (KVKs) are partners in this project. Agricultural Technology Application Research Institutes (ATARIs) are collaborators for implementation of Seed-Hubs project.

Human Resource Development: Empowerment of farmers and other stakeholders about improved varieties and good agronomic practices is of utmost importance to improve production and productivity.

Technology Transfer: Front line Technology demonstrations (FLDs) conducted during last two

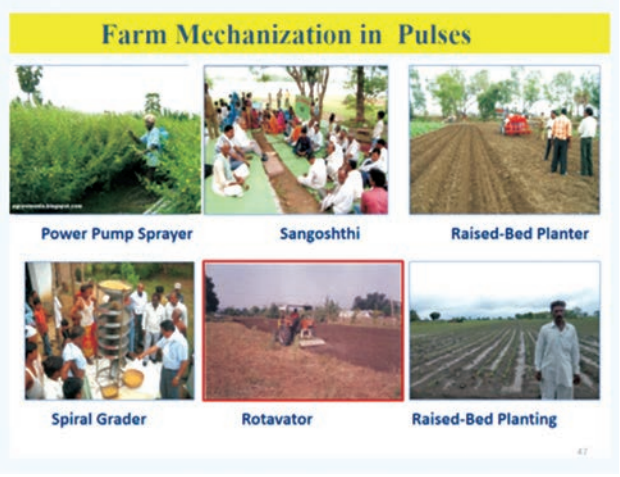

Table 4. Minimum Support Price (Rs/Quintal) of Pulses

	Minimum Support Price (Rs/Quintal) of pulses					
Crops	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Pigeonpea	3850	4300	4350	4625	5050	5450
Chickpea	3000	3100	3175	3500	4000	4400
Mungbean	4400	4500	4600	4850	5225	5575
Urdbean	4300	4300	4350	4625	5000	5400
Lentil	2900	2950	3075	3400	3950	4250

**MSP includes Bonus as well*

decades indicated that pulses productivity can be enhanced by at least 20-30 per cent if available technologies are transferred and farmers are informed about advantages of these technologies. Central Government has launched massive program **"Cluster front Line demonstrations"** on pulses and it has paid dividends. Farmer participatory trials/ demonstrations are very helpful in convincing the farmers the benefit of improved cultivars and technologies. Distribution of small seed samples (2-5 kg) to large number of farmers would help in rapid spread of new varieties and integrated crop management technologies. Use of information technology (IT) can play a big role, therefore user friendly mobile based apps need to developed in regional languages and suitable agro-advisories are issues using IT tools.

Value addition: Store grain pests cause huge losses to pulses grains when stored without splitting as most of the pulses are harvested at seed moisture content of around 14-15 per cent, which is good enough for multiplication of insect pests like bruchid. Therefore, capacity development needs to be taken up for value addition and small scale processing and milling machineries development for pulses. Keeping changing consumption pattern and choice of young Indians in mind, investments must be made in research for development of value added ready-to-use products out of nutritious pulses.

Procurement and Storage of Pulses: Procurement and storage of pulses cannot be in similar manner as it is for two major cereals- wheat and rice. Procurement and storage of pulses to maintain buffer stocks to stabilize prices for consumers needs in-depth discussions for developing suitable policies including human resources for purchase' networks, maintain quality, storage and disposal mechanisms, etc. Pulses need to be dried before storage, bringing down grain moisture content below 8 per cent and for seeds around 10-12 per cent. Therefore, storage facilities need to be created for pulses' grains/seeds. Storage facilities can be developed following public-private-people partnership mode where initial investment in constructions is partially supported by government and farmers are encouraged to pay for storage. Creation of storage facility for pulses is more important in coastal belt or states receiving higher rainfall and having high humidity. Farmers can be encouraged to store seeds of pulses or grains in such stores on payment basis. It is important that credit facilities are extended to the farmers based on seed/ grain stored by them. Government can also make use of such storage facility for maintaining buffer stocks.

Minimum support price and remunerative price always remain a point of discussion among different stakeholders. Recently, government has increased MSP substantially (Table 4) and in future it can reach to the level of remunerative price, if trend continues.

Future: The kind of technologies such as high yielding varieties insulated against major biotic and abiotic stresses, and good agronomic practices including plant protection measures developed by ICAR and SAUs combined with various schemes launched for higher pulses production and positive policy support from Government can certainly enable the Indian farmers to produce more pulses in years to come. There are indications that during 2017-18 pulses production of previous year will not only sustain but it can further go up. However, to achieve self sufficiency in pulse production there is need of long term investment in research and development on sustained basis besides continuance of a favourable policy support.

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TACKLING REGIONAL IMBALANCES IN AGRICULTURE

Dr. Jaspal Singh and Dr. Amrit Pal Kaur

To mitigate the regional gap in agricultural productivity, the policy prescription would be more and more investment in the lagged region, extension of public and private credit in remote rural areas. Development of research focusing the development of dry land area, development of technology requiring less water, less fertilizer and cheap farming and finally implementation of watershed development approach are necessary for a more balanced and sustainable agricultural development in the country. There is an acute need to pay special attention to the needs of eastern states and other rain-fed regions.

The inter-state variations in agricultural productivity in India is quite high, however, the advanced states are facing stagnation in growth rates of agricultural productivity while the lagging states are keeping pace with the advanced states by adoption and better implementation of market reforms and farm friendly policies. Over the period of time, it has been observed that there is a trend of convergence among states in terms of agricultural productivity. Different set of policies are required for agriculturally advanced and lagging states to mitigate the regional gap. The lagging states should strengthen the modern farm inputs to increase agricultural productivity, while the advanced states should explore the second stage of agriculture development in terms of diversification and agro-business activities.

The agriculture sector continues to be the backbone of Indian economy and plays a vital role in overall development of a country. As per the II_{nd} advised estimates by the Central Statistics Office (CSO), the share of agriculture and allied sectors (including agriculture, livestock, forestry and fishery) is estimated to be 17.3 per cent of the Gross Value Added (GVA) during 2016-17 at 2011-12 prices. Though, with the growth of other sectors, the overall share of agriculture in GDP of the country has decreased. Still, it employs nearly half of the workforce in the country.

From a net importing country, India is today consistently producing 275.68 million tonnes (Fourth Advance Estimates for 2016-17 by DES) of food grains, and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. It is the highest producer of milk and second highest producer of fruits and vegetables. In 2013, India contributed 25 per cent to the world's pulses production, 22 per cent to the rice production and 13 per cent to the wheat production. It also accounted for about 25 per cent of the total quantity of cotton produced, besides being the second highest exporter of cotton for the past several years.

