

AI 3010 WASTE AND BY PRODUCT UTILIZATION

UNIT I NOTES



MAGNITUDE OF WASTE GENERATION IN DIFFERENT FOOD PROCESSING INDUSTRIES

Types of food by-product and wastes

Five system boundaries have been distinguished in the food supply chains (FSC) which are mainly responsible for generation of wastages

- i) **Agricultural production:** Wastage of agricultural resources due to environmental conditions, losses due to mechanical damage and/or spillage during harvest operation (e.g. threshing or fruit picking), curing/ pre-treatments, on-farm temporary storage and sorting of crops etc.
- ii) **Postharvest handling and storage:** including losses due to spillage and degradation during handling, storage and transportation between farm and distribution.
- iii) **Processing:** including losses due to spillage and degradation during industrial or domestic processing, e.g. juice production, canning and bread baking. Losses may occur when crops are sorted out if not suitable to process or during washing, peeling, slicing and boiling or during process interruptions and accidental spillage.
- iv) **Distribution:** including losses and waste in the market system, at e.g. wholesale markets, supermarkets, retailers and wet markets.
- v) **Consumption:** including losses and waste during consumption at the household level.

Magnitude of by-products/wastes in food production

The food grain production in India has increased from 52.0 million tonnes in

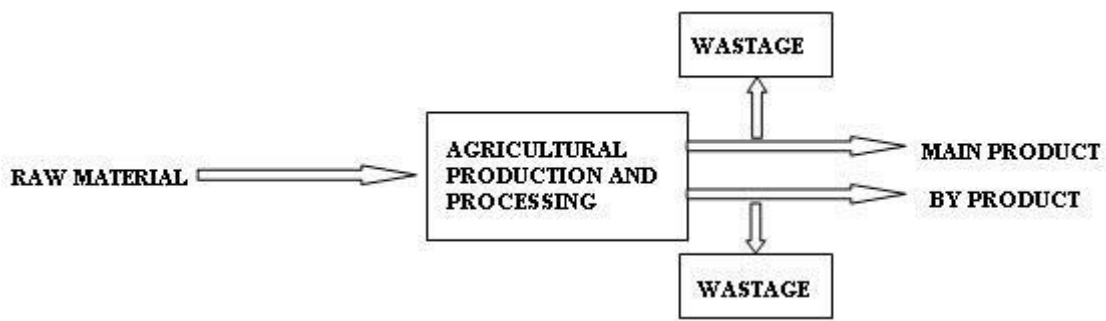
1951-52 to 234 million tonnes by 2005. More than half of the dry matter produced annually in cereals, legumes, roots and tuber crops is the inedible phytomers. From country's annual crop production figures, the calculated residue production from the major food crops that are grown on nearly 50% of the country's cultivable area comes to about 306.6 million tonnes which is nearly 58% of the annual aggregate crop harvest of the major food crops (Table 1.1)

Table 1.1: Annual harvest of major food crops and crop residue (1999-2000)

| S.No | Crop | Crop Production (mt) | Crop residue Produced (mt) |
|------|-----------------|----------------------|----------------------------|
| 1 | Wheat | 74.3 | 111.4 |
| 2 | Rice | 88.3 | 114.7 |
| 3 | Maize | 11.6 | 17.2 |
| 4 | Total pulses | 13.1 | 14.4 |
| 5 | Total oil seeds | 21.2 | 42.4 |
| 6 | Sugarcane | 325 | 6.5 |
| 7 | Total | 533.4 | 306.6 |

Magnitude of by-products/wastes in food processing

The food processing industry provides vital linkages and synergies between industry and agriculture. Raw materials - grain, livestock, milk, fruit, vegetables etc. -are converted into foodstuffs through processing activities which may involve other inputs - energy, water, packaging and so forth. However not all inputs consumed result in useful outputs, and the result is waste.



Food processing wastes are those end products of food industries that have not been recycled or used for other purposes. They are the non-product flows of raw/processed materials whose economic values are less than the cost of collection and recovery for reuse; and therefore discarded as wastes.

Typical wastes encountered in the food processing sector

- Food wastes – shavings, peelings, stones, animal by-products etc. in addition to wasted food
- Packaging waste - packaging of incoming materials and waste product packaging
- Waste water and liquid effluent
- General factory waste

Extent of food wastage

| Parameter | By-product | waste |
|-----------|------------|-------|
| | | |

| | | |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Usability | Can be processed further or employed directly as final product | Not suitable for direct use. May be used after recycling or recovery |
| Intention of the holder | Transform it into useful product and market the material | Usually tends to discard the material |
| Certainty of use | Further use is certain | Often discarded |
| Legislation | Further use in compliance with all relevant product, environmental and health protection requirements for specific further use. | Waste management (i.e. recycling, recovery, disposal) as per waste disposal laws |

Roughly one-third of the edible parts of food produced for human consumption gets lost or wasted globally, which is about 1.3 billion ton per year. Food is wasted throughout the food supply chain (FSC), from initial agricultural production down to final household consumption. In developed countries food gets wasted at the consumption stage while in developing and low-income countries It is mostly lost during the harvesting and in post harvesting stages of the food supply chain in the below table. Little food is wasted at the consumer level.

Comparison between by-products and waste

Estimated/assumed waste percentage for each commodity group in each south Asia

| Commodity | Agricultural production | Postharvest handling and storage | Processing and packaging | Distribution | Consumption |
|---------------------|-------------------------|----------------------------------|--------------------------|--------------|-------------|
| Cereal | 6% | 7% | 3.5% | 2% | 3% |
| Roots & Tubers | 6% | 19% | 10% | 11% | 3% |
| Oilseeds & Pulses | 7% | 12% | 8% | 2% | 1% |
| Fruits & vegetables | 15% | 9% | 25% | 10% | 7% |
| Meat | 5.1% | 0.3% | 5% | 7% | 4% |
| Fish & Seafood | 8.2% | 6% | 9% | 15% | 2% |
| Milk | 3.5% | 6% | 2% | 10% | 1% |

Food manufacturers are increasingly acting as bio-refineries, in which agricultural raw materials are separated into a long series of products, comprising not only food but also feed, fertilizers, cosmetics, bio-fuels and others. Full utilization of this raw material in the food sector increases resource-efficiency and productivity, reduces bio-degradable waste and supports the transition to a bio-based economy (use of renewable resources).

Food processing operations and associated waste

| Catagory | Operations | Wastes |
|---------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Raw material Preparation | Cleaning, Sorting, Grading, Peeling | Cleaning water effluent (BOD or COD), peelings, hair, feathers, grit, blood, contaminated foodstuffs |
| Size Reduction | Chopping, cutting, slicing, dicing, Milling of Solid foods, pulping Emulsification and homogenization of liquids | Poor quality (too coarse / fine) product with loss of nutritional / sensory characteristics Dust Agglomerates. Waste off-cuts. Fat bearing effluents from colloidal products (e.g. dairy) Risk of pathogenic contamination in emulsification (e.g. dairy) |
| Mixing and forming | Mixing, forming malformed pieces. | Wrongly proportioned batches, poorly mixed ingredients |
| Separation and Concentration | Centrifugation, Filtration Expression, Solvent extraction Membrane concentration | Separated solids (e.g. after clarification of liquids press residues (e.g. fruit juice extraction) |
| Fermentation and use of enzymes | Fermentation, Enzyme technology | Spent biomass. |