STRATEGY TO REDUCE POSTHARVEST LOSSES AND WASTAGE

Dr. R. K. Vishwakarma

Project Coordinator, All India Coordinated Research Project on PHET

& Principal Scientist

ICAR-Central Institute of Postharvest Engineering and Technology, Ludhiana-141004

Definitions of Post Harvest Losses and Food Wastage

- **Postharvest losses** (PHL) and **Food wastage** (FW) are defined as the measurable reduction in agricultural and livestock produce intended for human consumption (FAO, 2011).

- **PHL** encompasses the quantity of food material diverted for feed/industrial use due to quality deterioration during handling and storage. Food produced for animal feed, and non-food industrial uses are not the part of PHL.

- **Food waste (FW)** is defined as the reduction in the quantity or quality of food resulting from decisions and actions by retailers, food services, and consumers (FAO, 2019). **Food waste** is "food that is of good quality and fit for human consumption but that does not get consumed because it is discarded-either before or after it spoils (Lipinski et al., 2013).

Methodology to Assess Harvest and Post-Harvest Losses

Quantitative PHL estimation

- **Define Initial point to obtain production figure of commodities** - ripeness stage, maturity stage, milking from udder, animals ready for slaughter.

- **Definitions of field/orchard/herd/pond for data collection -**

  - Minimum piece of land- at least $1000m^2$; cluster of minimum 12 fruit bearing trees on single piece of land; A pond or other water bodies used to rear fish for sale in market for food purpose; A poultry unit to rear birds for commercial egg or meat production; A herd of min. 5 milch animals.

- **Storage points**

- **Data collection process**- P**ersonal interviews** and **recording actual observation** in the field/operations.

  - Identify **geographical area** for crops/commodities, **unit operations** and **respondents**.

  - **Stratified multistage random sampling method**.

- **Data recording forms**

- **Data analysis**

Qualitative Food loss Estimation

- Specified initial and end point of data collection

- The material already discarded or considered as quantitative loss should not be included in the production figure for qualitative loss estimation.

- Defined kind of qualitative loss.

- Loss of market value due to inherent characters should not be counted.

- Weighted figure of loss in value chain should be considered.

- Points such as interrelation of quantum of qualitative loss and effect of processing should be considered.

- Respondent selection and data collection methodologies may be similar to that of quantitative loss.

Processing Loss estimation

- The initial point of start for the data collection should be the estimation of proportional quantity of produce going for the preparation of a specific product from the whole raw material production.

- Non-edible material must be subtracted from the theoretical recovery for estimating the processing loss.

- The group of industries on the basis of capacity, type of machinery used, capacity utilization, etc. must be defined precisely for each commodity.

- The material already discarded or considered as quantitative loss should not be included in the production figure for projecting the processing loss at national level.

- Respondent selection and data collection methodologies may be similar to that of quantitative loss.

Food waste estimation

- Food wastage estimation usually considers the **mass of wasted material** obtained after processing.
- Wastage occurred due to **natural calamities, accidents, rejection of shipments** because of international trade regulations, etc. should not be taken into account as FW.
- Food wastage of raw produce will be considered only when the raw produce of standard quality is thrown/destroyed intentionally.
- Define the stages of the value chain for the commodity.
- Group the respondents according to the consumer class, type of food server, etc.
- The material already discarded or considered as quantitative/qualitative loss should not be included in the weight/volume production figure for food waste estimation.
- Respondent selection and data collection methodologies may be similar to that of quantitative loss.
- The weight/volume handled by each respondent group should be determined initially. Summing the food wastage of each stage will lead to exaggerated value of waste. To estimate the total wastage, data of percent flow in each component of value chain are required and weighted average should be reported as waste.

