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Appropriate and Adoptable Post-Harvest Technologies for Rural Development

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Rural Development is a process of changes carried out deliberately for the upliftment of the rural people. It is generally refers to the process of improving the quality of life and economic well-being of people living in relatively isolated and sparsely populated areas. It is a comprehensive term. It essentially focuses on action for the development of areas that are lagging behind in the overall development of the village economy. Agriculture is the major source of livelihood in the rural sector. Mahatma Gandhi once said that the real progress of India did not mean simply the growth and expansion of industrial urban centers but mainly the development of the villages. This idea of village development being at the center of the overall development of the nation is relevant even today.

Agriculture sector in India-

Agriculture is the primary source of livelihood for 58 per cent of the country's population. As per the fourth advance estimate of production of major agricultural crops for 2020-21 have been released by the Department of Agriculture and Farmers Welfare, a record 308.65 million tons of food grains have been produced. India holds the second largest agricultural land globally. All the 15 major climates are found in India and the country also possess 45 of the 60 soil types in the world. India is the largest producer of pulses, milk, tea, cashew and jute, and the second largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds. The country is among the 10 leading exporters of agricultural products in the world.

Diagram 1: India's position in Agricultural Sectors (Source: MOFPI, 2021)

Post-harvest losses in India were estimated to be INR 926.51 billion (USD 15.19 billion) in FY2014, representing a significant loss of national wealth (Jha et al., 2015). At the same level despite high food production, India ranks only 94th out of 107 countries on the 2020 Global Hunger Index.

Recent study indicates that almost 30-40 per cent of vegetables and fruits and almost 10 per cent of the total agricultural produce go to waste in the country. Proper preservation of these productswill results into value additionof perishables which may help in doubling the farmers' income. Lack of cold chain and proper storage facilities, exports, transportation, adequate processing facilities, and marketing are fields where the government has failed to deliver, leading to wastage of food.

Post-harvest decay of fruits and vegetables occurs during harvesting and subsequent handling, and storage. There are many technologies already developed in the past whichare not practiced may be due to unavailability of materials locally, less effective and expensive technology. By adoption of simple post-harvest management practices, processing and value addition operations viz. proper harvesting, sorting, grading, packaging, pulping, pickling, drying and dehydration at farmer's level during the peak season will help in minimization of post-harvestlosses as well as doubling the farmer's income.

The minimization of these post-harvest losses may be reduced by extending the shelf life of fresh horticultural produces either through pre orpost-harvest management practices or by processing it into different value added products. Several factors influence the post-harvest lossesin fruits and vegetables that include losses due to physical,

physiological, mechanical and unhygienic conditions, lack of proper storage conditions, refrigerated facilities and diseases and pests, etc. While harvesting to handling for storage till marketing, several wound pathogens are known to infect the produce that reduce the keeping quality, quantity ultimate lyresults into economic losses.

Various Post-Harvest Technologies

Post-harvest management is one of the techniques which has key role in achieving the objective of increasing the farmers' income. It involves proper harvesting, washing, sorting, grading, drying, packing and storage. Post-harvest losses in fruits and vegetables is staggering one lakh crores of rupees every year. Following techniques if applied effectively, it may reduce the post-harvest losses significantly and will help in increasing the farmers' income. There are many academic and research institutions developed postharvest technologies for minimal processing, on farm storage, primary processing etc. CIPHET, Ludhiana developed 35 affordable processing equipment's. CSIR-CFTRI offers a variety of technologies in the post-harvest handling, storage and processing of the varieties of foods. Over 400 processes have been developed in food science and technology and allied fields. The Indian Agricultural Research Institute (IARI) has also developed affordable post-harvest technologies for rural India for majorly minimizing storage losses at farm level. Some of appropriate and adoptable technologies have been explained below.

Minimal Processing

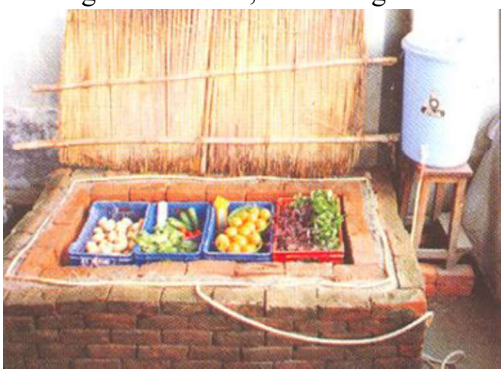
Minimally processed operations have been defined as, those procedures such as washing, sorting, trimming, peeling, slicing, chopping, anti-oxidants treatments and packing etc. that do not affect the fresh like quality of fruits & vegetables. The minimally processed fruits & vegetables are the products that are partially prepared so that no additional preparation is required for their use. The result of such operation is that the products can be prepared and consumed straightway in very short time. The commonly terms referred to minimally processed products are Lightly Processed, Partially processed, Ready to Use (RTU), Ready to Eat (RTE), Ready to Cook (RTC), Ready to Fry (RTF), Ready to Drink (RTD) etc. Minimally processed fruits and vegetables offer a number of advantages such as, convenient time saving and reducing solid waste problems. The physiology of minimally processed products is essentially the physiology of wounded tissue. There is an increase in rate of respiration and ethylene production, oxidative browning, water loss, and texture loss.

