Policy Brief No. 5

National Academy of Agricultural Sciences

Saving the Harvest: Reducing the Food Loss and Waste

New Delhi
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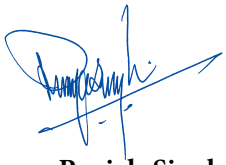
Preface

India achieved a record food grain and horticultural production of 281 and 315 million metric tonnes (MMT), respectively in 2018-19. In addition, India produces large quantities of pulses, oilseeds, sugarcane, milk, poultry, meat and fish. According to the FAO estimates, nearly 40% of the food produced in India is lost or wasted. Food Loss and Waste (FLW) is not confined to India alone, as the FAO studies have shown that yearly global FLW is nearly 30% of cereals, 40 to 50% of horticultural crops, 20% of oilseeds, meat and dairy products, and 35 % of fish.

This policy brief developed by the National Academy of Agricultural Sciences outlines the path for reducing the FLW in the country, through the mapping of the areas requiring greater attention for the management of FLW, improvement in on-farm operations through technological interventions, strong and urgent need for a bigger push to increase the capacity of cold storage facilities and cold chain system to ensure their availability throughout the country, promotion of the use of efficient storage systems like metal silos, improvement in the transportation and availability of integrated cold chain, modernization of the domestic slaughter houses, increasing the food processing capacity, establishing real-time communication system along the supply chain, support to the establishment of Food Banks to cover the vulnerable areas in particular, and creation of public awareness about FLW and the urgency to reduce such losses and wastage. There is an urgent need for a greater investment by both the public and private sectors in infrastructure, storage, transportation, food processing and packaging industries, to reduce the FLW by halve by 2030 for ensuring sustainable consumption and production patterns as envisaged in the SDG.

The NAAS can play an important role in implementing the suggested recommendations, by (a) organizing interactive meetings of the concerned officers of the Central and State Governments, representatives of industry, service providers and other stake holders, (b) developing extension material – posters, leaflets, short videos, TV programmes, etc., (c) arranging training programmes, (d) providing technical backup to the industry and farmers, and (e) monitoring and impact assessment.

On behalf of the Academy, I compliment the Convener Prof Anupam Varma and discussants for their valuable efforts in developing the policy brief, and Dr V.K. Bhatia and Dr Kusumakar Sharma for their editorial help.



Dated : 29 May, 2019

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Saving the Harvest: Reducing the Food Loss and Waste

India achieved a record food grain and horticultural production of 281.37 and 314.67 million metric tonnes (MMT), respectively in 2018-19. In addition, India produces large quantities of pulses (24 MMT), oilseeds (31 MMT), sugarcane (381 MMT), milk (165 MMT), poultry (broiler 4.2 MMT; eggs 75 billion), meat (7 MMT) and fish (10.8 MMT). India also generates over 620 million tonnes (MMT) of non-edible crop residues from its diverse cropping systems. According to the FAO estimates[1] nearly 40% of the food produced in India is lost or wasted. Other sources, such as the Food Corporation of India, report a share of losses ranging from 10 to 15 percent of the total production. The Ministry of Food Processing Industries (MFPI) estimate losses of 23 million tons of grains, 12 million tons of fruits and 21 million tons of vegetables for a total approximate value of about 4.4 billion USD while total value of food loss and waste generated is supposedly 10.6 billion USD[2]. Food loss and waste (FLW) is not unique for India, as the FAO studies have shown yearly global FLW is nearly 30% of cereals, 40 to 50 % of horticultural crops, 20 % of oilseeds, meat and dairy products, and 35 % of fish.

