2.4 AGRICULTURAL DRAINAGE

- An agricultural drainage system is a system by which water is drained on or in the soil to enhance agricultural production of crops. It may involve any combination of storm water control, erosion control, and water table control.
- It shows the field (or internal) and the main (or external) systems. The function of the field drainage system is to control the water table, whereas the function of the main drainage system is to collect, transport, and dispose of the water through an outfall or outlet.
- In some instances one makes an additional distinction between collector and main drainage systems. Field drainage systems are differentiated in surface and subsurface field drainage systems.
- Sometimes (e.g., in irrigated, submerged rice fields), a form of temporary drainage is required whereby the drainage system is allowed to function only on certain occasions (e.g., during the harvest period).
- If allowed to function continuously, excessive quantities of water would be lost. Such a system is therefore called a checked, or controlled, drainage system.
- More usually, however, drainage systems are meant to function as regularly as possible to prevent undue water logging at any given time and it is this regular drainage system that is most often employed. In agricultural literature, this is sometimes also called a "relief drainage system".

Classifications:

While there are more than two types of drainage systems employed in agriculture, there are two main types:

(1) Surface drainage and

(2) Sub-surface drainage.

1. Surface drainage systems:

- The regular surface drainage systems, which start functioning as soon as there is an excess of rainfall or irrigation applied, operate entirely by gravity. They consist of reshaped or reformed land surfaces and can be divided into:
  - Bedded systems, used in flat lands for crops other than rice;
  - Graded systems, used in sloping land for crops other than rice.
- The bedded and graded systems may have ridges and furrows.
- The checked surface drainage systems consist of check gates placed in the embankments surrounding flat basins, such as those used for rice fields in flat lands. These fields are usually submerged and only need to be drained on certain occasions (e.g., at harvest time).
- Checked surface drainage systems are also found in terraced lands used for rice.
- In literature, not much information can be found on the relations between the various regular surface field drainage systems, the reduction in the degree of waterlogging, and the agricultural or environmental effects.
- It is therefore difficult to develop sound agricultural criteria for the regular surface field drainage systems. Most of the known criteria for these systems concern the efficiency of the techniques of land leveling and earthmoving.
- Similarly, agricultural criteria for checked surface drainage systems are not very well known.

2. Subsurface drainage systems

- Like the surface field drainage systems, the subsurface field drainage systems can also be differentiated in regular systems and checked (controlled) systems.
- When the drain discharge takes place entirely by gravity, both types of subsurface systems have much in common, except that the checked systems have control gates that can be opened and closed according to need. They can save much irrigation water. A checked drainage system also reduces the discharge through the main drainage system, thereby reducing construction costs.

- When the discharge takes place by pumping, the drainage can be checked simply by not operating the pumps or by reducing the pumping time. In northwestern India, this practice has increased the irrigation efficiency and reduced the quantity of irrigation water needed, and has not led to any undue salinization.
- The subsurface field drainage systems consist of horizontal or slightly sloping channels made in the soil; they can be open ditches, trenches, filled with brushwood and a soil cap, filled with stones and a soil cap, buried pipe drains, tile drains, or mole drains, but they can also consist of a series of wells.
- Modern buried pipe drains often consist of corrugated, flexible, and perforated plastic (PE or PVC) pipe lines wrapped with an envelope or filter material to improve the permeability around the pipes and to prevent entry of soil particles, which is especially important in fine sandy and silt soils. The surround may consist of synthetic fiber (geotextile).
- The field drains (or laterals) discharge their water into the collector or main system either by gravity or by pumping.
- The wells (which may be open dug wells or tube wells) have normally to be pumped, but sometimes they are connected to drains for discharge by gravity.
- Subsurface drainage by wells is often referred to as vertical drainage, and drainage by channels as horizontal drainage, but it is more clear to speak of "field drainage by wells" and "field drainage by ditches or pipes" respectively.
- In some instances, subsurface drainage can be achieved simply by breaking up slowly permeable soil layers by deep plowing (sub-soiling), provided that the underground has sufficient natural drainage. In other instances, a combination of sub-soiling and subsurface drains may solve the problem.