A significant acceleration in growth of output and productivity was observed in agriculture in India since independence. However, the agricultural yield (quantity of a crop produced per unit of land) is found to be lower in the case of most crops, as compared to other top producing countries such as China, Brazil and the United States. Further, the gains from productivity are uneven across states and regions in the country. This study makes an attempt to examine the performance of major Indian states in the level of agricultural development and also disparity prevailing across states in terms of agricultural productivity. The study also focuses on the nature of convergence of inter-state agricultural productivity and identifying the factors that are responsible behind the productivity imbalances in India.

Data Sources and Methodology:

The period of the study covers 10 years period from 2004-05 to 2014-15. Twenty three major states have been studied for interstate comparisons. Mostly secondary data has been employed in the study viz., National Account Statistics of the Central Statistical Organisation of the Govt. of India, Agriculture statistics At a Glance, Directorate of Economics and Statistics, Ministry of Agriculture and National Account Statistics, Ministry of Statistics and Programme Implementation, Government of India.

Agricultural productivity has been estimated as below:

$$Agricultural\ Productivity\ (Rs./\ Ha) = \frac{NSDP_{it}}{NSA_{it}}$$

Where

NSDP – Net state domestic product from agriculture of i^{th} state at t^{th}time

NSA – Net Sown area of i^{th} state at t^{th}time

For Convergence Analysis, α convergence (measure the behavior of cross sectional dispersion of a particular variable overtime) has been examined in this paper.

Agriculture Productivity: Growth and Regional Imbalances

In order to meet the food grain requirements of the country, the agricultural productivity and its growth needs to be sustained and further improved. Virtually majority of land is under cultivation, so increasing productivity per unit of land should be the main engine of agricultural growth. However, there exist wide variations in the agricultural productivity across the states. It has been observed that Arunachal Pradesh has the highest productivity of Rs 326917 per hectare at current prices among the states (Table 1). Further, Andhra Pradesh (Rs 260346 per ha) was closely followed by Tamil Nadu (Rs 259921 per ha) which witnessed higher productivity levels among states. Also, Figure 1 visualizes the interstate agricultural productivity during 2015-16 at current prices. The map divides the states into three categories on the basis of their agricultural productivity levels: high (green), medium (yellow) and low (red).

States like Punjab and Haryana have enjoyed a pre-eminent position in productivity rankings for many decades, especially in foodgrains falls in the higher productivity zone (green) while they had registered low growth rate in productivity i.e. 1.73 per cent and 3.15 per cent respectively during the study period of 2004-05 to 2014-15. States like J&K, Himachal Pradesh, Kerala etc. fall in the green zone because of plantation crops and also show low growth rates. On the contrary, the states for instance Odisha, Madhya Pradesh and Gujarat fall in the low productivity zone (red) (Figure 1) had shown the higher growth rates in agricultural

Table 1: Interstate Agricultural Productivity and Growth of productivity (2004-05 to 2014-15)

State/UT	Productivity at current prices (Rs/ha)	Growth Rate of Productivity (2004-05 to 2014-15)
Andhra Pradesh	260346	3.44
Arunachal Pradesh	326917	0.72
Assam	134480	1.91
Bihar	146338	4.45
Chhattisgarh	85503	4.89
Goa	266236	1.56
Gujarat	135178	5.54
Haryana	222280	3.15
Himachal Pradesh	237135	2.78
Jammu & Kashmir	242725	1.41
Jharkhand	219919	8.40
Karnataka	100319	2.74
Kerala	237843	0.23
Madhya Pradesh	110609	5.75
Maharashtra	99108	3.77
Manipur	94847	-0.77
Meghalaya	146017	1.28
Mizoram	318132	1.92
Nagaland	136792	4.34
Odisha	124111	6.12
Punjab	234529	1.73
Rajasthan	88868	3.94
Tamil Nadu	259921	3.94
Uttar Pradesh	151405	2.23
Uttarakhand	207069	2.69

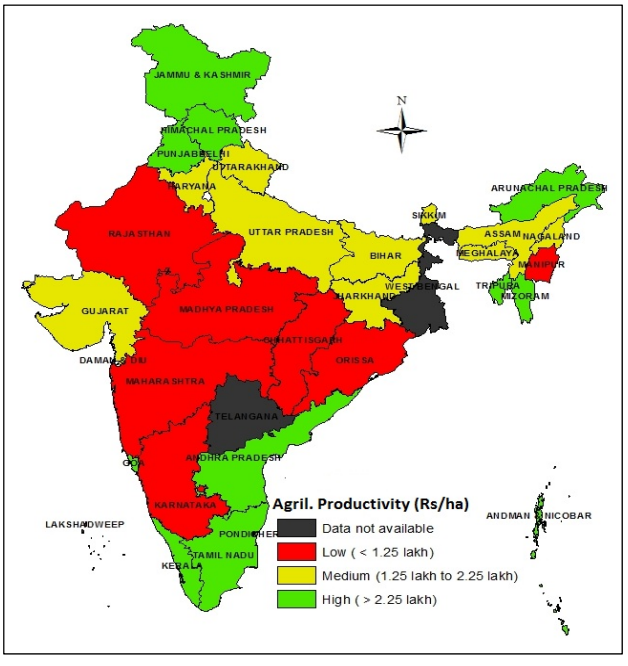
(Source: Author's estimation)

productivity viz., 6.12per cent; 5.75per cent and 5.54 per cent. Since most of these states adopted and implemented various market reforms and farm friendly policies.

Thus, it is observed from Table 1 and figure 1 that the states with higher agricultural productivity levels in agriculture i.e. the states fall in the green zone witnessed low growth rates, since in most of the agriculturally advanced states, the growth in agricultural productivity got very marginal rate or stagnant. As agriculture sector in these states reached at the highest capitilisation situation and with the same set of technologies, it is difficult to grow further. While the states in red zone with low productivity levels have registered higher growth rates during the study period. The scope for improved productivity in these latter states is substantial.

