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New Technologies in Agricultural Development

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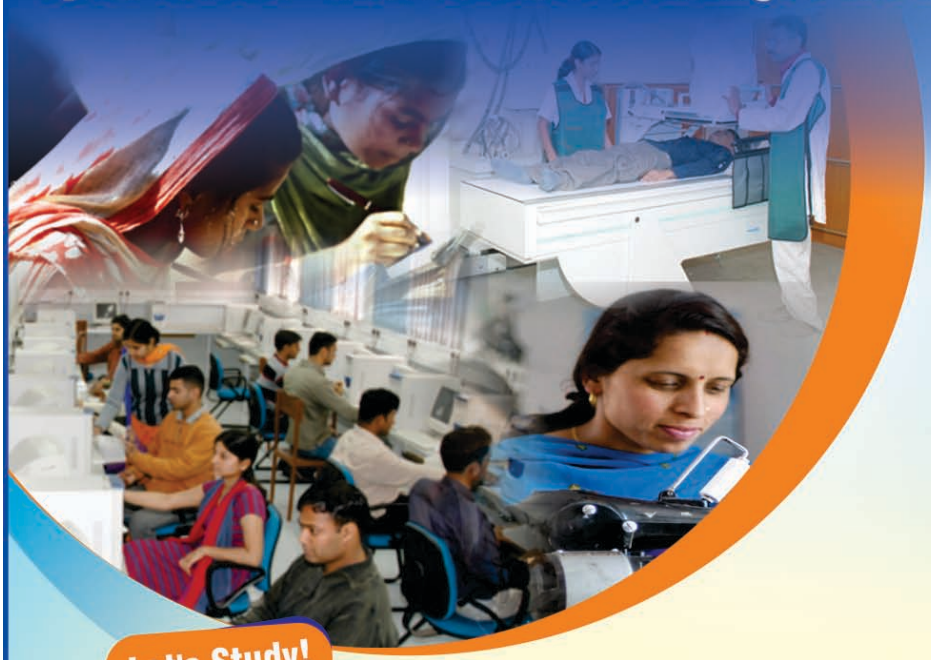

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INSIDE

To feed the growing population, agriculture productivity has to be increased using new technologies, including biotechnology and nanotechnology. The technology deficit gap needs to be filled on fast track basis to match productivity ratios with the rest of the world.

The 11th Five Year Plan (2007-12) witnessed an average annual growth of 3.6 per cent in the gross domestic product (GDP) from agriculture and allied sector. The growth target for agriculture in the 12th Five Year Plan is estimated to be 4 per cent.

New technologies are needed to push the yield frontiers further, utilize inputs more efficiently and diversify to more sustainable and higher value cropping patterns. These are all knowledge intensive technologies that require both a strong research and extension system and skilled farmers but also a reinvigorated interface where the emphasis is on mutual exchange of information bringing advantages to all.

Utilization of resources, effectively, is the driving force behind the use of all agricultural technologies Several resource conservation technologies are being used including zero and reduced tillage, green manuring, crop rotations etc. Zero tillage in wheat is reported have reduce the production costs by 2000 to 2500 Rupees per hectare and 15-20 per cent saving in irrigation water. Similarly by using drip and sprinkler type of irrigation methods more area can be brought under irrigation. Use of Farm Yard Manure (FYM), Compost, and Bio fertilizers help reduce over dependence on the chemicals led intensive cultivation.

Boosting agricultural growth is essential for inclusive growth because this sector sustains livelihood of 65 per cent of the population. However, agriculture contributes only 14 per cent to Gross Domestic Product (GDP).

Several revolutions in agriculture have taken place to boost the sector. These include the Green Revolution, Evergreen Revolution, Blue Revolution, White Revolution, Yellow Revolution, Bio-technology Revolution, ICT Revolution.

While nearly all relevant technologies and know how required, is available with us, what is required is extension of these developed systems to the field. Agriculture Extension combined with adequate infrastructure is the key in agricultural growth. Involvement of the private sector would help absorption of technologies in the fields faster.

AGRICULTURAL DEVELOPMENT-*THE ROAD AHEAD*

Dr. Harender Raj Gautam and Rohitashw Kumar

India has a very high share of labour (55 %) with lesser contribution to farm mechanisation (40 %). India makes farming less remunerative and leads to farmers' poverty. While USA (2.5 %) and Western Europe (3.9 %) has very low share of labour in comparison to 95 per cent share of mechanization.

Agriculture needs technology infusion to accelerate the production so that food is accessible to the common man. According to 'The State of Food and Agriculture 2013' of the Food and Agriculture Organization (FAO) of the United Nations, 12.5 percent of the world's population (868 million people) are undernourished in terms of energy intake. Of these people, 852 million were reported to be citizens of developing countries. According to the estimates of the Food and Agricultural Organization (FAO), agricultural production would need to grow globally by 70 per cent by 2050 and more specifically by almost 100 per cent in developing countries, to feed the growing population alone. Pace of technology infusion should be fast. The study found that malnutrition accounted for a loss of 5 per cent of the world Gross Domestic Product (GDP) by way of lost productivity and expenditure on treatment. On the other hand, money spent on reducing malnutrition boosts earnings with a benefit-to-cost ratio of almost 13 to 1.

Productivity

Our country has made progress in agriculture but productivity of our major agricultural and horticultural crops is very low in comparison to other countries. Our agriculture is still technology deficit. Yields per hectare of food grain, fruits and vegetables in our country are far the below global averages. Our rice yield is one-third of China's, and about half of Vietnam's and Indonesia's. Even India's most productive states lag global average. Similarly, the productivity of pulses and oilseeds can be increased 2.3 to 2.5 times, through attention to seeds, soil health, pest management, crop life saving irrigation and post-harvest technology. India's population is expected to reach 1.5 billion by 2025, making food security most important social issue and food production will have to be increased considerably, to meet needs of growing population. India's food grain production reached the level of 259 million tonnes by 2011-12 and agriculture output (at farm gate prices) in 2011 was valued at 12.69 lakh crores. India's export of agricultural and allied products has increased from Rs. 1, 78,800 crore in 2011-12 to Rs. 2, 01,000 crore in 2012-13, registering a growth of nearly 11 per cent. According to the FAO, India is still home to some 217 million undernourished people, or a quarter of all undernourished people globally. There is urgent need to embrace new technologies like biotechnology, nanotechnology, high-tech protected cultivation and modern irrigation methods to accelerate agriculture production.

Biotechnology

Use of biotechnological tools in agriculture could make food crops high yielding and more robust to biotic and abiotic stresses. This could stabilize and increase food supplies, which is important against the background of increasing food demand, climate change and land and water scarcity. In 2012, 170 million hectares (ha) by more than 17 million farmers in around 12 per cent of the global arable land were planted with genetically modified (GM) crops, such as soybean, corn, cotton, and canola, but most of these crops were not grown primarily for direct food use. In India, genetically modified cotton- Bt cotton was first commercialized in 2002 and in 2012, over 7 million farmers had adopted this technology on 10.8 million ha area which is equivalent to 93 per cent of the country's total cotton area. Bt cotton has certainly increased the profitability of the farmers and simultaneously reduced the use of chemical pesticides in this crop drastically. Studies suggest that the introduction of Bt technology has reduced food insecurity by 15 – 20 per cent among Indian cotton growers. But, the use of genetically modified crops was restricted to cotton only due to concerns echoed by various environmentalist groups. But, now the Central Government has allowed the trials of other GM crops also which will give a momentum for adoption of other GM crops. The government has approved 17 GM crops of 8 traits which are of virus- and bacteria-resistant as in 2012. The country has also developed golden rice which is rich in ß-carotene. This is a great solution for India as nearly 5,000 children go blind every year because of ß-carotene deficiency.

Nanotechnology

Nanotechnology can be used in agriculture in many ways. It can help in promoting soil fertility and balanced crop nutrition; effective weed control; enhancing seed emergence using carbon nanotubes; delivery of agriculture chemicals, field-sensing systems to monitor the environmental stresses and crop conditions and improvement of plant traits against environmental stresses and diseases. Applications within animal husbandry might include improving feeding efficiency and nutrition of agricultural animals, minimizing losses from animal diseases, and turning animal by-products and waste and environmental concerns into value-added products. Nanotechnology offers considerable opportunities for the development of innovative products and applications for agriculture, water treatment, food production, processing, preservation and packaging, and its use may bring potential benefits to farmers, food industry and consumers alike. Nanotechnology-based food and health food products and food packaging materials are already available to consumers in some countries and additional products and applications are currently in the research and development stage and some may reach the market soon. In view of such progress, it is expected that nanotechnology-derived food products will be increasingly available to consumers worldwide in the coming years.

The use of nano size silver particles as antimicrobial agents has become more common as technology advances, making their production more economical. Since silver displays different modes of inhibitory action to microorganisms, it may be used for controlling various plant pathogens in a relatively safer way compared to commercially used fungicides. Silver is known to affect many biochemical processes in the microorganisms including the changes in routine functions and plasma membrane. Nanoparticles are also effective against insects and pests. Nanoparticles can be used in the preparation of new formulations like pesticides, insecticides and insect repellants. It can be used to deliver DNA and other desired chemicals into plant tissues for protection of host plants against insect pests. Porous hollow silica nanoparticles (PHSNs) loaded with validamycin (pesticide) can be used as efficient delivery system of water-soluble pesticide for its controlled release. Such controlled release behaviour of PHSNs makes it a promising carrier in agriculture, especially for pesticide controlled delivery whose immediate as well as prolonged release is needed for plants. Nanotechnology has a huge potential in revolutionizing the food packaging. Nanoparticles such as titanium dioxide, zinc oxide and magnesium oxide, as well as a combination of them, once functionalized can be efficient in killing micro-organisms and are cheaper and safer to use than metal based nanoparticles.

Protected Cultivation

Protected cultivation or greenhouse cultivation is the most promising area where production of horticultural crops has improved qualitatively and quantitatively world over in the last few decades. Presently, Spain, the Netherlands and Israel are the

leaders in cultivation of crops in polyhouses and greenhouses. Spain has maximum area of around 70, 000 ha under protected cultivation. The application of Plasticulture can substantially decrease the costs and therefore can lead to high productivity with a better quality of crops. In India, the area under protected cultivation is presently around 25,000 ha while the greenhouse vegetable cultivation area is about 2,000 ha. India and the Netherlands having more or less same land under flower cultivation but in world's flower export, the Netherlands' contribution is 70 per cent and India's contribution is just 1 per cent or even less because of advanced technology of poly houses in the Netherlands. In the Netherlands, glasshouse cultivation covers less than 1 per cent of agricultural land but accounts for 40 per cent of the annual gross income from agriculture with annual crop revenue as high as 600,000 €/ha. Faced with constraints of land holdings, rapid urbanization, declining crop production, declining biodiversity and ever increasing population, demand for food, especially vegetables has increased manifold and protected cultivation has offered a new dimension to produce more in a limited area. Polyhouses can also be used for rain water harvesting. The rough annual demand for a 175 square metre poly-house is of the order of 52,000 litres. The semi-annual demand for a crop of duration six months is 26,000 litres of water. In a place with an annual rainfall of 400 mm, the rainwater falling on the roof of the poly-house is of the order of 70,000 litres. Assuming a collection efficiency of 80 per cent, 56,000 litres of rainwater can be harvested, which is more than the annual demand.

Farm Mechanization

India has a very high share of labour (55 %) with lesser contribution to farm mechanisation (40 %). India makes farming less remunerative and leads to farmers' poverty. While USA (2.5 %) and Western Europe (3.9 %) has very low share of labour in comparison to 95 per cent share of mechanization. Power is the major crunch in mechanization as only 1.36 kw/ ha power is used in India in comparison to 8.75 kw/ ha in Japan. Similarly, our country is far behind Japan with 461.2 number of tractors and 236.9 combine harvesters per hectare in comparison to 15.75 number of tractors and 0.026 combine harvesters per hectare. One of the major bottlenecks in farm mechanization in India is 138 million land holdings which are very large in comparison to only 2 to 3 per cent of the population having landholdings in USA. In spite of rapid farm mechanization (149 million farm machinery), the Indian farming employs 263 million farm workers to cover 140 million hectares of total cultivated land. Farm mechanization and use of modern gadgets/ machines/ equipments/ tools for timely and effective completion of different operation in agricultural field is one of the most important factors for maximizing profitability. Smaller machines suitable for horticultural operations in the hills and mountains will also enhance operation effectiveness and farm income. Farm mechanization will help to enhance the overall productivity and production with the lowest cost of production. Farm mechanization can help in 15-20 per cent savings in seeds, 15- 20 per cent savings in fertilizers, 5-20 increase in cropping intensity, 20-30 per cent savings in time, 20- 30 per cent reduction in manual labour and 10- 15 per cent overall increase in farm productivity.

Use of Modern Irrigation Methods

Availability of water is most critical for increasing the productivity in agriculture. In India, around 78 per cent water goes to the agriculture sector, while the remaining part shared out between drinking, industry and other usage. Therefore, it is required that water storage facilities to be increased in the country to 450 million cubic meter by 2050. Dry land agriculture should be the main focus area as more than 60 per cent of the cultivated area in the country is without irrigation. The water use efficiency under conventional flood method of irrigation, which is predominantly practised in Indian agriculture, is very low due to substantial conveyance and distribution losses. Recognizing the fast decline of irrigation water potential and increasing demand for water from different sectors, a number of demand management strategies and programmes have been introduced to save water and increase the existing water use efficiency in Indian agriculture. Irrigation is crucial to the global food supply as the 18 per cent of the world's irrigated farmland yields 40 percent of the world's food. Still, less than 4 per cent of the world's irrigated land is equipped with micro-irrigation systems. There is need to adopt modern methods of irrigation like drip and sprinkler irrigation. Compared with conventional flood or furrow irrigation, drip methods can reduce the volume of water applied to fields by up to 70 percent, while increasing crop yields by 20-90 per cent. Dramatic gains have occurred in China and India,

where the area under micro-irrigation expanded 88-fold and 111-fold, respectively, over the last two decades. India now leads the world, with nearly 2 million hectares (about 5 million acres) under micro-irrigation methods. But, still there is tremendous potential to go way from use of underground water to adoption of such methods by harnessing the vast potential of rainwater.

Irrigation water must be applied at the right time and right amount, but climate change will affect the irrigation demand as well as the quantity and timing of water availability, with consequences for the performance of reservoirs, tube wells and other on-farm irrigation infrastructures. It is necessary to develop, conserve, utilize and economically manage this critically important resource on an integrated basis so as to meet the ever-growing demand for agriculture, industry and domestic use. The modern techniques of irrigation will increase irrigation potential and stretches out in the direction of the optimal utilization of water resources through optimum irrigation scheduling i.e., determination of accurate crop water requirement through micro irrigation. Micro irrigation is advance techniques of irrigation will increase water use efficiency and crop productivity.

Modernize Technology Transfer Tools

Technology transfer in agriculture should focus on key interventions at different stages of the crop from sowing of the seed, crop protection and harvesting, post-harvest management to marketing. Technology transfer needs effective interactive groups like Self Help Groups and Farmers Clubs which should become tools of disseminating information about various government sponsored schemes and these entities will help in liaising with various government departments for developmental activities. As central government has ambitious programme of connecting every Gram Panchayat of the country with internet facilities. These Gram Panchayats should become technology transfer hubs to the farmers. Internet and mobile phones are potential tools to Impart knowledge on new developments, improved methods of cultivation /technologies in the field of agriculture. These tools can also be useful in dissemination of weather data and agro climatic conditions, latest information on prices of agriculture produce to farmers. Krishi Vighyan Kendras (KVKs) have been established in each district of the country and now these are the backbone of technology dissemination in our country. There are 637 KVKs in the country with the mandate to function as knowledge and resource centres of agricultural technology at the district level which could increase the technology adoption rate. These KVKs should work as technology umbrella in the district and should work in an integrated way with state departments of Agriculture, Horticulture and other sister departments in the district for effective delivery of the technology and inputs in an effective way. Village Knowledge Centres and online databases in local languages should be established. Fast technology dissemination will certainly reduce the knowledge deficit with the farmers and will help in accelerating the stagnant growth of agriculture, realizing higher potential of our land and hard work of our farmers.

