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New Agriculture Techniques

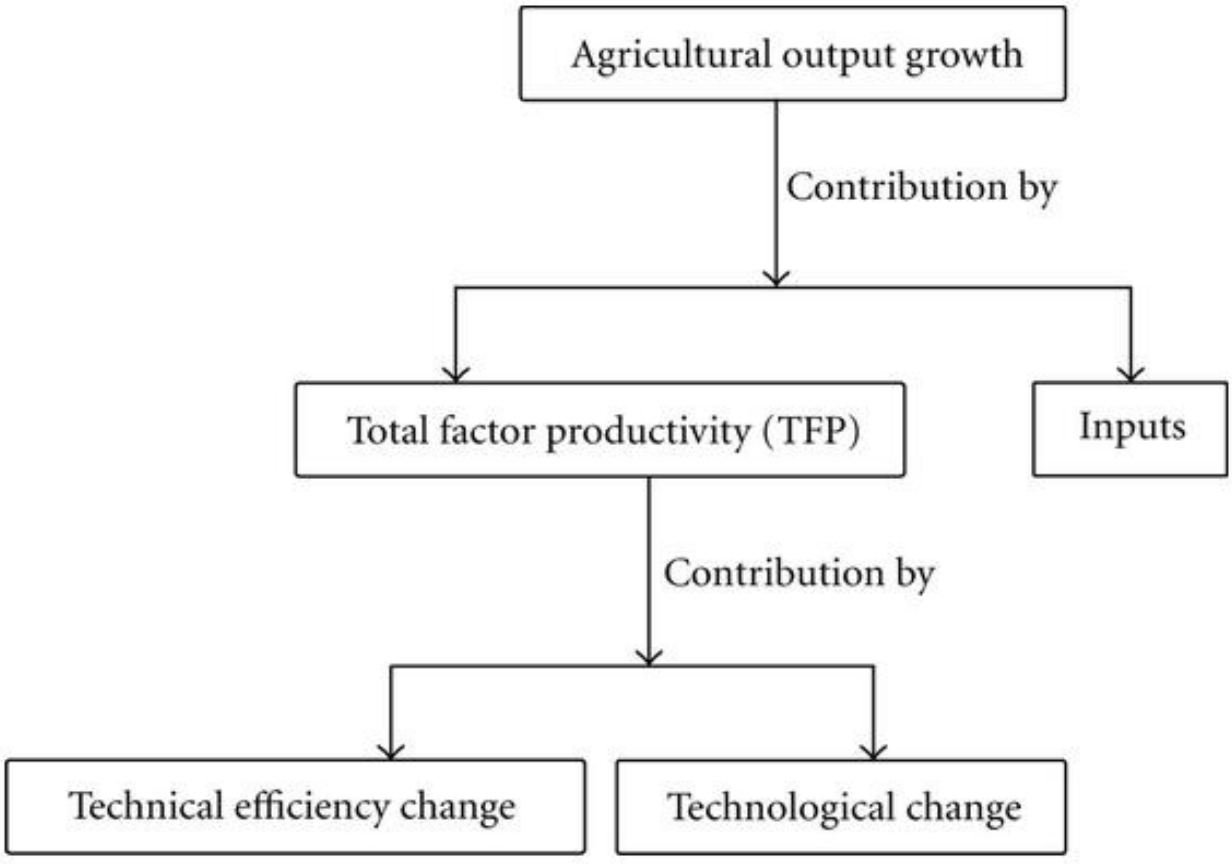
Introduction: India has a very high share of labour (55 %) with lesser contribution to farm mechanisation (40 %). India makes farming less remunerative and leads to farmers' poverty. While USA (2.5 %) and Western Europe (3.9 %) has very low share of labour in comparison to 95 per cent share of mechanization.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

New Agriculture Technology

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. **New agriculture technologies involved are:-**

- **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 4 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 microorganisms and are cheaper and safer to use than metal based nanoparticles.

Fig: Waste Water Management in Agriculture

- **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.

Fig: Drip Irrigation System

- **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 Kurukshetra June 2014 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 f lood 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 f lood 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 88fold and 111-fold, respectively, over the last two decades. India now leads the world, with nearly 2 million hectares (about 5 million acres) under microirrigation 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.

HARVESTING HI-TECH

India looks to satellite-based computing, cutting-edge remote sensing and a growing rural smartphone user base to renew a fading green revolution

BHUVAN

It's a multi-purpose end-user satellite application platform powered by the Indian Space Research Organisation

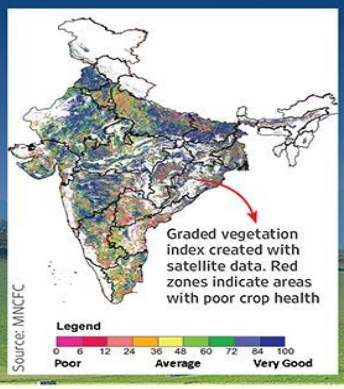
How it works: Acts like a clearing house for satellite data. Essentially a humongous software that integrates and processes ground inputs with satellite data for diverse needs. All state governments use it. Offers nearly 3.6 lakh products, 10 million data points, 800 GB of transactions and 60 million user hits a month

CHAMAN (Coordinated programme on Horticulture Assessment and Management using geoinformatics)

Satellite mapping of area and output of 7 horticultural crops in 12 states

Outcomes

- Digital inventory of all horticulture zones in the country
- Will help decide cold-storage hubs
- Help manage inflation through accurate data of food stocks



FASAL (Forecasting Agricultural output using Space, Agro-meteorology and Land based observations)

Monitoring health of 8 crops using optical and microwave tech of RISAT-1 MRS & Landsat 8 satellites

Drones

- In a first, drones being used to directly study crop locations

NADAMS (National Agricultural Drought Assessment and Monitoring System)

Remote sensing-based real-time information on current or developing droughts at state, district and sub-district level

Outcomes

- Currently covers 14 states at district level, which are predominantly drought-prone, such as Andhra, Bihar, Gujarat, Jharkhand, Karnataka, Madhya Pradesh
- Drought scan at sub-district level available for 5 states

APP, APP AND AWAY

Android apps are the new tools in the hands of officials, farmers

CCE Agri: Revenue officials now use this android app to estimate crop damage and yield loss at 1,100 location points in 12 states

Ground Truth: Tablet-based app to monitor crop health being used by 18 state govts

Bhuvan Hailstorm App: Currently being used to capture hailstorm losses in states such as Madhya Pradesh

mKisan: Nearly 90 million farmers now enrolled for farm advisories, such as weather and pest updates, on their phones

Graphic by SAJI C.S.