The disposal of over 620 million tonnes of crop residues, including over 190 million tonnes of rice crop residue (RCR), is a major challenge, primarily to clear the field for sowing the succeeding crop. Traditionally, RCR was used for domestic and industrial uses, but due to the availability of a short window of 10-20 days between the rice-harvest and wheat sowing particularly in the North-West plains, a large proportion of RCR is burnt on the farm, resulting in not only the depletion of soil fertility but also causing threatening air pollution in the area. Burning of RCR also results in annual nutrient losses to the tune of 3.85 million tonnes of organic carbon, 59,000 to 236,000 t of nitrogen, 20,000 to 90,000 t of phosphorus and 34,000 to 200,000 t of potassium[3]. Recommendations of the NAAS[4] for the adoption of technology of concurrent use of combines and turbo happy-seeder for in situ management of RCR has been effective in reducing the RCR burning with concomitant reduction in environmental pollution in the region. However, saving the non-edible biomass from burning and wastage continues to be a challenge, as the burning of wheat straw – a valuable non-edible resource - continues unabated with nearly 24% increase in the incidences of burning in 2019 compared to the 2018 incidences in Haryana alone. Such losses are also important component of saving the harvest, but in this brief we are examining the issues related to the FLW, which are of a greater concern to the society.

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[1]Global Initiative on Food Loss and Waste Reduction of the FAO: Pilot activities and measurements conducted during an FAO Technical Cooperation Project: TCP\RAS\3502, Reduction of post-harvest Losses in horticultural supply chains in SAARC Countries.

[2]Segrè A., Falasconi L., Politano A., Vittuari M. 2014. Background paper on the economics of food loss and waste (unedited working paper). Rome, FAO.

[3]Kumar, P., Kumar, S. and Joshi, L., (2015a). Socioeconomic and Environmental Implications of Agricultural Residue Burning - A case study of Punjab, India. *Springer Briefs in Environmental Science*, XIX, 144 p. 5 illus., Softcover. ISBN : 978-81-322-2146-3 DOI 10.1007/978-81-322-2014-5_2

[4]NAAS, (2017). Innovative Viable Solution to Rice Residue Burning in Rice-Wheat Cropping System through Concurrent Use of Super Straw Management System-fitted Combines and Turbo Happy Seeder. *Policy Brief No. 2*, National Academy of Agricultural Sciences, New Delhi. 16 p.