These regional variations in agricultural productivity are result of the inter-play of many factors as irrigation coverage, cropping intensity, use of fertilizers, credit, land holding size, level of policy support, and institutional factors. In the study, we have also considered Rank in Agricultural Marketing and Farmer Friendly Reforms Index (AMFFRI) as one of the major determinant for regional imbalances in agriculture productivity (Chand & Singh, 2016). Table 2 shows these determining factors for inter-regional

Figure 1: Interstate agricultural productivity during 2015-16 at current prices



productivity imbalances and their status in major states of India. The regional variation in agricultural infrastructure and the use of agricultural inputs in India is quite high. Punjab (98.7 per cent), Haryana (89.1 per cent) and UP (80.2 per cent) has highest irrigation coverage and similarly noticed greatest cropping intensity. Other factors as fertilizer use (kg/ha), credit (Rs/ha) and larger land holding sizes are on higher side for the states with higher productivity levels across India. Thus, the states that are able to channelize these factors efficiently into their agricultural sector resulted into better productivity and yield rate. Further, in AMFFRI, the state of Maharashtra achieved first rank in implementation of various reforms. The state has implemented most of the marketing reforms and it offers best environment for 8 doing agribusiness among all the states and UTs. Gujarat ranks second with a score of 71.5 out of 100, closely followed by Rajasthan and Madhya Pradesh. Agriculturally developed state of Punjab ranks 14th with a score of 43.9. This is because of poor implementation of market reforms in the state. Almost two third states/UTs could not reach even halfway mark of reforms score. Major states like U.P., Punjab, West Bengal, Assam, Jharkhand, Tamil Nadu and J&K are in this group.It is observed from the table that the state with higher productivity levels has better utilization of agricultural inputs.

However, where performance of various states is good in terms of adoption of market reforms and farm friendly policies i.e with higher Rank in AMFFRI has higher growth rates in agricultural productivity and approaching the advanced states.

Agricultural Growth in India: A Convergence Analysis

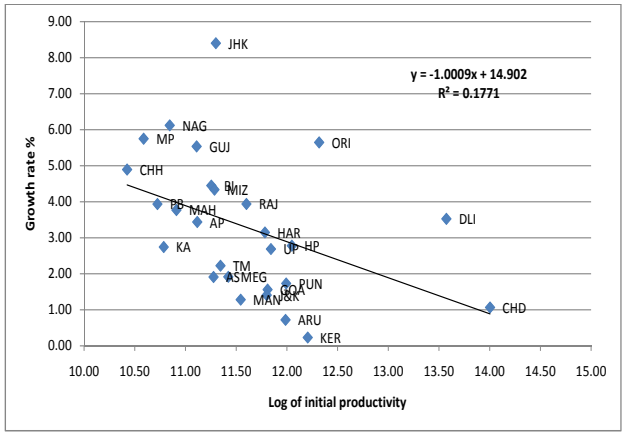
Several attempts have been made in India to explain the nature of convergence in agricultural growth. In this paper, Alpha α convergence has been examined. The growth of productivity is regressed with log of initial productivity (2004-05 productivity). As shown in Figure 2, convergence is tested by regressing of growth rate of agriculture productivity with log of initial agricultural productivity across states. The result is displayed in Figure 1. Downward slopping curve indicates a trend of convergence over the study period among states of India in terms of agricultural productivity. Most of the low agricultural productivity states like Odisha, Gujarat, and Madhya

Table 2: Determining factors for Inter-Regional Productivity Imbalance

State/UT	Irrigation coverage %	Cropping intensity %	Fertilise use (Kg/ha)	Credit (Rs/ha)	Land holding size(ha)	Rank in AMFFRI
Andhra Pradesh	50.5	123.3	226	118883	1.08	7.4
Arunachal Pradesh	18.7	132.8	2	7594	3.51	21.1
Assam	9.2	144.4	45	13812	1.1	37.1
Bihar	68.7	145.4	220	76809	0.39	12.4
Chhattisgarh	31.2	122.4	100	18110	1.36	47
Goa	24.6	122.0	49	44567	1.14	52.8
Gujarat	47.1	124.0	125	43257	2.03	70.1
Haryana	89.1	185.6	220	141379	2.25	65
Himachal Pradesh	21.0	167.0	57	93133	0.99	59.6
Jammu & Kashmir	42.8	155.3	64	36403	0.62	7.4
Jharkhand	14.3	112.2	55	26450	1.17	49.2
Karnataka	34.2	121.9	175	84462	1.55	55.5
Kerala	17.9	128.5	44	212406	0.22	10.8
Madhya Pradesh	43.3	155.1	84	33941	1.78	64.4
Maharashtra	18.2	135.3	122	36194	1.44	66.4
Manipur	18.0	100.0	42	418	1.14	7.4
Meghalaya	37.1	120.0	0	3774	1.37	14.3
Mizoram	14.5	100.0	18	6842	1.14	37
Nagaland	21.2	130.3	6	3074	6.02	33.3
Odisha	28.7	115.6	63	40793	1.04	27.9
Punjab	98.7	190.8	249	205525	3.77	43.9
Rajasthan	42.0	138.3	62	38597	3.07	69.6
Tamil Nadu	56.6	124.4	175	218339	0.8	17.7
Uttar Pradesh	80.2	157.5	156	22490	0.76	45.8
Uttarakhand	49.5	156.7	169	90492	0.89	25.2

(Source: Agriculture Statistics at a glance, DES, MoFWPI)

Figure 2: Convergence of inter-state Agricultural Productivity



Pradesh are converging with the agriculturally advanced states of India like Arunachal Pradesh, Punjab and Haryana over the period of time. Efforts should be undertaken to keep up this pace since there are greater implications of the persistence of regional disparity. There is a need for measures to promote regional balance in development in the form of policy responses countering regional productivity differences.

Thus to conclude, this study makes an attempt to examine the growth performances of agricultural production and productivity of major States of India and the nature and extent of disparity in the performances of agriculture.

The growth performances have been analyzed, it has been found that the states in central zone of India with low productivity levels in agriculture should strengthen the determining factors of increase in agricultural productivity i.e. the use of inputs like fertilizers, improved seeds, irrigation, machinery, credit and technology back up. While it is observed that the states in high agricultural productivity zone (green zone) are experiencing stagnation in growth of agricultural productivity. For instance, the agriculture in states like Punjab, Haryana has reached a plateau making it very hard to make further progress under available technologies and natural resource base.There is a need to consider the factors that are highly favorable for diversification towards high value horticultural and livestock products and attribute-based products. Turning food-processing industry into a major export industry can also create vast employment opportunities for workers since it is a labour-intensive industry. Therefore for lagging states, separate set of policies are required. On the contrary, for advanced states, there is a need for discrete set of interventions like diversification in value horticultural and livestock products, agro-buisness etc.

To mitigate the regional gap in agricultural productivity, the policy prescription would be more and more investment in the lagged region, extension of public and private credit in remote rural areas. Development of research focusing the development of dry land area, development of technology requiring less water, less fertilizer and cheap farming and finally implementation of watershed development approach are necessary for a more balanced and sustainable agricultural development in the country. There is an acute need to pay special attention to the needs of eastern states and other rain-fed regions.

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South Asia Regional Center (ISARC)

The Union Cabinet chaired by the Prime Minister Shri Narendra Modi has approved the establishment of the International Rice Research Institute (IRRI), South Asia Regional Center (ISARC) at campus of National Seed Research and Training Center (NSRTC) in Varanasi.

