

RATHINAM TECHNICAL CAMPUS-COIMBATORE-641021
DEPARTMENT OF AGRICULTURE ENGINEERING
AI 8007 - AGRICULTURE WASTE MANAGEMENT

UNIT-1
INTRODUCTION

SYLLABUS:

Availability of different types of agriculture wastes - its overall characteristics -
classification of agro wastes based on their characteristics - its recycling and utilization potential
- current constraints in collection and handling of agricultural wastes - its environmental impact.

AGRICULTURE:

- Agriculture is the largest contributor of any resource sector, to the economy. It is also a large generator of waste materials.
- **Agriculture** is also called as farming which is the cultivation of animals, plants, fungi, and other life forms for food, fiber, biofuel, drugs and other products used to sustain and enhance human life.



AGRICULTURE WASTE:

The residues from the growing field crops and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products and crops.



They are the non-product outputs of production and processing of agricultural products that may contain material that can benefit man but whose economic values are less than the cost of collection, transportation, and processing for beneficial use.



This term includes both natural (organic) and non-natural wastes produced through various farming activities such as dairy farming, horticulture, seed growing, livestock breeding, grazing land, market gardens, nursery plots and even woodlands

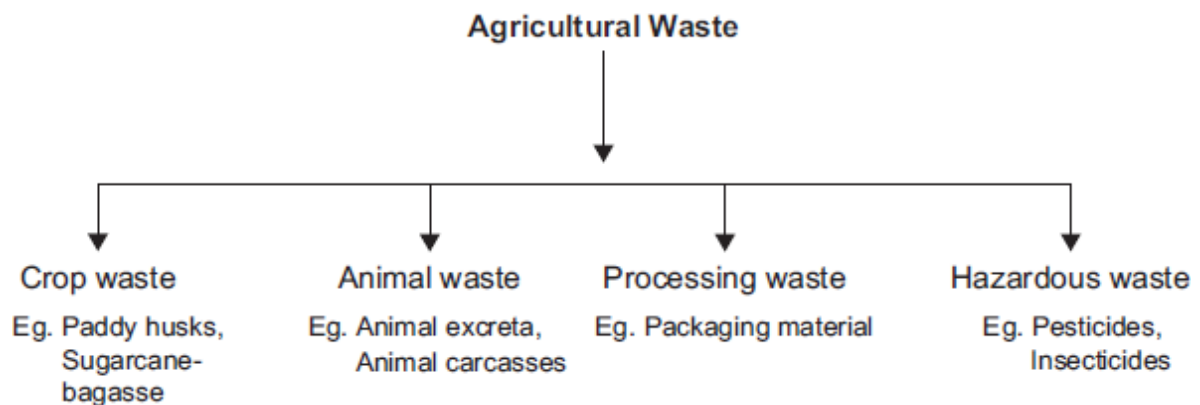
AW can be in the form of solid, liquid or slurries depending on the nature of agricultural activities. Although the quantity of wastes produced by the agricultural sector is significantly low

compared to wastes generated by other industries, the pollution potential of agricultural wastes is high on a long-term basis.



Glossary of Environment Statistics, UN (1997) defines agricultural waste as:

- Agricultural waste is waste produced as a result of various agricultural operations. It includes manure and other wastes from farms, poultry houses and slaughterhouses; harvest waste; fertilizer run-off from fields; pesticides that enter into water, air or soils; and salt and silt drained from fields.
- Agricultural waste otherwise called agro-waste is comprised of animal waste (manure, animal carcasses), food processing waste (only 20% of maize is canned and 80% is waste), crop waste (corn stalks, sugarcane bagasse, drops and culls from fruits and vegetables, pruning's) and hazardous and toxic agricultural waste (pesticides, insecticides and herbicides, etc.)



CROP WASTE:

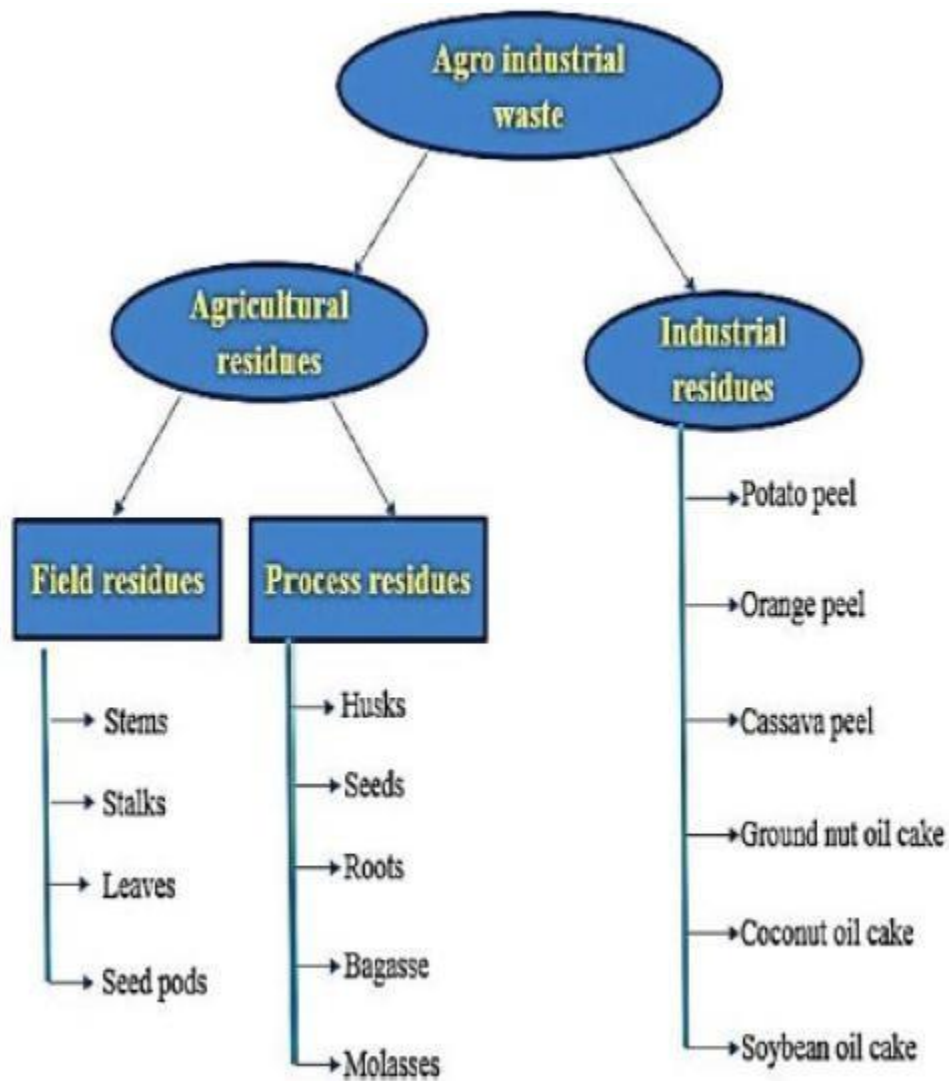


ANIMAL WASTE:





CLASSIFICATION OF AGRO WASTES:



Agro industrial waste classified into two major classifications:

- ✚ Agriculture residues,
- ✚ Industrial residues.