Quantum of Food Loss and Waste

- Globally, one-third of food produced is either lost or wasted before consumption (FAO, 2011).
- Developed countries contributed to 56% of total FLW; developing countries accounted for 44% (Lipinski et al., 2013).
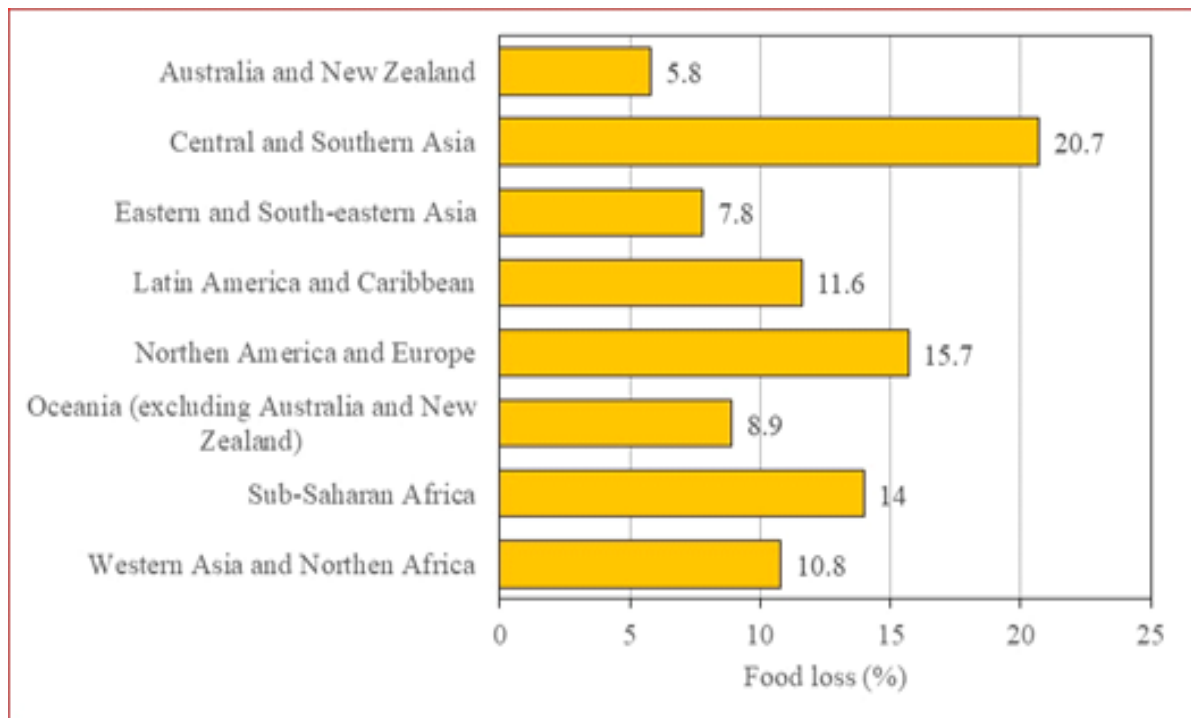
Status of Food Loss in Different Regions of World in 2016 (FAO, 2019).
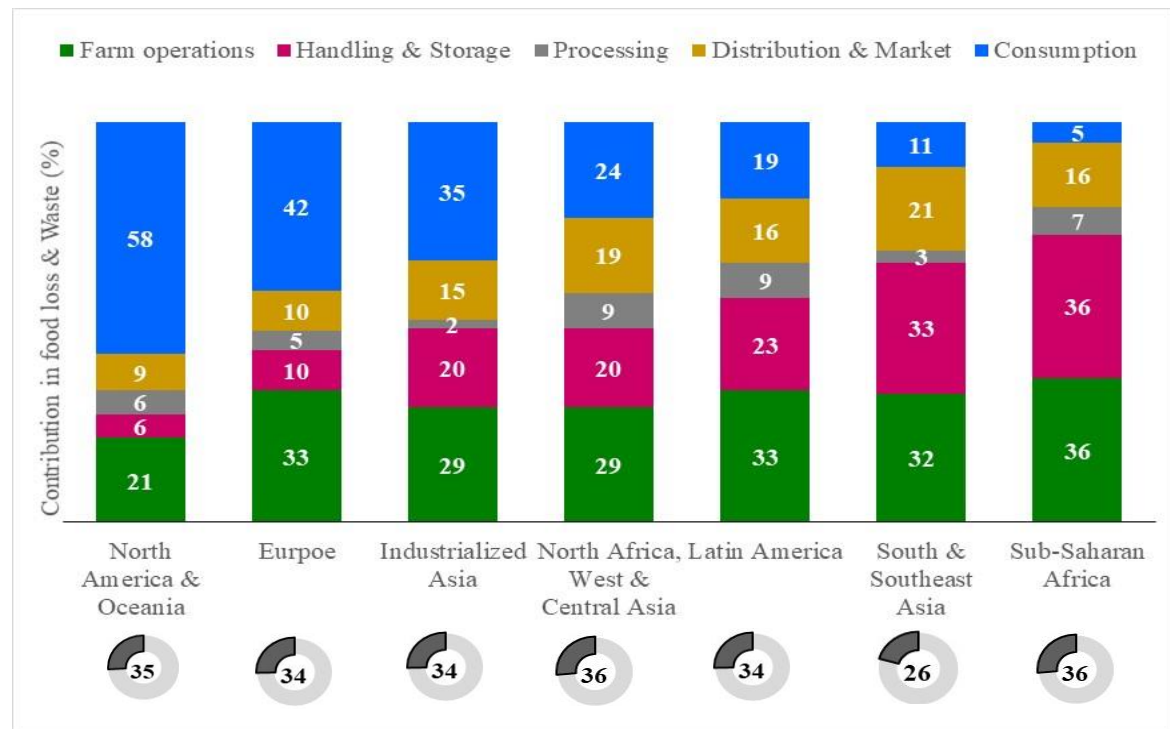
Contribution of Value Chain Components in Food Loss and Waste for Different Regions of World (FLW percent in Pie chart). (Flanagan et al., 2019)