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NEW WAYS OF IMPROVING AGRICULTURE

Sabita Kumari

Agriculture in India has a significant history. Today, India ranks second worldwide in farm output. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India.

Problems in Agriculture

"Slow agricultural growth is a concern for policymakers as some two-thirds of India's people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and India's yields for many agricultural commodities are low. Poorly maintained irrigation systems and almost universal lack of good extension services are among the factors responsible. Farmers' access to markets is hampered by poor roads, rudimentary market infrastructure, and excessive regulation." (World Bank: "India Country Overview 2008")

"With a population of just over 1.2 billion, India is the world's largest democracy. In the past decade, the country has witnessed accelerated economic growth, emerged as a global player with the world's fourth largest economy in purchasing power parity terms, and made progress towards achieving most of the Millennium Development Goals. India's integration into the global economy has been accompanied by impressive economic growth that has brought significant economic and social benefits to the country.

Technological Needs and Future Agriculture

It is apparent that the tasks of meeting the consumption needs of the projected population are going to be more difficult given the higher productivity base than in 1960s. There is also a growing realization that previous strategies of generating and promoting technologies have contributed to serious and widespread problems of environmental and natural resource degradation. This implies that in future the technologies that are developed and promoted must result not only in increased productivity level but also ensure that the quality of natural resource base is preserved and enhanced. In short, they lead to sustainable improvements in agricultural production.

Productivity gains during the 'Green Revolution' era were largely confined to relatively well endowed areas. Given the wide range of agro-ecological setting and producers, Indian agriculture is faced with a great diversity of needs, opportunities and prospects. Future growth needs to be more rapid, more widely distributed and better targeted.

Responding to these challenges will call for more efficient and sustainable use of increasingly scarce land water and germplasm resources.

New technologies are needed to push the yield frontiers further, utilize inputs more efficiently and diversify to more sustainable and higher value cropping patterns. These are all knowledge intensive technologies that require both a strong research and extension system and skilled farmers but also a reinvigorated interface where the emphasis is on mutual exchange of information bringing advantages to all. At the same time potential of less favoured areas must be better exploited to meet the targets of growth and poverty alleviation.

These challenges have profound implications for products of agricultural research. The way they are transferred to the farmers and indeed the way research is organized and conducted. One thing is, however, clear – the new generation of technologies will have to be much more site specific, based on high quality science and a heightened opportunity for end user participation in the identification of targets. These must be not only aimed at increasing farmers' technical knowledge and understanding of science based agriculture but also taking advantage of opportunities for full integration with indigenous knowledge. It will also need to take on the challenges of incorporating the socio-economic context and role of markets.

With the passage of time and accelerated by macro-economic reforms undertaken in recent years, the Institutional arrangements as well as the mode of functions of bodies responsible for providing technical underpinning to agricultural growth are proving increasingly inadequate. Changes are needed urgently to respond to new demands for agricultural technologies from several directions. Increasing pressure to maintain and enhance the integrity of degrading natural resources, changes in demands and opportunities arising from economic liberalization, unprecedented opportunities arising from advances in biotechnology, information revolution and most importantly the need and urgency to reach the poor and disadvantaged who have been by passed by the green revolution technologies.

Here are 12 of the most advanced agricultural technologies employed today:

1. Tractors on autopilot

Thanks to GPS tractors, combines, sprayers and more can accurately drive themselves through the field. After the user has told the onboard computer system how wide a path a given piece of equipment will cover he will drive a short distance setting A & B points to make a line. Then the GPS system will have a track to follow and it extrapolates that line into parallel lines set apart by the width of the tool in use.

These systems are capable of tracking curved lines as well. The tracking system is tied to the tractor's steering, automatically keeping it on track freeing the operator from driving. This allows the operator to keep a closer eye on other things. Guidance is great for tillage because it removes human error from overlap, saving fuel and equipment hours. Trust me when I tell you that once you starting auto tracking, you'll never go back manual steering.

2. Swath control and variable rate technology

Building on GPS technology are swath control and Variable Rate Technology VRT. This is where guidance really begins to show a return on investment. Swath control is just what it sounds like. The farmer is controlling the size of the swath a given piece of equipment takes through the field. This video is a great visual representation of how swath control works.

The savings come from using fewer inputs like seed, fertilizer, herbicides, etc. Since the size and shapes of fields are irregular you are bound to overlap to some extent in every application. Thanks to GPS mapping the equipment in the field already knows where it has been. Swath control shuts off sections of the applicator as it enters the overlap area, saving the farmer from applying twice the inputs on the same piece of ground.

VRT works in a similar fashion. Based on production history and soil tests a farmer can build a prescription GPS map for an input. By knowing what areas of a field are most and least productive the application rate of an input like fertilizer can be tailored to increase or decrease automatically at the appropriate time. This is a big benefit for farms. Instead of applying a set rate of fertilizer over the entire field (many times a high rate to help those low producing areas) an operator can now apply a rate most effective for a particular section of ground.

3. Your tractor is calling

Telematics is being touted as the next big thing in agriculture. This technology allows equipment to talk to farmers, equipment dealers, and even other

equipment. Imagine you have a problem in the field and have to stop working. With telematics your dealer can access the onboard diagnostic system of your tractor. Depending on the problem they might be able to fix your equipment right from dealer. No waiting on a mechanic to drive out to wherever you might be. You're back to work, and the dealer saved a trip too. Farmers will be able to keep track of what field equipment is in, fuel consumption, operating hours, and much more. Personally I've noticed on our farm as we become more technologically advanced our downtime is often caused by electrical, software, or hardware problems as opposed to mechanical.

Tractors can even communicate between themselves. The best example is a combine and a grain cart. Grain carts pull up next to harvesting equipment so the harvester can unload on the move without stopping to unload. Telematics can tell the grain cart operator when a combine is filling up with grain. Even better if one cart is chasing two combines.

4. Your cow is calling too

And it's not saying "Moo!" Collars developed for livestock are helping producers keep track of their herds. Sensors in the collar send information to a rancher's smartphone giving the rancher a heads up on where a cow might be, or maybe she's in some sort of distress, or maybe just in the mood for some mating. I suppose you could say it's kind of like telematics for cows.

RFID tags are also a handy device for livestock management. The information kept on a tag helps producers keep track of individual animals, speeding up and making record keeping more precise. I recently read about RFID tags placed in to hay as it is baled. Data such as moisture and weight can be stored in the tag to be scanned later.

5. Irrigate via smart phone

Mobile technology is playing a big role in monitoring and controlling crop irrigation systems. With the right equipment a farmer can control his irrigation systems from a phone or computer instead of driving to each field. Moisture sensors in the ground are able to communicate information about the level of moisture present at certain depths in the soil. This increased flexibility allows for more precise control of water and other inputs like fertilizer that are applied by irrigation pivots. Farmers can also combine this with other tech like VRT mentioned earlier to control the rate of water applied.

6. Sensing how your crop is feeling

This is taking variable rate technology to the next level. Instead of making a prescription fertilizer map for a field before you go out to apply it, crop sensors tell application equipment how much to apply in real time. Optical sensors are able to see how much fertilizer a plant may need based on the amount of light reflected back to the sensor. I haven't seen one of these systems in operation yet, but I'm keeping a close eye on them. It's fairly new and pretty expensive, but I see huge potential here. Crop sensors are going to help farmers apply fertilizer in a very effective manner, maximizing uptake and reducing potential leaching and runoff into ground water.

7. Field documentation

Because of onboard monitors and GPS the ability to document yields, application rates, and tillage practices is becoming easier and more precise every year. In fact farmers are getting to the point where they have so much good data on hand that it can be overwhelming to figure out what to do with all of it.

And of course, every farmer's favorite form of documentation is the yield map. It sums up a year's worth of planning and hard work on a piece of colorful paper. As harvesting equipments rolls through the field it calculates yield and moisture as it goes tying it in with GPS coordinates. When finished a map of the field is printed. These maps are often called heat maps. I liken then to weather radar maps. Each color on the map relates to a certain yield range. Now the farmer can see what varieties had the best, worst, or most consistent yield over varying conditions. Maps like this can tell a farmer how well a field's drainage system is working.

8. Biotechnology

Biotech or genetic engineering (GE) isn't new tech, but it is a very important tool with much more potential yet to be unleashed. The form of GE most people have probably heard of is herbicide resistance. The other would likely be insect resistant traits. Crops can be made to express toxins that control particular pests. Many employ Bt toxin that is the same toxin found in some organic pesticides. That means a farmer won't have to make a pass through his fields to apply pesticide, which not only saves on pesticide, but fuel, labor, and wear on equipment too.

New bioteches coming online right now are things like drought resistant traits and nitrogen use efficiency. What does that mean? In short it means that crops are going to be able to protect more potential yield in drought conditions. Another way to look at it would be that farmers who irrigate their crops can cut back on water use and not see yields suffer.

9. Don't forget to flush

Ray Prock dedicated a whole blog post on how he manages cow manure on his California dairy. I'm sure most people know that manure makes good fertilizer, but it's the method Ray uses to collect it for use that is so cool. An automatic system uses water to flush manure away from the cattle into a holding area where all the solid matter dries up. After it dries the solid manure can be picked up and further processed.

The liquid manure continues on into another area. From here it can be pumped out and used to fertilize Ray's crop or it can be sent back in to flush out more manure. A metering device lets him know exactly how much liquid is used so that just the right amount is placed on the crops. Excess nutrients are at risk of reaching groundwater, but Ray is all over that too. Irrigation runoff is captured in ponds and is recycled over and over again in the system.

10. Ultrasounds and more for livestock

They aren't just for checking on baby animals in the womb. Ultrasounds can be used to discover what quality of meat might be found in an animal before it goes to market. DNA testing helps producers identify animals with good pedigrees and other desirable qualities. This information can then be use to improve the quality of the herd which helps the farmer improve his bottom line.

11. There's an app for that

Mobile tech is big in agriculture and it's getting bigger all the time. Farmers and ranchers are using all the social media sites for all types of reasons. Some are using apps like foursquare to keep tabs on employees. You might even catch me on a twitter chat tweeting away right from the tractor cab. The tractor is driving itself and my hands are free so why not?

Apps can control irrigation and grain storage systems. Want to load grain into a truck without getting out of the cab? Load Out Technologies has you covered. I can't tell you how many times the flashlight app on my phone comes in handy. Even the camera can be put to work on the farm. If you think you might forget how something goes back together after you take it apart take a picture of it assembled. On my phone I have apps that show me soil type via GPS, agricultural news and markets, insect pests, calculations for mixing herbicide solutions, and one that tracks growing degree days. GDDs are an index based on temperature that gives a grower an idea of how mature a crop may be. If you plan on visiting the National Farm Machinery Show in Louisville, you won't have to carry around a map all day that shows vendors booths and event schedules. There's an app for that too.

12. Smile for the camera

Putting up cameras around the farm is a trend that's catching on. We have a rear-facing camera on the back of the combine that shows up on a monitor in the cab. I can think of all kinds of places to put cameras on large pieces of equipment to help eliminate blind spots. Our grain cart is wide enough that you can't see around it so I'd like to have one out back to I know if I'm holding up traffic when driving from field to field. Another idea would be to have a camera or two looking at the implement behind the tractor. Craning your neck around left and right all day to look behind you gets a little painful after a while.

Livestock managers are wiring up their barns, feedlots, and pastures with cameras that send images back to a central location like an office or home computer. They can keep a closer eye on animals when they are away or home for the night. Val Wagner told me she is setting up cameras to monitor cows during calving season. Her hope is that by being able to watch the cows during this critical time they can lessen the chance of calves being born outside on those well below zero North Dakota nights.

So now you're up to speed on some of the latest and greatest things going on in agriculture. It's all about more data, efficiency, and precision. Farmers and ranchers have a lot of awesome stuff to help them produce a bountiful harvest. So long as Mother Nature chooses to play along. She'll come up with at least one monkey wrench each year no matter what you do, but that goes with the territory.

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AGRICULTURAL DEVELOPMENT-POLICY DIMENSION

Lalan Kumar Mahto

The National Policy on Agriculture seeks to actualize the vast untapped growth potential of Indian agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro business, create employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization.

Rapid growth of agriculture is essential not only to achieve self-reliance at national level but also for household food security and to bring about equity in distribution of income and wealth resulting in rapid reduction in poverty levels. Indian agriculture has, since Independence, made rapid strides. In taking the annual food grain production from 51 million tonnes in early fifties to 206 million tonnes at the turn of the century, it has contributed significantly in achieving self-sufficiency in food and in avoiding food shortages.

Over 200 million Indian farmers and farm workers have been the backbone of India's agriculture. Despite having achieved national food security the well being of the farming community continues to be a matter of grave concern for planners and policy makers. The establishment of an agrarian economy which ensures food and nutrition to India's billion people, raw materials for its expanding industrial base and surpluses for exports, and a fair and equitable reward system for the farming community for the services they provide to the society, will be the mainstay of reforms in the agriculture sector.

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agro business, create employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization.

The salient features of the new agricultural policy are:

1. Over 4 per cent annual growth rate aimed over next two decades..
2. Greater private sector participation through contract farming.
3. Price protection for farmers.
4. National agricultural insurance scheme to be launched.
5. Dismantling of restrictions on movement of agricultural commodities throughout the country.
6. Rational utilization of country's water resources for optimum use of irrigation potential.
7. High priority to development of animal husbandry, poultry, dairy and aquaculture.
8. Capital inflow and assured markets for crop production.
9. Exemption from payment of capital gains tax on compulsory acquisition of agricultural land.
10. Minimize fluctuations in commodity prices.
11. Continuous monitoring of international prices.
12. Plant varieties to be protected through legislation.
13. Adequate and timely supply of quality inputs to farmers.
14. High priority to rural electrification.
15. Setting up of agro-processing units and creation of off-farm employment in rural areas.

Sustainable Agriculture

The policy will seek to promote technically sound, economically viable, environmentally non-degrading, and socially acceptable use of country's natural resources–land, water and genetic endowment to promote sustainable development of agriculture. Measures will be taken to contain biotic pressures on land and to control indiscriminate diversion of agricultural lands for non-agricultural purposes. The unutilized wastelands will be put to use for agriculture and afforestation. Particular attention will be given for increasing cropping intensity through multiple-cropping and inter-cropping.

Rational utilization and conservation of the country's abundant water resources will be promoted. Conjunctive use of surface and ground water will receive highest priority. Special attention will be focused on water quality and the problem of receding ground-water levels in certain areas as a result of over-exploitation of underground aquifers. Proper on-farm management of water resources for the optimum use of irrigation potential will be promoted.

Erosion and narrowing of the base of India's plant and animal genetic resources in the last few decades has been affecting the food security of the country. Survey and evaluation of genetic resources and safe conservation of both indigenous and exogenously introduced genetic variability in crop plants, animals and their wild relatives will receive particular attention. The use of bio-technologies will be promoted for evolving plants which consume less water, are drought resistant, pest resistant, contain more nutrition, give higher yields and are environmentally safe. Conservation of bio-resources through their *ex situ* preservation in Gene Banks, as also *in situ* conservation in their natural habitats through bio-diversity parks, etc., will receive a high priority to prevent their extinction. Specific measures will also be taken to conserve indigenous breeds facing extinction. There will be a time bound programme to list, catalogue and classify country's vast agro bio-diversity.

Food and Nutritional Security

Special efforts will be made to raise the productivity and production of crops to meet the increasing demand for food generated by unabated demographic pressures and raw materials for expanding agro-based industries. A regionally differentiated strategy will be pursued, taking into account the agronomic, climatic and environmental conditions to realize the full growth potential of every region. Special attention will be given to

development of new crop varieties, particularly of food crops, with higher nutritional value through adoption of bio-technology particularly genetic modification, while addressing bio-safety concerns.