Under the proposal, a Centre of Excellence in Rice Value Addition (CERVA) will be set up in Varanasi. This will include a modern and sophisticated laboratory with capacity to determine quality and status of heavy metals in grain and straw. The Centre will also undertake capacity building exercises for stakeholders across the rice value chain.

This Center will be the first international Center in the eastern India and it will play a major role in harnessing and sustaining rice production in the region. It is expected to be a boon for food production and skill development in the eastern India and similar ecologies in other South Asian and African countries.

Benefits from ISARC :

1. The Centre will help in utilizing the rich biodiversity of India to develop special rice varieties. This will help India to achieve higher per hectare yields and improved nutritional contents. India's food and nutritional security issues will also be addressed.
2. The Centre will support in adopting value chain based production system in the country. This will reduce wastage, add value and generate higher income for the farmers.
3. The farmers in Eastern India will benefit in particular, besides those in South Asian and African countries.

ROLE OF WOMEN IN AGRO-ECONOMY

Nirendra Dev

It is not without good reason that Prime Minister Narendra Modi has given a clarion call in his address to national conference of Women legislators/lawmakers in 2016 that it would be prudent to move forward from women's development to 'women-led development'. This cannot be achieved without directing more purposeful role for women in farm and rural sectors.

Women in India, more so in rural and farm sectors, are often considered obstinate about surviving and moving ahead.In general sense, one can say, it was the 'woman' who first perhaps domesticated crop plants, gathered seeds from the native flora and also cultivated those keeping the focus on providing food for the family and fodder for the animals. In India, there has been something about the women determination as also their commitment and faith in the cherished traditional wisdom of share and care for their children and family members that propelled them to brave the hurdles.

The rural women have not only been active in agricultural fields. They have been actually employed in most arduous field operations like sowing, harvesting, threshing and agro-processing. Traditionally, women in this sub-continent and especially in river belts have learnt the art of protecting the health of the soil through organic recycling. They have also promoted crop security through the maintenance of diversity and imposed genetic resistance.

In fact, according to Food and Agriculture Organisation, women's contribution to agriculture in India stands at over 32 per cent. Agriculture thus, has played in bringing women close to government's initiatives for updating skills in land management, ensuring (or providing) training in traditional female skills vis-a-vis farms, credit programs for micro-enterprises, and income-generation schemes to bring rural and poor women into the market economy. But having said these, one can only emphasise that perhaps over the years, more ought to be done and achieved in terms of agricultural extension efforts to help women improve food production while allowing them to shift more of their labour to revenue generation and if possible to lead that to marketing of farm products.

Thus, on the face value, it ought to be underlined that changes in legal, financial, and educational systems could be brought about in order to enhance women's social and economic contributions to agro-economy and rural development in both mid and long terms.

The Government of India has time and again emphasised that uplift of rural infrastructure and the status of women in revenue generation – especially in agro-economy initiatives and food processing , which are some of the major cornerstones for the overall growth of the Indian economy.

It is firm assertion of this principle that it is not without good reason that Prime Minister has given a clarion call in his address to national conference of Women Legislators/lawmakers in 2016 that it would be prudent to move forward from women's development to 'women-led development'. This cannot be achieved without directing more purposeful role for women in farm and rural sectors.

As it is women are doing their lot in agro-economy initiatives. Almost entire post harvest and agro processing activities are performed by women in many states such as Punjab, Maharashtra, Madhya Pradesh, Sikkim and West Bengal. The

operations like cleaning, grading, drying, storage are performed by women. Moreover, adoption of modern inputs along with cultural practices has enhanced the agricultural productivity. The introduction of tractors has been a boon and as a result, we have combined harvesting introduced in states like Punjab, Haryana, Rajasthan, Madhya Pradesh, Karnataka, Uttar Pradesh, Gujarat and Maharashtra.

Steps have been accordingly taken, in the words of Union Agriculture Minister Radha Mohan Singh, and schemes are being tailored to ensure creation of gainful employment in villages and small towns especially with higher involvement of women to generate a resource base to improve agriculture and allied sectors.

In fact, there is a plethora of different world seen in tribal and far-flung villages today. Stone crushers would shatter the stillness of silence of hills and valleys as a large number of men and women jointly participate in construction of roads and would also work in agricultural fields.

"The Government of India under Prime Minister recognizes the importance of the role of women in agro-economy and overall development of the society and rural India.Several rural and farm-related schemes in last few years have special components for women. Some of the guidelines stipulate certain provisions for creation of specific facilities at the worksites for the working women facilitating their participation in the programme.

To strengthen women's participation in agriculture and allied activities, proper structural, functional and institutional measures are being promoted by the central government to empower women, to build their abilities and to increase their access to input technology. According to Agriculture Ministry, in financial year 2016-17 alone, at least 21 techniques related to women were evaluated and over 2.56 lakh women were trained in agriculture-related fields like animal husbandry and poultry.

The Government of India has also advised the states to identify widowed women, deserted women and destitute women who qualify as a household under the MG-NREGA to ensure that they are provided 100 days of work.

When it comes to agri-sector uplift and the role of women, one should not miss the focus about Horticultural crops. These play a unique role in India's economy as well as help improving the income of the people with enhanced participation of women. Cultivation of these crops is labour intensive and as such they generate a lot of employment opportunities for the women population. Fruits and vegetables are not only used for domestic consumption, but also are processed into various products – like pickles, preserves sauces, jam, jelly squash, etc.

In fact, across the states in north-eastern region like Sikkim, Meghalaya, Tripura, Mizoram, Nagaland and Arunachal Pradesh as also in Himachal Pradesh and Jammu and Kashmir in north, horticulture is a chief occupation among a large section of womenfolk. At the national scale, with more than 28.2 million tonnes of fruits and 66 million tonnes of vegetables, India is the second largest producer of fruits and vegetables in the world.

Another new foray vis-à-vis women employment and rural development has been witnessed in the state of Jharkhand. In quite a path-breaking measure and showing sensitivity to local sentiments, the state government has drawn out a scheme under which every village would comprise a water and sanitation committee where in compulsorily there will be a woman member from the village. That particular member of the committee would be identified as 'Jal Sahiya' (Water Friend) and in order to ensure her empowerment in that panel, it is also mandatory that the female member 'Jal Sahiya' would be the treasurer of the committee.

According to officials, this committee is responsible for implementation of water supply schemes in the villages. This has certainly ensured community participation and also better results.