Food losses in different parts of the world

Developing countries

- For F&V, PHL in Asian countries are more than 10%.

- For 45 crops and livestock produce, annual value of the losses in India were US$ 15.19 billion in 2014.

- PHL were 4.65 to 5.99% in cereals, 6.36 to 8.41% in pulses, 3.08 to 9.96% in oilseeds, 6.7 to 15.88% in fruits, and 4.58 to 12.44% in vegetables in India (Jha et al. 2015).

- 13.5% of cereals produced in Sub-Saharan Africa is lost ~ US$ 4 billion (World Bank et al., 2011)

- PHL in Ethiopia ranges from 15.5 to 27.2% for major food grains and 23% average loss for all crops (MANR, 2018).

Developed countries

- North-America and Europe: Food Loss is 280-300 kg/year, about 31% (FAO, 2011).

- In USA, Canada, and Mexico, annual FLW was 168 MT (Mesterházy et al. 2019).

- About 40% of the annual US food supply is lost and wasted.

- PHL in North American and European countries was estimated to be 17-33.33 % in horticultural crops, 0.7-12.5% in meat, fish and poultry and 5.2% in milk (NABCONS, 2022).

- High and strict quality standards should be kept in consideration.

Food waste in different regions
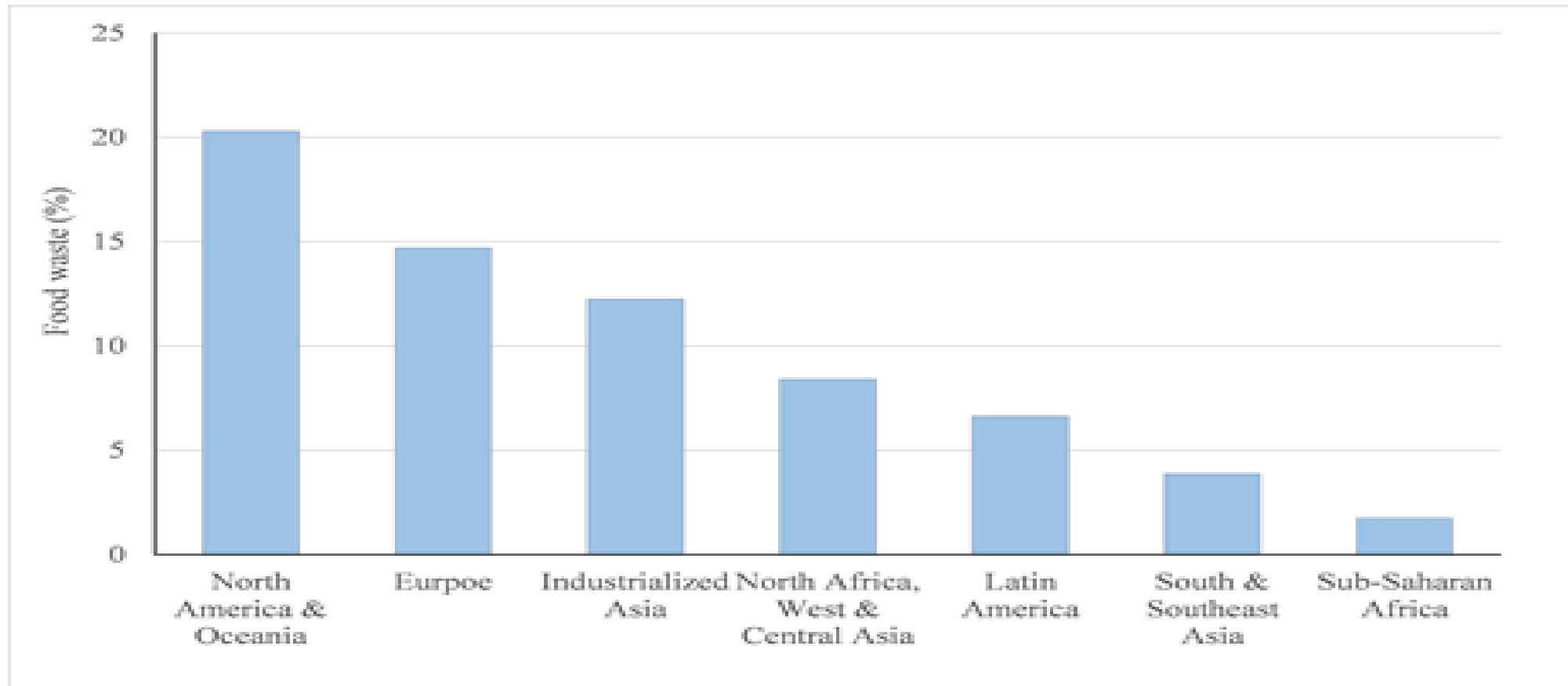
Estimated Food Wastes in Different Regions of the World (Flanagan et al., 2019)
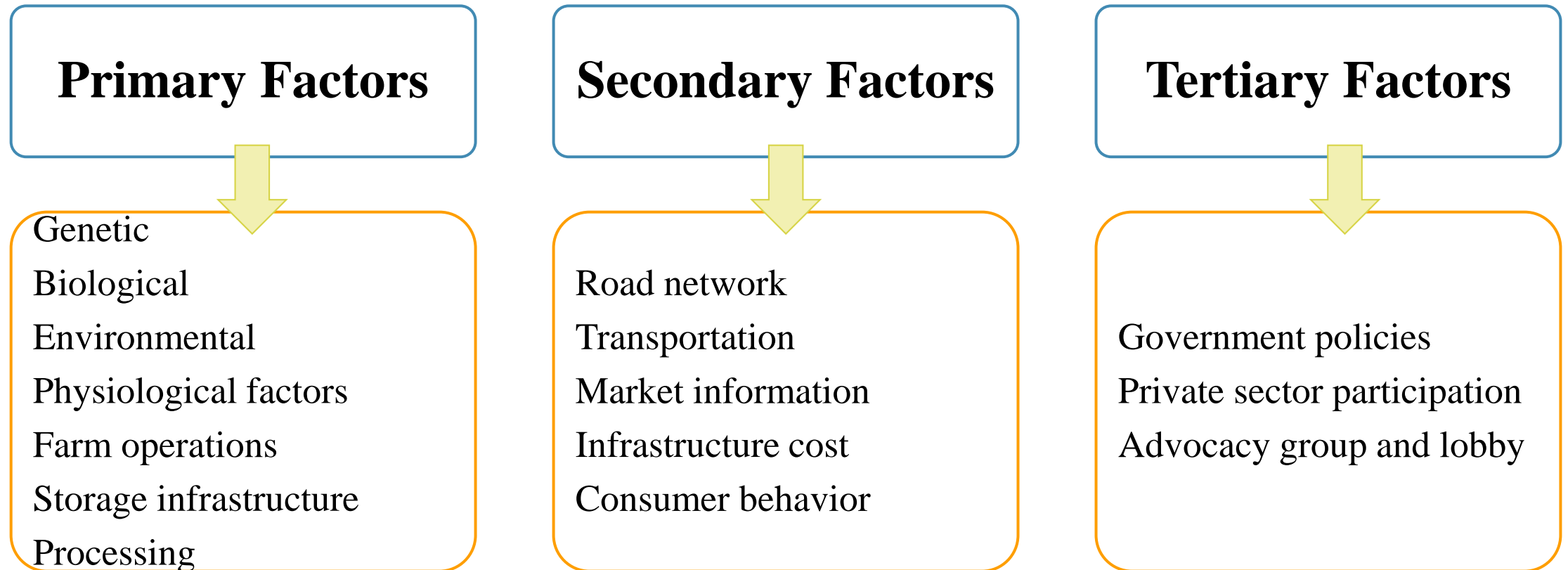
UNEP Food Waste Index Report (2021)

- UNEP reported **higher FW in low income regions as household waste**.

- Only **one** study (Miezah et al., 2015) of Ghana was considered as **high confidence** for the purposes of the Food Waste Index in low-income countries, which showed FW-84 kg/capita/year.

- FW at **consumer level** (household and food service) is **more than twice** the previous FAO estimate (FAO, 2011).