A major thrust will be given to development of rainfed and irrigated horticulture, floriculture, roots and tubers, plantation crops, aromatic and medicinal plants, bee-keeping and sericulture, for augmenting food supply, exports and generating employment in rural areas. Availability of hybrid seeds and disease-free planting materials of improved varieties, supported by a network of regional nurseries, tissue culture laboratories, seed farms will be promoted to support systematic development of horticulture having emphasis on increased production, post-harvest management, precision farming, bio-control of pests and quality regulation mechanism and exports.

Animal husbandry and fisheries also generate wealth and employment in agriculture sector. Development of animal husbandry, poultry, dairying and aqua-culture will receive a high priority in the efforts for diversifying agriculture, increasing animal protein availability in the food basket and for generating exportable surpluses. A national livestock breeding strategy will be evolved to meet the requirements of milk, meat, egg and livestock products and to enhance the role of draught animals as a source of energy for farming operations and transport. Major thrust will be on genetic upgradation of indigenous/native cattle and buffaloes using proven semen and high quality pedigreed bulls and by expanding artificial insemination network to provide services at the farmer's doorstep.

> Over 200 million Indian farmers and farm workers have been the backbone of India's agriculture.

Generation and Transfer of Technology

A very high priority will be accorded to evolving new location-specific and economically viable improved varieties of agricultural and horticultural crops, livestock species and aquaculture as also conservation and judicious use of germplasm and other bio-diversity resources. The regionalization of agricultural research, based on identified agro-climatic zones, will be accorded high priority. Application of frontier sciences like bio-technology, remote sensing technologies, pre and post-harvest technologies, energy saving technologies, technology for environmental protection through national research system as well as proprietary research will be encouraged. The endeavour will be to build a well organized efficient and result-oriented agriculture research and education system to introduce technological change in Indian agriculture. Upgradation of agricultural education and its orientation towards uniformity in education standards, women empowerment, user-orientation, vocationalization and promotion of excellence will be the hallmark of the new policy.

The research and extension linkages will be strengthened to improve quality and effectiveness of research and extension system. The extension system will be broad-based and revitalized. Innovative and decentralized institutional changes will be introduced to make the extension system farmer-responsible and farmer-accountable. Role of Krishi Vigyan Kendras (KVKs), Non-Governmental Organizations (NGOs), Farmers Organizations, Cooperatives, corporate sector and para-technicians in agricultural extension will be encouraged for organizing demand-driven production systems. Development of human resources through capacity building and skill upgradation of public extension functionaries and other extension functionaries will be accorded a high priority. The Government will endeavour to move towards a regime of financial sustainability of extension services through effecting in a phased manner, a more realistic cost recovery of extension services and inputs, while simultaneously safeguarding the interests of the poor and the vulnerable groups.

Inputs Management

Adequate and timely supply of quality inputs such as seeds, fertilizers, plant protection chemicals, bio-pesticides, agricultural machinery and credit at reasonable rates to farmers will be the endeavor of the Government. Soil testing and quality testing of fertilisers and seeds will be ensured and supply of spurious inputs will be

checked. Balanced and optimum use of fertilizers will be promoted together with use of organic manures and bio-fertilizers to optimize the efficiency of nutrient use.

Development, production and distribution of improved varieties of seeds and planting materials and strengthening and expansion of seed and plant certification system with private sector participation will receive a high priority. A National Seed Grid will be established to ensure supply of seeds especially to areas affected by natural calamities. The National Seeds Corporation (NSC) and State Farms Corporation of India (SFCI) will be restructured for efficient utilization of investment and manpower.

Protection to plant varieties through a ***sui generis*** legislation, will be granted to encourage research and breeding of new varieties particularly in the private sector in line with India's obligations under TRIPS Agreement. The farmers will, however, be allowed their traditional rights to save, use, exchange, share and sell their farm saved seeds except as branded seeds of protected varieties for commercial purpose. The interests of the researchers will also be safeguarded in carrying out research on proprietary varieties to develop new varieties.

The National Policy on Agriculture seeks to actualize the vast untapped growth potential of Indian agriculture

Incentives for Agriculture

The Government will endeavour to create a favourable economic environment for increasing capital formation and farmer's own investments by removal of distortions in the incentive regime for agriculture, improving the terms of trade with manufacturing sectors and bringing about external and domestic market reforms backed by rationalization of domestic tax structure. It will seek to bestow on the agriculture sector in as many respects as possible benefits similar to those obtaining in the manufacturing sector, such as easy availability of credit and other inputs, and infrastructure facilities for development of agri-business industries and development of effective delivery systems and freed movement of agro produce.

Consequent upon dismantling of Quantitative Restrictions on imports as per WTO Agreement on Agriculture, commodity-wise strategies and arrangements for protecting the grower from adverse impact of undue price fluctuations in world markets and for promoting exports will be formulated. Apart from price competition, other aspects of marketing such as quality, choice, health and bio-safety will be promoted. Exports of horticultural produce and marine products will receive particular emphasis. A two-fold long term strategy of diversification of agricultural produce and value addition enabling the production system to respond to external environment and creating export demand for the commodities produced in the country will be evolved with a view to providing the farmers incremental income from export earnings. A favourable economic environment and supportive public management system will be created for promotion of agricultural exports. Quarantine, both of exports and imports, will be given particular attention so that Indian agriculture is protected from the ingress of exotic pests and diseases.

In order to protect the interest of farmers in context of removal of Quantitative Restrictions, continuous monitoring of international prices will be undertaken and appropriate tariffs protection will be provided. Import duties on manufactured commodities used in agriculture will be rationalized. The domestic agricultural market will be liberalized and all controls and regulations hindering increase in farmers' income will be reviewed and abolished to ensure that agriculturists receive prices commensurate with their efforts, investment. Restrictions on the movement of agricultural commodities throughout the country will be progressively dismantled.

Investments in Agriculture

The agriculture sector has been starved of capital. There has been a decline in the public sector investment in the agriculture sector. Public investment for narrowing regional imbalances, accelerating development of supportive infrastructure for

agriculture and rural development particularly rural connectivity will be stepped up. A time-bound strategy for rationalisation and transparent pricing of inputs will be formulated to encourage judicious input use and to generate resources for agriculture. Input subsidy reforms will be pursued as a combination of price and institutional reforms to cut down costs of these inputs for agriculture. Resource allocation regime will be reviewed with a view to rechannelizing the available resources from support measures towards assets formation in rural sector.

A conducive climate will be created through a favourable price and trade regime to promote farmers' own investments as also investments by industries producing inputs for agriculture and agro-based industries. Private sector investments in agriculture will also be encouraged more particularly in areas like agricultural research, human resource development, post-harvest management and marketing.

Rural electrification will be given a high priority as the prime mover for agricultural development. The quality and availability of electricity supply will be improved and the demand of the agriculture sector will be met adequately in a reliable and cost effective manner. The use of new and renewable sources of energy for irrigation and other agricultural purposes will also be encouraged.

Bridging the gap between irrigation potential created and utilized, completion of all on-going projects, restoration and modernization of irrigation infrastructure including drainage, evolving and implementing an integrated plan of augmentation and management of national water resources will receive special attention for augmenting the availability and use of irrigation water.

Institutional Structure

Indian agriculture is characterized by pre-dominance of small and marginal farmers. Institutional reforms will be so pursued as to channelize their energies for achieving greater productivity and production. The approach to rural development and land reforms will focus on the following areas:

- Consolidation of holdings all over the country on the pattern of north-western States;
- Redistribution of ceiling surplus lands and waste lands among the landless farmers, unemployed youth with initial start-up capital;
- Tenancy reforms to recognize the rights of the tenants and share croppers;
- Development of lease markets for increasing the size of holdings by making legal provisions for giving private lands on lease for cultivation and agri-business;
- Updating and improvement of land records, computerization and issue of land pass-books to the farmers, and
- Recognition of women's rights in land.

The rural poor will be increasingly involved in the implementation of land reforms with the help of Panchayati Raj Institutions, Voluntary Groups, Social Activists and Community Leaders.

Private sector participation will be promoted through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured markets for crop production, especially of oilseeds, cotton and horticultural crops.

The basic support to agriculture has been provided by cooperative sector assiduously built over the years. The Government will provide active support for promotion of cooperative-form of enterprise and ensure greater autonomy and operational freedom to them to improve their functioning. The thrust will be on :

- Structural reforms for promoting greater efficiency and viability by freeing them from excessive bureaucratic control and political interference.
- Creation of infrastructure and human resource development.
- Improvement in financial viability and organizational sustainability of cooperatives.
- Democratisation of management and increased professionalism in their operations.

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TECHNOLOGIES TO BOOST AGRICULTURE PRODUCTION

Dr. Parveen Kumar

An IFPRI reports that soil compaction alone has caused yield reduction of between 40-90 per cent in western African countries, and nutrient depletion also reduces productivity in Sub-Saharan Africa (SSA) and South Asia.

Indian agriculture has been characterized by many revolutions that changed the very face of this sector. The green revolution, blue revolution, yellow revolution and white revolution have been the important milestones in Indian agriculture. One thing common in all these revolutions was the use of technology. The revolutions could not have occurred without relevant technologies. The technological led agricultural development saw India emerging as world leader in many important food commodities. Our food production which was merely 50 million tonnes at the time of independence has now reached more than 250 million tonnes. Similarly in case of livestock, we are the leading producers of the milk in the world and the largest producers of pulses.

While more than sixty percent of the population depends on the agricultural sector, yet the sector also carries the blot of farmers' suicides, high food inflation, the low yields, the climate threat and the still presence of a considerable population in the grip of below poverty line category. This is also happening at a time when we have to achieve the Millennium Development Goals in the near future. Food production has to be increased in the context of worsening land and water scarcity and climate-change-related weather shocks. The problems in agriculture are not confined to a particular territorial jurisdiction. Some of them have now become universal. Land degradation is also another important factor affecting productivity. This is despite large investments in yield-enhancing varieties. An IFPRI reports that soil compaction alone has caused yield reduction of between 40-90 per cent in western African countries, and nutrient depletion also reduces productivity in Sub-Saharan Africa

(SSA) and South Asia. Meanwhile, twenty African countries are already experiencing severe water scarcity and another 12 will face water scarcity over the next 25 years. Land degradation is worse in areas where poverty and hunger are concentrated. Further the climate change disproportionably affects smallholders as they are more likely to depend on rainfed agriculture and degraded land. All this demands renewed and vigorous efforts towards technologies for agricultural development. Broadly the different types of technologies for furthering agricultural development are as:

Resource conserving technologies: Resources are an important asset for a country. Unfortunately the non judicious use of these has put them in very critical situation. The indiscriminate use of chemicals for increasing productivity and disease controls have polluted water bodies and degraded soils. What is worrying is that there is a gender specific effect to the resource degradation. It is increasing the time required for fulfillment of female responsibilities such as food production, fuel wood collection and soil and water conservation. An array of resource conservation technologies is available. These include zero and reduced tillage. green manuring, crop rotations etc. Resource conservation technologies aim to produce more at less cost while at the same time enhancing the natural resource base and maintenance of soil quality in fairly good conditions. The input use efficiency also gets increased due to the right placement of the seeds and fertilizers at right time and at right depth. Some of the resource conservation practices areas:

- Reduction of tillage and retention of adequate surface crop residues over the soil. Zero Tillage in wheat has reported to reduce the production costs by 2000 to 2500 per hectare and 15-20 per cent saving in irrigation water. No till wheat is also more tolerant to abrupt climate changes.
- Similarly by using drip and sprinkler type of irrigation methods the more area can be brought under irrigation than the conventional irrigation methods by canals.
- The use of Farm Yard Manure (FYM), Compost, and Bio fertilizers also reduce over dependence on the chemicals led intensive cultivation. These also are beneficial for soil health, soil micro organisms and soil fertility in the long run.
- Promoting diversification of agriculture with subsidiary occupations also lead to enhancement of farm incomes and reduction of risks in case of failure of one of the components.

High yielding technologies: The green evolution of the sixties would not have occurred without the High Yielding Varieties of Wheat and Paddy. These high yielding varieties along with increased area under irrigation fertilizers saw India becoming a bread basket from once being leveled as a begging bowl. Unfortunately, presently also our yields are less comparative to the yields of crops in other countries. This has severely reduced our total production. If Indian agriculture is to remain in competition with the global agriculture it has to increase the per unit yield of its crops. This requires the development and production of seeds which have more yields, are resistant to diseases, are not susceptible to insect pest attack, and can withstand the environmental extremities

Sustainable intensification of agriculture is a good alternative to avoid localized chronic food and nutrition insecurity when between 75 and 90 per cent of staple foods are produced and consumed locally. System of Rice Intensification (SRI) has emerged as an alternative to the conventional rice growing methods. SRI uses less water, is more efficient in using available water and considerable higher yields are achieved by this method. Unleashing the full potential of smallholders, including that of women farmers, is thus key to global food and nutrition security, creation of decent work, and sustainable agriculture

Post harvest technologies: Post harvest infrastructure also plays an important role in Indian agriculture. A considerable proportion of our produce goes wasted in the absence of suitable post harvest infrastructure. A study puts this losses to the tune of rupees 44,000 crore. This can be avoided if suitable post harvest infrastructure is provided to the farmers. As most of the horticultural produce is perishable therefore immediate handling of the produce after harvest

is necessary. Suitable post harvest infrastructure in terms of cold storages, processing units, road networks in inaccessible areas, establishment of local regulated markets at the Panchayat levels can give a big boost to the agriculture sector by promoting value addition and food processing. This can also help in creating employment opportunities for the others also.

Climate resilient technologies: The effects of Climate change are being witnessed all over the globe but the vulnerability of Indian agriculture to this is high. This is because a large population is dependent on agriculture and also we lack suitable coping mechanisim. Already negative effects of the rising temperatures have been reported in many food crops and the situation can get further aggravated. In India agriculture is mostly in rainfed areas therefore climate resilient technologies are the need of the hour. In the country a project entitled 'National Initiative on Climate resilient Agriculture' has been going on. This aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstrations in most vulnerable districts of India. The basic purpose is to enable the farmers to cope up with the climatic variability through efficient management of their resources.

Technologies for drudgery reduction: Agriculture in India is prone to drudgery and women that constitute half of the work force in agriculture are more susceptible to this. Mechanization is also another important aspect for enhancing agricultural production. Unfortunately mechanization is very low in India. Farmers still operate with their traditional implements which hamper their performance. Women which constitute an important partners in this sector are still not been recognized properly. A study done in Orissa under the Project, 'Standardization of women specific field practices in rice in Orissa' revealed that women of family contributed highest hours per season in harvesting and post harvest operations (61.66).

But their condition still is deplorable deep down in the drudgery. Women do most of the operations right from the harvesting to winnowing, grading and storage. FAO estimates that giving women better access to land, inputs, and technology could increase yield by 2.5-4 per cent and reduce undernourishment by 12-17 percent. Improved farm tools and implements for reducing drudgery reduction are the need of the day. Our research efforts should also focus on relieving the women of this drudgery by developing appropriate tools that could reduce drudgery of the women engaged in this sector. The Central Institute of Agricultural Engineering, Bhopal has developed tools such as the seed drill, seed broadcaster, seed treatment drum, hand ridges and dibblers.

The marginal and small farmers despite being the major producers of food, especially in developing regions, are the majority of the world's poor people still outside the ambit of technologies and a very large proportion of the chronically undernourished. Agriculture which is not specific to growing of food crops but also includes livestock, apiculture, pisiculture, apiary, goatry forestry etc has to undergo a significant transformation in order to meet the above related challenges. This new agriculture paradigm must ensure that the small and marginal farmers be at the center stage of any technological interventions.

Boosting agriculture productivity, in particular of smallholders, is one of the most effective ways of addressing global poverty and food and nutrition security. Output growth in agriculture is more effective in reducing than poverty than the same growth emanating from other sectors. What is needed is that the appropriate technological interventions be provided to the farming community according to their agro climatic conditions.