Conclusion:

When it comes to women role in driving agro-economy, there is a need to examine carefully the implications of land tenure laws and regulations for women. In broad sense, the educational policies and funding could be changed to reflect the very high social and economic returns to women's primary education and literacy – more so about their knowledge in agri and allied sectors. Now importantly, one has to also examine the power and autonomy the woman enjoys when it comes to decision making vis-a-vis farm sector growth and development, use of land and marketing of the products.

Women in India have been often discriminated against men in human resource development with utter disregard to their actual and potential contribution to the agriculture progress in particular and national development in general. Various independent research have shown that the major decision makers in agricultural activities were men even though women – at times - performed more in agricultural related activities than men.

On an average, an estimate shows that a woman spends 14 hours a day working in and outside the home. Obviously, during harvesting season she spends about 16 hours a day. But when it comes to agro-economy decisions – in her fields - women have less importance. These are also because women have less access to information about technology due to their limitation on educational status and relative isolation from public life – often from modern tools of development like computer and even use of tractors etc. Some officials at the state levels say there are occasions when even the suggestions of knowledgeable rural women are ignored or are not taken seriously. Traditionally men have been major lawmakers!

Hence, what ought to be recommended is that there is need for evolving a system wherein women role in decision making enhances. This is certainly not possible only at the governmental level. The issue is more social than mere legislative or political.

But as an underlining theme these days is about 'change' – as a mantra, there is need for a cautious approach too. In Mizoram and Nagaland, for instance, women enjoy all liberty and perhaps more in many ways as compared to their counterparts elsewhere in the country. But traditionally there have been oppositions to electing women as legislators. In Mizoram, with regard the Food Security Act – the clause that 'woman' should be made head of the family was opposed by the state government officially.

Therefore, the policy changes , as one is underlining , thus needs to be tailor-made based on the local requirements and keeping in tune with local sentiments and customs and traditions. It is often said human societies operate by standards of average performance. They sustain themselves by practicing the familiar. Traditionally Indian society has been synonymous following a treaded path.

There is another twist in the tale.In some states, studies have revealed that states like Uttar Pradesh, which is primarily an agrarian economy, female participation rates are low as compared to male worker and majority of female workers (85.4%) in rural areas are engaged in agriculture.

But it is also true that in recent times, the rural economy of Uttar Pradesh has witnessed major change in last two decades. Agriculture is also about farm and non – farm sectors.

During 1993-94 to 2004-05, employment growth in agriculture in UP was lower (1.2%) compared to non-farm employment growth (4.76%). But male activities in rural-non-farm-sector rose considerably from 18.1per cent to 33 per cent over the period 1972-73 to 2004-05; female participation in non-farm employment accounted for only a marginal change from 15 per cent to about 17 per cent.

Studies also reveal that in Uttar Pradesh itself, different regions have different stories of women participation due to plethora of factors.

In some regions, again governmental efforts have brought in phenomenal results in improving women participation in economic exercises. Non-farm employment avenues generally have benefitted men more than women largely due to education and skill factors. Therefore, we have higher percentage of women in agriculture than men and this percentage is mostly lower in case of non agricultural sector.

However, there are regions wherein it has been found that around 60-70 per cent women of eastern UP are working in non -agricultural sector. In states like Madhya Pradesh, Tripura and Jharkhand, field evidence suggests that MG- NREGA is providing better and more job opportunities to female workers. This has also resulted in higher work participation among female in non agricultural activity. However, in many places it has been found that the most disturbing trend is that a large percentage of women are working as casual labour.

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SWABHIMAAN: INTEGRATING SWACHHTA WITH NUTRITION, HEALTH AND LIVELIHOOD

Swachh Bharat Mission is in full swing across the country with significant milestones achieved during last three years. New and innovative approaches are being adopted every day to fulfill the dream of a clean and healthy India. One such project is – *'Swabhimaan'* by UNICEF.

The *'Swabhimaan'* project has been designed bearing this in mind the fact that- packaging the sanitation agenda alongside nutrition, health and livelihood components finds far greater acceptance among the villagers rather than sanitation on its own. The programme engages women self help groups (SHGs) to integrate all these elements to achieve open defecation free (ODF) communities and eventually leads to their empowerment.

With support from IKEA Foundation, it is a promising and potentially convergent platform to reach out to adolescents and women. It provides a package of health and nutrition services at the Gram Panchayat Level Federations (GPLF) of women SHGs, under the Deendayal Antayodaya Yojana - National Rural Livelihood Mission (DAY-NRLM).

In Odisha, the ongoing integrated programme is being implemented in Koraput block of Koraput district and Pallahara blocks of Angul district since 2016. In fact, among the 10 *sutras* or principles by which SHGs operate, water, sanitation and hygiene (WASH) now figures prominently. Further, a WASH module has been included in the training of SHGs.

As far as the ODF drive is concerned, the SHGs are leading it with as many as 106 out of 111 households in the Nigamaniguda village having constructed their toilets, of which 88 households are currently using toilets.

It's been a year now since the launch of *'Swabhimaan'* and there is ample evidence of women's empowerment. This empowerment is evident in regular use of toilets, taking of loans to build toilets and monitoring usage – all carried out by SHG members who also act as natural leaders.

Clearly, the *'Swabhimaan'* project is not only bringing about behaviour change towards adopting safe sanitation practices, but also empowering women through various projects.

There has been amazing participation and drive by women from within the communities. Now their efforts to create ODF communities are not an activity in isolation but a part of a wider approach towards empowerment.

In the areas of nutrition, health and livelihoods, *'Swabhimaan'* mobilizes trained community resource persons (CRPs) also called '*poshan sakhis*' to engage with SHGs through monthly meetings. They form adolescent girls' clubs and motivate them for secondary education. They also engage with '*Krishi Mitras*' (agriculture resource persons) and farmer producer groups on nutrition-sensitive

agriculture techniques, and support nutritionally at-risk women and newly-weds on food, care, livelihood linkages.

At Nigamaniguda village, the SHGs have prepared and implemented *Poshan* (nutrition) Micro Plan (PMP) on critical nutrition issues. These plans focus on important health issues like anaemia, malaria, identification of at-risk mothers, as well as prohibition of child marriage. Considerable focus is also given to Village Health and Nutrition Days (VHND) that are observed periodically where mothers and adolescent girls are counselled on key hygiene messages such as HWWS (hand washing with soap) and its linkage to maternal and child health.

Significantly, after being trained on minimal-cost cultivation of mixed vegetables, as many as 14 landless families have developed backyard kitchens. Further, SHG members are now accessing the Horticulture Department to buy the seeds of papaya, drumstick, banana and other vegetables.

UNICEF's pilot woman's/adolescents nutrition programme using the DAY-NRLM and SHGs as its multi-sector platform is also being undertaken in Chhattisgarh and Bihar.