Main drainage systems:

- The main drainage systems consist of deep or shallow collectors, and main drains or disposal drains.
- Deep collector drains are required for subsurface field drainage systems, whereas shallow collector drains are used for surface field drainage systems, but they can

also be used for pumped subsurface systems. The deep collectors may consist of open ditches or buried pipe lines.

- The terms deep collectors and shallow collectors refer rather to the depth of the water level in the collector below the soil surface than to the depth of the bottom of the collector. The bottom depth is determined both by the depth of the water level and by the required discharge capacity.
- The deep collectors may either discharge their water into deep main drains (which are drains that do not receive water directly from field drains, but only from collectors), or their water may be pumped into a disposal drain.
- Disposal drains are main drains in which the depth of the water level below the soil surface is not bound to a minimum, and the water level may even be above the soil surface, provided that embankments are made to prevent inundation. Disposal drains can serve both subsurface and surface field drainage systems.
- Deep main drains can gradually become disposal drains if they are given a smaller gradient than the land slope along the drain.
- The technical criteria applicable to main drainage systems depend on the hydrological situation and on the type of system.

Main drainage outlet

The final point of a main drainage system is the gravity outlet structure or the pumping station.

Applications:

- Surface drainage systems are usually applied in relatively flat lands that have soils with a low or medium infiltration capacity, or in lands with high-intensity rainfalls that exceed the normal infiltration capacity, so that frequent water logging occurs on the soil surface.
- Subsurface drainage systems are used when the drainage problem is mainly that of shallow water tables.
- When both surface and subsurface waterlogging occur, a combined surface/subsurface drainage system is required.

- Sometimes, a subsurface drainage system is installed in soils with a low infiltration capacity, where a surface drainage problem may improve the soil structure and the infiltration capacity so greatly that a surface drainage system is no longer required.
- On the other hand, it can also happen that a surface drainage system diminishes the recharge of the groundwater to such an extent that the subsurface drainage problem is considerably reduced or even eliminated.

DOWNSTREAM IMPACTS

Impact on downstream systems:

- The rapid transfer of exceedance flow over the surface can have a significant and damaging impact on downstream receptor systems.
- The situation is exacerbated when such systems themselves are subjected locally to the effects of an extreme event at the same time, and this can impose significant additional liabilities on stakeholders.
- Detailed advice on assessing the impact on downstream systems and developing mitigation measures is given in the drainage exceedance guidance (C635). However a few vital points are worth noting.
- It is important to understand the interaction between the upstream system conveying the flow, and the downstream receptor system.
- As well as considering the peak rate of runoff and the flood volume, the timing of the peak relative to that in the receptor system is essential.
- For example, where a small upstream area discharges into a large river system, the actual impact may be small, not because the rate of exceedance flow is small, but because the maximum value occurs ahead of the peak in the receiving river.
- It may pass downstream without detriment and in such cases it may be detrimental to provide storage attenuation if this leads to the peak flows occurring at around the same time.
- The downstream system can also prevent the exceedance flow from freely discharging, increasing the risk of upstream flooding. For example, when

discharging to coastal areas, tide levels may affect the performance of surface flood pathways. An extreme event coinciding with a high tide may not drain as effectively as one occurring at the time of a low tide.

- In such cases a joint probability analysis may be necessary. Outfalls from surface flood pathways may require agreements/consents from the owners of receiving watercourse, riparian owners and/or environmental regulators.
- Early planning of such consents or agreements will greatly assist in land (re)development.
- Exceedance flows may convey large quantities of sediments, pollutants washed of surface areas, and other pollutants discharged from wastewater collection systems.

Irrigation extraction and irrigation development affect downstream river (locally and globally):

- Reduction in flow - Q = Input – ET (long term equilibrium)
  - Any change in ET will decrease Q: shifting blue water (Q) to green water (ET)
- Flow inversion, timing mismatch between natural high flows and irrigation demands
  - Irrigation demand in summer, flows from Dam
  - Natural high flow in winter, stored in Dam
- Salinity, salt balance
  - Salt storage = Salt Input – Salt Output.
  - To manage salt storage, salt output needs to increase if input increases with irrigation water: Leaching Fraction
- Other water quality issues:
  - Blue Green Algae due to low flows
  - Acid sulphate soil exposure

Irrigation and irrigation development will always impact downstream ecosystems and other users.