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In India agriculture is mostly in rainfed areas therefore climate resilient technologies are the need of the hour.

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NEW TECHNOLOGIES IN VEGETABLE PRODUCTION

Yerasu Suresh Reddy, Shubhadeep Roy and Shailesh K. Tiwari

With the advancement in science and its applications in agriculture, the tailoring of crops became more precise and rapid.

In present scenario, survival of farmers, especially small and marginal farmers is challenged by continuously reduced land holdings, decreased subsidies for inputs, increased labour costs, input costs and slow increase in price per unit volume of output of grain-based crops. On the other hand, increasing urbanization, rising purchasing power and increased awareness about health benefits of vegetable consumption among economically middle and high strata of society leads to more demand for vegetables. Welfare schemes of Government of India like MNREGA, Mid-day meal scheme, *Food Security Bill* provides more scope for economically weaker sections of society to include nutritious and high value commodities (like vegetables) in their diet, by supporting them to invest less on food grains. Under these conditions, diversification of cropping systems with high value crops like, vegetables can be regarded as a viable option for Indian farmers to improve their incomes and the economic viability of Indian agriculture. In this context, some of the new technologies can be pivotal for promotion of vegetable production in the country. Some modern technologies related to vegetable production have been discussed here.

Development of new varieties

Since man started domesticating plants, development of new crops and their varieties for better yield, quality, resistant to diseases, pests and abiotic stresses has become a dynamic process. With the advancement in science and its applications in agriculture, the tailoring of crops became more precise and rapid. Technologies like molecular markers, tagging, sequencing, cloning etc., made it possible to isolate and study specific genes or genomic regions conferring resistance to one or more biotic and abiotic stresses. Such useful genes or genomic regions from wild relatives of crop

plants are being transferred to cultivated forms with the help of marker assisted selection (MAS). Kashi Aman, a tomato variety resistant to tomato leaf curl virus has been developed by combining MAS and traditional pedigree breeding method at Indian Institute of Vegetable Research, Varanasi.

Conventional plant breeding approaches have been and always will remain the backbone of any genetic improvement strategies including vegetable crops. In addition to these, biotechnological tools enables the plant breeders to bring favourable genes, often previously inaccessible, into elite cultivars and gives unique opportunities to decrease the losses caused by insects, viruses and other pathogens, as well as to improve nutritional quality of different crops. Many vegetable crops have been genetically modified to include resistance to pests, pathogens and herbicides, and for other improved features like, slow ripening, higher nutritional status, seedless fruit, and increased sweetness. At the end, such products will be successful only if clear advantages along with safety of the products are guaranteed to both growers and consumers.

Nursery raising

Healthy nursery raising is most crucial step in vegetable production, which determines the productivity and profitability in vegetable cultivation. Vegetable nursery is a place where plants are nurtured during the early stages of growth, providing optimum conditions for germination and subsequent growth until they become strong enough to be planted in the main field. A nursery can be as simple as a raised bed in an open field or sophisticated with well equipped instruments like a glass-house with micro-sprinklers and automatic temperature control system. Seedlings can also be grown in pots filled with sterile media to reduce soil borne infection. A number of vegetables during *Rabi* and *Zaid* seasons are cultivated by transplanting method, wherein seeds are first sown in nursery beds to raise seedling and then seedlings are transplanted in the main field. The major vegetable crops which are usually cultivated through transplanting method include: tomato, brinjal, capsicum, cauliflower, cabbage, knol-khol, Chinese cabbage, Brussels sprouts, broccoli etc. Although many of these crops can also be cultivated through direct seeding in the main field, transplanting method is highly recommended because of several advantages like intensive care during seedling stage, reduced cost of cultivation, opportunity for selection of healthy seedlings etc.

Micro irrigation

Water is very crucial component for vegetable production. Vegetables require timely and adequate irrigation for its proper growth which should be managed properly through micro irrigation system so as to promote utilization of each drop and to check the wastage of such critical input. Further, micro irrigation methods are promising methods for applying fertilizers at root zone of the crops. There by micro irrigation helps in efficient utilization of scarce and costly inputs in vegetable production. Micro irrigation is growing fast in India. About 1.3 mha land under vegetables and high value crops is being irrigated through drip irrigation in India. Further, government is providing significant subsidies through several schemes to promote micro irrigation. The nature and type of micro irrigation systems available are as follows:

Sprinkler systems: Sprinkler irrigation is a method of applying irrigation water similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops (0.5-4.0 mm) which fall on to the plants on ground like rain water. In vegetables, this system is commercially used for irrigation of peas and sometimes for leafy vegetables. Sprinkler irrigation can also save water to the tune of 25-30% over flood irrigation.

Drip system: Drip irrigation is an effective irrigation system in terms of water conservation.

Fig-1: Drip Irrigation

It minimizes the wastage of water by delivering the water very near to root zone. In vegetables, drip irrigation is known to save 25-70% of water depending on soil, climate, crop and variety. The irrigation efficiency of drip system is very high (85-90%).

Table-1: Extent of water saving and increase in yield with drip irrigation system

Crops	Water saving (%)	Increase in yield (%)
Tomato	42	60
Watermelon	66	19
Cucumber	56	45
Chili	68	28
Cauliflower	68	70
Okra	37	33

(Singh & Singh, 2012) IIVR Technical bulletin No. 48

Micro sprinkler system: This is a combination of sprinkler and drip irrigation. Water is sprinkled around the root zone of trees with a small sprinkler working under low pressure. Water is given only to the root zone area as in the case of drip irrigation but not to the entire ground surface as done in the case of sprinkler irrigation method.

Pulse system: Pulse system uses high discharge rate emitters and consequently has short water application time. The primary advantage of this system is a possible reduction in the clogging problem.

Biwall system: It is extruded dual chamber micro-irrigation tubing manufactured from Linear Low Density Polyethylene (LLDPE). This system is suitable for all closely spaced row crops like sugarcane, cotton, vegetables, onion, tea etc.

Bubbler system: Bubblers typically apply water on a per plant basis. Bubblers are very similar to the point source external emitters in shape but differ in performance. In this system the water is applied to the soil surface in a small stream or fountain. This technology is not much popular in India and it is presently in research stage.

Integrated pest management (IPM)

Vegetable production is challenged by many pests. Pests can include insects, mites, diseases, nematodes, weeds and vertebrate pests. To control these pests many biological agents and their bi products and array of chemicals (pesticides) are being used. The residues of these chemicals have detrimental effect on health of environment and consumers. To avoid this, a holistic approach called Integrated pest management (IPM) has been developed. IPM is a strategy that depends on a range of methods to manage pests within economically acceptable levels and causes least ecological damage. IPM mainly relies on beneficial organism (bio-control agents) to manage insect pests and, on regular crop monitoring to incorporate more preventive strategies to reduce the need for direct control practices and to ensure that pesticides are used only when needed in such a way that they complement the survival of beneficial organisms.

Vegetable cultivation under protected conditions

Production of vegetables under protected condition is the best alternative to use the land and other resources more efficiently under changing climatic scenario. By adapting protected cultivation, year round availability of quality vegetables both for domestic use and export can be assured. Protected cultivation means some level of control over plant microclimate to alleviate one or more of abiotic stress for optimum plant growth, which can be achieved in green houses, poly hoses, net house, poly-tunnels, cold frames, etc. Crop yields under these structures can be several times higher than those of open field conditions. Quality of produce is also superior and input use efficiencies are usually higher under such structures. In many European Countries, USA, Japan, China, Israel, Morocco, Turkey etc, where extreme climate reduces the choices for year round outdoor production, vegetables are being produced in protected environments. India has entered into the area of greenhouse vegetable cultivation recently and the total area under protected vegetable production is around 10,000 hectares.

Fig-2: Low cost poly tunnel for protected cultivation

Post-harvest technologies in vegetables

Although, India is the second largest producer of vegetables and third largest producer of fruits with annual production of 141 million tones and 80 million tones, respectively, it is estimated that 20 -30 percent of horticultural crop such as fruits and vegetables perish due to lack of proper methods of processing and storage. The loss in monetary term is estimated to be about Rs.20 crores annually. It is also estimated that only 2% fruits and vegetables produced in our country are being processed. In India, agro processing sector ranks fifth in the country in size and employs over 1.6 million workers (20% of nation's labour force). Processing sector has the potential to boost the rural economy and generates employment throughout the country.

Post-harvest technology is an inter-disciplinary "Science and Technique" applied to agricultural produce after harvest for its protection, conservation, processing, packaging, distribution, marketing, and utilization to meet the food and nutritional requirements of the people in relation to their needs. Some of the modern post-harvest and processing techniques which can be adopted in small scale by rural people especially women are discussed hereunder.

Dehydration: The techniques of dehydration offer a highly effective and practical means of preserving horticultural produce to reduce post-harvest losses. Osmo-air drying is a simple process that can be adopted as home-scale industry by small entrepreneurs like self-help groups for preservation of vegetables for longer duration.

Hurdle technology: Innovative technologies based on hurdle techniques have been developed to give extended shelf life to high moisture foods without refrigeration. Hurdle technology treated fruits were found microbiologically safe with extended shelf life under ambient conditions in flexible pouches. The product can be eaten as such and also have the utility in preparation of salads or can be used in other food formulations.

Minimal processing: Minimal processing is an emerging technological concept, which has gained increased popularity in recent past. The technique enables global marketing of pre-cut fruits and vegetables in pre - packaged form and the products are made for specific end uses viz., curry, salads, pies, stuffing's, toppings and garnishing. Minimal processing allows consumers to have fresh like quality fruits and vegetables with convenience.

Steeping preservation: Large quantities of vegetables during peak season of production can be preserved in steeping solution consisting of permissible chemical preservatives and other food additives, which is non-thermal and alternate to processing technology with considerable scope for adoption at rural sector by women.

Kitchen gardening

Depending on the necessity, urgency and merits, old practices may have to be promoted as new technology. Kitchen gardening (and its other forms like, container gardening, roof top gardening) is such an old practice, being promoted as new technology to combat malnutrition among poor families and to make it as healthy habit among rich families. These gardens use spare land, recycled water and organic wastes from home and add nutritional value and variety to the food basket. This is especially important in rural areas where people have limited income-earning opportunities and poor access to markets. Home gardens are also becoming an increasingly important source of food and income for poor households in peri-urban and urban areas. Generally, products from kitchen garden are free from pesticide residues. If adopted in every hose hold, the practice of kitchen garden has the potential to reduce price fluctuations and makes most efficient use of natural resources.

Adopting new technologies helps vegetable sector in establishing its credentials for improving land productivity, employment generation, improving economic condition of farmers and providing nutritional security to the country. Promoting new interventions in handling, grading of vegetables from farm gate to consumer and other marketing interventions to reduce intermediaries in supply chain are highly required to promote vegetable sector in our country.

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BASMATI RICE FOR HIGHER INCOME AND PROSPERITY OF THE FARMERS

Dr. Yashbir Singh Shivay and Dr. Anshu Rahal

There is wide gap between the technologies developed at the research institutions and their applicability at the farmer's field. Choice of variety, seed treatment, nursery raising, field preparation, time and method of transplanting, nutrient management weed control, irrigation schedule, foliage pruning etc. have bearing on production.

Aromatic rice with extra long and soft textured grain, double expansion in length after cooking with excellent taste are unique characteristics of basmati, which is being cultivated in the foothills of Himalayas. There is appreciable demand for such rice in the international and domestic market; it is grown mainly in Haryana (Karnal, Jind, Ambala, Kaithal and Kurukshetra districts), Punjab (Kapurthala, Gurdaspur, Amritsar and Pathankot districts), Uttarakhand (Dehradun, Haridwar and US Nagar districts) and UP (Saharanpur, Muzaffarnagar, Rampur and Pilibbit districts.) Awareness among the farmers is to be created for better transfer of research technology.

Prolonged sunshine and assured water supply are the pre-requisites for an excellent basmati crop. The fragrance, cooking and eating qualities of basmati are improved, if the crop matures in relatively cooler temperature and doesn't suffer from any biotic and abiotic stress. There is wide gap between the technologies developed at the research institutions and their applicability at the farmer's field. Therefore, awareness among the farmers is to be created for better transfer of research technology in the interest of rice industry.

Choice of Variety

The varieties must be recommended after having the qualities based on market oriented demand, consumer's liking/cooking qualities,

appreciated by exporter/miller and minimum problem of plant protection, but always it is not happening with the varieties released by centre and state. Presently in the basmati growing areas, varieties 'Sugandha 4' ('Pusa 1121') and 'CSR 30' occupies about 70% share during kharif 2007-08. Other varieties like Taraori Basmati', 'Basmati 386' and 'Pusa Basmati 1' are also having sizable contribution in export of aromatic rice. Moreover, 'Type 3' ('Dehradun Basmati') and 'Kasturi' are also getting share in fields of Himachal Pradesh, Uttarakhand states due to domestic demand.

Seed and its Treatment

There is gain of 5-7% in production, if certified seed is adopted. Secondly, quality of production also improved remarkably. Quality seed @ 15-20 kg/ha is sufficient for raising nursery. Select heavy seed by dipping in 10% salt solution. Empty, partially filled and unhealthy seeds float, which should be removed. Wash the seed 2-3 times with fresh water, otherwise it may affect germination. Treat the selected seed with 5 g Emisan and 1 g streptocycline per 10 kg seed. Later on, it should be kept in 10 litre of water for 24 hour. This will provide protection from seed borne diseases. Further, soaked seed is to be incubated under wet gunny bags for 36-48 hour. When the seed sprout, it is ready for sowing.

Nursery Raising

Under present cultivation system, wet method of nursery raising is adopted by majority of the farmers, which is good. One tenth (1/10) area of main field is required for nursery raising. Generally, 2-4 dry harrowings/ploughings are sufficient to pulverize the soil. Give heavy irrigation after making bunds around the required area for nursery. Puddle the soil by 2-3 cross ploughings. Sprouted seeds are broadcast uniformly in the field after settling of the mud. Special care for water management is required during first week of nursery. The seedbed should be kept wet and the water should not be allowed to stagnate during the day time to avoid injury to the germinating tender seedling due to heat transmittance in standing water. After the nursery age of 12-15 days, hand-weeding is required or weedicide is to be used after sowing operation is over in nursery bed.

Field Preparation

It depends on the previous crop grown in the main field. These may be *Sesbania* spp. (green manuring crop), greengram / cowpea (summer crop) and sorghum/maize (fodder), mint, lentil and wheat after harvesting of the previous crop, two dry harrowings are needed in the field, which helps to uproot the existing weeds and residue of crop. Before preparing the field for transplanting, proper leveling the field is required. Laser leveler is a very good implement for this purpose, which is now in the approach of common farmer. It also helps to increase irrigation efficiency. Fill the field with water to the depth of 5-7 cm, than puddle the field and plank properly. One pass of rotavater is another better choice for puddling operation, which is time saving device with better performance. Two cross passes of rotavater are sufficient, if green manure crop is to be buried before transplanting.

Time and Method of Transplanting

Planting time plays a pivotal role in producing higher yield and quality of basmati rice. Early planting causes excess vegetative growth particularly in traditional basmati varieties, on the other hand, late planting provides insufficient plant growth with higher infection of blast to crop. Therefore, the time for transplanting of traditional basmati varieties ('Basmati 386,' 'Taraori Basmati', 'Type 3') and 'CSR 30' must be second fortnight of July. However, evolved varieties 'Sugandha 4' and 'Pusa Basmati 1' should be transplanted in the first fortnight of July. Keeping particular area in mind, early part of schedule started from Punjab passing through Haryana, Uttarakhand and in the end time in U.P. Late (August) planting of basmati did not yield economical production. Panicles/m^2 and grains/panicle also decreased with delay in planting. There is always (whole transplanting period), 20-25 days old seedling provides higher grain yield. Farmers are advised not to grow basmati varieties as second crop, if 2 crops grown in a season.