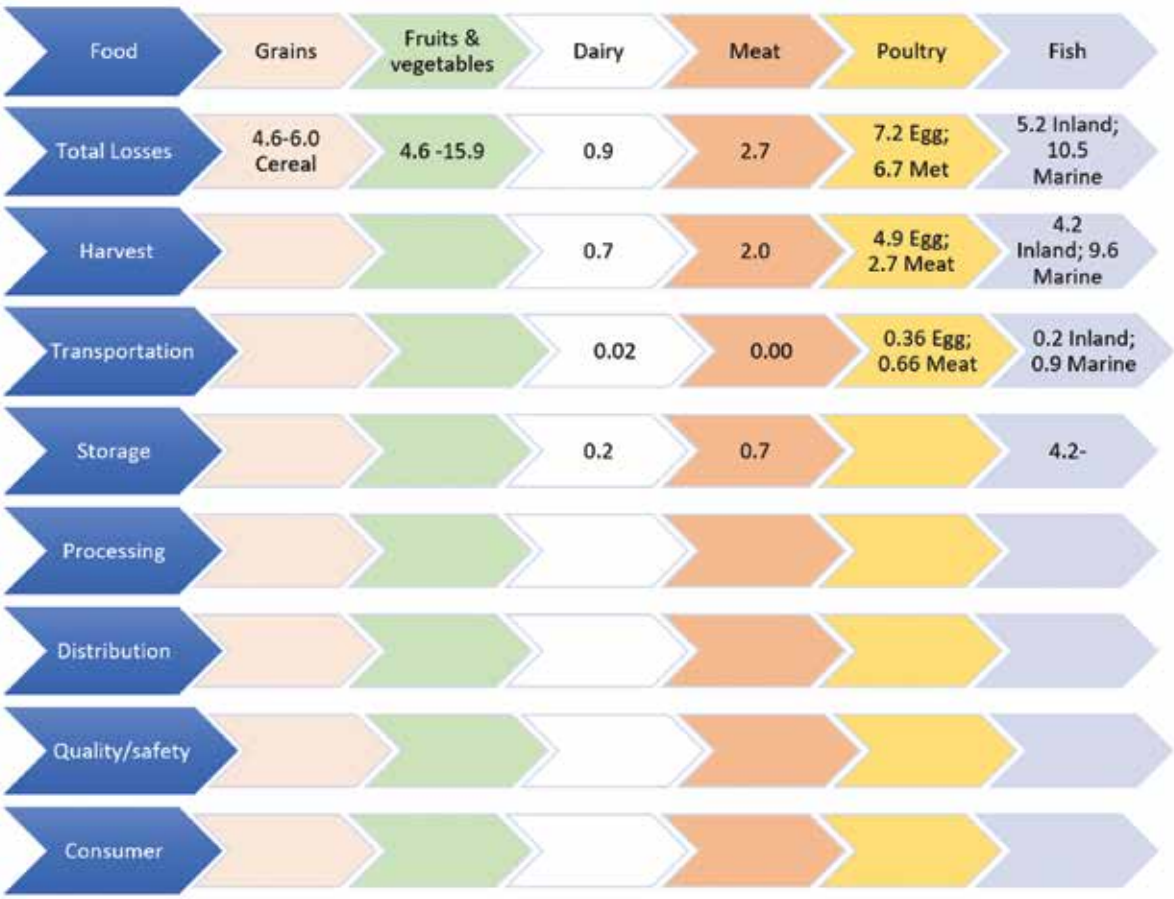

Fig. 1. Food loss and waste along the food chain

FLW along the food chain. Annual losses in percentage of agricultural produce, milk, meat, marine and poultry products as reported by ICAR-Central Institute of Post-Harvest Engineering and Technology (CIPHET) study conducted in 2014. The open boxes indicate limited availability of data on FLW along the food chain in India.

Although accurate estimates of the magnitude of FLW in India are not available, the losses of major agricultural produce at the national level were reported to be of the order of Rs. 92,651 crore according to the report of the Government of India, based on the production data of 2012-13[5]. The actual post-harvest losses may be much greater as the above estimates are based on assumptions of <6% loss of cereals, <16% fruits and vegetables, <11% marine fish, etc. and do not take into account the food waste. The quantity of post-harvest losses may represent a small percentage of the total agricultural output in India, but undoubtedly FLW in India are unacceptably high, and warrant urgent science-based solutions to strengthen the Government's resolve to reduce the post-harvest losses. Reduction in FLW is also important to India's efforts of combating hunger, malnutrition and poverty.

Estimation of food losses occurring at various stages, on farm, in transportation, storage, processing, retail and consumption are required. Any food produced for human consumption but not eaten by humans is food loss. Food waste is also a part of food loss when food intended for human consumption is left to spoil along the food supply chain or unserved or left on the plates by the consumers. In

[5]PIB: Information given to the Lok Sabha on 09.08.2016

general, the food losses are greater in horticultural crops, exemplified by the post-harvest losses of 29% of banana, 52% of cauliflower, 20% of mandarin, 38% of mango, and 46% of tomato in the SAARC countries.[6] FLW results from a wide-ranging infrastructural and technical limitations in the food chain from harvest to consumption, including harvesting, surplus production, storage, transportation, processing, packaging, marketing, food safety, quality and waste due to inadequate planning by the consumers. In recent years, food waste has received growing interest from the policymakers, NGOs and academics. While food waste occurs in all stages of the food supply chain, individual households have been identified as key actors in food waste generation, particularly in the developing world.[7]

Reducing food losses and waste requires correct estimate of losses at different stages of handling (Fig. 1), to identify the underlying causes for judicious selection of potential solutions for product specific needs. Any food saved will have a direct impact on reducing hunger and the pressure on the natural resources required for food production to meet the additional requirement.