- Changes in flow timing, quantity and distribution
- Salinity impacts are also unavoidable, simple salt balance
- Exacerbated in a high salt environment
- Large spaces and low data density makes assessment of impacts difficult
- New data and new tools might improve assessing impact
- Identification of thresholds is crucial and needs to be more than location or species specific

2.5 AGRICULTURE VERSUS URBAN IMPACTS

In recent decades, India has been experiencing rapid urbanization, represented by significant changes in its demographic composition and large-scale expansion of its urban landscape. For instance, total urban population jumped from 78.94 million in 1961 to 377.10 million in 2011 which is about 388 % increase. The percentage of urban population (or number of cities/towns) increased from 17.97 % (or 2657) in 1961 to 31.16 % (or 7935) in 2011. In contrast, increase in the country's rural population was at a much slower rate; it increased from 36 million in 1961 to 83 million in 2011, i.e. a mere 131% increase. This indicates that urban population in India is growing at a much higher rate along with a significant decline in the share of rural population.

Agriculture sector in India is majorly dependent on monsoon which is often unpredictable; therefore it is has been characterized by disguised and seasonal unemployment. The decline in employment opportunities in the agriculture and lower productivity level are the major reasons for the decline in the share of agriculture sector to total GDP. On the same logic, it could be construed that the increasing share of industry and service has also lead to the decline in the share of agriculture in GDP. Total extent of agricultural land also decreased from 96.98 % in 1985 to 96.78 % in 2000 90.77 % in 2010 and to 90.70 by 2012. In this perspective, it is important to note that Pandey and Seto (2014) clearly measured the total agriculture land loss due to urbanization in India. They found that the total amount of agricultural land lost in India during 2001-2010 was a staggering 0.7 million hectares. Agricultural land loss to urban expansion was the highest (0.12 million hectares) in the first one-year period of the study, June 2001 - May 2002, which decreased marginally until 2006, only to increase thereafter.

The discussion clearly indicates that India is experiencing a transformation from agricultural lead economy to industry and service based urban economy. In fact, this transformation is an inevitable stage of development, which had been experienced by many developed countries in their early stage of development. The basic reason behind this phenomenon is that the resources (e.g., land, worker etc) which are excess in rural areas (mostly in developing countries) are being released and absorbed in the urban areas. Since urban area provides the advantage of higher productivity, the resource shifting from rural to urban sector leads to higher economic growth of the country through increasing rate of urbanization. In this phase of development, demand and supply side economics play an important role. Demand side factors such as higher income/job opportunity, higher level of standard of living and higher accessibility of basic infrastructure pull the rural population into urban areas. On the other hand, higher level of agricultural productivity works as a supply side factor in releasing rural resources for the urban areas.

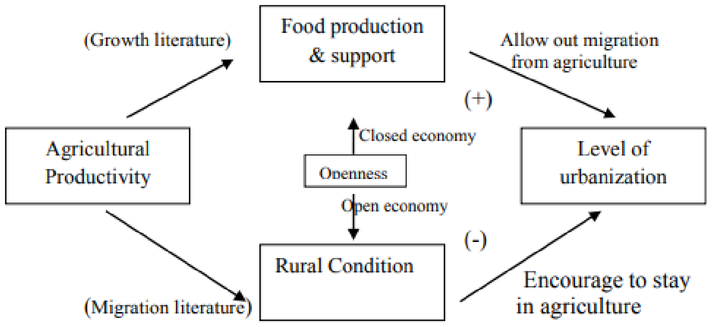

Figure 2.5.1 Effect of Agriculture on Urbanization

[Source:https://images.app.goo.gl/zU63RrxxMYbbyNgE7]