AGRICULTURE RESIDUES:

Agriculture residues are materials left in an agricultural field after the crop has been harvested. These residues include stalks and stubble (stems), leaves and seed pods.

There are two types of agricultural residues are:

- ✓ Field residues,
- ✓ Process residues.

Field Residues:

Field residues are materials left in an agricultural field or orchard after the crop has been harvested. These residues include stalks and stubble (stems), leaves, and seed pods.



Stems residues

The residue can be ploughed directly into the ground, or burned first. In contrast, no-till, strip-till or reduced-till agriculture practices are carried out to maximize crop residue cover.



Stalk residues

Good management of field residues can increase efficiency of irrigation and control of erosion. Simple line-transect measurements can be used to estimate residue coverage.



Leaves residues



Seed pods

Process Residues:

Process residues are materials left after the crop is processed into a usable resource. These residues include husks, seeds, bagasse, molasses and roots.



Corn husk

Paddy husk

Husk is the outer shell or coating of a seed. A husk or hull includes the protective outer covering of a seed, fruit, or vegetable.

Bagasse is the dry pulpy fibrous material that remains after crushing sugarcane or sorghum stalks to extract their juice. It is used as a biofuel for the production of heat, energy, and electricity, and in the manufacture of pulp and building materials.



Sugarcane bagasse

Molasses is a viscous substance resulting from refining sugarcane or sugar beets into sugar. Molasses varies in the amount of sugar, method of extraction and age of the plant. Molasses is a major constituent of fine commercial brown sugar. It is also one of the primary ingredients used to distil rum.



Molasses sugarcane

They can be used as animal fodder and soil amendment, fertilizers and in manufacturing.

INDUSTRIAL WASTES:

A huge amount of organic residues and related effluents are produced every year through the food processing industries like juice, chips, meat, confectionary, and fruit industries. These organic residues can be utilized for different energy sources.



Potato peel

Orange peel

Fruit industrial wastes constituents have potential to biochemically digested to produce useful products like production of biogas, bio-ethanol.



The waste produced from food industries contains high value of BOD, COD, and other suspended solids.

Characterization of Agriculture Waste Depending on the Agricultural Activity:

S.No	Agricultural activity	Types of wastes	Method of disposal
1	Crop production and harvest	Straw, Stover.	Land application, burning, plowing.
2	Fruit and vegetable Processing	Biological sludges, trimings, peels, leaves, stems, soil, seeds, pits.	Land filling, animal feed, Land application, burning.
3	Sugar processing	Biological sludges, pulp, lime mud.	Land filling, burning, composting, animal feed
4	Animal Production	Blood, bones, feather, litter, manures, liquid effluents.	Land application, manure.
5	Dairy product processing	Biological sludges.	Land filling, Land spreading.
6	Leather tanning	Fleshings, hair, raw and tanned trimmings, lime & chrome sludge, grease.	By product recovery, Land filling, Land spreading.
7	Rice production	Bran, straw, hull / husk.	Feeds, mulch/ soil conditioner, packaging material for glass, ceramics.
8	Coconut production	Stover, cobs, husk, leaves, coco meal.	Feeds, vinegar, activated carbon, coir products.

Agro wastes contains,

- ✓ Insoluble chemical constituents (e.g., cellulose and lignin) and
- ✓ Soluble constituents (e.g., sugar, amino acids, and organic acids).

Other constituents are

- Fats, oil waxes, resins, pigment, protein & mineral.

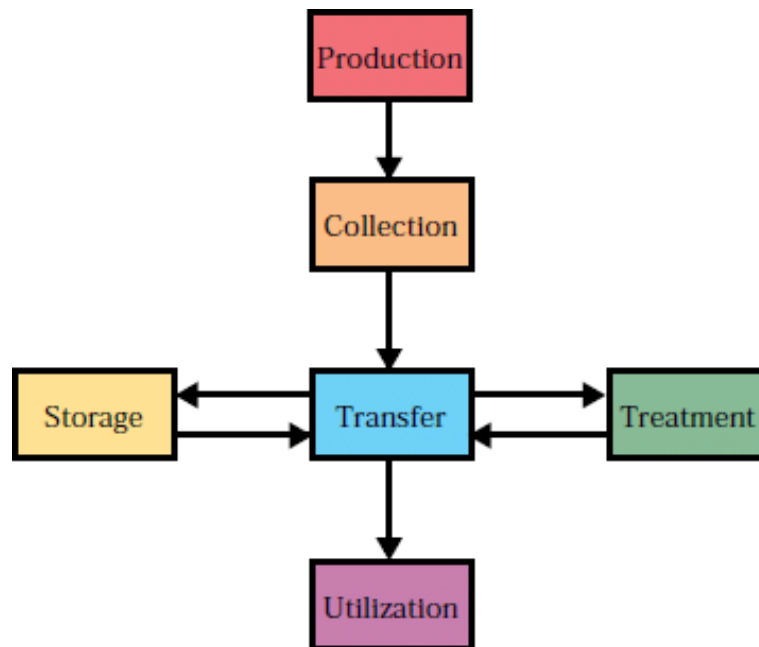
The agro wastes such as decaying part of plants are the primary source of organic matter in soil.

Therefore, agro-wastes are the cheapest source that can be used by farmers to improve the fertility of soil.

AGRICULTURAL WASTE MANAGEMENT:

- If wastes are not properly handled they can pollute surface and groundwater and contribute to air pollution.
- The proper management of waste from agricultural operations can contribute in a significant way to farm operations.
- Waste management helps to maintain a healthy environment for farm animals and can reduce the need for commercial fertilizers, while providing other nutrients needed for crop production.
- The waste which is reduce, recycle and make it usable for different purpose is a waste management.

Agricultural waste management system (AWMS) consists of six basic functions,



Waste management system functions

✚ Production,

✚ Transfer,

✚ Treatment,

✚ Collection,

✚ Storage,

✚ Utilization.