Random planting is the method used by the farmers. Therefore, planting 30-35 hills/m is advised to obtain required plant population in the field. Mostly, the plant population of 18-20 hills/m^2 has been observed at farmer's field, but in the

few areas, it was recorded up to 22-28 hills/m^2. Major emphasis is given to maintain optimum plant population, which helps to reduce the attack of pests, 6-7 days early maturity, uniform grain filling, reducing green grain percentage. Optimum depth (2.5 to 5.0 cm) favours tillering and root growth. With deep planting (5 to 10 cm), there is reduction in grain yield, panicle weight and grains/ panicle. Uprooting of seedlings under water helps to overcome the bacanae disease.

Nutrient Management

It is better to apply fertilizers on soil test basis. Otherwise, the required nutrients should be applied by 60 kg N + 50 kg P_2O_5 + 40 kg K_2O + 25 kg $ZnSO_4$/ha for tall basmati varieties 'Basmati 386', 'Taraori Basmati' and 'Type 3' and 'CSR 30'. Additional dose of 30 kg N/ha should be added for 'Pusa Basmati 1' and 'Sugandha 4'. Whole P, K and Zn are to be applied before transplanting and N is to be top dressed in 3 equal parts i.e. one third (1/3) N at 7, 20 and 40 days after transplanting. There should not be standing water in field at the time of top dressing. Moreover, green manuring of *Sesbania* spp (about 4-5' height) and 25 kg $ZnSO_4$/ ha are sufficient for basmati crop.

Deciding the nutrient requirement for basmati, fertility status of soil, crop rotation and choice of variety are to be considered carefully. Excess application of N fertilizer to basmati causes crop susceptible to diseases and reduces the percentage of head rice recovery (HRR).

Weed Control

There is comparatively low weed problem, if good puddling, dense planting and proper water schedule techniques have been adopted. As per availability of labour, manual weeding should be done at 20 and 40 days after transplanting. Otherwise weedicides like Butachlor – 1.5 kg a.i. /ha or Anilophos – 0.4 kg a.i. /ha or Pretilachlor – 0.75 to 1.0 kg a.i. /ha should be used within 2 days of planting to overcome weed problem. Roughing is essential field operation to take our residue to weeds, other paddy varieties and bacanae disease infected plants. This will help to produce good quality product, which fetches higher price in market.

Irrigation Schedule

The water requirement is comparatively low in the nursery raised after puddling (wet method). First fortnight ponding of ± 5 cm water is useful for crop establishment as well as controlling the weeds in main field. There should be no water stress at the time of tillering, panicle initiation (PI), panicle emergence and grain development stages of crop. It helps in increasing the production grain quality and reduction in the infection of blast. Under low water availability, the irrigation just before crackling the field may save the water without significant reduction in yield. Continuous ponding of water is not desirable.

Foliage Pruning

Tall varieties of basmati have the tendency of lodging at the time of ear emergence and/ or grain development. Excess nutrients, more ponding of water and very early planting are major causes for this unwanted incidence of basmati. This may be reduced by pruning of upper foliage of crop, i.e. cutting of 10 cm above collar of last leaf at the age of 45-50 days after transplanting. This may also help to reduce the incidence of leaf folder in addition to check the lodging without sacrificing the productivity.

Harvesting and Threshing

Basmati rice varieties should be harvested as soon as they mature, i.e. when the panicles are nearly ripe (yellow) and the straw has just turned green to yellow. Delayed harvesting may result in the over-ripening and shattering of grains in the field and increase breakage during milling process. Most of the basmati crop is harvested by sickle and threshed by hand beating exercise. However, limited reaper and modified threshers are available. The harvested crop should preferably be threshed on the same or next days of harvesting. The delayed threshing causes shattering losses and reduced HRR. The produce should be dried properly and cleaned before sending to the market for fetching high prices.

Important Steps for Extension Agencies

- Ensure quality/certified seed for the growers, to obtain best quality rice for export.

- Supply of inputs particularly pesticides through government network to discourage use of sub-standard quality of adulterated products.
- Proper percolation of approved technology to basmati growers.
- The arrangement for the training of the farmers is essential for production of high quality rice.
- Discourage late planting, high nitrogen dose, and growing basmati on problem soil to ensure production of quality rice.

Organic Product

For organic basmati rice cultivation, the following major steps/considerations are to be taken:

- No use of synthetic agro-products to the soil and crop.
- Nutrient management through farm made and naturally available resources.
- Use of agro-pesticides and fungicides (Home/ factory made) for plant protection measures.
- Certification of land/product and mill/ processing unit.

Presently well tested agro-techniques are available for cultivation of organic basmati. Therefore, remarkable area under this programme has been planted in the states of Punjab, Haryana, Uttarakhand and UP during current *kharif*, being increasing export demand. The varieties 'Taraori Basmati' 'Type 3', 'Pusa 1121' etc. are major choice of the traders. There is difference for seed treatment, nutrient management and pests control among both the farming systems, i.e. organic and existing (based on chemical etc). However, important different cultural operations are given below.

- *Pseudomonas florisence* is available for effective seed treatment.
- Field sterilization before transplanting must be done by *Pseudomonas florisence* + *Trichoderma harzilanum*.
- Application of green manure (*Sesbania* spp.) and $ZnSO_4$ are providing sufficient nutrients to basmati crop. Use of vermicompost is another good choice.
- Uniform broadcast of 4 kg mustard oil (raw) and 20 kg saw dust (after mixing thoroughly) next day to transplanting in standing water is as good as any weedicide for paddy.
- The following products are well tested in large field area against different insects and diseases.

Insect- Pests

- Prepared cow urine solution with leaves of locally available tree/herbs.
- Harit pani, (a farm product by locally available ingredients).
- Pheromone trap / Trico-cards (*Trichogramma japonicum*).
- Use of Beauvera (Biological control).
- Other farm made products, i.e. solution of garlic and chilly etc.

Diseases

- *Pseudomonas florisence* (based on bacteria).
- *Trichoderma harzilanum* (based on fungi).
- Others, i.e. calmonas, calpnomel and calopaste.

Conclusions

There is wide gap between the technologies developed at the research institutions and their applicability at the farmer's field. Choice of variety, seed treatment, nursery raising, field preparation, time and method of transplanting, nutrient management weed control, irrigation schedule, foliage pruning etc. have bearing on production. Therefore, awareness among the farmers is to be created for better transfer of research technology in the interest of rice industry.

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AGRICULTURE TECHNOLOGY FOR RICE WHEAT CROPPING SYSTEM IN INDIA

Dasharath Prasad and Suresh Pal

Rice-wheat cropping system is major cropping system in the South Asian food security. The billions of people depend on this system for their food. The rice-wheat system has been practiced by farmers in Asia for more than 1000 years. It has since expanded and is currently estimated at 23.5 million ha. The rice-wheat system covers 13.5 million ha in South Asia: India (10.0), Pakistan (2.2), Bangladesh (0.8) and Nepal (0.5). It represents 32% of the total rice area and 42% of the total wheat area in these countries. Despite its more or less assured yield and comparative profitability over other competing crops/ crop rotations, continuance of traditionally growing of Rice -wheat cultivation over the years has resulted in severe implications for resources. The most common consequences of these are:

- Indiscriminate use of inorganic fertilizers and chemicals.
- Increased cost of cultivation especially tillage cost.
- Salinity and sodicity build up in canal irrigated areas.
- Depletion of water resources in areas of good quality underground water.
- Deficiencies of nutrients in the soil.
- Hard pan formation and reduced organic matter content in the soil.
- Degradation of ecosystem.
- Loss of biodiversity
- Late sowing of raai crops.
- Nutrient mining

In the Indo-Gangetic Plains (IGP), which stretches across these four countries, rice is usually grown in the wet summer (May/June to October/ November) and wheat in the winter (November/ December to February/March). Although rice-wheat cropped area in the IGP is irrigated or has assured rainwater in sub-humid regions, the soils and crop management undergo drastic changes during the two cropping seasons. Several yield-reducing and yield limiting factors, together with delayed planting of wheat and transplanting of rice; energy, labour, and other input shortages; resistance of the weed and crop residue burning have contributed to the stagnating or declining production, productivity and sustainability of this system. To overcome of these problems new resources conserving technologies should be adopted, these are following given.

Resource-conserving technologies

Resource-conserving technologies are defined here as any practice that improves the efficiency of use of natural resources, including

water, air, fossil fuels, soils, inputs, and people. This can only be possible if the planting techniques of rice or wheat crops are improved resulting to saving of time, cultivation cost and irrigation water. Resource conserving technologies can be helpful in the achievements of major goals.

Late planting is a major problem in most rice-wheat areas. To improve system productivity, the wheat crop must be planted at the optimal time. The other major cause of late wheat planting is the long turnaround time between rice harvest and wheat planting. Long turn around can be caused by many factors, including excessive tillage, soil moisture problems (too wet or too dry), lack of animal or mechanical power for ploughing, and the priority farmers place on threshing and handling the rice crop before preparing land for wheat.

Coupled with the problems of late planting of wheat is the problem of poor germination and plant stands. Most farmers in the IGP have sown wheat by broadcasting the seed into plowed land and incorporating it by another plowing. Part of the reason for this is residue management problems in fields following rice. The loose straw and stubbles are raked and clog the seed drills. Broadcast seed results in seed placement at many different depths and into different soil moistures, with resulting variable germination. The problems of late planting and poor plant stand have been addressed by promoting various resource-conserving tillage and crop establishment techniques described below (Gupta and Seth (2007).

Technology used in rice cultivation

(a) Laser levelling

All the technologies can benefit from levelled fields. This is being promoted to improved water efficiency. However, when this is combined with zero tillage, bed planting and non-puddled rice culture, plant stands are better, growth is more uniform and yields higher. Use of permanent bed systems and zero tillage results in less soil disturbance and reduces the need for future levelling. India is also starting work on this and promoting levelling in farmer fields in Haryana and Western UP.

(b) Brown manuring

Traditionally, *dhaincha* (*Sesbania aculeate*) is sown during mid May for the purpose of green manuring and is incorporated 45 days after sowing before transplanting of rice crop. However, due to dearth of irrigation water during summer, majority of the rice farmers are not able to raise the green manure crop. Brown manuring is a new innovative approach where both rice and *Sesbania* crops are seeded together and allowed to grow for 25-30 days.

(c) Direct Seeded Rice

It is a cost effective rice establishment method where dry seed is drilled into the non-puddled soil. It includes proper land leveling and effective weed control measures.

Benefits of Direct Seeded Rice

- Avoids repeated puddling, preventing soil degradation and plow-pan formation
- Facilitates timely establishment of rice and succeeding crops as crop matures 10-15 days earlier
- Saves water by 35-40%, reduces production cost by Rs 3000/ha, and increases yields by 10%
- Saves energy: labour, fuel, and seed
- Solves labour scarcity problem and reduces drudgery of labours

(d) System of Rice Intensification (SRI)

SRI is a combination of several practices those include changes in nursery management, time of transplanting, water and weed management. Its different way of cultivating rice crop though the fundamental practices remain more or less same like in the conventional method; it just emphasizes altering of certain agronomic practices of the conventional way of rice cultivation. All these new practices are together known as System of Rice Intensification (SRI).

(e) Leaf colour chart (LCC)

Nitrogen (N) fertilizer is one of the major input in rice production. Inadequate or excessive amount or improper timing of nitrogen application may lead to large nitrogen losses and poor nitrogen-use-efficiency in rice fields. New tools are needed to synchronize N application with crop demand and minimize nitrogen losses to the environment. Leaf Colour Chart is simple and inexpensive tool that could improve farmers decision making process in nitrogen management for rice. 1eaf Colour Chart is a tool that helps farmers in deciding the right time of N application to paddy crop.

Technology used in Wheat Cultivation

Surface Seeding

Surface seeding is the simplest zero-tillage system being promoted. In this tillage option, wheat seed is placed on a saturated soil surface without any land preparation. In either case, surface seeding entails no soil disturbance whereas typical zero-till systems cause minimal soil disturbance during opening of the slits. Surface seeding can be done either by seed broadcasting method or by placing seed/fertilizer in rows by machine.

Zero Tillage

Zero Tillage is defined as farming where the soil is left relatively undisturbed from harvest to planting. During the planting operation, a narrow seedbed is prepared or holes are drilled in which seeds are planted. Disc openers, coulters and other tools used to create the seedbed or slots leave most of the ground surface and previous crop residue largely undisturbed. Weeds, insects and disease outbreaks are commonly managed with some combination of herbicide application, crop rotation, fire, sanitation or other biological means. Zero Tillage is considered a management tool under what is known as conservation tillage practices.

Benefits of Zero Tillage

Zero Tillage significantly reduce soil erosion, helping preserve the long-term productive capacity of the managed fields. The practice can alwso increase farm profits by reducing tillage costs without reducing crop productivity.

Furrow Irrigated Raised Bed (FIRB) Systems

To reduce water use, conserve rain water and improve productivity, the system of raised bed planting of crops may be advantageous in up and low land situations. In bed planting systems, wheat or other crops are planted on raised beds. This practice has increased dramatically in the last decade. Farmers have given the following reasons for adopting the new system:

- Management of irrigation water is improved.
- Bed planting facilitates irrigation before seeding and thus provides an opportunity for weed control prior to planting.
- Plant stands are better.
- Weeds can be controlled mechanically, between the beds, early in the crop cycle.
- Wheat seed rates are lower.
- After wheat is harvested and the beds are reshaped for planting the succeeding soybean crop.
- Herbicide dependence is reduced, and hand weeding and roguing is easier.
- Less lodging occurs.
- System of Wheat Intensification (SWI)

In this condition, better management of soil with low seed rate is the best option for reducing the cost of production for wheat. SWI is a technology of wheat production which is based on manipulation of soil environment with minimum external input and very low seed rate. Therefore the problem of low productivity of wheat in hilly region of Nepal could be addresses by SWI techniques but some more work should be done to make this technology more suitable in local socio economic and ecological conditions.

Crop residue management

The practice of burning of left over paddy stubble is most commonly followed with the sole objective to reduce the cost of seed bed preparation for sowing the succeeding wheat crop. On the other hand, this practice not only reprieve the soil of recycling of left over crop residues but also causes environmental pollution. The paddy and wheat residues amount to as much as 7-8 tons per ha per year. The residues, when burnt during land preparation, generate CO_2, which pollutes the air, deprives organic matter of soils and reduces supply of fodder for livestock.

Legume in rotation

Short duration legume crop should be used in rice wheat cropping system to maintain soil health, soil micro flora, to reduce the nitrogen management to the next crop and reduce the cost of cultivation.

The use of cultivation in agriculture that increase the per capita income, increase production and lower costs, soil health management, increase biodiversity, conserve environment, reduce the level of global warming gasses and improved farmer livelihoods. The profession of agriculture may profitability and productive in yield as well as soil health concern.

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KISAAN SMS PORTAL: ICT TOOL FOR AGRICULTURAL EXTENSION

Dr. Gopal Sharma

Agriculture in India is the pivotal sector for ensuring food and nutritional security, sustainable development and for alleviation of poverty. It is a key sector for generating employment opportunity. Indian agriculture sector contributes 14 per cent of GDP, provides food to one Billion People, sustains 65 per cent of the population and contributes about 11 per cent of the export earnings. Indian agriculture contributes to 8 percent global agriculture gross domestic product to support 18 per cent of world population on only 9 per cent of world's arable land and 2.3 of geographical area. This sector also influences essential ecosystem services such as water and carbon sequestration. Milestones in agricultural development in India includes: Green Revolution, Evergreen Revolution, Blue Revolution, White Revolution, Yellow Revolution, Bio-technology Revolution, ICT Revolution and so on.