The negative impact of the share of agriculture and cultivated land area on urbanization clearly indicates that when agriculture activity increases urbanization rate decreases. In other words, agriculture activities decrease with the rise of urbanization in India. This has been evidenced by the declining share of agriculture and cultivated land area in India. For instance, the share of agriculture declined from 35.7 in 1981 to 13.9 in 2015. On the other hand, due to urbanization total 89 thousand hectare agriculture land was lost in 2009-10. The result supports the findings of Pandey and Seto (2014). Consumption of fertilizers and budgetary expenditure in agriculture has a positive effect on urbanization. The result indicates that more expenditure by government on agriculture sector and higher consumption of fertilizer increases the level of agricultural productivity and the rural living conditions. Public expenditure (budgetary expenditure) plays a crucial role in the development of Indian agriculture. State budgetary support to agriculture also increases private household investment in agriculture (Roy, 2001). As a sizable amount of public expenditure is meant for creating and facilitating infrastructure and as it augments productive capacity, the level of public expenditure is crucial for growth of output. Higher agricultural productivity provides surplus food and agricultural products by using fewer workforces, and thus allows rural to urban migration which actually becomes the main thrust behind higher level of urbanization. It is also very much evident that agriculture productivity has increased over the decades.

Except rice and pulses production, others (i.e., wheat, maize, jowar, bajra and pulses) have a positive effect on urbanization in India. This also indicates that higher agricultural production caused by higher productivity, has had a positive effect on urbanization in India. It is important to note that India is one of the largest producers of rice in the world, accounting for about 20% of all world rice production. It is India's principal and the staple food of the people of the eastern and southern parts of the country. In India, one-fourth of the total cropped area is covered by rice and it provides food for about half the Indian population.

2.3 EROSION AND PROBLEMS OF DEPOSITION IN IRRIGATION SYSTEMS

Erosion:

In earth science, erosion is the action of surface processes (such as water flow or wind) that removes soil, rock, or dissolved material from one location on the Earth's crust, and then transports it to another location. This natural process is caused by the dynamic activity of erosive agents, that is, water, ice (glaciers), snow, air (wind), plants, animals, and humans.

Physical processes:

1. Rainfall and surface runoff:

Rainfall, and the surface runoff which may result from rainfall, produces four main types of soil erosion:

- Splash erosion
- Sheet erosion
- Rill erosion, and
- Gully erosion.

2. Rivers and streams

Valley or stream erosion occurs with continued water flow along a linear feature. The erosion is both downward, deepening the valley, and head ward, extending the valley into the hillside, creating head cuts and steep banks.

3. Coastal erosion

Shoreline erosion, which occurs on both exposed and sheltered coasts, primarily occurs through the action of currents and waves.

4. Chemical erosion

Chemical erosion is the loss of matter in a landscape in the form of solutes.

5. Glaciers

Glaciers erode predominantly by three different processes: abrasion/scouring, plucking, and ice thrusting.

6. Floods

Erosion Occur by large volumes of rapidly rushing water.

7. Wind erosion

Wind erosion is a major geomorphologic force, especially in arid and semi-arid regions.

8. Mass movement

Mass movement is the downward and outward movement of rock and sediments on a sloped surface, mainly due to the force of gravity

Factors affecting erosion Rates:

- **Climate**

The amount and intensity of precipitation is the main climatic factor governing soil erosion by water. The relationship is particularly strong if heavy rainfall occurs at times when, or in locations where, the soil's surface is not well protected vegetation

- **Vegetative cover**

The removal of vegetation increases the rate of surface erosion.

- **Topography**

The topography of the land determines the velocity at which surface runoff will flow, which in turn determines the erosive of the runoff. Longer, steeper slopes (especially those without adequate vegetative cover) are more susceptible to very high rates of erosion during heavy rains than shorter, less steep slopes.

Soil Erosion Problems in Irrigation System:

- The factors affecting soil erosion from irrigation are the same as
  - Rainfall
  - water detaches
  - Transports sediment.
- However, there are some unique differences in how the factors occur during irrigation and in our ability to manage the application of water that causes the erosion. All surface irrigation entails water flowing over soil.
- Soil type, field slope, and flow rate all affect surface irrigation erosion, with flow rate being the main factor that can be managed.

- Ideally, sprinkler irrigation will have no runoff, but application rates on moving irrigation systems can exceed the soil infiltration rate, resulting in runoff and erosion.
- Using tillage practices to increase soil surface storage and selecting sprinklers with lower application rates will reduce sprinkler-irrigation runoff. Irrigation can be managed to minimize erosion and maintain productivity.