For a specific system, these functions may be combined, repeated, eliminated, or rearranged as necessary.

Production:

- ✓ Production is the function of the amount and nature of agricultural waste generated by an agricultural enterprise.
- ✓ The waste requires management if the quantity produced is sufficient enough to become a resource concern.
- ✓ A complete analysis of production includes the kind, consistency, volume, location, and timing of the waste produced.

Generation:

- ✓ India is one of the richest country in agricultural resources.
- ✓ Presently in India, annually 350 MT are organic wastes from agricultural sources.
- ✓ The major quantity of solid waste generated from agricultural sources are sugarcane bagasse, paddy and wheat straw and husk, waste of vegetables, food products, tea, oil production, jute fibres, groundnut shell, wooden mill waste, coconut husk, cotton stalk, etc.

Collection:

- ✓ Collection refers to the initial capture and gathering of the waste from the point of origin or deposition to a collection point.
- ✓ The AWMS plan should identify the method of collection, location of the collection points, scheduling of the collection, labor requirements, necessary equipment or structural facilities, management and installation costs of the components, and the impact that collection has on the consistency of the waste.
 - Waste like fruit and vegetable waste are collected from houses called domestic waste.
 - Waste collected from road street or side.
 - Collected waste like dry refuse and green waste, animal dung from agricultural field.

Transfer:

- ✓ Transfer refers to the movement and transportation of the waste throughout the system.
- ✓ It includes the transfer of the waste from the collection point to the storage facility, to the treatment facility, and to the utilization site.

Storage:

Storage is the temporary containment of the waste.

- ✓ The waste management system should identify the storage period; required storage volume; type, estimated size, location, and
- ✓ Installation cost of the storage facility;
- ✓ Management cost of the storage process; and
- ✓ Impact of the storage on the consistency of the waste.

Treatment:

- ✓ Treatment is any function designed to reduce the pollution potential or modify the physical characteristics of the waste, such as moisture and TS content, to facilitate more efficient and effective handling.
- ✓ Manure treatment is comprised of physical, biological, and chemical unit processes. It also includes activities that are sometimes considered pretreatment, such as the separation of solids.

Various treatment processes are performed on agricultural waste:

- When dealing with agricultural waste, we must follow health and safety regulations.
- We should provide written instructions for storing and disposing of each type of waste we produce.

Treatment process:

✚ Composting,

✚ Recycling, ✚

Incineration.

Utilization:

- ✓ Utilization includes reusing and/or recycling of waste products.
- ✓ Agricultural wastes may be used as a source of energy, bedding, mulch, organic matter, or plant nutrients.
- ✓ Properly treated, they can be marketable.
- ✓ A common practice is to recycle the nutrients in the waste through land application.

WASTE	UTILIZATION
Rice husk ash and char coal	Additive in cement mixes, water glass manufacture, active carbon.
Rice husk	Electricity production.
Banana peel and sugarcane fibers	Paper making pulp.
Husk and bagasse	Mushroom cultivation.
Bagasse, banana fruit reject	Ethanol production and animal feed.
Animal waste	Compost fertilizer.
Husk, straw, cow dung	Biogas production.
Sugarcane ethanol	Green polythene.

Challenges or obstacles in going from “organic waste production” (inner circle) to “organic waste utilization”:

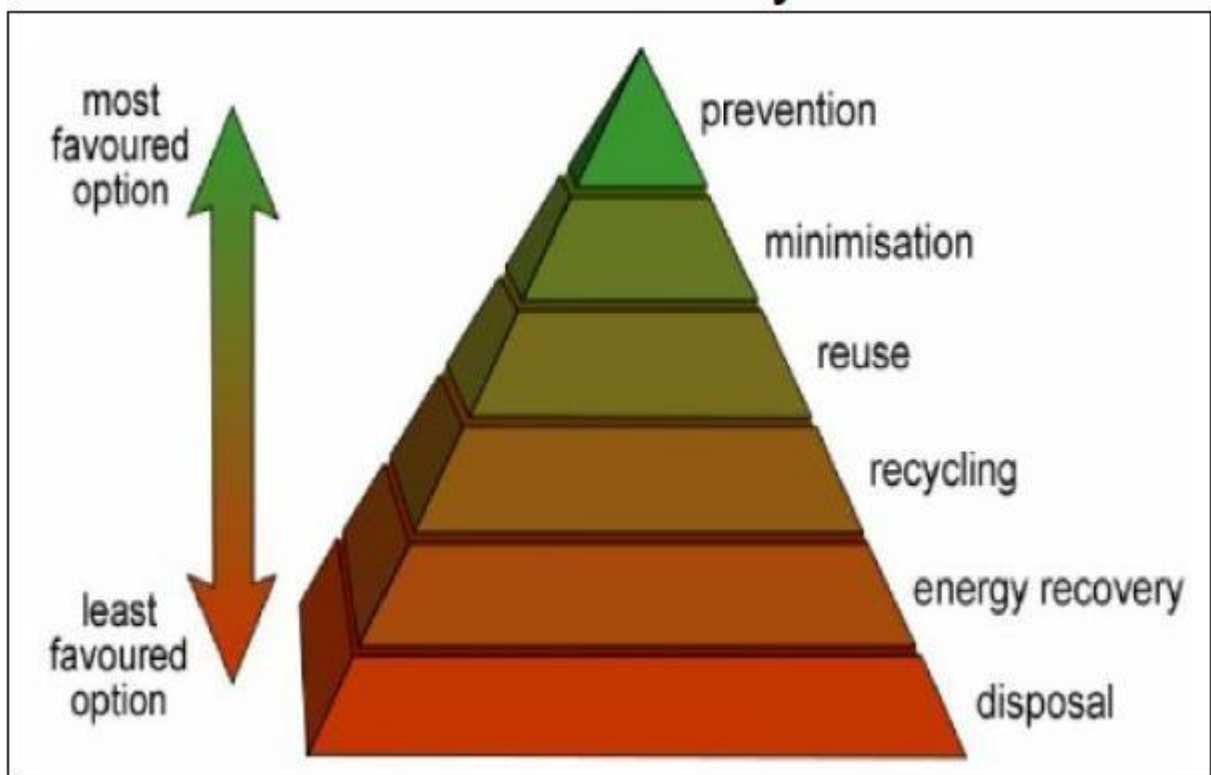


The challenges for integration of organic wastes into agriculture:

- ❖ **Regional imbalances of nutrients** (e.g., not enough land on the farm to apply nutrients produced by animals on the farm),
- ❖ **Imbalance of nutrients** in organic residues compare with fertilizer.
- ❖ **Relatively low nutrient concentration.**
- ❖ Often **bulky nature** of organic waste making it more difficult to **haul and spread consistently.**
- ❖ Possible environmental concerns, such as **emission of ammonia** and other gases, **odor,** and **pathogens.**

WASTE HIERARCHY:

- ✓ Waste hierarchy refers to 3 R's: Reduce, Reuse, Recycle.
- ✓ Waste minimization efficiency is stated to be better achieved applying 3 R's in a hierarchical order - Reduce, Reuse and Recycle.