- FW level: **11%** in households, 5% in food service and 2% in retail.

- Location of non-edible waste generation- **processing units in developed countries** whereas **household level in developing countries**.

- Calculations of FW UNEP (2021) are based on **mass of processed food**, which may not be accurate, particularly in case of cereals, where mass of FW was taken as wet mass wastage.

Income group	Average food waste (kg/capita/year)		
	Household	**Food service**	**Retail**
High-income countries	79	26	13
Upper middle-income countries	76	Insufficient data	
Lower middle-income countries	91	Insufficient data	
Low-income countries	Insufficient data		

Average Food Waste (kg/capita/year) as per World Bank Income Classification

Reasons for food loss and waste

The reasons of PHL and FW may be classified into primary, secondary and tertiary factors, which directly influence the total food supply chain-

Primary Factors	**Secondary Factors**	**Tertiary Factors**
Genetic	Road network	Government policies
Biological	Transportation	Private sector participation
Environmental	Market information	Advocacy group and lobby
Physiological factors	Infrastructure cost	
Farm operations	Consumer behavior	
Storage infrastructure		
Processing		

Causes of Postharvest Losses in horticultural crops

- **Metabolic** Processes

- **Mechanical injuries** during handling, packaging and transportation

- **Developmental**- sprouting, germination etc.

- **Parasitic diseases-** microbial attack

- **Physiological deterioration-** enzymatic deterioration, unsuitable temperature or atmospheric conditions

- **Lack of market demand-** over production

- **Consumption**- inadequate preservation methods at home level

- **Others**- lack of infrastructure, technical support, cold storage, market facilities and market information service (MIS).

Impact of Post-Harvest Losses and Food Wastage

Social Impact

- Food security for women and marginalized communities

- PHL are generally higher for marginal/small farmers

Economic Impact

- Total annual economic costs of FW - US$ 2.6 trillion.

- Quantitative loss of 45 crops and livestock- INR 926.51 billion

Resources Loss

- Cropland used to grow lost food- 1.4 billion hectares

- Fertilizers-causing nitrous oxide emissions

- Excess water consumption

Environmental Impact

- 3.3 G tonnes of CO_2 emissions every year due to FW

- Loss of Biodiversity

Recent Technological Interventions in Reducing Post-Harvest losses

- Mechanization of Postharvest operation

- Efficient storage technology- Controlled and modified atmosphere storage, Hypobaric storage

- Cultured meat production

- Bio-plastics from sludge

- Microbial fuel cell

- Bio-hydrogen production

- Rendering

- Gasification

- Food waste treatment through composting or anaerobic digestion.

- Novel processing techniques- Irradiation, High pressure processing, ozone processing, Ultrasonic processing, Pulsed electric field processing

Quality, Safety Regulations and Policies on Post-Harvest Losses

- Waste Framework Directives of European Union

- Good Samaritan Law

- Tax credits and Tax deductions for Food Redistribution

- Food date Labelling

- Supermarket Food waste Recovery requirement

- Banning of organic waste to Landfills

- Pay-As-You-Throw (PAYT)

- Regulations pertaining to food waste prepared and treated to be used as animal feed.

Policy Interventions in Reducing Post-Harvest Losses

- Control human population growth.

- Building local knowledge of value chains.

- Repository of machineries at production catchment level for custom hiring.

- Setting up cold chain for perishables.

- Promoting cultivation complementing to processing and marketing facilities.

- Investment in infrastructure and public goods.

- Involvement of private sector.

- Advisory for farmers to use scientific methods of harvest and post-harvest operations.

- Adopting smart harvesting, grading and packaging tools, equipment, technology for extraction of high value bioactive compounds from F&V residue.

- Improving technologies for effective utilization and eco-friendly disposal of wastes and by-products.

- Adoption of GAP and GMP.

Conclusion

- In the last decade, the global attention towards reduction of postharvest food loss and waste has increased considerably.

- Different studies conducted so far around the world has adopted different PHL assessment methodologies including interviews, sampling, and hybrid methods.

- Studies highlighting qualitative and economic loss measurements are very few in number.

- Poor quality of available data is one of the crucial gaps identified related to postharvest loss assessments.

- Most of the PHL studies reviewed focused only on one or two stages of the value chain, making it difficult to sum up postharvest losses along the entire food supply chain.

- Other gaps in postharvest assessment include the lack of standardized methodologies and reporting protocols, lack of access to learning platforms for PHL measurement, and the lack of sufficient postharvest loss assessment skills and experience.