The pre-harvest damage in the field due to biotic factors such as weeds, insect pests and diseases are important, but they are not included in the scope of "food loss and waste". However, the pre-harvest factors play an important role in post-harvest qualitative and quantitative food losses, which vary from location to location. Post-harvest preparations for proper drying of the grains to a safe, low moisture content (<13 percent, with variations depending on the grain) is critical for proper storage. However, due to inefficient dissemination of knowledge to the farmers and lack of infrastructure, the grains are often dried improperly for storage. Grains with high moisture content are predisposed to damage by insect pests and fungi.[8] For example, in maize, losses attributed to post-harvest pests are estimated to be 30 percent. Losses are also caused by over-production and consequent reduction in prices, at times, forcing the farmers not to harvest the crops or discard the produce in protest against the market price fluctuation.

The losses in the meat sector occur as *"pre-slaughter losses"*, *"slaughter losses"* and *"post-slaughter losses"*. The studies have shown[9] that the pre-slaughter losses (injuries, illness and death) are higher in sheep and goat (10-12%) compared to buffaloes (4-5%), whereas the slaughter losses (condemnation of meat and by-products) are negligible (<0.5%) for buffalo, sheep and goat and pig meat. However, the post-slaughter losses (transportation, storage, preparation and serving), mainly comprising by-products, are higher in buffaloes as compared to sheep, goat and pigs. According to the estimates in an another study[10], total losses in meat and poultry sector are 2.3 and 3.7%, in monetary terms equivalent to Rs. 235 and Rs.104 crores, respectively. Losses comprising all materials routinely discarded during slaughter, dressing and by-products processing operations have the potential for revenue generation, if organised collection and processing is carried out into value added products. The extent of post-harvest losses in

[6]Global Initiative on Food Loss and Waste Reduction of the FAO: Pilot activities and measurements conducted during an FAO Technical Cooperation Project: TCP\RAS\3502, Reduction of post-harvest Losses in horticultural supply chains in SAARC Countries.

[7]Schanes et al (2018)

[8]IFPRI (2010)

[9]Indian Veterinary Research Institute under the National Agricultural Technology Project

[10]All India Coordinated Research Project (AICRP) on Post-Harvest Technology (PHT)

livestock produce in the year 2012-13 was estimated to be around Rs. 18,987 crores and poultry meat accounts for 21% of the total loss accounting for Rs. 3,987 crores[11].

Buffalo Meat Sector: Over 21% of the total meat produced in India (7.4 MMT) undergoes processing and value addition. Nearly 90% of total buffalo meat produced in India (~1.5 MMT) undergoes chilling, packaging, freezing and branding export. Most of the buffalo meat is processed at around 85 state-of the art export slaughter houses approved under APEDA. These processing plants have all the facilities for solid and liquid waste management and to convert all the inedible waste and by-products into meat and bone meal, blood meal or fertilizer using rendering or composting technique. Therefore, waste from buffalo meat sector in India is limited.

Sheep & Goat Meat Sector: Sheep and goat sector contributed Rs. 32,000 crore to the gross domestic product of India in 2012 -13 and has the potential to contribute over Rs. 1,50,000 crore. Most of the edible offal or by-products produced from sheep and goat are also marketed and consumed in India. Hence, the waste from this sector is minimal. However, major chunk of the sheep and goat meat in India is produced in domestic slaughter houses which are in very poor condition and realisation from in-edible by-products is very limited. Organised slaughter in sheep and goat sector will improve the returns to farmers.

Poultry Meat Sector: The poultry Industry in India is to the tune of Rs. 1,00,000 crores. The 75% of poultry sector (breeding, feeding, hatcheries and broiler farming) in India is organised with complete integration, however remaining 25% including slaughter, distribution and retail is unorganised with predominantly wet market business. This also includes micro-economic activity for sustainability in rural areas. The 11% of poultry meat is produced in India from more than 21 large (>1000 birds/hour capacity) and around 20 smaller (<1000 birds/hour capacity) poultry processing plants. This means that almost 90% of the poultry meat in India is produced under wet market conditions through highly scattered road side poultry processing plants. This leads to inefficient utilization of all poultry by-products and disposal problems. However, no meat or edible by-products is wasted either at retail or consumer level.