The concept of minimizing waste reduces the quantity and ill-effects of waste generation by,

- Reducing quantity of wastes,
- Reusing the waste products with simple treatments, and
- Recycling the wastes by using it as resources to produce same or modified products.

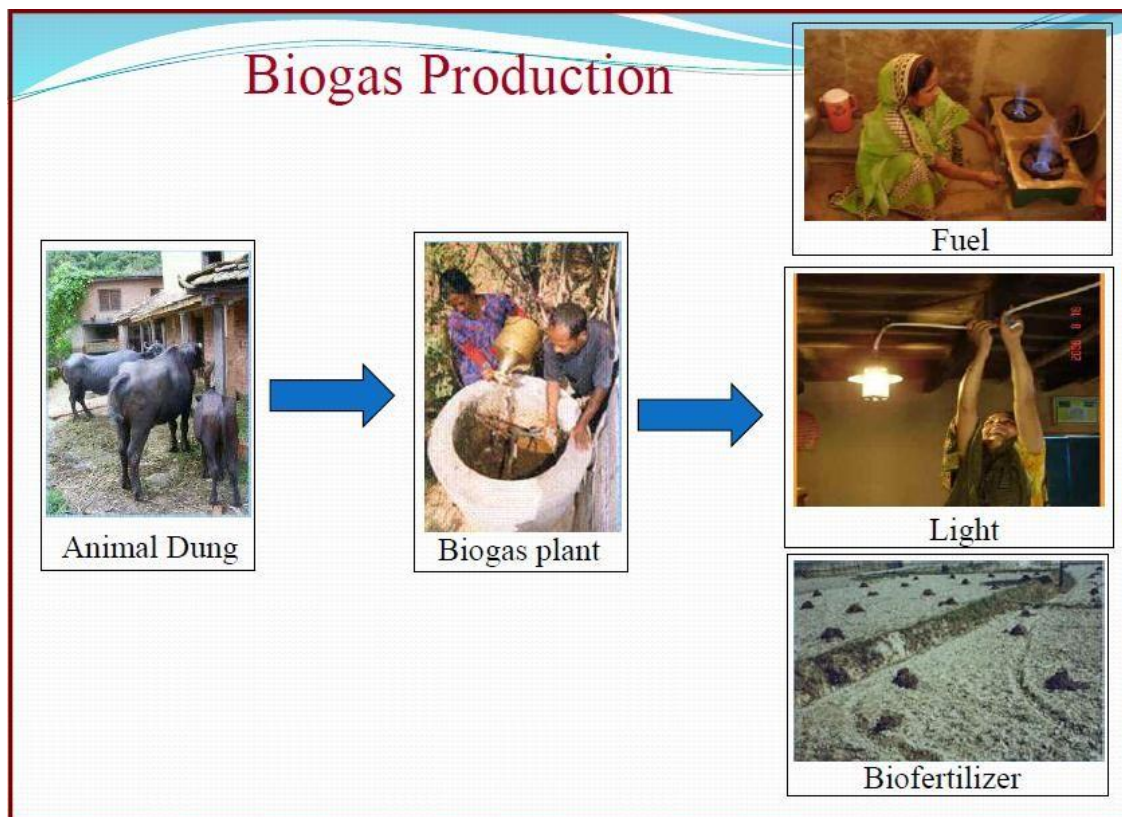
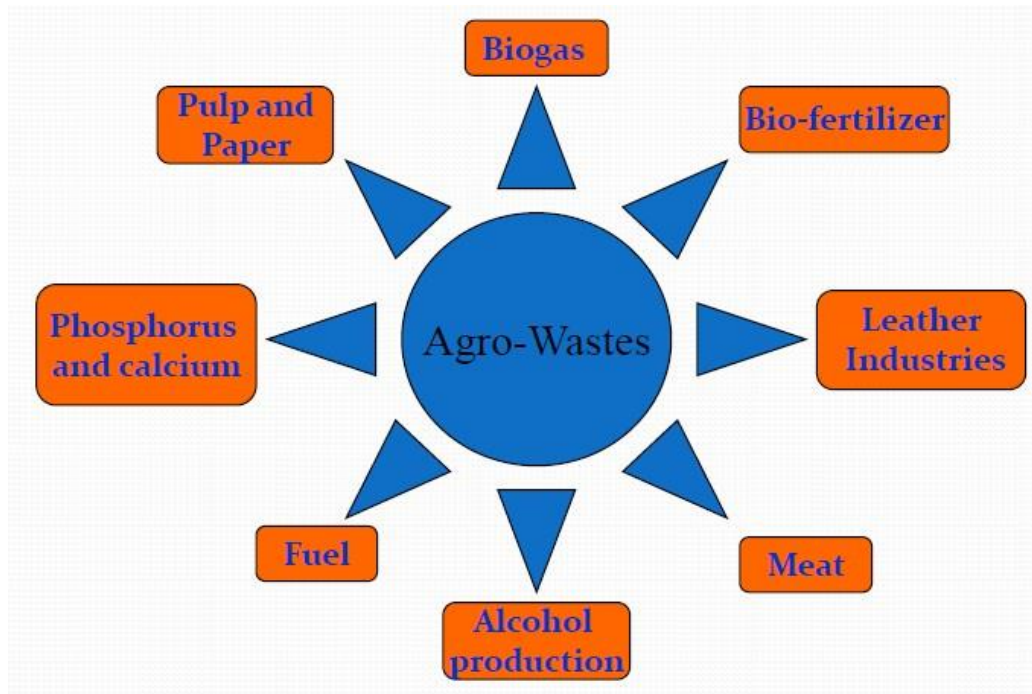
The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

S.No	BASIS FOR COMPARISON	REUSE	RECYCLE
1	Meaning	Reuse, means putting an item to same or a different use, after it has fulfilled its original function.	Recycle is a process, where in a used item is turned into a new product, to reduce waste of potentially useful material.
2	Form	Does not change the original form of the product.	A new product is created, so form of product is changed.
3	Harm to Environment	It does not harm environment, in any way.	It sometimes causes harm to environment.
4	Energy	Saves energy	Consumes a little amount of energy, but saves it too.
5	Objective	To elongate the life of article.	To use basic material in the creation of various products.