For example, rainfall occurs relatively uniformly over an entire field, whereas irrigation is seldom applied to an entire field at the same time. Irrigation is a controlled procedure where water is applied to a specific field, or portion of a field, at a specific time. This can affect the hydrology of the erosion processes on surface- and sprinkler-irrigated fields. A center pivot, for example, is essentially a moving storm that covers only 1–2% of the field at any given time.

- This results in unique runoff conditions where water can do the following:
  - Flow parallel to the lateral under similar conditions as rainfall
  - Flow from wet soil onto dry soil if the lateral is moving downhill; or
  - Flow onto wet soil if the lateral is moving uphill.

- In surface irrigation, water flow rate decreases with distance during surface irrigation as water infiltrates. Furrow flow rates also increase with time as infiltration rate decreases .
- This creates a condition where sediment can be detached on the upper end of the field and deposited on the lower end.
- Erosion rates on the upper end of a field those were 6 to 20 times greater than the field-average erosion rates eroded furrows on the upper end of a field after one furrow irrigation.
- During rainfall, raindrops wet the soil surface and detach soil particles. As runoff begins, rills form in wet soil. In contrast, irrigation furrows are formed prior to irrigation, and water flows onto initially dry soil.
- Furrows with initially dry soil have greater soil erosion than furrows that were preset immediately before furrow irrigation.

- Irrigation water flowing in furrows is not exposed to falling raindrops that can increase sediment detachment and decrease deposition.
- The quality of irrigation water can vary dramatically among water sources, or even within an irrigation tract if drainage water is reused. Conversely, electrolyte concentration of rainfall is quite consistent.
- Electrolyte concentration in irrigation water affects erosion for both surface and sprinkler irrigation. Lower electrolyte concentrations in water cause greater dispersion of soil particles, which tends to reduce infiltration and increase soil loss.

How to Prevent Soil Erosion:

1. Crop Rotation:

Rotating in high-residue crops such as corn, hay, and small grain can reduce erosion as the layer of residue protects topsoil from being carried away by wind and water.

Figure 2.3.1 Crop Rotation

[Source:https://static.eos.com/wp-content/uploads/2020/07/crop_rotation_1200-580.jpg]

2. Conservation Tillage:

Conventional tillage produces a smooth surface that leaves soil vulnerable to erosion. Conservation tillage methods such as no-till planting, strip rotary tillage, chiseling, and disking leave more of the field surface covered with crop residue that protects the soil from eroding forces.

Figure 2.3.2 Conservation Tillage

[Source:https://mda.maryland.gov/resource_conservation/PublishingImages/ConservationTillage.jpg]

3. Contour Farming:

Planting in row patterns that run level around a hill instead of up and down the slope has been shown to reduce runoff and decrease the risk of water erosion.

4. Strip Farming:

In areas where a slope is particularly steep or there is no alternative method of preventing erosion, planting fields in long strips alternated in a crop rotation system (strip farming) has proven effective.

5. Terrace Farming:

Many farmers have successfully combated erosion by planting in flat areas created on hillsides in a step-like formation (terrace farming).

6. Grass Waterways:

By planting grass in areas of concentrated water flow, farmers can prevent much of the soil erosion that results from runoff, as the grass stabilizes the soil while still providing an outlet for drainage.

7. Diversion Structures:

Used often for gully control, diversion structures cause water to flow along a desired path and away from areas at high risk for erosion.