Most of the loss in poultry value chain is during transportation of live birds (pre-harvest) due to transportation loss by injuries and death of birds. Limited loss may happen at restaurants/hotels or in functions where buffet lunch/dinner is served.

Fish Sector: Fish is a highly perishable food leading to huge post-harvest losses during transport, storage, marketing, and processing. As per the available data, 5.2 % losses are caused in the production of inland fisheries and 10.5 % in the marine fisheries. Fish is a valuable "*renewable resource, … characterized by … a regeneration ratio of 10% per year … a sustainable management allows the capture of not more than 10% fish in a year. This proportion is not respected in every part of the world. … In this sector, one of the most relevant waste is caused by the discards and by catch… as the fishermen throw back the caught animals*."[12] The proportion of fish resources harvested annually is critical for sustaining marine fisheries in particular.

[11]Jha et al. (2015)

[12]Segrè A., Falasconi L., Politano A., Vittuari M. 2014. Background paper on the economics of food loss and waste (unedited working paper). Rome, FAO.

The Issues and Challenges

The major issues and challenges faced by the Indian farmers in saving their harvests include post-harvest handling and storage in the open, lack of cemented structures for post-harvest farm operations (*sometimes forcing the farmers to even use road surfaces for drying their produce*), lack of suitable and adequate storage infrastructure, lack of packing houses, cold chain, on-farm processing facilities, fragmented supply chain, uncertain returns leading to either not harvesting or abandoning the produce on streets, besides spillage during harvesting and threshing. In a larger perspective, the country faces the **problem of plenty** due to insufficient storage capacity for rice and wheat stocks and other food items important for food security

Losses in Storage

Storage is the most important cause of post-harvest losses for all types of food in India. Considering this requirement, the GOI has established the National Centre for Cold Chain Development (NCCD), an autonomous body, to establish cold chains for perishable agriculture and horticulture produce.[13] As on March 2017, the country had created almost 7645 cold storages, with a total holding capacity of 34.95 million tons. Currently, 57% of the total cold storage capacity is based in Uttar Pradesh and West Bengal and the remaining in five other states. Nearly 75% of the available cold storage capacity is used for potato, whereas 30-40% fruits and vegetables are lost due to the non-availability of cold storage facilities.[14] There is a need for a bigger push to increase the cold storage capacity and to ensure their availability throughout the country.

Use of **metal silos** has demonstrated to show reduction in post-harvest losses in grains in many developing countries. When properly used, metal silos are very effective in reducing the crop loss to almost zero[15]. The main challenge to adoption of metal silos by smallholder farmers is the high initial cost, which ranges between USD40 and 350 depending on the storage capacity. However, the cost is offset by the accruing benefits over 10-20 years use of the metal silos.[16] Farmers in India use a variety of traditional systems for storage. Considering the metal silos are more efficient and available in smaller sizes, the promotion of their use for small scale storage may help in significantly reducing the losses in stored grains. For India, bulk storage in metal silos is of utmost importance for the effective maintenance of the buffer stocks for the national food security. Currently, the capacity for bulk storage in silos is 0.2 MMT[17] that needs to be augmented to save the losses caused in bulk storage. There is a need to have a congenial policy environment to promote the technology.

[13]Report on Cold-chain (rationalising concept & requirements) NCCD 1-Feb-2016

[14]Cold Chain Logistics – Transforming Agri Food Supply Chain, ASSOCHAM, 2018

[15]Tefera et al. (2011)

[16]Source: http://www.sdc-foodsecurity.ch; FAO (2008)

[17]Dhingra, D. (2017) Evolution and Trends in Grain Storage in India; https://www.slideshare.net/DevinderDhingra/evolution-and-trends-in-grain-storage-in-india

Food Processing Initiatives

The Ministry of Food Processing Industries has introduced a variety of schemes to curb the losses in supply chain of agriculture produce and to improve the existing infrastructure for food processing. It includes integrated cold chain, modernization of abattoirs, and modernization of infrastructure for Food Processing. The objective of these projects is to provide hygienic finished meat and meat products, slaughter waste management to avoid environmental pollution, reduce post harvest losses of horticulture and non-horticulture produce and to provide remunerative prices to farmers for their produce. The integrated cold chain and preservation infrastructure facilities are to be without any break from the farm gate to the consumer.