- **Zero-energy cool chamber (ZECC)**

Spoilage of fresh fruits and vegetables is a serious problem in tropical countries. Cool storage can prolong the life of fresh produce, but refrigeration equipment is expensive to buy, expensive to run, and expensive to maintain. There is, however, a practical, low-cost alternative cooling system for on-farm fruit and vegetable storage which employs the cooling power of evaporation. Zero energy cool chambers stay 10- 15° C cooler than the outside temperature and maintain about 90 percent relative humidity. Moreover, they are easy to build out of locally available materials, such as brick, sand, bamboo, straw, and gunny bags.

Advantages

- No mechanical or electrical energy is needed, ideal for household storage.
- Reduces losses and thus pays for itself in a short time.
- Useful for temporary storage of curd, milk, and cooked food.
- Can also be used for mushroom cultivation, raising silk - worms, and storage of biofertilizers.



- **Pusa Farm Sun Fridge (Pusa-FSF)**

Scientists from the ICAR-Indian Agricultural Research Institute (IARI) have developed an on-farm green energy refrigeration system (Pusa-FSF). Pusa Farm Sun Fridge (Pusa-FSF) is a 100% solar-powered battery-less cold store that can preserve around 2 tonnes of freshly-harvested produce at 3-4°C during the day and 8-12°C at nighttime.It has rooftop solar panels that generate 5 kilowatt (KW) power, which helps in running air conditioning.The panels also power a 105-watt submersible pump circulating about 1,000 litres of water from a tank through overhead PVC pipes.At night, there is only passive evaporative cooling, with the water chilled during the day acting as a natural heat sink.All farmers with solar pumps are a potential market for the Pusa-FSF. India has an estimated four lakh-plus installed solar water pumps.

- **Mobile cool chamber**

It was developed for short duration storage and transportation of fish for retail marketing. The insulated box was designed in such a way that it could hold 8 plastic crates ofsize 540 X 360 X 295 mm in two layer of four each for keeping fish. The total capacity of storage was 150 kg of fish with 80% filling of each plastic crates and 1:1 ratio of ice and fish. It costs around Rs. 18,000-20,000/- and can be used for fruits and vegetables also.

- **Pusa Concentric Onion Storage Structure**

A concentric onion storage structure (5 tier) of 250 kg (5 X 50) capacity, made of bamboo and wooden planks, was developed to be used by small and marginal farmers and the consumers in rural areas. Concentric Onion Storage structure comprises a concentric cylinder made of bamboos, a wooden base, an inlet and an outlet in each tier, four supporting legs and a top cover. The inner and outer walls are made of 25mm dia. bamboos. The base of each tier is made of 740 mm x 740mm perforated wooden planks. The height of the bottom base above the ground level as well as the height of each tier is 450mm. The cost of storage of onion in this structure has been estimated as Rs. 2.21/kg.

- **Use of novels chemicals**

Recently application of various novel chemicals such as hexanal, 1-methylcyclopropene (1-MCP), salicylic acid, oxalic acid, sliver nanoparticles, etc. is gaining major importance in extending the shelf life of freshly harvested fruits and vegetables. These chemicals are also effective at very lower concentration and therefore are cost effective. Use of such chemicals is the best alternate way in order to overcome the energy crisis which is an essential part in other post-harvest technologies.

In this way doubling the time of storage of fresh agricultural commodities by effective application of above techniques would real play a major role in minimizing the post harvest losses and will help in fetching better remunerative prices to the farmer's for their perishable commodities. Such low cost techniques are having significant potential of enhancing the quality of fresh agricultural produce which will strengthen the farmers in all aspects.

Conclusion

Agricultural development is one of the most powerful tools to end extreme poverty, boost shared prosperity, and feed a projected 9.7 billion people by 2050. Growth in the agriculture sector is two to four times more effective in raising incomes among the poorest compared to other sectors. The use of these simple, appropriate and adoptable technologies either alone or in combination helps farmers to reduce postharvest losses for all the horticultural crops. The general principles that are

being achieved by their use will work well for protecting all horticultural crops from high losses.If we avoid building expensive, complex postharvest infrastructure that is difficult for smallholders to utilize, manage and instead promote the development of an integrated postharvest management system for small farmers and marketersalong with comprehensive package of training, demonstrations, postharvest goods, services and advice targeting the bottlenecks and missing components of the value chains will results in to the real rural development in India.

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