PROBLEMS OF DEPOSITION IN IRRIGATION SYSTEMS

- Deposition of sediment in the irrigation-drainage canal network is an undesirable, yet inevitable occurrence in the course of the use and operation of any canal network system.
- Apart from the sediment deposited in the bottom and consequently reducing the designed, basic purposes and the functional performance of the canal network as well as hydraulic works constructed on them, the physical, chemical and biological properties of these sediment deposits are becoming issues of more immediate concern.
- Nutrients contained in the sediments may adversely affect water quality and uses; intensify eutrophication and growth of vegetative cover in the canals, with no limitations regarding the disposal of dredged sediment in the surrounding areas, due to its favorable impact on soil properties and fertility.
- However, increased content of hazardous and toxic substances in the sediment, followed with further degradation of suspended solids due to accumulation of pollutants, raised concentration or synergic effects of the said substances, etc. can have serious impacts (toxic, pathogenic, carcinogenic, mutagenic, etc.) not only on the canal system but also on the environment in which dredging sediment is disposed and stored.
- Suspended sediment in water bodies may contain, for the most part, necessary macro and micro nutrients, humus organic compounds and other ingredients improving properties of the soil onto which dredged sediment is to be deposited and spread.
- This refers particularly to the arable land, its texture and fertility, and consequently, to the yield and quality of the crops.
- Thus, reasons for the use of sediment on the land for agricultural purposes are more than obvious. It is clear that non-contaminated sediment may have positive impact on the land, and one of the basic principles calls for the incorporation of sediment in the land whenever possible. On the other hand, however, sediment

may contain heavy loads of nutrients and other unwanted substances with harmful affects on the land, crops and public health.

- Great care and caution is, therefore, needed in handling and depositing sediment in the environment, as well as the introduction of restrictive measures in its application in agricultural sector, that is, in its spreading or injecting on the farmland.
- Fine sediments settle on the beds of the smaller canals in many run of river irrigation schemes.
- Sedimentation affects the operation of schemes by reducing discharge capacities and raising water levels, and sediment deposits have to be removed periodically to maintain irrigation supplies.
- In many schemes de-silting costs are excessive, and in some, sediment settles faster than it can be removed using the funds that are available for maintenance. This results in problems of undersupply, inequity, and an inevitable decline in the area that can be irrigated.
- Sediment control structures are used at intakes from rivers to exclude or extract sediments in the sand and gravel size range, which would otherwise settle in main canals.
- However, these structures have little effect on the very fine sands and silts that are transported through main canal systems, but settle in smaller distributaries canals.
- The options for controlling deposition of fine sediments are limited, but could include: Sediment exclusion by closing the canal, or by reducing canal flows, during periods in which high sediment concentrations are transported.

2.2 MECHANIZED AGRICULTURE AND SOIL COVER IMPACTS

- Mechanized agriculture is the process of using agricultural machinery to mechanize the work of agriculture, greatly increasing farm worker productivity.
- In modern times, powered machinery has replaced many farm jobs formerly carried out by manual labour or by working animals such as oxen, horses and mules.
- Farm mechanization is a term used in a very broad' sense. It not only includes the use of machines, whether mobile or immobile, small or large, run by power and used for tillage operations, harvesting and thrashing but also includes power lifts for irrigation, trucks for haulage of farm produce, processing machines, dairy appliances for cream separating, butter making, oil pressing, cotton ginning, rice hulling, and even various electrical home appliances like radios, irons, washing machines, vacuum cleaners and hot plates."
- The entire history of agriculture contains many examples of the use of tools, such as the hoe and the plough. The ongoing integration of machines since the Industrial Revolution however has allowed farming to become much less labour-intensive.
- Current mechanized agriculture includes the use of tractors, trucks, combine harvesters, countless types of farm implements, aero planes and helicopters (for aerial application), and other vehicles. Precision agriculture even uses computers in conjunction with satellite imagery and satellite navigation (GPS guidance) to increase yields.
- Mechanization was one of the large factors responsible for urbanization and industrial economies. Besides improving production efficiency, mechanization encourages large scale production and sometimes can improve the quality of farm produce. On the other hand, it can displace unskilled farm labour and can cause environmental degradation (such as pollution, deforestation, and soil erosion), especially if it is applied shortsightedly rather than holistically.

Figure 2.2.1 Mechanization in agriculture

[Source:https://greengoldfarmsghana.com/wp-content/uploads/2019/10/tractor-03-1646x1080.jpg]

Sustainable mechanization can:

- Increase land productivity by facilitating timeliness and quality of cultivation.
- Support opportunities that relieve the burden of labour shortages and enable households to withstand shocks better.
- Decrease the environmental footprint of agriculture when combined with adequate conservation agriculture practices.
- Reduce poverty and achieve food security while improving people's livelihoods.

