UNIT 5 ORGANIC FARM MANAGEMENT

Structure

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5.0 OBJECTIVES

After studying this Unit, you will be able to:

- explain the key components of farm design, including planning, layout, etc.;
- examine the role of different farm components across agro-ecosystems;
- demonstrate the farm layout by incorporating principles of land preparation, crop planning, and livestock integration; and
- examine sources of soil and water contamination in farming systems.

5.1 INTRODUCTION

Organic agriculture is a holistic production management system that promotes and enhances the health, resilience, and productivity of interdependent communities like soil, plants, animals, water, and all the stakeholders within a farm ecosystem. Unlike conventional systems that often

rely heavily on synthetic inputs/chemical fertilizers, organic farming imitates the structure and function of natural ecosystems, emphasising biodiversity, biological cycles, and soil biological activity.

In this Unit, the prima facie of any cultivation starts from designing, so the Farm Design, which explores key elements critical to establishing and maintaining functions such as organic systems. Beginning with planning and layout, it addresses how farms are spatially organized to optimize resource flows and biological interactions. We then examine farm components across diverse agro-ecosystems, tailoring design to local conditions from humid tropics to arid zones, ensuring adaptability and resilience. Land preparation and seed and planting strategies are explored next, grounded in techniques that support soil health and biodiversity rather than degrade it. The water management section emphasises practices that enhance the soil's water-holding capacity and improve water-use efficiency through natural methods. Recognizing farm systems' vulnerability to pollution, the unit delves into soil and water contamination, identifying threats and exploring contamination control strategies that align with organic principles. Finally, the module concludes with livestock management in organic farming, highlighting how integrating animals fosters nutrient cycling, enhances soil structure, and contributes to ecosystem health.

5.2 FARM DESIGN

A farm is not merely a piece of land where crops are grown or animals are reared. It is a complex production unit where land, water, labour, capital, equipment, crops, and livestock interact with each other to form an integrated system. For this reason, careful farm design is essential to ensure that all resources are used efficiently, productivity is maintained, and ecological balance is preserved. Farm design refers to the systematic planning, arrangement, and organization of all components of a farm, such as crops, livestock, water resources, infrastructure, and natural habitats in a way that optimises resource use, minimizes competition, and enhances long-term sustainability. In organic farming, farm design goes beyond profit-making and focuses on maintaining soil health, conserving biodiversity, recycling resources, and ensuring ecological harmony.

In simple terms, farm design answers the questions:

- What enterprises (crops, livestock, allied activities) should be included in the farm?
- Where should each component be located on the farm?
- How can resources such as soil, water, and labour be shared without competition but with maximum benefit?

Principles of Farm Design are to:

1. **Optimize Resource Use**– land, water, energy, capital, and labour should be allocated efficiently.
2. **Maintain Soil Fertility**– through composting, crop rotation, cover crops, and natural nutrient cycles.

3. **Ensure Balanced Farm Income**– by combining short-duration crops (vegetables), medium-duration crops (pulses, oilseeds), and long-duration enterprises (orchards, livestock).
4. **Promote Biodiversity**– including trees, hedgerows, pastures, ponds, and wetlands that create habitats for beneficial organisms.
5. **Integrate Enterprises**– livestock, aquaculture, apiary, and poultry should be combined with crops to recycle nutrients and provide multiple income streams.
6. **Reduce Risk and Dependency**– diversity in farm enterprises protects against crop failure and market fluctuations.

A Well-designed Farm Usually Includes Components in Farm Design:

- *Crop Components:* cereals, pulses, oilseeds, vegetables, fruits, spices, fodder, and green manure crops.
- *Livestock Components:* dairy animals, poultry, goats, sheep, fish ponds, and apiary.
- *Farm Structures:* cattle sheds, poultry houses, compost yards, biogas units, irrigation structures, storage houses, and farm roads.
- *Natural and Ecological Components:* pastures, meadows, hedgerows, wetlands, and water bodies to conserve biodiversity and natural resources.