ICT for Agriculture Extension Initiative in India

In India the following ICT measures are adopted for agriculture extension: aAQUA, Kissan Kerala, TNAU AGRITECH Portal, AGRISNET, DACNET, e-krishi, ASHA, Indian Development Gateway (InDG Portal), Rice Knowledge Management Portal (RKMP), Agropedia, AGMARKNET, ITC-e-Choupal, EID Parry-Indiagriline, Indiancommodities.com, Mahindra Kisan Mitra, IFFCO Agri-Portal, Agrowatch Portal, iKissan, Village Knowledge Centres (VKCs) -M.S. Swaminathan Research Foundation (MSSRF), Village Resource Centres (VRCs) –Indian Space Research Organisation (ISRO), Community Information Centres (CICs), Common Service Centres (CSCs), Farmers Call Centre (Kissan Call Centre), Lifelines India, IFFCO Kisan Sanchar Limited (IKSL), Fisher Friend, Reuters Market Light (RML), Mobile Advisory Services by Krishi Vigyan Kendras (KVKs) of Indian Council of Agricultural Research (ICAR), e-Arik, e-Sagu, Digital Green, Knowledge Share Centres and so on.

Kisaan SMS Portal

The generation and application of agricultural knowledge is increasingly important, especially for small and marginal farmers, who need relevant information in order to improve, sustain and diversify their farm enterprises. The Indian farmers are not much aware of the latest technologies developed for the improvement of agricultural products. It is a fact that there are different methods of extension system of information and technology in India but to reach rural India is always a difficult task because of remoteness of the places and the level of consciousness. In order to solve this problem in 2013 an SMS Portal for Farmers was created by

the Department of Agriculture & Cooperation, Government of India for dissemination of relevant information, giving topical and seasonal advisories and providing services through SMSs in language of the state. It is an integrated Farmers' Portal and has been hosted as a Beta site and Farmers' Portal is the most important part of it. This Portal has been developed completely in-house by DAC.

Main features

The main features of the Kisaan SMS Portal include:

- The farmers can register to this portal by calling Kisaan Call Centre or through the web portal. The registration is free of cost. They can register their queries, about the weather report, soil type, prospects and problems of market and so on by using this SMS portal.
- The relevant information will be provided to farmers in their own or regional languages.
- The SMSs will get transmitted only to the farmers within the territorial jurisdiction of an officer, scientist or experts for the crop or agricultural practice that such a farmer might have opted for.
- The farmers will get the information, services and even some advisories through this portal. The content may include information about the schemes, advisories from the experts, markets.
- The officers can send SMS to the farmers belonging to the entire area of their jurisdiction or a part of it.
- This Portal will also integrate existing farmer database of the farmers.

Strengths

There are many advantages of this portal. If the farmers are aware of this portal they can be benefited in different ways which are as follows:

- Crop advisory will lead to the adoption of more appropriate technologies suited to local condition. The farmers can choose the relevant techniques and technologies that they desire.
- Information on schemes and programmes of Government of India can help every farmer to reap benefit out of these schemes thus widening the footprint of these schemes.
- Weather always plays a crucial role so far as agriculture is concerned. On the onset of any adverse weather condition, advice can be provided to the farmers on effective resource to be adopted.
- Outbreak of the disease/pests can be controlled as advisories can be provided immediately to the farmers in and around the area of initial report of the disease/pest. Early treatment may minimise the damage.
- Selection of suitable and better variety/breed by the farmer based on the information/ advisory can provided to him/her.
- Soil test results in his mobile will help in selecting the right fertilizer and the dosage.
- This Portal is Cost effective. The farmers can get all the information through SMS after registering their details on the toll free number.
- Timely market information will give better bargaining power to the farmer.
- Weather forecast can help the farmer in planning farm operation effectively.

Threats

The major threats of the portal are as follows:

- There is no provision for self generation of finances for the maintenance of the portal.
- Role of middle man (Because of the lack of education some framers hesitate to talk in the mobile phone and some middle man may create problems or disturbances.)
- The function of this portal is like one way information flow. The farmers will not receive any information until and unless he asked for the same.
- The mechanism of evaluation is lack or unsystematic in this SMS Portal system.

Suggestions

In order to improve the activities and to make this portal a very effective one the following measures can be adopted:

- Farmers should be made aware of this portal.
- There should be a close link with the Panchayati Raj Institutions.
- The banking facilities should be included in this portal.
- There should be at least one facilitation centre in each village.
- There should be the provision of checking the fraud SMSs.

Conclusion

ICTs are changing all the spheres of human lives and agriculture cannot be an exception. ICTs now may act as an agent for changing agrarian and farmers' life by improving access of information and sharing knowledge. This Kisaan SMS Portal can improve the productivity of the agriculture by adopting different measures. This ICT tool can change the ideas, activities and knowledge of the farmers. Farmers can adopt appropriate measures at the time of need.

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NEED FOR 24 HOUR TELEVISION CHANNEL ON AGRICULTURE

Dr. Bankey Bihari

Agriculture is the sector that ensures food security but it has always been neglected and ignored only because it has been the profession of poor and weaker sections all over the world. It is surprising that in India, farmers and farming are still not taken seriously. No efforts have been made to promote agriculture in a big way nor has the care been taken to develop and manage the capacities of our farmers. Though a lot is discussed to manage other resources in the country but hardly anybody talks about management of farmers, the biggest lot of human resources available in our country. Until and unless this big lot is given due respect & importance, educated and guided sufficiently & properly about how to do improved and science based agriculture, it is neither possible to improve farmer's own conditions nor to ensure food security, manage the natural resources and to cope with the climatic variability in the country. "Development and progress cannot take place unless those who participate in the process are socially, economically, technologically and politically literate" (Prof. Layle D. Lawrence, West Virginia University, USA-1998).

Expectations from Indian Agriculture

In 2050 the estimated total food grain demand of 377 million tonnes for 1.6 billion people (about 33.0 % more from now) will have to be met in our country (Amar Singh et.al.,2007). India at present supports world's 18.0% human population and 15.0% livestock population on world's 2.4% land mass and 4.2% fresh water (NAAS, 2009).

Rain fed area, which constitutes about 61.0% of gross cultivated area, contributes only 42.0% to the total food grain production, while 39.0% of irrigated area accounts for 58.0% of total output to the national food basket (GoI, 2011). As per FAO study, food consumption levels in India are projected to increase from current level of 2400 kcal/capita/day to about 300 kcal/capita/day and demand for cereals to 243 Mt in 2050, an increase of 0.9 % per year. During the past five decades (1950-51 to 2004-05), area under agriculture has increased by 23 M ha from 119 M ha to 142 Mha, while cultivated area declined by 22 M ha from 49 M ha to 27 M ha. Presently the net sown area is 46.3% which along with fallow land of 25 M ha accounts for 54.5% of total land use. It is

estimated that per capita land availability, which was 0.32 ha in 2001 against the world average of 2.19 ha, will decrease to 0.23 ha in 2025 and 0.09 ha by 2050 (GoI, 2011).

Capacity building of the farmers is to be ensured in terms of know- how and do- how about the latest and improved agricultural technologies, viz; crop production, plant protection, soil health, climate resilient agriculture, conservation of natural resources, livestock production, farm machinery, use of ICTs and sustainable livelihood options, so that scientific thinking and action among the farming community could be ensured for a safe and sustainable agricultural development in the country.

Present Scenario

Network of Research and Extension agencies involved in technology

- Development and its dissemination in agriculture:
- ICAR Institutes-47
- ICAR Deemed universities-5
- Project Directorates-25
- National Research Centres-17
- National Bureaux-6
- Extension Education Institutes (EEI)-4
- Central/ state agricultural universities-1+56
- Zonal Project Directorates-8
- KrishiVigyan Kendra-634
- Central/State agricultural deptts.
- Private seed/fertilizer/farm implements/ insurance companies
- NGOs like DHAN, PRADHAN, MYRADA, BAIF, SKDRDP etc.
- Media (print/electronic)

New Extension Initiatives:

- New Generation KVKs
- Agricultural Technology Management Agency (ATMA)
- Agri-clinics and Agribusiness Centres
- Diploma in Agricultural Extension Services for Input Dealers (DAESI)
- Producer Company models- PEPSI, TATA, AVT, Reliance Fresh, Wal-Martetc.
- ICT models-AGROWEB, E-PKSAR, AgrInnovate, RKMP, Agropedia,
- AGRISNET, ITC e- Choupal, HariyaliKisan Bazars, Tata KisanSagar, Mahindra
- KrishiVihars, i-kisan, e-Sagoo, e- kutir, Reuters Lite etc.

With such a huge system support, Indian agriculture has come to a long way and has established several records in terms of production & productivity and during past few years export of the agricultural produce has also touched new heights. The food grain production has increased by 4 times, horticultural crops and milk by 6 times, fish by 9 times and egg by 27 times since 1950-51. India ranks second worldwide in farm output. This growth may be attributed to the Green, White, Blue and Yellow revolutions in the country. The Indian agriculture still accounts for about 14.1% in the GDP (2011-12) and employs about 52.0% of the total workforce (NSSO, 66th Round). But still there are several issues, though seem to be very basic, need to be addressed on priority to create an atmosphere for rainbow revolution in Indian agriculture.

Farmers committed suicide during 2011:

States	Male	Female	Total
Madhya Pradesh	1132	194	1326
Maharastra	3093	244	3337
Kerala	732	98	830
Karnataka	1694	406	2100
Andhra Pradesh	1822	384	2206
West Bengal	662	145	807
Total	**12048**	**1956**	**14004**

Source: Current affairs, Hindustan (Dehradun), Sept.6, 2012.

(1) Diversification in agriculture could not be achieved up to the desired level.

(2) Migration from the rural areas has become a serious concern.

(3) Most of the govt./non-govt. efforts viz; Amul, ACABC, Watershed management programmes, Producer company models, ICT models etc., though, have been able to create no. of success stories, could not trickled down to the entrepreneurs in a systematic manner.

(4) Computer/internet/websites/portals etc. may have number of success stories to its credit but have not been able to create desired amount of impact on mass level in the typical Indian conditions.

Reasons for the Plight

(1) Govt. and Non-government agencies including media engaged in agriculture and rural development sector have not been able

to reach and educate to the communities sufficiently in a meaningful manner. Limited time devoted to agriculture and rural development on Television and Radio, limited coverage in newspapers and farm magazines has made things pathetic.

(2) Also, most important thing is that whatever means of communication are used, are not compatible with the majority of communities/ regions, in terms of availability of variety of information, completeness of information and availability of information on a regular basis.

(3) Advertising, though the most powerful way of reaching the communities all over the world for popularization/promotion of all kind of products/programmes, is hardly practiced in our country for promotion of agriculture and rural development.

(4) Lack of awareness and exposure among farming community about different schemes/projects related to agriculture/rural development is either almost nil or by the time they come to know, the period of scheme/project is over.

(5) Lack of knowledge and awareness about improved agricultural technologies.

(6) Lack of exchange/exposure about Indigenous Technological Knowledge (ITKs) / Modern Technological Knowledge (MTKs) available with the farmers in different agro-ecological regions of the country.

(7) Due to lack of knowledge, excessive use of chemicals fertilizers / insecticides / pesticides leads to the soil & environmental pollution.

(8) Agriculture is still backbone of Indian Economy. In case of any kind of economic or climatic variability it is the most reliable sector that sustains and supports the development. It is still the biggest sector that provides maximum employment in the country. But the media coverage for creating awareness about natural resource management among farming community has been negligible.

Liberalization and globalization of the Indian economy has opened up equal opportunity for Indian agriculture to blossom and grow to its full potential in terms of commercialisation, diversification, high value agriculture, precision farming, organic farming, hi-tech horticulture, micro-propagation, integrated nutrient management, post-harvest management, biotechnology and market linkages etc. But lack of relevant information, knowledge and skill among farmers and other stakeholders has been withholding the transformation of Indian agriculture.

Media Situation in India:

Radio:

In 1947, All India Radio (AIR) had a network of Six stations, covering 2.5% of area and 11.0% population, now is one of the largest broadcasting organisations in the world in terms of the number of languages of broadcast, the spectrum of socio-economic and cultural diversity it serves, AIR's home service comprises 376 stations today located across the country, reaching nearly 92% of the country's area and 99.19 % of the total population. AIR originates programming in 23 languages and 146 dialects.

Radio Programmes:

1. **Sahitya Bharati:** is a radio literary magazine programme covering all 23 Indian languages and includes literature's modern trends, contemporary issues along with their creative writings and criticism too.
2. **Sanskriti Bharati**: is a cultural magazine programme devoted to Indian composite culture. This programme is broadcast every second Wednesday of the month.
3. **Chitra Bharati:** programme is devoted to Indian cinema, its trends in art, and creativity and modern issues in Indian cinema industry. This programme is produced by Vivith Bharati Service AIR, Mumbai.
4. **Vigyan Bharati:** science magazine programme is broadcast every 4th Wednesday. This programme is devoted to science related subject to create scientific temperament among Society.
5. **Yuva Bharati:** contains Youth related issues, their achievements, aspirations and needs. This programme is broadcast every 5th Wednesday of the month.

   Other farm based programmes: KrishiJagat/ Yuvovani and Local programmes.

NEWS PAPERS:

- Newspapers and Periodicals- 35,595
- Circulation of newspapers and periodicals- 67 millions
- Daily newspapers- 367 in 18 languages
- Circulation of Dailies- 20 million

Farm Magazines:

- No. of farm magazines- 250 (approx.)

Television:

- As of 2012, there are over 823 channels of which 184 are pay channels.
- More than half of all Indian households own a television.
- Primary viewers: more than 400 million (Approx.)
- Farm based programmes: Krishi Darshan/ Choupal/Krishi Katha/Ankur etc.

But the efforts being made by the media seem to be insufficient or ineffective to promote the Indian Agriculture.

"Total telecast/broadcast time devoted on agriculture by media is not sufficient and quality of information also is not up to the mark to cope with the circumstances because complexity of the technologies including its impact on nature's health as well public health are generally ignored"(Bankey Bihari et.al.2001).

In today's world, Television is the strongest medium of information flow which has exhibited drastic social/technological/business changes. At present about more than 500 TV channels are there. India's Doordarsan channel has the biggest network in the wold. It has 5 national channels (DD-1, DD-2, DD News, DD Bharti, DD Sports and DD Urdu) along with regional centres at hyderabad, Guwahati, Patna, Raipur, Ahmedabad, Shimla, Srinagar, Ranchi, Bangalore, Thiruvananthapuram, Bhopal, Mumbai, Bhubneshwar, Jalandhar, Jaipur, Chennai, Lucknow & Kolkata and 11 channels on regional languages. It plays important role in dissemination of information of all kind, including agriculture and rural development. Because of its audio-visual nature, it conveys the message along with proper demonstration of the each and every aspect that makes it the most powerful medium of information dissemination. But, at present, through agriculture related programmes on television the amount of information being made available and its quality is a matter of concern. It needs a lot of improvement in terms of its compilation and presentation to the varied category of viewers.

Recommendations

1. Until and unless quality information is made available to create awareness and a scientific thinking among farming community as well as its application in real field situations is promoted, no other revolution like evergreen revolution or food security, nutritional security or environmental security is possible in the country.
2. Awareness in a planned manner among Indian farming community is to be created on a regular basis to ignite and sensitize farmers mind about latest developments in agriculture and rural development and accordingly guide them about how maximum benefits could be harnessed.
3. Green revolution had a number of negative impacts afterwards because no comprehensive details about the agricultural practices/ technologies could be communicated to the farming community. Likewise in our country no other revolution can be successful without Information revolution and it is possible only through Indian television.
4. It will be a boon for the farmers, who are really involved in the farming operations and generally do not get time to go out of village so frequently and always lack in exposure/knowledge about improved/latest innovations.
5. It must be ensured that what is being informed to the farmers through the television/radio or by any other means, related inputs/services are available either with govt. departments or in private.
6. Govt. agencies may or may not be able to reach to each and every farmer but farmers, if educated and informed properly & sufficiently, may reach to the government/ non-government agencies/ sources to avail the services/inputs/benefits.
7. The very purpose of using any media in rural India is for entertainment second comes the news and sports. In such a situation communicating science and technology may be a challenge. Keeping the above fact into consideration, it is to be researched and seen whether science is to be put into entertainment or entertainment is to be put into science or vice- versa, to communicate the science and technology in an effective manner.