Ministry of Information and Broadcasting observes Swachhta Pakhwada

Ministry of Information & Broadcasting observed 'Swachhta Pakhwada' from 16th January to 31st January, 2018. During this fortnight, a number of activities were undertaken by various media organisations under the Ministry to further the goals of Swachh Bharat Mission.

'Pakhwada' activities undertaken by the Ministry include-

i) *'Swachhta shramdaan'* was organised wherein , Secretary , Information and Broadcasting, Sh N K Sinha also took part along with other officials of the Ministry and media units.

ii) 'Swachhta Oath' by the staff was taken.

iii) Weeding of old files, disposal of waste like old furniture and unusable items. Cleaning and maintenance of office equipments and beautification of office premises.

iv) Organising essay/painting/debate competitions etc. on 'swachhta'.

v) Highlighting success stories on Swachh Bharat Mission through various media units of the Ministry.

vi) Engaging communities through special outreach programmes.

The Secretary, Ministry of Information and Broadcasting, Shri N.K. Sinha offering shramdaan, on the occasion of "Swachhata Pakhwada", in New Delhi on January 17, 2018.

vii) Publication of articles and success stories in Publication Division's journals – 'Yojana', 'Kurukshetra', Employment News, 'Bal Bharti'.

viii) Production and screening of films/documentaries on SBM.

ix) Generate awareness on 'swachhta' through all available means.

Swachh Survekshan - 2018

In October, 2015, the Swachh Bharat Mission team in the Ministry of Housing and Urban Affairs (MoHUA) conceptualized and introduced a healthy competition 'Swachh Survekshan' among cities to improve the status of urban sanitation in India.

Subsequently, 'Swachh Survekshan-2016' survey for the rating of 73 cities in January 2016 and 'Swachh Survekshan-2017' ranking 434 cities was conducted in January- February 2017.

Now, MoHUA now proposes to conduct its third survey to rank all 4041 cities based on assessment of progress from January 2017 till December 2017 under Swachh Bharat Mission-Urban (SBM-U).

The objective of 'Swachh Survekshan-2018':

To encourage large scale citizen participation and create awareness amongst all sections of society about the importance of working together towards making towns and cities a better place to live in. Additionally, the survey also intends to foster a spirit of healthy competition among towns and cities to improve their service delivery to citizens, towards creating cleaner cities.

The focus of **'Swachh Survekshan-2018'** been shifted from process and output based indicators to indicators focusing on outcome and sustainability.

The survey attempts to capture the progress in following 6 broad parameters –

1. **Collection and Transportation of Municipal Solid Waste:** to ensure that segregated dry and wet waste is collected daily from the households and our public areas are clean.
2. **Processing and Disposal of Municipal Solid Waste:** to encourage cities to process their waste and wherever possible recycle the dry waste.
3. **Sanitation related progress:** to verify whether city is ODF with access to toilet available for citizens. This year even all Petrol Pumps of the country are coming forward to offer their toilets as Public Toilets.
4. **IEC (Information, Education and Communication):** Whether cities have started campaigns promoting Swachh Survekshan, engaging citizens in waste management, maintenance of Community and Public Toilets etc.
5. **Capacity Building:** to assess whether officials in the ULBs were provided sufficient opportunities to attend trainings and go for exposure visits.
6. **Innovation and Best Practices:** This component has been introduced first time in this survey – encourage cities to come forward and share their best practices in Swachh Bharat Mission. It will help the country to learn how our cities have responded the call for **Make India Clean** and **ODF** by October 2019.

FAECAL SLUDGE MANAGEMENT: A CHALLENGE TO SWACHH BHARAT MISSION

Padma Kant Jha, Yogesh Kumar Singh

Decentralised treatment plant,, a much needed scenario for the country, will offer increased opportunities for private sector players, increased rate of employment, safe and healthy environment.To capacitate local bodies in meeting the challenges of increasing population and providing efficient faecal sludge treatment i.e. from emptying the pit to treatment facility is vital. If the right model of toilets are adopted, and local bodies are capacitated enough to tackle the problem of faecal sludge,the benefits relating to access to improved sanitation may be realised.

Swachh Bharat Mission, launched on 2nd October 2014, has helped the country in achieving 76 per cent coverage of rural households and more than 97 per cent coverage of urban households with sanitation facilities from 38 per cent in rural areas and 91 per cent in urban areas. The figures are eloquent enough that the Mission is progressing towards attaining its objective of getting Open Defecation Free (ODF) status by 2nd October, 2019.

As per Ministry of Drinking Water and Sanitation, Government of India, ODF is the termination of faecal-oral transmission, defined by

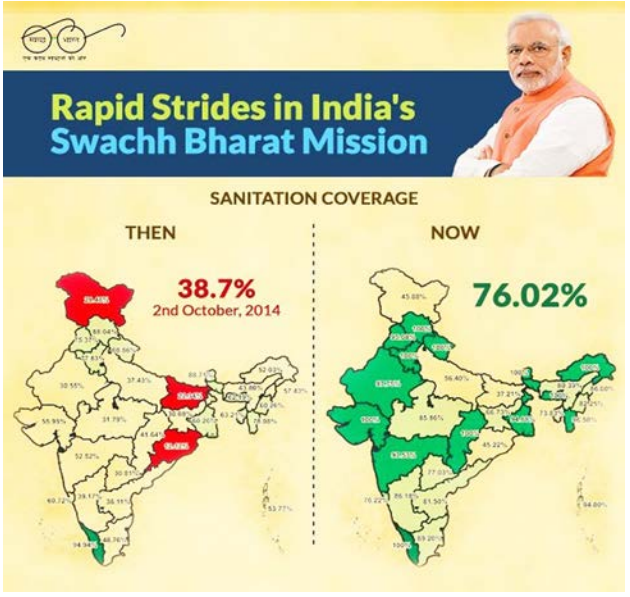
- No visible faeces found in the environment/ village.
- Every household as well as public/ community institutions using safe technology for disposal of faeces. The safe technology options mean:

i. No contamination of soil surface, ground water or surface water.
ii. Excreta inaccessible to flies or animals.
iii. No handling of fresh excreta.
iv. Freedom from odour and unsightly conditions.

Ministry of Drinking Water and Sanitation has developed a real-time monitoring platform for the number of toilets constructed, but the type of toilet which is an important indicator is missing in the Ministry's monitoring format. It is essential to go down to grassroots level and monitor the type of toilets being constructed under the Mission.