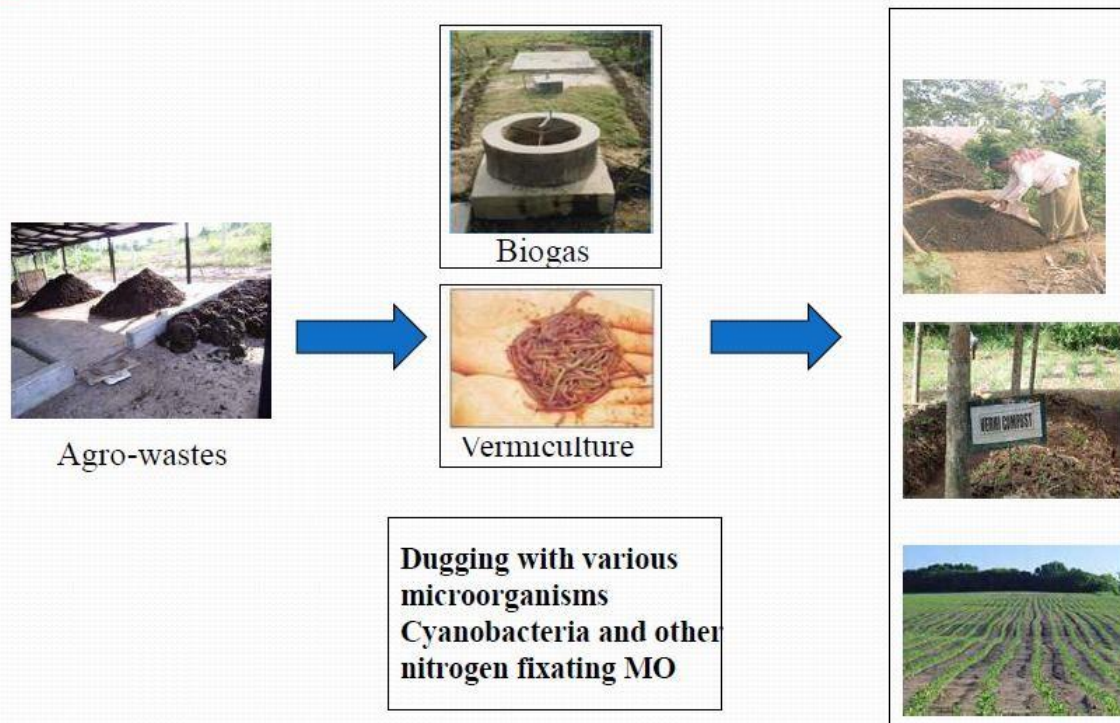
RECYCLING:

- Process to change waste into new products.
- Prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage.
- Reduce air pollution from incineration and water pollution from land filling.
- Lower greenhouse gas emissions.
- Key component of modern waste reduction and is the third component of the "Reduce, Reuse, Recycle".

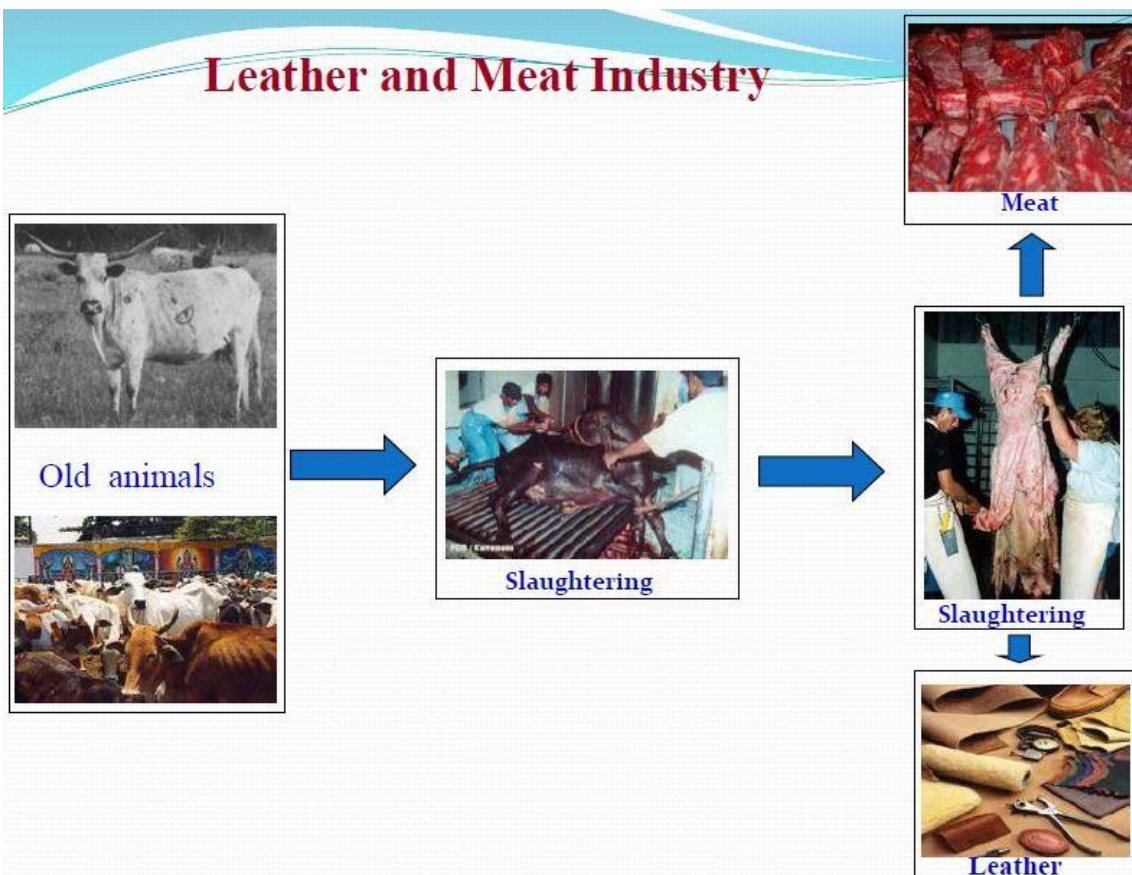
MANAGEMENT OF RECYCLING AGRO-WASTES:

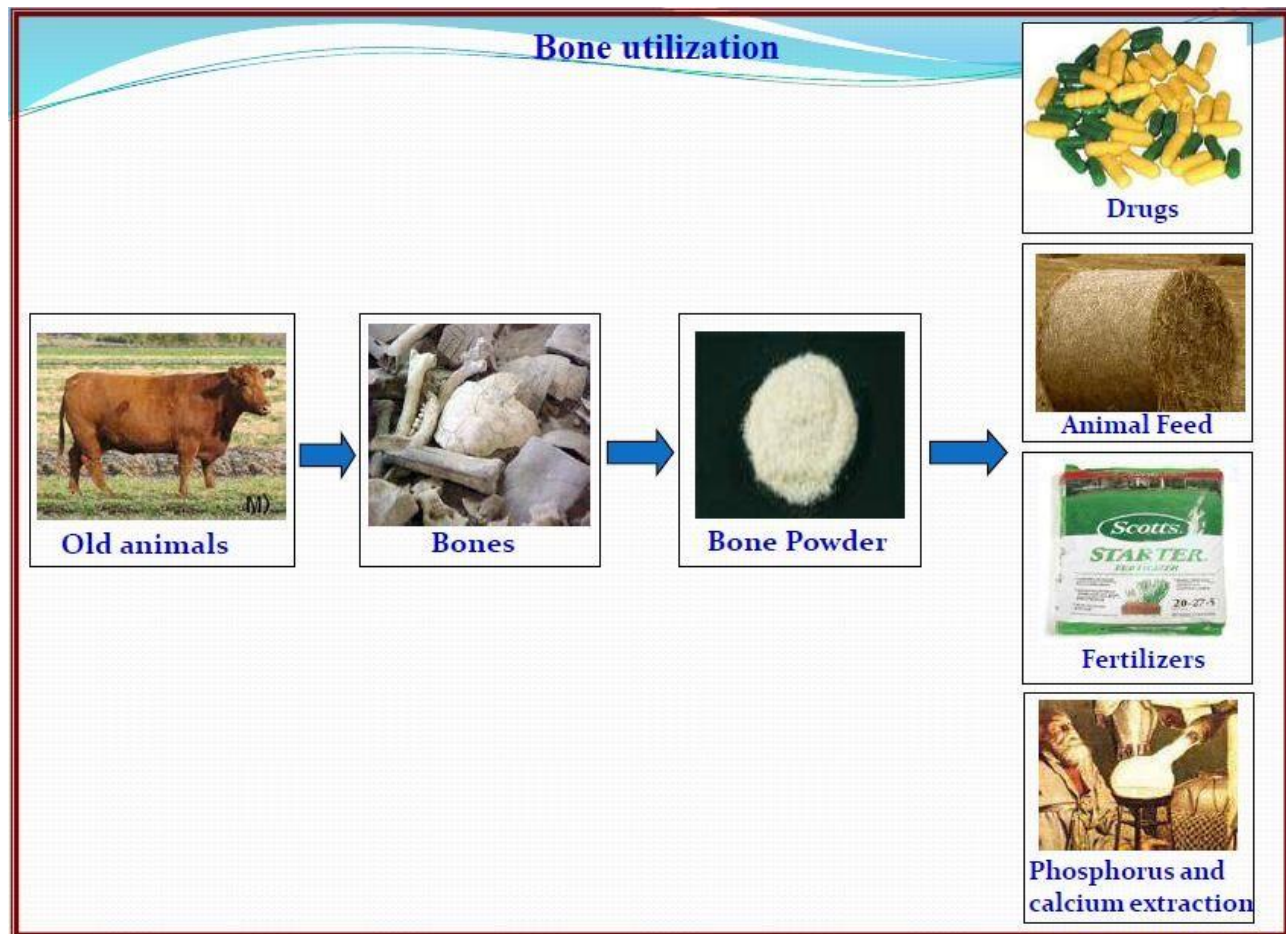


Bio-fertilizers production

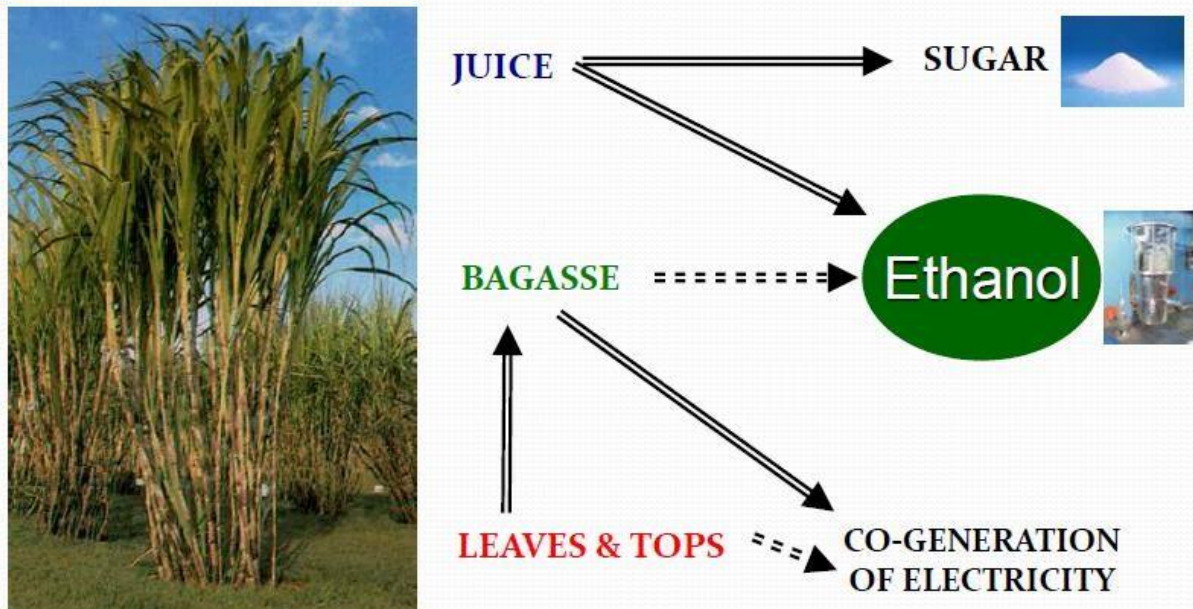


Leather and Meat Industry

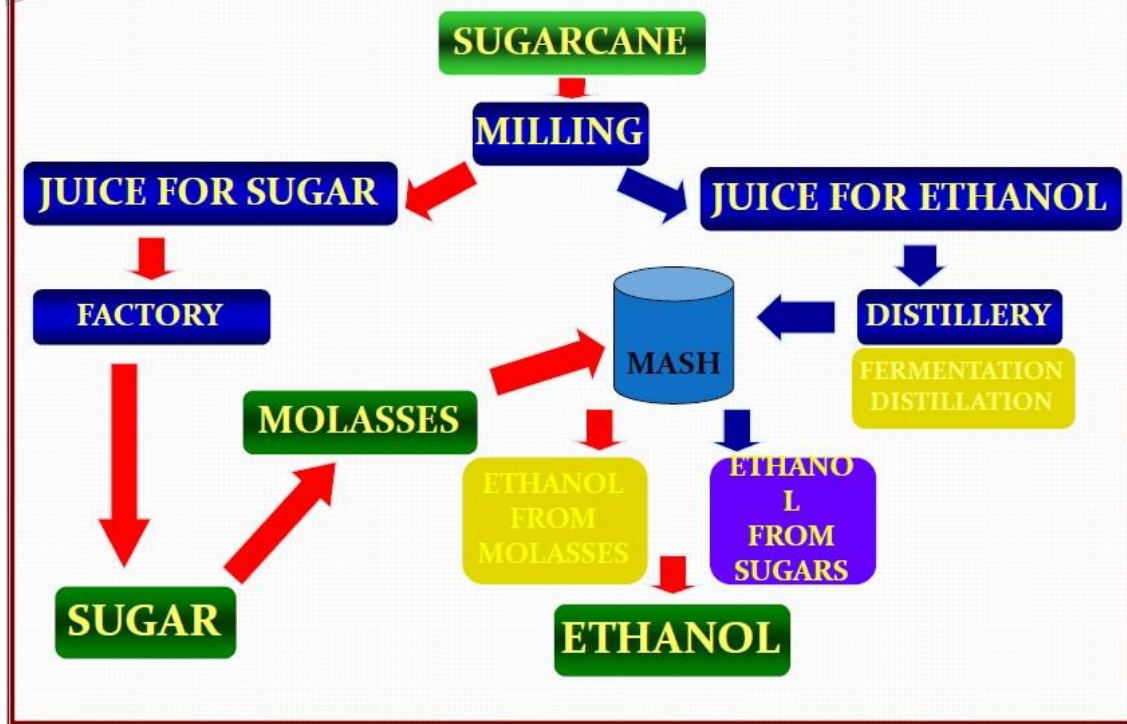




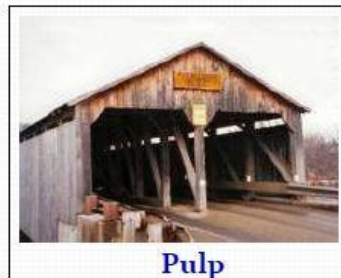
Sugarcane – Source of Green Energy



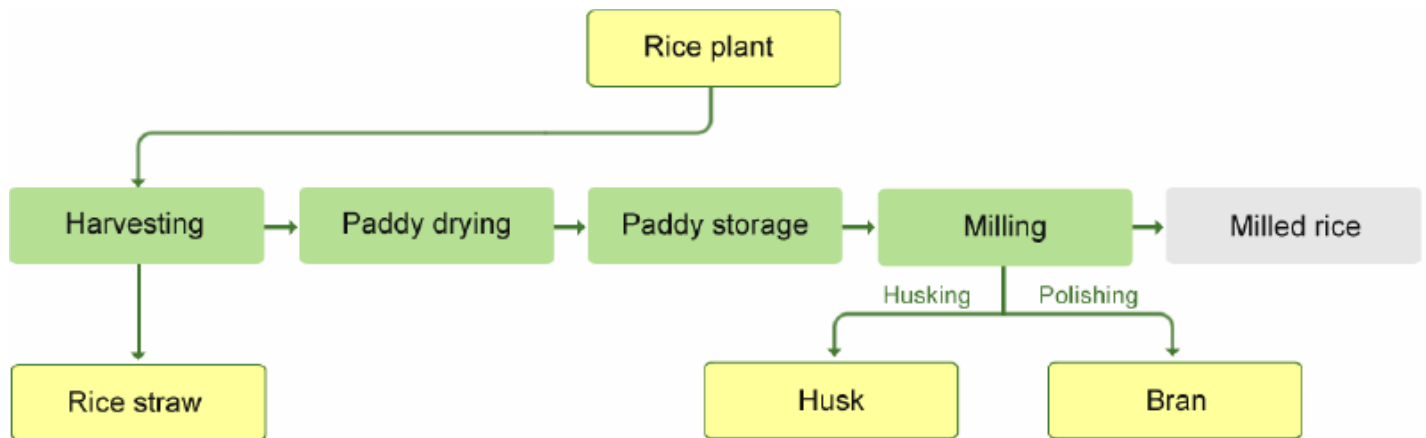
Ethanol from Molasses and Juice



Straws and peals used for Pulp and Paper Production



The Main By-Products of Rice Are Rice Straw, Rice Husk or Hull and Rice Bran



- Rice straw is produced when harvesting paddy.
- Straw comes from what is left on the plant after it is harvested and the grains are threshed.
- Rice husks or hulls are generated during the first stage of rice milling, when rough rice or paddy rice is husked.
- Rice bran is produced during the second stage in milling, the whitening or polishing process, when the bran layer is removed from the brown rice kernel.

Current Constraints in Collection and Handling of Agricultural Wastes:

Major Constraints:

- The product is weighty and bulky, making it expensive to transport.
- The nutrient value of compost is low compared with that of chemical fertilizers, and the rate of nutrient release is slow so that it cannot usually meet the nutrient requirement of crops in a short time, thus resulting in some nutrient deficiency.
- The nutrient composition of compost is highly variable compared to chemical fertilizers.
- Agricultural users might have concerns regarding potential levels of heavy metals and other possible contaminants in compost, particularly mixed municipal solid wastes. The potential for contamination becomes an important issue when compost is used on food crops.
- Long-term and/or heavy application of composts to agricultural soils has been found to result in salt, nutrient, or heavy metal accumulation and may adversely affect plant growth, soil organisms, water quality, animal and human health.