Importance of Farm Design in Organic Farming

A well-designed farm plays a crucial role in strengthening the overall efficiency and sustainability of agricultural systems. It enhances productivity by minimizing resource wastage and ensuring that every part of the farm contributes meaningfully to output. At the same time, it maintains ecological balance through practices such as crop rotation, polycultures, and the integration of livestock, which together promote natural cycles and reduce dependency on external inputs. By relying on on-farm resources like compost, green manures, and biological methods of pest control, the farm ensures long-term sustainability while preserving soil fertility and ecosystem health. Moreover, a diversified farm system improves resilience against climate variability, pest outbreaks, and diseases, reducing risks associated with monocropping. Importantly, such a design also supports steady income generation by combining short-term returns from seasonal crops with long-term benefits from perennial systems and livestock enterprises, ensuring both economic stability and ecological soundness for the farmer**.**

An organic farm with possible components should look as illustrated below in Fig. 5.1:

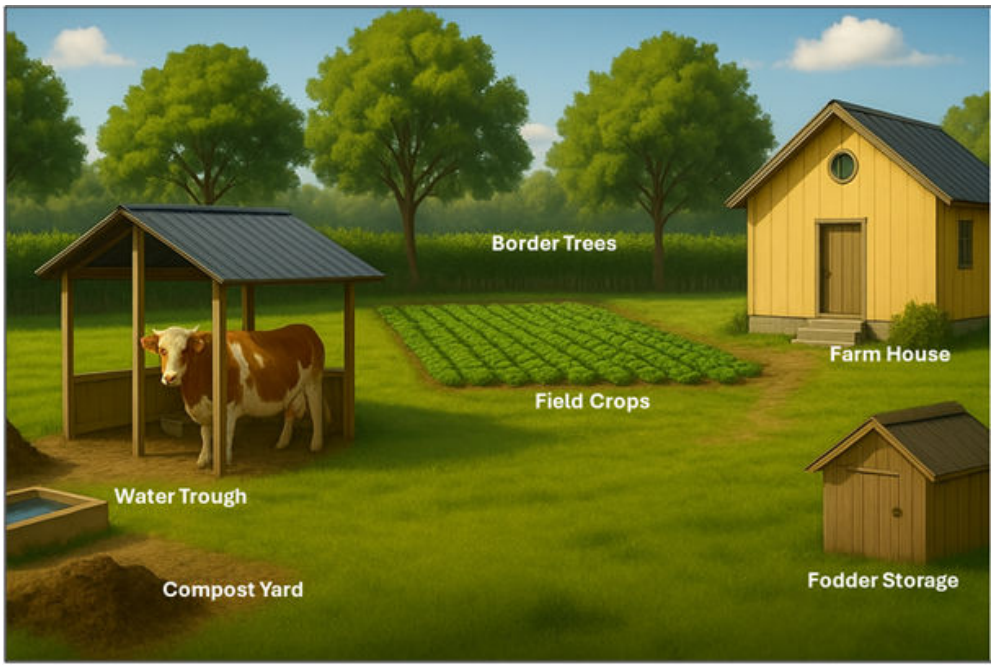

Fig. 5.1: Farm Design

Now, let us examine the features of an organic farm and its characteristics.

An Organic Farm

So far, we have learnt what the purpose of designing an organic farm is. However, in organic agriculture, the farm design and management should achieve sustainable farm productivity using on-farm available resources and preventing contamination. The organic farm is a system of organically raizing crops and livestock in the form of a combination of enterprises. The on-farm available resources are utilized by applying farm management principles. The farm management helps in the selection, organization and operation of an individual farm business for the purpose of obtaining the greatest possible profit. The benefit could be the net income, pollution-free products, healthy resources and agro-biodiversity.

5.2.1 Planning and Layout of the Farm

In organic farming, the design and layout of the farm are of utmost importance because they determine how effectively natural resources are utilized, how enterprises are integrated, and how sustainable the system remains over time. Unlike conventional systems, where productivity often depends on external chemical inputs, organic farms rely heavily on ecological balance, soil fertility, and resource recycling. Therefore, every aspect of farm layout must be carefully planned. The farm planning and layout in organic farming is not just about convenience it is about creating a self-sustaining system where crops, livestock, and natural resources are arranged to complement each other. Careful field organization, crop rotation, efficient use of irregular areas, protective fencing, and strategic placement of structures all contribute to long-term productivity, ecological balance, and farm profitability while adhering to the principles of organic agriculture.

An organic farm must be carefully planned to ensure efficient use of resources and ease of operation. Well-connected farm roads save labour and

protect standing crops. Fields are best kept rectangular, but where not possible, smaller plots can be combined for crop rotation. Irregular fields can be used for pastures, agroforestry, or perennial crops, which provide fodder, biodiversity, and long-term ecological benefits. Crop rotations should include both short- and long-term plans such as cereals with legumes, or fodder and green manures to maintain soil fertility, control pests, and ensure a steady supply of food, feed, and marketable produce.