To understand the changing situation of rural sanitation on the ground, a survey called 'Swachh Survekshan-Gramin' was conducted through Quality Council of India on the direction of Ministry of Drinking Water and Sanitation. According to the survey, around 91 per cent of rural households, which have access to toilets, are using it.This shows the success of the Mission. The survey also focused on the reasons for the toilets not being used even if households have access to it. The survey data tells that apart from old habit of open defecation as a major constraint for not using the toilets, 31.97 per cent households do not use toilets because of their under-construction status, broken seat and overflowing pits. Other reasons for not using the toilets are lack of water (10.33%), can't sit on the toilet (3.25%), foul smell (1.41%), darkness in the toilet (1.11%) and no air circulation (0.91%). This poses the technological challenge to the Mission.

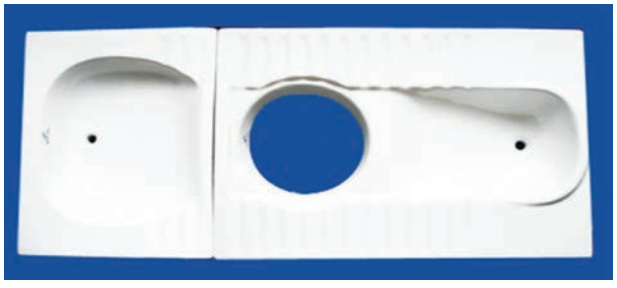
The overflowing pits, foul smell, darkness in the toilet, no air circulation and non-availability of water have been the reasons for the toilets not being used by some beneficiaries. It might be the case that the toilets which are being used may not be used in future, due to same reasons, posing a challenge to the Mission. The beneficiaries, who have availed the financial assistance from the Government for constructing sanitation facilities, will not be eligible for seeking financial assistance again which might defeat the objective of ODF under the Mission. Poor quality of toilets has been one of the reasons that earlier sanitation programmes were not successful and the same should not be repeated in case of this Mission.



Faecal Sludge Management is an important aspect associated with the sanitation facilities. Faecal sludge includes flush water, cleansing materials and excreta that go into the on-site containment. But water closet flush toilets or toilets requiring more water for flushing, pose a challenge to the faecal sludge management. For most of the cities and villages, Sewage Treatment Plant (STP) is still an awaited phenomenon. In such condition, treatment of faecal sludge at unit level becomes essential. It is an emerging challenge under the Mission. Due to dense population across the country and absence of sewage connection to each household, it is necessary to adopt onsite treatment facility or decentralised waste management.

Ministry of Drinking Water and Sanitation has been conducting several awareness programmes for popularising the twin pit model of toilets. However, the report of Swachh Survekshan states that out of total households surveyed, 40.87 per cent are having access to single pit toilets followed by 31.93 per cent and 23.89 per cent households are having access to toilet with septic tank and double pit toilet respectively.

The single pit latrine is the super-structure having a pit in which urine, faeces and water used for cleansing get collected. This single pit toilet takes a long time to fill up when there is minimum use of water. But in Indian scenario where water is an inseparable part of using toilets and if the pit is permeable and ground water table is high, it will let the water percolate from faecal sludge to ground-water. Both instances pose a challenge for sustainable use of the toilets as well as protecting ground water from contamination. On the other hand, once the pit is filled, emptying the pit is another challenge. Apart from this, the beneficiaries will have to find an alternate option to the existing toilets for the duration between the pit getting completely filled and emptying it. In nucleated densely populated villages, emptying the toilets is more difficult than in villages with the dispersed population. But in cities, many septic tanks are typically constructed under the house without access to suction vehicle. As most of the local bodies are not capacitated enough for emptying the septic tank, the role of private player comes into picture which should not only clean the septic tank, but also dispose of the faecal sludge safely.



EcoSan Toilet

There are some other issues related to septic tanks. As per Bureau of Indian Standards (BIS) direction, at least two chambers separated by a partition must be built for septic tanks having capacity over 2000-litre. Such standards are not being followed in rural as well as in urban areas which result in construction of a single chamber tank having overflow pipe. Overflow from such source sometimes causes contamination of drinking water. A scientific mechanism is very much needed to be developed by the local bodies to clean this kind of septic tanks periodically and treat the waste.

Flushing in an open area or in open drain is also a major problem in rural and urban areas. STPs are being used by a few Municipal Corporations only. STPs can't be economically viable unless the rainwater, storm-water and waste water are separated, as mixing of additional water with faecal sludge puts an extra burden on STP. So the country should move on to the technologies which require no water or less water in sanitation facilities.

In an article titled Septage: Kerala's Looming Sanitation Challenge by Suseel Samuel, it is mentioned that after covering households with the toilets in Kerala, the community is facing other challenge of periodic cleaning of septic tank and safe disposal of septage. He mentioned that most of activities related to emptying tank are taken up between 10 p.m. to 5 a.m. and the septage is dumped in open space in absence of mechanism for safe disposal.

Using more water in toilets not only leads to the loss of scarce water resource , but also delays the composting process. Sulabh Foundation, a famous agency in the area to sanitation sector, founded by Mr Bindeshwar Pathak, has developed a toilet pan with a slope of 25 to 28 degree that needs only 1 to 1.5 litres of water for flushing.This helps in conserving water as well as stimulates the quick composting process.

The other alternative for the toilets with the septic tank is EcoSan toilet which is a low cost toilet, does not need water, and is appropriate in both water scarce areas and areas with the higher water table in rural areas. The basic principle of the toilet is recycling of nutrients from excreta and using them for agricultural purposes. Earth/ash must be used to cover excreta after every use and cover the tank with lid when the toilet is not in use.In EcoSan toilet, once the pit is filled, it is closed and sealed. The excreta collected in the chamber for six to nine months for allowing it to decompose and get composted.The compost harvested from the chamber is used as manure in the agricultural fields. During this period, the user can switch to another pit.

Solar-powered self-cleaning toilet

Solar-powered self-cleaning toilet is a new technology developed in recent years. These automated, sleek and stainless steel toilets are designed in such a way that it can be installed in any location even if access to electricity and treatment facility of faecal sludge is not available. Being an automated toilet, this toilet flushes itself after every use, using a minimum amount of water which is determined through sensors: On an average, each flush uses 1.5 litres of water, compared to the 8-10 litres used by a normal flush. Its floor is automatically washed after every tenth use. The lights turn on automatically and draw power from a built-in solar panel. There are also provisions for waste treatment using anaerobic bio-degradation. The great thing about this energy efficient toilet is the fact that facilities can be stacked on to the basic framework. This kind of technology is best suited for public toilets both in rural and urban areas. Even for slums, we need technologies which have inbuilt faecal treatment facilities.