Other Constraints:

- ✓ Agriculturally caused pollution is but one part of the national environmental quality problem. All pollution sources; i.e., municipal, industrial, marine, agricultural, and mining sources, must be considered in an integrated manner to improve the quality of the environment. Recent changes in agricultural production methods have caused natural interest in agriculturally related pollution to escalate. Such pollution is no longer considered minor or uncontrollable.
- ✓ Changing agricultural practices have altered the traditional view of agricultural production. All agricultural production is becoming more intensive. Had agricultural production practices remained static, food production and the standard of living of the public would not have reached the high levels enjoyed today.
- ✓ However, remarkable changes in the efficiency of Indian agriculture have occurred in recent decades. Farm size and productivity per farm worker have increased significantly. Intensive crop and animal production have taken on many aspects of industrial operations.
- ✓ The increased efficiency of agricultural production has generated or been associated with a variety of environmental problems. Efficiency of agricultural production and quality of the environment are inescapably interrelated and frequently appear to be diametrically opposed.
- ✓ Methods of handling, treating, and disposing of agricultural wastes may adversely affect air, water, and soil quality, and may be a nuisance to those who dwell nearby. Encroachment of suburbia into rural areas has sharpened the awareness of the problems generated by the handling and disposing of agricultural wastes.
- ✓ Within recent years it has been documented that agriculturally related pollution is not minor and deserves the increasing attention of scientists, engineers, and administrators interested in the enhancement of the environment. A number of reports and symposia have been developed to place the agricultural waste problem in perspective, to establish priorities, and to estimate the cost of needed research and control measures to retard possible deterioration of environmental quality by agricultural activities.

- ✓ Examples of adverse environmental quality problems attributed to agricultural operations include: excessive nutrients from lands used for crop production or waste disposal that unbalance natural ecological systems and increase eutrophication; Microorganisms in waste discharges that may impair the use of surface waters for recreational use: impurities in ground water from land disposal of wastes; contaminants that complicate water treatment: depletion of dissolved oxygen in surface waters causing Kills and. septic conditions: and odors from concentrated waste storage and land disposal.
- ✓ The causes and concerns of agricultural waste treatment and disposal are analogous to the environmental problems caused by people. When people were fewer in number, when agricultural production was less concentrated, and when both were better distributed throughout the land, their wastes could be absorbed without adversely affecting the environment. Aggregations of people in cities and the development of large-scale industrial operations have caused the air and water pollution as well as health problems of which we are increasingly aware. While the problem of municipal and industrial wastes has been increasing for decades, the agricultural waste problem has been more recent and dramatic being apparent to those most closely associated with the problem for only about a decade and to those less closely associated for only the past few years.
- ✓ Perhaps the most dramatic changes in agricultural production have occurred in animal production which has changed from small, individual farm operations into an industry involving large-scale enterprises. Small animals, such as chickens and hogs. are confined within small areas buildings in which the environmental conditions are controlled to produce the greatest weight gain in the shortest period of time. There is an increasing trend for cattle to be finished in similarly controlled areas, dry lot feedlots. Under such conditions it is no longer possible for these animals to drop their wastes on pastures where the wastes can be adsorbed by nature without adversely affecting the environment.
- ✓ Concentrated animal feeding operations may be a prime pollution contributor in some areas of the country. For example, certain sections of the Midwest have feedlots in watersheds containing high animal concentrations, Intensive storms can flush heavy loadings of animal

waste runoff to small streams where the volume of storm water may be insufficient to provide adequate dilution along the entire watercourse. Fish kills and lowered recreational values have resulted. Runoff from manured fields and effluents from animal waste disposal lagoons also can affect the quality of adjacent streams.

- ✓ Odors can be another problem associated with animal production facilities especially during land spreading of the wastes. Some odors are inevitable near such facilities. Odors can be reduced by proper sanitation in production facilities and by proper waste management. There is an increasing concern with the environmental effect of the disposal of wastes on the land. Land application of wastes has been a traditional method of agricultural waste disposal and remains the best approach in most locations. The high concentrations of animal wastes in a small area and the disposal of the wastes on the soil have raised questions about surface runoff and groundwater quality problems.
- ✓ Because of inexpensive fertilizers and increased labor costs, use of animal wastes as fertilizers has been less economical. Transportation costs and the quantity of the wastes produced at confined animal operations have caused an interest in liquid handling and treatment systems and in drying and solids destruction systems. These in turn have caused other problems. Food processing wastes are an agricultural waste problem. In contrast to animal wastes which are very high strength, low volume wastes, food processing wastes are lower strength, higher volume wastes. The discharge of untreated food processing wastes to streams has caused pollution problems and the improper use of land disposal by irrigation can cause resultant runoff, soil clogging, and odor problems. In the last few years, nutrient budget studies have indicated another concern of agricultural production. The quantity of nitrogen in a number of stream and river basins has been inferred to be a result of agricultural practice, especially of crop fertilization and animal waste disposal in these areas. Undoubtedly, some of the excess nutrients from crop production and waste disposal are reaching surface waters and ground waters and contributing to the eutrophication and nutrient concentrations in some areas, the magnitude of this contribution requires better information and will vary between basins.

- ✓ Past and to a large extent, current pollution control activities are being directed at domestic and industrial wastes. When pollution from these sources are controlled, wastes from agricultural operations still may impart considerable undesirable material to the waters of the nation unless a determined and continuing effort is made to control real and potential pollution from agricultural operations.
- ✓ The primary focus of agricultural waste management is on the obvious problems such as odor control and feedlot runoff. There is, however, awareness of potential long-range problems associated with land runoff from rural and agricultural lands, contaminant leaching to ground waters, and salt buildup where land is used for waste disposal or where water reuse is practiced. Odor problems are mainly social in nature and efforts to control this problem represent the minimum management needed. The time scale of emphasis on agricultural waste management problems is,
- ✓ **Present:** Odor control from confined animal operations; Biochemical Oxygen Demand (BOD) and suspended solids control of liquid agricultural wastes.
- ✓ **Near future:** Nitrogen control; rural and agricultural runoff.
- ✓ **Future:** Inorganic salt control.

Concerns about agricultural waste management:

- If not managed properly, agricultural waste can pollute the environment.
- The degradation of water quality can impact adjacent waterways and groundwater both onsite and offsite.
- This degradation reduces the ability of these resources to support aquatic life and water for human and animal consumption.
- Nitrates can found in fertilizers and agricultural waste runoff, can seep into groundwater.
- Well water contaminated with nitrates is hazardous to humans, as it results in oxygen depletion in the blood.

Drawbacks of Improper Agro-Waste Management:



Global warming



Field filling



Mosquito generated diseases

Benefits of Agricultural Waste Management:

- ✚ The reuse of animal waste in farming operations can reduce the quantity and hauling costs of commercial fertilizer.
- ✚ The contribution of animal waste increases the organic matter content of soils, which increases nutrient availability for crops and improves the water holding capacity.
- ✚ Good waste management reduces the instances of well water contamination and minimizes surface water pollution.