Losses in Transportation

Losses in transportation are also a major cause of FLW. It is not uncommon to find highly perishable produce being transported in open, unrefrigerated trucks. Additionally, loading and off-loading of fruits and vegetables are done manually by casual labourers who rough handle the products, causing extensive mechanical injury. Some transporters use sacks, or simply load the products directly onto the trucks. The Indian horticultural sector is characterized by low productivity, high cost of production, significant post-harvest losses, lack of cold chains and inefficient supply chain leading to the waste of about 30% of the fruit and vegetable production.[18] A strong policy support is required to ensure availability of integrated supply and cold chain to save the horticultural produce from post harvest losses.

Under various Government of India projects, 88 Integrated Cold Chain projects have commenced commercial operation, and 46 are in various stages of development. The completed cold chain projects have the capacity of 3.31 Lakh MT of Cold Storage/CA/Deep Freezer, 77.15 MT/hr of individual quick freezing, 31.80 Lakh litre per day of milk processing/storage and 423 Number of refrigerated vans. In addition, the National Horticulture Mission (NHM), National Horticulture Board (NHB), and National Cooperative Development Corporation (NCDC) under the Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture & Farmers Welfare, and Agricultural Products Export Development Authority (APEDA) under Department of Commerce, Ministry of Commerce and Industries, are also setting up cold storages under their respective domains. *The efforts of the Government in establishing the integrated storage and cold chain system in the country is commendable*. It is a good beginning, but *there is a need for a much greater push to meet the total requirement of the country for minimizing the FLW*. Integrated cold chain system concomitant with promotion of cottage industry for food processing will go a long way in adding value to the produce and also utilization of the waste generated at the farm-gate for processing it into useful products.

Retail and Consumers

The retailers are the important link with the consumers in the supply chain. High losses of easily perishable agricultural produce (*like fruits, vegetables, fish, meat and dairy products*), occur at the retail stage that are estimated to be 10 to 18% in different countries. Such losses in India may be even higher.

[18]Mittal, S. (2007) https://www.researchgate.net/publication/23777531_Can_Horticulture_be_a_Success_Story_for_India

The consumer waste problem is considered to be an issue in developed countries. Such food waste is difficult to measure. According to the available estimates[19], the food waste by the consumer is 18% in Spain, and 9% in the USA and UK. The food waste by the consumers has emerged as a serious concern in India. Although actual estimates are not available, the combined wastage of food in marriage receptions, hotels, restaurant, roadside eateries and households is enormous. Such waste can be utilized for fighting the hunger and malnutrition in the country. It is heartening to note that some Non-Governmental Organizations have taken initiative to establish food banking networks like No Food Waste, Feeding India, Roti Bank and others and feeding about a lakh people every day. Such commendable initiatives require replication across the country.

Recommendations

Solutions to saving the harvest depend upon integrated efforts for providing adequate infrastructure, technical support and creating public awareness for the critical loss points along the food chain from harvest to consumption. These include, harvesting/field drying, threshing/shelling, winnowing, farm storage, packaging, cold chain, transportation to market, market storage, avoiding wastage at the retailer and checking wastage in consumption.

1. Need for greater investments and policy support

There is an urgent need for greater investments by both the public and private sectors in infrastructure, storage, transportation, food processing and packaging industries, the critical stages identified (Fig. 2.) for reducing FLW in India. Urgent actions are required to at least halve the FLW along the food chain from farm to consumption by 2030 in order to eliminate hunger and meet the Sustainable Development Goals (SDGs), especially **SDG 2** (End Hunger) and **SDG 12** (Ensure sustainable consumption and production patterns).