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SOCIO-ECONOMIC CONDITION OF SCHEDULED CASTE AGRICULTURAL LABOURERS OF BIHAR: *A CASE STUDY*

Dr. Kumar Amarendra Narain

Human society is dynamic. Its socio-economic and cultural landscape goes on changing constantly, consequent upon the interaction of physical and socio-cultural forces. From the time immemorial, the society has moved from primitive communism to the present industrial stage. The scheduled caste community has remained isolated, deprived and neglected from the days of Manu. This community was secluded from the very beginning and was treated inhumanly by the privileged section of the Hindu society. Scheduled caste people were object of hire and fire from the early period. The theory of 'Chaturvarna' kept them deprived from the mainstream of national life. Their economic base was without any solid foundation. In the early period, a 'chamar' was asked to carry dead animals. They were also asked to beat drums and rural musical instruments on various religious occasions and also during ceremonial or ritual performances for which they were paid petty amount either in case or kind. Similarly Dusadh, Dhobi, Pasi, or Doms were asked to perform specified works to suit the interest of other Hindu castes. They were branded as untouchables. They were punished physically and socially if they defied the social system.

The idea of economic development being a determinant of socio-cultural development is implicit in Marxian literature. Many economists and social anthropologists although rejecting the Marxian economic views have accepted the Marxian approach that economy proceeds the society. Further, it had been observed that changes in the system of production led to remodeling of the social, political and cultural set up of the society. But the scholars like G. Mydral stresses upon the role of social institutions in the economic development, particularly in the Asian stage. Many other sociologists undermine the supremacy of the economic forces determining the changes in the society. They have given priority to some social and non-economic factors. The economic growth also depends upon economic activities, increasing knowledge and increasing capital.

To study the socio-economic condition of the scheduled caste agricultural labourers of a particular area (Jehanabad District of Bihar) it would not be out of place to focus on the historical background of the social stratification of the caste system under greater fold of Hinduism.

India is a classical land of caste. More than 2800 castes and sub-castes with all their peculiarities exist. Of these four prominent groups of castes are Brahmins, Kshatriyas, Vaisyas and Sudras (depressed and untouchable) are found in every corner of the country. The caste stratification of the Indian society has had its origin in the 'Chaturvarna' system. The Varna system which was prevalent during the Vedic period was mainly based on the division of labour and occupation. The sacredness of the caste system in India consisted in belief that it was established with divine sanctions hence it was everybody's concern to fulfil his caste duties in accordance with his Dharma. This is the doctrine inculcated in the popular 'Bhagwat Gita'.

Occupations

In a caste-ridden society, there is a gradation of occupation also. Some occupations are considered to be superior or sacred, while certain others degrading and inferior. For a long time occupations were very much associated with caste system. Each caste had its specific occupations and the occupations were almost hereditary. The caste system puts restriction on the range of social relation also. The idea of pollution makes their point clear. It means that a touch of a higher castes man particularly by the scheduled caste defiles a man of higher caste. Even his shadow is considered enough to pollute a higher caste man. In Kerala for a long time a Nayar could approach a Nambudari Brahmin but would not touch him. Further a Tiyan was expected to keep himself at a distance of 36 steps from Brahmins and a Pulaya at a distance 96 paces. They were considered to be unholy, inferior, low and were looked down upon by other castes. The society even today suffers from the stigma of untouchables. The scheduled castes were not allowed to use common wells, ponds and other civic facilities. In facts, the practice of untouchability is a stigma attached to Hindu society. It is an age old system which has its root in our social and religions system. Gandhiji regarded this practice as leper wound.

But the orthodox rural society particularly the upper caste and even intermediate caste to look upon the scheduled caste workers (both male and female) as most hateful object although their agricultural works including other domestic works would remain incomplete in their absence. Their antagonistic attitude is still deeply rooted in their hearts when they find young scheduled caste boy and girls educated and well dressed. They become envious when these educated boys and girls deny working in their fields and at home.

The caste system was undemocratic and authoritarian in the extreme. This is still hierarchically graded, each caste being considered inferior to those above it and superior to those below it. The status of a person born in a particular caste was determined by the rank of that caste in this hierarchy. Once born in that caste his status was pre-determined and immutable. Thus birth decided his status which could not be altered by any talent he might have or wealth he might accumulate.

Here, we are highlighting the socio-economic condition of scheduled caste agricultural labourers of Bihar with a special reference to the naxal affected district of Jehanabad.

Jehanabad district, and erstwhile sub-division of Gaya district of Bihar, finds a prominent place on the map of India due to naxal movement in which many extremist organizations, like, people's War Group (PWC), Indian People's Front, (now CPI-ML) Sangram Samiti, Maoist Communist Centre (MCC) and other organizations are making constant terrorist attacks on rich peasantry groups of rich landlords. To counteract such terrorist activities engineered by extremist organizations another organization in the name "ranvir sena" and other Senas made by feudal lords have sprang up. These organizations have created terror in the rural areas for mercilessly killing of innocent persons who mostly belong to downtrodden castes and other backward communities including scheduled caste. Among the victims, landless farmers and agricultural labourers belonging to Rabidas, Dusadh, Pasi, Dhobi, Mushar, Rajwar (all scheduled caste group), Koiri, Kurmi, Yadav, Nonia etc (Backward castes) are prominent. In fact, attack and counter-attack by different organizations have vitiated the serene atmosphere or rural life of the district which requires immediate action by the government and the other NGOs.

Jehanabad, a revenue sub-division of erstwhile Gaya district was made in the year 1872. It became a separate district on 1st August, 1986 with population of 15, 11,406 (male 7, 83,960 Female 7, 29,446) as per 2001 Census. Out of which 2, 78,215 belong to scheduled caste communities. The scheduled caste is overwhelmingly rural with 93.3 percent residing in rural areas. Gaya district has the highest proportion of scheduled castes (29.6 percent) whereas Kishanganj has the lowest proportion of scheduled caste population (6.6 percent). In Bihar, there are 23 categories of scheduled caste people. Chamar is the most populous caste constituting 31.3 percent of the total scheduled caste population. Dushad is the second (30.9 percent) followed by Mushar, Dhobi and Pasi.

Jehanabad is primarily a district of villages and a small number of urban and semi-urban towns/ bazaraas are in existence. Jehanabad is a big town with population of 81,723; other urban centres within the district are like Arwal (now a separate district) Kako, Ghosi, Makhdumpur, Kurtha, Karpi, Tehta,Hulasganj and Modanganj.

A major portion of the population depends upon agriculture out of which 59 percent live below the poverty line. A big chunk (64%) of its population is constituted by backward castes and only 13 percent belongs to upper caste (Bhumihar, Rajput, Brahman and Kayastha) which dominate economic, political and cultural life of the district.

The existing caste hierarchy and social stratification of the rural society is well marked. Long back Dr. G.A. Grierson, who was the district collector of Gaya has divided poor classes of people into four categories namely, the cultivators, agricultural labourers, artisans and lastly those who subsisted on charity. Among the agricultural labourers Mushar, Dusadh, Chamar, Pasi are prominent whose total percentage of the agricultural labourers stands as 60 percent. Among the rest labourers belonging to Yadav, Kanu, Koiri, Beldar, Nonia whose percentage is roughly 20 percent.

The socio-economic condition of the agricultural labourers belonging to the scheduled caste communities is most appalling and deplorable. Economic disparity led the foundation of social and political exploitation by upper caste and rich farmers of intermediary class. Ordinarily the scheduled caste labourers live on the outskirts of the villages where other social facilities and economic advantages do not reach them. On trifling issues, they are frightened by the police who were being influenced by the big zamindars or rich influential persons of higher castes. These are the untold miseries found in the pages of social history. The atrocities perpetrated on poor and down-trodden agricultural labourers particularly labourers belonging to scheduled caste community are beyond human tolerance.

Literacy

The literacy among the scheduled caste of Bihar is dismally low. The overall literacy of scheduled caste is 28.5 percent (2001 census) which is nearly half of that recorded for all scheduled caste at national level (54.7 percent) Male and Female literates constitute 40.2 percent and 15.6 percent respectively. Among the major castes, Dhobis have the highest proportion of matriculates (19.7 percent) whereas Mushars have the lowest proportion of matriculates (6 percent). Educationally, the entire district is most backward. The literacy percentage of Bihar as a whole is 54.6 as against 90.92 percent of Kerala or 77.27% of Maharashtra. The percentage of literacy among the scheduled caste agricultural labourers stands at low ebb even after independence. More than 90 percent of them are still illiterate; only their sons are going to the primary schools or attending 'Anganwari Kendras or Sarva Sikha Kendras' but their percentage is again poor. The district of Jehanabad is having 561 primary schools, 118 middle schools, 39 high schools and 8 colleges, but their admission is quiet negligible. Most of their sons and daughters are engaged in light works in order to supplement their parent's income. The parents also seldom encourage their sons and daughters to go to schools. Thus, educationally, they are dwarf and economically bankrupt.

The agricultural labourers are called 'Kamia'. This is like a class of bonded labourerswho work throughout the year to the farm of a particular man. They do not go elsewhere neglecting their masters' work. In case there is no work, they may go anywhere for selling their labour.

The daily routine life of the labourer is like machine which moves without any interruption.

The women folk of a labour family add to the family's income working in the houses of some rich neighbours and keep themselves busy in doing household works such as carrying water, washing clothes, looking after children, scrap grass, pluck leaves and woods or twigs for their cattle. Thus the entire family is struggling for existence without caring for their health. They never care for health; they have no money to purchase medicines. The diet of such labourers is ill-nourished and its calorie value being very poor.

The socio-cultural life is most horrible. Their social relationship with other higher caste people is very restricted. Both male and female are not allowed to enter into the courtyard of higher castes. Higher caste people will not take anything offered by the labourers belonging to scheduled caste. The cultural life is also very limited and deplorable.

The sanitary condition of the villages inhabited by the agricultural labourers of scheduled caste community is extremely primitive. The ignorance of civic sense and unwholesome habits of the people renders the task of village sanitation very difficult. The arrangement of lavatory hardly exists in the rural areas and the villagers resort to promiscuous excretion generally by the side of road, ponds and the rivers. They live in a small room without ventilation where the entire family sleeps on the ground floor ignoring the privacy required for grown up ladies. The houses are mud-built, without any proper arrangement for ventilation and drainage. Use of unfiltered river water, tank or pond water is the normal feature. Consequently, infectious and water borne diseases are common to them.

In a feudalistic society of Jehanabad district, social exploitation, economic discrimination and deprivation have given birth to anti-social activities in which large number of frustrated labourers belonging to scheduled castes and other backward castes have shaken hands to fight against injustice. The wealthy farmers, having major portion of agricultural land are their common target. The unequal distribution of landed property and socio-economic exploitation has led to the migration of labourers of Jehanabad district to other states. The incident ('Kand') at Belchi (1977), Paras bidha (1980), Pipra (1986), Kansara (1986), Arwal (1986), Bathanitola (1996), Senari (1999) and many other places are the reflections of exploitation of labourers. Simmering discontentment due to denial of social justice in respect of weaker section of society, unfair and uneconomic wages, demand and deprivation of fruits of political participation in democracy have led to the social unrest in rural society. Political discrimination in respect of scheduled caste is the ground reality. They are terrorized by private armed groups like Ranvir Sena, Kunwar Sena, Brahmarishi Sena, Lorik Sena, Bhumi Sena etc. during general and local bodies' election. They are forced not to come out of their houses during pool hours; otherwise, they would face serious consequences. Thus these poor and helpless labourers swallow up social deprivation due to lack of support by the government or other agencies. Untold miseries and atrocities perpetrated on poor and downtrodden agricultural labourers particularly belonging to scheduled caste on trifling matters have become the talk of the people. They are frightened even today of being arrested by the police who are being influenced by the feudal lords, zamindars or rich influential upper caste people.

It is no denying fact that the scheduled caste agricultural labourers are economically hard pressed and socially secluded. No governmental agency or even NGO's are keenly interested to bring them into the mainstream social and economic life. These labourers have no labour organization to fight for social justice. They are under constant pressure of the feudal lords or rich peasantry class. They are unable to raise their voices to demand higher wages in wake of soaring prices of the essential commodities of their daily lives.

In fact, the benefits of our development are still to reach all sections of scheduled castes. We cannot look at the future without addressing the needs of disadvantaged sections of our society. Mahatma Gandhi has emphasized long back that 'Farmers and workers make India. Their poverty is India's curse and crime. Their prosperity alone can make India a country fit to live in. Neither the lawyers, not the doctors nor rich landlords are going to secure it.'

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BIOTECHNOLOGY- AN EFFECTIVE TOOL FOR FOOD SECURITY IN INDIA

Priyanka Suryavanshi and Y.V Singh

In the present context of global climate challenges, biotechnology has the potential to the increase food production, reduce pesticide damage to the environment, sunscreen natural resources and create alternate fuels from the renewable sources

World population continues to expand at about 80 million people per year and it will reach at 10 billion in 2060 from the 7 billion at present. The requirement for food security remains an overpowering anxiety for developing countries, where under nutrition of large population remains a continuous problem. There is little or no scope to expand the existing agricultural footprint without further damaging natural eco systems. At the same time, climate change is leading to production uncertainty to meet these challenges. Biotechnology has emerged as a tool to the increases global agriculture production and for protecting the environment through the reduced use of agro-chemicals like pesticides, fertilizer and rodenticides.

Through biotechnological tools, scientists are able to the produce a plant with new advantageous and desirable characteristics through inserting one or more gene into a plant. Biotechnology is being used to achieve many goals and improvements in the plant which were attempted through conventional methods. Biotechnology gives scientists the ability to isolate genes and introduce new traits into the foods without simultaneous introducing undesirable traits. Because of increased precision offered by the bioengineered methods, the risk of introducing detrimental traits is reduced.

Global status of the transgenic /GM crops

The global area of genetically modified (GM) agricultural crops has seen a tremendous increase since its first adoption in 1996 to 148 million hectares in 2010. A variety of traits have been introduced in plant species which include: herbicide resistance, pest resistance, viral resistance, slow-ripening, fungal and bacterial resistance, abiotic stress tolerance (drought, salinity, temperature etc), quality improvement (starch, protein and oil), value-addition (vitamins, micro- and macro-elements), pharmaceutical and therapeutic proteins, edible vaccines, industrial importance and phytoremediation. The first commercial transgenic crop variety 'Flavr Savr' of

tomato was released in 1994 and it was engineered for slow ripening character. So far, 184 GM extents have been authorized for the food and feed production in the 59 countries. In the 2010, the planting area of GM crops reached 148 million hectares and 15.4 million farmers cultivated GM crops and experienced socio economic and environment in the benefits among them, 14.4 million farmers were small scale, resource poor the farmers in the development nations. A list of the leading countries in the biotech crops is given in Table 1.

Along with food security it is also important to achieve nutritional security, which is particularly relevant to developing nations like India. There are several examples of biotechnological attempts to develop nutritionally rich crop varieties. The most celebrated example is the development of 'Golden rice'. Three different genes phytoene synthase (psy), lycopene cyclase (lyc) and phytoene desaturase (crtI) have been introduced into japonica rice through agro-bacterium mediated transformation that has resulted in synthesis of beta carotene which is the precursor of vitamin A in human body.

Status of transgenic crops in India: Efforts are being made in India since early eighties to develop transgenic crops. The first transgenic crop commercialized in India was Bt cotton in 2002. Currently, six transgenic events of Bt cotton (>1 000 hybrids) are available and the success story of Bt cotton cultivation has been reviewed. Fruit borer resistant Bt brinjal hybrids developed by Mahyco and varieties developed by UAS, Dharwad and TNAU, Coimbatore have been cleared by GEAC with respect to environmental safety and biosafety. In India besides Bt cotton and Bt brinjal, a no. of multi-institutional programme have been launched which include development of the transgenic resistance for stem borer in tomato and rice tungro in rice, development of the nutritionally improved potato with the balanced amino acid composition using a protein from the amaranth.