Bio-digester toilets are also very useful in the scenario where effective faecal sludge treatment process is not available.Bio-digester toilets were initially designed for the armed forces by Defence Research Development Organization's (DRDO) research lab in Gwalior for installation at places of high altitudes. The purpose of designing such toilets was to avoid manual scavenging and safe disposal of the excreta. Earlier the persons were deployed to collect the waste from deep pits of the toilets and the waste was incinerated using energy, as low temperature does not allow the process of natural biodegradation of the waste. At higher altitude, this kind of toilets is installed with a solar panel of 240 watts for generating the needed heat for processing of the waste. Such toilets are designed to convert human waste into gases and manure. However, micro bacteria used for bio-digester toilets break down human excreta into usable water and gas. Bio-digester toilets have bio-digester tank where anaerobic digestion takes place. Produced Methane gas through these tanks can be utilised for firing up gas stoves and generating electricity while the leftovers can be used as manure for gardening and farming. As this kind of toilets do not have any geographical or temperature limitation, it can be installed anywhere, moreover, it does not require to be connected to sewerage networks. These kinds of toilets have shown success after installing in houseboats in Srinagar and Indian Railways. Being Suitable for installation in high water table areas, these type of toilets have been installed in Lakshadweep on a large scale.

Bio-digester Toilet

The cost of bio-digester toilets is higher than the financial assistance provided for construction of toilet under Swachh Bharat Mission but may be found as economically feasible if the cost involved in collection and transportation of faecal sludge from septic tank to treatment plant or setting up sewage system, cost of land for setting up and running cost of STP are considered. The cost of bio-digester toilet may also be brought down by taking up mass production, creating awareness and generating demand among the masses.

The above-mentioned sanitation models are best suited for areas where sewage system is not in place. It is high time to move on from centralised approach of sludge treatment to decentralised approach. Furthermore, it has been found that centralised approach seeks high-cost involvement along with intervention from the different Ministries and departments. Decentralised treatment plant,, a much needed scenario for the country, will offer increased opportunities for private sector players, increased rate of employment, safe and healthy environment.To capacitate local bodies in meeting the challenges of increasing population and providing efficient faecal sludge treatment i.e. from emptying the pit to treatment facility is vital. If the right model of toilets are adopted, and local bodies are capacitated enough to tackle the problem of faecal sludge,the benefits relating to access to improved sanitation may be realised.

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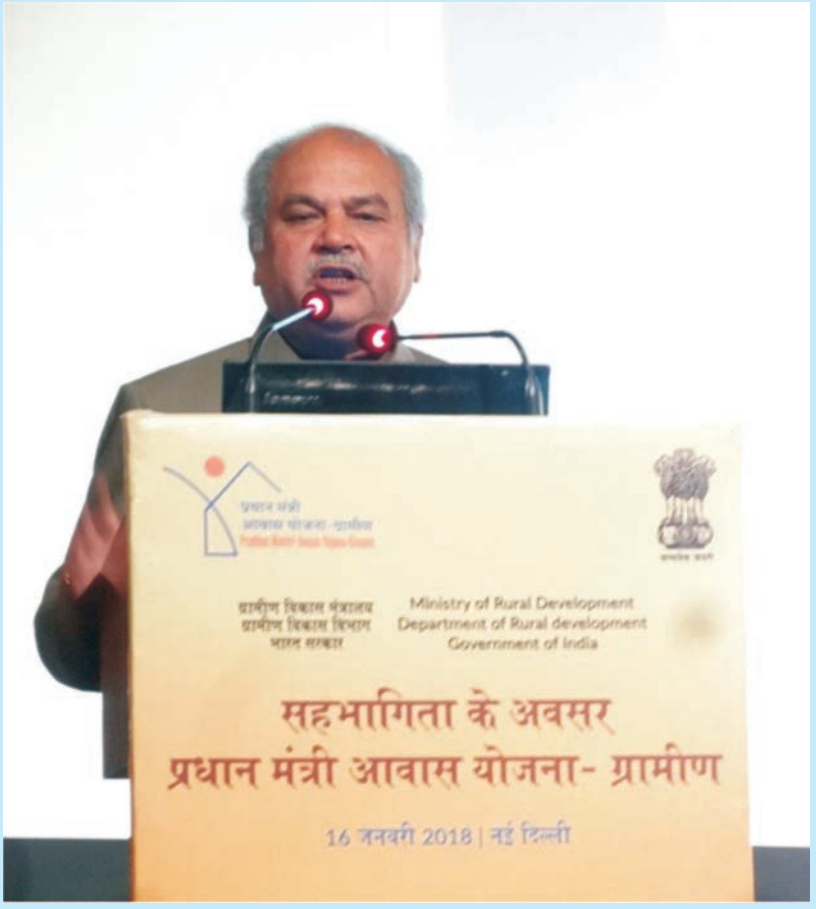
Rural Development Ministry organises workshop on PM Awaas Yojana (Gramin)

Union Ministry for Rural Development organised a workshop on *Pradhan Mantri Awaas Yojana – Gramin* on 16th January, 2018. The workshop was themed on 'Exploring Collaboration – Pradhan Mantri Awaas Yojana – Gramin' and was focussed on speeding up construction while maintaining the quality of houses built under PMAY-G.

The workshop was inaugurated by the Union Minister for Rural Development, Panchayati Raj and Mines, Shri Narendra Singh Tomar. Speaking on the occasion, he said that as on date, more than 16 lakh rural houses had been built and there was a target of building 1 crore rural houses across the country.



The Union Minister for Rural Development, Panchayati Raj and Mines, Shri Narendra Singh Tomar addressing the Workshop on PM Awaas Yojana (Gramin)

Pradhan Mantri Awaas Yojana (Gramin) was launched by the Prime Minister Shri Narendra Modi on 20th November, 2016 with an aim of "Housing for All" in rural areas. Under this scheme, the Government proposes to provide an environmentally safe and secure *pucca* house to every rural household by 2022. In its first phase the target is to complete one crore houses by March 2019. The unit cost for these houses has been significantly increased and now through convergence a minimum support of nearly Rs. 1.5 lakh to Rs. 1.6 lakh to a household is available. There is also a provision of Bank loan upto Rs. 70,000/-, if the beneficiary so desires. The selection of beneficiaries has been through a completely transparent process using the Socio Economic Census 2011 data and validating it through the Gram Sabha.

A large scale use of local materials is envisaged along with a complete home with cooking space, electricity provision, LPG, toilet and bathing area, drinking water etc through convergence. The programme targets the poor households and uses ICT and space technology to further confirm correct selection of beneficiaries and progress of work. The entire payments are through IT/DBT mode with Aadhaar linked Bank accounts with consent, to ensure complete transparency and accountability.