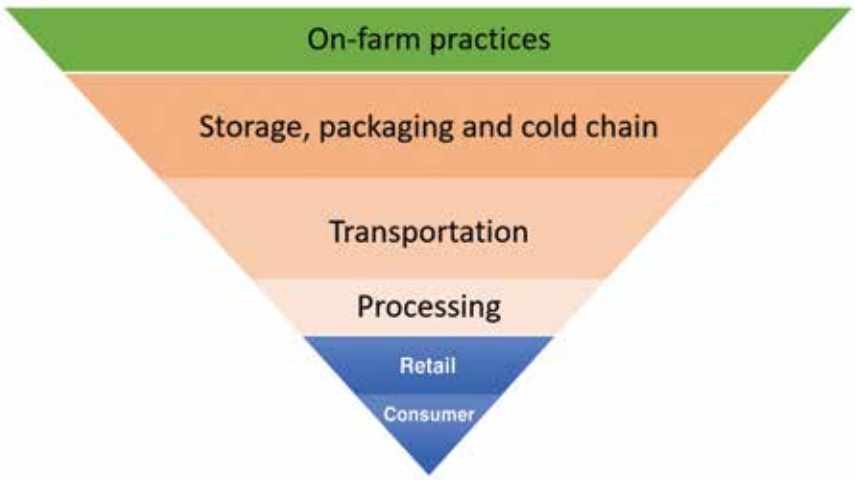

Fig. 2. The six critical stages for reducing the food loss and waste in India

[19](HISPACOOP, 2012)

2. Research for the assessment of FLW in the supply chain from production to consumption

The data on FLW in the country is very limited. A mission mode effort is required to develop efficient pathway for collecting and assessing data on the FLW at all the critical stages (Fig. 1). These efforts should cover all the sectors of food production across the country for mapping the areas that require greater management. Measurement of the losses and the cause is an essential requirement of the concept -*what gets measured and gets managed*.

3. Improvements in on-farm operations through technological interventions

Need for the dissemination of knowledge to the farmers for adopting good agricultural and veterinary practices and concomitant development of infrastructure for (i) pre-harvest care to save the produce from damage or contamination caused by pests and pathogens, (ii) post-harvest processing support for proper drying of the grains to a safe, low moisture content, (iii) facilitating primary on-farm processing of produce in order to prepare raw materials for the tertiary processing in the industries.

4. Storage and conservation solutions

(i) A key intervention all along food chains is to improve storage conditions, and apply the known post-harvest technologies to protect the stored grains and horticultural produce from spoilage. The technologies also need to be extended to the smallholder farmers.

(ii) There is a strong and urgent need for a bigger push to increase the capacity of cold storage facilities and cold chain system to ensure their availability throughout the country.

(iii) Congenial policy environment to promote the use of metal silos.

5. Improvement in transportation

Availability of integrated cold chain is essential to save the horticultural produce and dairy and meat products from post-harvest losses and from spoilage, respectively. Even simple innovations like the use of plastic crates instead of sacks for transportation can substantially reduce qualitative losses in tomatoes. Improvement is also required for the transportation of live animals to slaughter houses, and poultry to markets.

6. Modernization of the domestic slaughter houses

A majority of the slaughter houses are in a very poor condition resulting in high wastage of the inedible parts, which can be utilized for by-products. Organised slaughter in sheep and goat sector will improve the returns to farmers.

7. Need to increase food processing capacity

The food processing industry is a major sector providing large scale employment. The surplus agricultural production is a good opportunity to generate resources and employment by expanding installed capacity for food processing.

8. *Establishment of efficient communication environment*

Establishing real-time communication system along the supply chain to match demand and supply of food

9. *Food banks for reducing food waste*

Support to the public/private sector and societal organisation in establishing Food Banks in different parts of the country for useful utilization of leftover food to help in not only reducing food waste but also in reducing hunger in the country.

10. *Need to create public awareness*

Creation of public awareness about the food losses and waste, through different modes, including television and radio programmes and print media highlighting the good agricultural practices and success stories on handling, packaging, transportation, retail and consumption that will go a long way in saving the harvest.

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