Applications

- Preparing land for planting
- Seed drilling, planting
- Weeding, crop spraying
- Harvesting

Benefits of Mechanization of Agriculture:

- It Increases Production
- It Increases Efficiency and Per Man Productivity
- Mechanization Increases the Yield of Land Per Unit of Area
- Mechanization Results in Lower Cost of Work.

- It Contracts the Demand for Work Animals for ploughing water lifting, harvesting, transport etc.
- It Brings in other Improvements in Agricultural Technique
- It Modifies Social Structure in Rural Areas
- It Leads to Commercial Agriculture
- It Solves the Problem of Labor Shortage
- It Releases Manpower for Non-Agricultural Purposes
- It Results in Better Use of Land
- It Increases Farm Income
- It Reduces Fodder Area and Enlarges Food Area

ADVANTAGES OF MECHANIZED AGRICULTURE

Farm mechanization has the following advantages

1. Timeliness of operation

Farm mechanization ensures that all farm operation are done and completed within a given period of time

2. Mechanization saves time

In farm mechanization, all most human efforts are substituted with machines. Hence labour saved could be employed somewhere else

3. Mechanization reduces health hazards

Farm mechanization reduces health hazards including those posed by the use of cutlass, hoe, digger, knives, stumps and pests

4. Mechanization reduces drudgery

Farm mechanization makes it easy to avoid unpleasant manual jobs

5. Mechanization increases farm yield

As a result of mechanization, farmers become richer due to increased yield

6. It encourages large scale farming

With the use of machine which reduces labour and thereby making the work faster and easier, farmers tends to go into large scale farming activities

7. Increase in output

Mechanization makes it possible for farmers to have increase in output

8. It makes specialization of labour possible

Farm mechanization enables people to become specialized in certain operations within the farm.

9. Co-operation among farmers

Mechanization enables many farmers to come together and pool their resources together, thereby promoting or encouraging co-operation among farmers.

10. It saves time:

Mechanization translates quickly the products of man's brain into reality.

11. Reduction in cost of operation:

Mechanization leads to reduction in the cost of agricultural operations per unit output.

12. Improvement in quality of produce:

Mechanization usually improves the quality of some farm produce, e.g., rice processing.

13. Availability of labour for other sectors:

Mechanization also helps to release labour to other sectors of the economy.

14. Use of less human labour:

Mechanization helps to accomplish lots of work with less human labour.

DISADVANTAGES OF AGRICULTURAL MECHANIZATION

Farm mechanization has the following disadvantages

1. High cost of running:

Farm mechanization, due to the high cost and numerous machines involved, is very expensive to operate

2. Displacement of workers:

In farm mechanization, very few workers are required. Hence many people will be out of job when mechanization is introduced

3. Compaction of soil:

Mechanization lead to compaction of soil due to the movement of heavy machines

4. It causes environmental pollution:

Mechanization causes environmental pollution due to smokes emanating from engines of these machines, chemicals and the use of fertilizer

5. Degradation of landscape:

Mechanization leads to degradation of landscape due to or as a result of continuous excavation

6. Land tenure system:

Land system may hinder efficient use machines like tractors, bulldozer due to small holdings of farmland

7. Destruction of soil structures:

The soil structure can easily be destroyed due to continuous use of heavy machines

8. Redundancy of farm labour

With farm machines working on the farms, the work can easily be completed and this situation can create redundancy in farm labour

9. Few crops can be mechanized

Very few crops like maize, rice, millet and guinea corn that easily be mechanized

10. Inadequate technical know-how

There is always inadequate technical know-how in handling the farm machines and equipment in most developing countries of the world

11. Damage to crops

Most crops are easily damaged during mechanize farm operation

12. Inadequate spare parts

Most of the spare parts or replacement parts for most of these machines are not readily available

13. High cost of maintenance

There is usually high cost of maintenance of machines involved in mechanized agriculture especially for the heavy duty machines

14. Spread of pest and diseases

Mechanization helps to spread diseases through contaminated machineries

15. Human control

Mechanization needs human labour to control it

16. Unstable fuel supply

Unstable supply of fuel in the international market can easily affect the use of these machines in mechanized agriculture

SOIL COVER IMPACTS

Soil cover refers to vegetation, including crops, and crop residues on the surface of the soil.