Development process of GM crops: The main steps involved in the development of GM crops are:

1. **Isolation of the gene(s) of interest:** Existing knowledge about the structure, function or location on chromosomes is used to identify the gene(s) that is responsible for the desired trait in an organism, for example, drought tolerance or insect resistance.
2. **Insertion of the gene(s) into a transfer vector:** The most commonly used gene transfer tool for plants is a circular molecule of DNA (plasmid) from the naturally occurring soil bacterium, *Agrobacterium tumefaciens*. The gene(s) of interest is inserted into the plasmid using recombinant DNA (rDNA) techniques.
3. **Plant transformation:** The modified *A. tumefaciens* cells containing the plasmid with the new gene are mixed with plant cells or cut pieces of plants such as leaves or stems (explants). Some of the cells take up a piece of the plasmid known as the T-DNA (transferred-DNA). *The A. tumefaciens* inserts the desired genes into one of the plant's chromosomes to form GM (or transgenic) cells. The other most commonly used method to transfer DNA is particle bombardment (gene gun) where small particles coated with DNA molecules are bombarded into the cell.
4. **Selection of the modified plant cells:** After transformation, various methods are used to differentiate between the modified plant cells and the great majority of cells that have

Table 1. Global area of the genetically modified crops in 2009

Country	Area (million ha)	Genetically modified crops
USA	64.0	Soya bean, maize, cotton, rape squash, papilla
Brazil	21.4	Soya bean , maize, cotton
Argentina	21.3	Soya bean and cotton
India	8.4	Cotton
Canada	8.2	Rape, soybean. sugar beat
China	3.7	Cotton, tomato. poplar, soybean
Piragua	2.2	Soya bean
South Africa	2.1	Maize, soya bean, cotton

not incorporated the desired genes. Most often, selectable marker genes that confer antibiotic or herbicide resistance are used to favor growth of the transformed cells relative to the non-transformed cells. For this method, genes responsible for resistance are inserted into the vector and transferred along with the gene(s) conferring desired traits to the plant cells. When the cells are exposed to the antibiotic or herbicide, only the transformed cells (containing and expressing the selectable marker gene) will survive. The transformed cells are then regenerated to form whole plants using tissue culture methods.

5. Regeneration into whole plants via tissue culture involves placing the explants (plant parts/cells) onto media containing nutrients that induce development of the cells into various plant parts to form whole plantlets. Once the plantlets are rooted they are transferred to pots and kept under controlled environmental conditions.
6. Verification of transformation and characterization of the inserted DNA fragment. Verification of plant transformation involves demonstrating that the gene has been inserted and is inherited normally. Tests are done to determine the number of copies inserted, whether the copies are intact, and whether the insertion does not interfere with other genes to cause unintended effects. Testing of gene expression (i.e., production of messenger RNA and/or protein, evaluation of the trait of interest) is done to make sure that the gene is functional.
7. Testing of plant performance is generally carried out first in the greenhouse or screen house to determine whether the modified plant has the desired new trait and does not have any new unwanted characteristics. Those that perform well are planted into the field for further testing. In the field, the plants are first grown in confined field trials to test whether the technology works (if the plants express the desired traits) in the open environment. If the technology works then the plants are tested in multi-location field trials to establish whether the crop performs well in different environmental conditions. If the GM crop passes all the tests, it may then be considered for commercial production.
8. **Safety assessment.** Food and environmental safety assessment are carried out in conjunction with testing of plant performance.

Types of GM crops

Genetically modified crops have been broadly divided into eight sub-groups:

i) **Herbicide resistance** (canola, soybean, cotton, rice, wheat, carnation, chicory, corn, sunflower, tobacco and sugar beet)

ii) **Insect Pest resistance** (cotton, corn, rice, tomato and potato)

iii) **Viral resistance** (papaya, squash, plum and potato)

iv) **Slow-ripening and softening** (tomato and melon)

v) **Improved oil quality** (canola and soybean)

vi) **Male sterility** (canola and corn)

vii) **Pigmentation pattern** (carnation)

viii) **Reduced nicotine content** (tobacco)

The dominant technology applied so far is herbicide tolerance in the soybeans, which account for 70% of the world wide soybean production. GM maize having herbicide tolerance (HT) and insect resistance covers 30% of the global maize area and 24% of the production.

Herbicide resistance: Herbicide tolerant crops resolve many problems because they include transgenes providing tolerance to the herbicides like Roundup (chemical name: glyphosate) or Liberty (glufosinate). These herbicides are broad-spectrum, meaning that they kill nearly all kinds of plants except those that have the tolerance gene. Another important benefit is that this class of herbicides breaks down quickly in the soil, eliminating residue carry-over problems and reducing environmental impact. Herbicide tolerant varieties are popular with farmers because they enable less complicated, more flexible weed control. These varieties are commonly marketed as Roundup Ready or Liberty Link varieties.

Insect resistant: "Bt" short for *Bacillus thuringiensis,* is a soil bacterium whose spores contain a crystalline (Cry) protein. In the insect gut, the protein breaks down to release a toxin, known as a delta-endotoxin. This toxin binds to

and creates pores in the intestinal lining, resulting in ion imbalance, paralysis of the digestive system, and after a few days, insect death.

Virus resistance: Expression of viral genes encoding coat protein, non structural proteins and use of antisense technology are some of the strategies that have been effectively used in plants to confer resistance against viral diseases. The transgenic expression of viral structural protein stops replication and spread of the infecting virus and the plant shows resistance reaction. The biggest success story of transgenic mediated virus resistance is the cultivation of transgenic papaya expressing capsid protein in Hawaii, which virtually saved the papaya industry from dreaded threat of ring spot disease.

Broad objective of promoting biotechnology in agriculture include:

1. Conservation of biodiversity and the sustainable use of its biotic resources.
2. Production of high yielding, drought and pest resistant seeds suited to different agro climatic zones.
3. Improving the quality and production potential of the stock popularity and aquatic eco system.
4. Promotion of the environment safe technologies for pollution abatement, especially treatment of urban waste and industries effluent.
5. Generation and use of different types of bioenergy.
6. Promotion and cultivation of the medicinal and aromatic plant, and the processing and value addition of their produce.

Applications of the biotechnology in crop production

1. **Nutritional enhancement:** The prevalence of iron deficiency is estimated to be about 30% of the world population making iron the most efficient nutritional disorder worldwide. Food bio-fortification has been considered the best long term strategy for the prevention of anemia.
2. Screening for the noble microbes and their bioprospecting for saline tolerant, nitrogen fixing, phosphate solublising and plant growth promoting rhizobacteria (PGPR) has a potential as biofertizers and pseudomonas strains as bio-control agents in the agriculture.
3. **Bio prospecting:** Bioprospecting is basically the search for the commercially valuable biochemical and genetic resources in the plants, animals and micro organism. In India, it can be done by bio-resource mapping and monitoring of bio-logical durability.
4. **Eco-enterprise development:** Low cost units are established for the production of the biological software's for the promotion of the organic farming. The production of eco-enterprise like *Trichoderma viride*, *Trichogramma* and *Pseudomonas florescence* are successfully managed by the women SHGS.
5. **Animal husbandry:** Development of recombinant diagnostic and vaccines for the major diseases in animals are some of the potential areas. Modern biotech can be applied to solve the problems of diseases that can be transferred from the animals to humans such as bird flu and swine flu, dwindling feed resources and rising cost of the veterinary drugs.
6. **Fisheries and aquaculture:** Biotech practices like sex reversal, molecular proofing are used to diagnose disease and to the determine purity of fish stock.
7. **Food processing:** The greatest application of the biotechnology in the food industry is microbial formulations of bacteria that can be genetically engineered to the produce specific enzymes for different purposes.
8. **Crop improvement:** Modern biotechnological tools have involved advanced tissue culture technologies such as those used in the development of the new rice for the Africa and the production of the balance in the Kenya.

Biosafety, food safety and the environment:

There are several widely accepted environmental drawbacks associated with the rapid deployment and widespread commercialization of GM crops in large monocultures, including:

- The spread of transgenes to related weeds via crop-weed hybridization
- Reduction of the fitness of non-target organisms

Table 2. Biotechnological products showing longer term promise for the adaptation to climate change

Product	Trait	Function
Drought tolerant rice	HARDY (HRD) genus from Arabidopsis reducing transpiration and enhancing photosynthesis assimilation	Increase water use efficiency, adaptive increase of root mass under water stress.
Drought tolerant tobacco	Delayed drought induced leaf senescence	Retained water content and photo synthesis resulting in minimum yield loss under drought 30% water requirement
Drought tolerant maize	Expression of glutamate dehydrogenate gene from E. Coli	Germination and grain biomass production under drought increases
Salt tolerant rice	A QTL (salt) associated with drought resistance	Allows close to normal yield under high salinity situation (Bangladesh)

through the acquisition of transgenic traits via hybridization

- The rapid evolution of resistance of insect pests such as Lepidoptera to Bt
- Accumulation of the insecticidal Bt toxin, which remains active in the soil after the crop is ploughed under and binds tightly to clays and humic acids;
- Disruption of natural control of insect pests through intertrophic-level effects of the Bt toxin on predators.
- Unanticipated effects on non-target herbivorous insects (i.e., monarch butterflies) through deposition of transgenic pollen on foliage of surrounding wild vegetation.
- Vector-mediated horizontal gene transfer and recombination to create new pathogenic organisms.

Biotechnology and climate change

In the present context of global climate challenges, biotechnology has the potential to the increase food production, reduce pesticide damage to the environment, sunscreen natural resources and create alternate fuels from the renewable sources and create alternative fuels from the renewable source without comportment the environment and increase farm income. Conservation agriculture techniques are efficient tools to help in the modeling climate change by the preventing wind, water erosions and loss and ground moistures, impressing soil biodiversity, increasing soil fertility and reduce carbon emissions. During the year 2007 alone, green house gas emission reduction from the use of biotech crops were equivalent to the removal of nearly 6.3 million cars from the road for one year. GM crops are globally grown by reduced pesticide application to the extent of nearly 224 million kg and thus eliminating the adverse impact of pesticide on environment and reducing 14% green house gas emission by 960 million kg of CO_2. Biotechnological products showing longer term promise for the adaption to the climate change are given in Table 2.

Conclusion: Biotechnological tools can play a very crucial role in development of new crop varieties which can adopt better under changing environment conditions. Biotech crops are globally accepted for reduced pesticide application and thus improving the environment quality. Biotechnology could be used to enhance global food production, food security and nutritional security in a sustainable manner. This technology can be used to manage the environmental hazards like drought through development of drought tolerant crops and thus help the farming community.

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Biotechnology gives scientists the ability to isolate genes and introduce new traits into the foods without simultaneous introducing undesirable traits.

BOOST YOUR HEALTH WITH PROBIOTICS

Monika Choudhary and Dr. Kiran Grover

The health benefits of probiotics include improvement of intestinal health, enhancement of the immune response, reduction of serum cholesterol, and cancer prevention

In the times of modern lifestyle and diet,
Probiotics are the tiny warriors you need to stay beside.

Nature is full of mesmerizing things and yet there is plenty to discover. One such amazing case is Probiotics of human gut. Probiotics include a wide variety of live active microorganisms such as lactic acid bacteria, also called *lactobacillus*, and *bifidobacteria.* Human gastro intestinal tract (GIT) is a vast surface that is tolerant to and flooded with complex and diverse community of micro organisms. There are billions of (good) bacteria in our gastrointestinal tract, where they serve as a key line of defence against toxins that invade our body. An appropriate microbial balance in the intestine is crucial for health. Probiotics suppress the growth of harmful bacteria and help increase the number of beneficial bacteria in the intestine. Probiotics are commonly consumed as part of fermented foods like *idli, dosa, dhokla* and *uttapam and* pickled vegetables like sauerkraut (cabbage pickle). Fermented milk products such as yoghurt, sour cream, *dahi*, and buttermilk are examples of foods that may act as probiotics.

The beneficial effects of probiotics consist of either reducing one or more risk factors for disease, or improving bodily functions. The health benefits of probiotics include improvement of intestinal health, enhancement of the immune response, reduction of serum cholesterol, and cancer prevention. Probiotics have been shown to reduce the duration of diarrhoea and the symptoms of lactose intolerance and irritable bowel syndrome. Lactose intolerant individuals develop diarrhoea, abdominal discomfort, and flatulence after consumption of milk or milk products. These digestive disorders happen when the balance of friendly bacteria in the intestines becomes disturbed. This can happen after an infection or after taking antibiotics. Intestinal problems

can also arise when the lining of the intestines is damaged. So, taking probiotics may help in this situation as probiotics suppress the growth of harmful bacteria and help increase the number of beneficial bacteria in the intestine. *Lactobacillus* species are a safe and effective form of treatment for children with infectious diarrhoea.

Many bacterial strains found in dairy products interact with our immune system and strengthen it in many ways. *Lactobacillus* bacteria have been found to restore the activity of natural killer (NK) cells in our bodies (NK cells protect us from viruses, bacteria and other disease-causing organisms and are the mainstay of our immune system), that usually diminishes due to smoking, lack of physical activity, and inadequate sleep. Prevention of cancer and its recurrence is closely related to the immune system. So, the consumption of probiotics may be beneficial in preventing the onset of cancer, but also in the treatment of existing tumours. Probiotics have been indirectly linked to improvement in disease like obesity, cardiovascular diseases and diabetes. Metabolic syndrome is a group of metabolic abnormalities, increases an individual's risk of developing obesity, diabetes and cardiovascular disease. This syndrome is influenced by digestive health as well. It is known that cholesterol levels in plasma and the consumption of diets rich in cholesterol are closely related to each other. It is important to determine, therefore, if organisms located in the intestine can assimilate some of the cholesterol ingested in the diet and make it unavailable for absorption into the blood. The cholesterol-lowering effect of probiotics has been partly attributed to their ability to bind cholesterol in the small intestine.

Probiotics directly modulates the immune system and show positive effects in allergies with improvement in mild allergic diseases like atopic dermatitis. Atopic dermatitis is a common chronic skin disorder of infancy and childhood with hereditary predisposition together with the individual's exposure to environmental allergens. Skin issues are often related to what is going on inside our gut. The ratio to healthy and unhealthy bacteria in the intestine is said to be best at 80/20. Lipophilli Bacteria are fat-soluble microbes that live on the exterior of our skin. They keep viruses, infections and fungal issues at bay. This protective layer is required for our body to maintain a radiant and youthful glow. Probiotics are also the perfect antidote to junk food, countering the junk food induced imbalance created in our digestive system. Junk food is usually low on fibre, essential to improve the motility (movement) of the intestines. Moreover, excessive fat intake and preservatives in junk foods suppress good bacteria and increase bad ones. Certain strains of probiotic bacteria may also prevent viral respiratory tract infections, alleviate complaints and/or shorten the duration of the disease. Taking probiotics seems to provide both children and adults with a mild degree of protection against many upper respiratory tract infections including the common cold. People who consume probiotics are also less likely to end up taking antibiotics for an upper respiratory infection. Upper respiratory infections include tonsillitis, inflammation of the pharynx and the most common cause of a sore throat. The symptoms of upper respiratory infections include nasal congestion, sore throats, hoarseness and coughing.

With the incredible advancements in the knowledge and quality research on proven probiotics and future trends predict the use of these strains in dietary supplements and functional health food formulation specifically designed to manage the chronic medical conditions including inflammatory metabolic disorders and life style diseases such as diabetes, obesity, cardiovascular diseases and cancer etc. Current innovations in functional/health foods particularly fermented and non fermented dairy products like *dahi*, yogurt, cheese, ice-cream and beverages along with other foods and convenience products supplemented with probiotics present attractive delivery options for these healthful ingredients so that the consumers and the affected target population benefit from their enormous curing power.

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