Figure 2.2.2 Soil Cover

[Source:https://infonetbiovision.org/sites/default/files/environmental_health/conservationagriculture/2855.400x400.jpeg]

Soil cover and reforestation is a mechanism to protect soil from water loss. Like the protection of an umbrella, soil cover and reforestation protects the soil and the microbes within from the impact of sun heat, rain and wind. It stops the soil surface from sealing, and reduces the amount of precious rainwater that runs off.

Introduction

With a reduction of moisture loss in the soil, groundwater resources are protected, soil quality and agricultural production can be improved, and water use for irrigation can be decreased, thus optimizing the local water cycle.

Soil moisture loss (and also soil degradation) can be minimized through different techniques of soil moisture conservation:

- Soil cover (with living plants) and
- Reforestation,
- Mulching,
- Different tillage techniques, and
- Soil amendments.

Soil cover is common on agricultural land. Reforestation is common to protect water protection areas and groundwater resources, or to prevent soil degradation in non-agricultural sites.

Benefits of Soil Cover

As a result of soil cover, agricultural production subsequently improves because soil cover both promotes and maintains,

- Optimum soil conditions for plant growth (nutrient availability) and
- Water infiltration (water availability).

Soil cover with living plants (soil can also be covered with mulch) protects the soil surface from rain, wind and sun (FAO 2005):

- It reduces soil erosion and protects the fertile topsoil, thus preventing the silting of rivers and lakes.
- It stops the soil surface from sealing, and reduces the amount of precious rainwater that runs off.
- It suppresses weeds by smothering their growth and reducing the number of weed seeds. This reduces the amount of work needed for weeding.
- It increases the soil fertility and the organic matter content of the soil.
- It increases soil moisture by allowing more water to sink into the ground and by reducing evaporation.
- Decomposing vegetation and the roots of cover crops improve the soil structure and make the clumps and lumps in the soil more stable – making it harder for rain to break them up and wash them away.
- Earthworms and other forms of life can prosper in the cover as well as in the soil.
- Soil cover stimulates the development of roots, which in turn improve the soil structure, allow more water to soak into the soil, and reduce the amount that runs off.

Types of soil cover:

1. Living plant material: crops, cover crops and forest structures.

2. Dead plant material: such as crop residues and pruning from trees and shrubs

Operation and Maintenance:

Soil cover management needs expert knowledge. The following list outlines some challenges you may encounter for maintaining soil cover and some ways to overcome them (adapted from FAO 2005):

- **Semi arid areas**:

In semi-arid areas, where there is little rain and most of it falls in one season, establishing a cover crop may be difficult. Crops, shrubs and trees produce few residues, and farmers often need them for feed or building materials. Cover crops use precious water.

- **Diseases and pests**:

Diseases and insect pests might attack the cover crop and will require special attention. Farmers often use fire to destroy pests and diseases. But this leaves the soil bare and destroys valuable organic matter.

- **Rats**:

A dense cover crop may encourage rats, which may attack the crop. Slash cover crop as close to the ground as possible, use traps (poison could kill other animals as well), or use rotating crops (interrupt food supply).

- **Termites**:

Many farmers fear that soil cover will attract termites. Only a few types attack crops, most of them are important (break down of soil organic matter, aeration).

- **Fire**:

Bushfires or uncontrolled fires on neighbouring fields can spread into a conservation agriculture field and destroy its soil cover. To prevent this, you can leave a buffer zone around your field.

- **Livestock**:

Livestock need to be fed. Farmers often allow them to graze on stubble or on fallow fields, and other livestock owners may not keep their animals out of a field planted to a cover crop. This may especially be a problem in dry years or in semi-arid areas, where few alternative sources of feed are available. Fence crop field or find alternatives.

Advantages

- Increases soil fertility and soil moisture
- Protects soil from sun, wind and rain, reducing evaporation and compaction
- Plant debris provides organic matter and nutrients to the soil
- Reduces erosion
- Prevents silting of rivers, lakes and reservoirs
- Reduces runoff and enhances infiltration
- Reduces work for weeding

Disadvantages

- Pesticides may need to be used.
- To prevent from bushfires, a buffer zone around the field is necessary