Farm fencing is crucial in organic systems to protect against stray animals, trespassers, and chemical contamination from neighbouring fields. Living fences of trees or shrubs can also supply fuelwood, fodder, and habitats for beneficial organizms. Support structures like cattle sheds, compost yards, storehouses, and offices should be placed on elevated land to prevent flooding. Compost yards near livestock sheds help recycle wastes into organic manure, while storehouses close to fields ensure safe storage and easy management of organic produce.

5.3 FARM COMPONENTS IN DIFFERENT AGRO-ECOSYSTEMS

The components of a farm vary widely due to different ecosystems. The components for lowlands, irrigated uplands, and dry lands are presented in this section. The lowland farming system accommodates crops, piggery, duck and fishery enterprises in all possible combinations with a view to recycling the residues and by-products of one component to another. The recycling process reduces the cost of production per unit of grain, meat, milk, egg, biogas, etc., and enhances the net return of the system. In irrigated upland, integration of crops, dairy, biogas, spawn and mushroom production, silkworm rearing, mulberry cultivation and homestead garden with apiary may be practised successfully. Border planting of trees and raising sunhemp between the trees for green manuring is also practised. In this manner, the organic farming will act as a self-regulating unit.

In dry lands, a farming system with grain crops, fodder crops, fodder trees, fruit trees, perennial grass and goat rearing is accommodated.

Now, let us discuss different components of an organic farm.

1. **Field Crops in Organic Farms:** They form the backbone of any organic farm. These include cereals, pulses, oilseeds, vegetables, fruits, spices, and fodder crops. In organic systems, crops are selected and rotated in a manner that maintains soil fertility, suppresses weeds, and prevents pest and disease build-up. Leguminous crops such as pulses and fodder legumes enrich soil nitrogen, while cereals provide staple food and cash income. Growing a mix of short-duration and long-duration crops ensures a steady flow of produce for consumption and sale. Intercropping and polycultures are encouraged to enhance biodiversity and resource use efficiency.

2. **Trees in Organic Farm:** Trees are an integral part of an organic farm, contributing to the ecological balance and providing multiple benefits.

They act as windbreaks, prevent soil erosion, and improve microclimatic conditions. Trees such as neem, subabul, and Gliricidia can be used as sources of green manure or organic pesticides, while fruit trees provide additional income.They also serve as habitats for birds, bees, and beneficial insects, thus strengthening the ecological services within the farm.

3. **Agro-Forestry:** Is the deliberate integration of trees with crops and/or livestock on the same unit of land. In organic farming, agro-forestry systems contribute to soil fertility through litter fall, fix atmospheric nitrogen (in the case of leguminous trees), and improve water retention. They also offer diversified outputs such as timber, fruits, fodder, and fuelwood, ensuring both ecological sustainability and economic stability. By combining perennial trees with seasonal crops, agro-forestry enhances biodiversity and resilience against climate variability.

4. **Farm Forestry:** It refers to the cultivation of trees on the boundaries and wastelands of the farms, primarily to meet the timber, fuel, and fodder requirements of the household. In organic farms, farm forestry reduces pressure on natural forests by providing on-farm sources of wood and biomass.Trees on field bunds and farm peripheries also act as live fences, protecting crops from animals and reducing wind velocity, which prevents lodging of cereals and conserves soil moisture.

5. **Farm Biodiversity:** Biodiversity is a cornerstone of organic farming. A diverse farm ecosystem with multiple crops, trees, livestock, pastures, water bodies, hedgerows, and beneficial organisms ensures ecological stability.Diversity helps in natural pest regulation, soil fertility enhancement, and resilience against extreme weather. *For example*, a farm with cereals, pulses, fodder, orchards, poultry, and fish ponds is more sustainable than a monocropping system. Preserving biodiversity also reduces dependence on external inputs and fosters natural balance.

6. **Field Bunds:** These are raised embankments constructed around fields to conserve soil and water. In organic farming, bunds are often planted with grasses, legumes, or small shrubs, which prevent erosion, enrich soil fertility, and provide fodder. They also act as habitats for beneficial insects and serve as barriers to weed and pest spread. Strengthened bunds improve water infiltration, making them crucial for rainfed organic farming systems.

7. **Compost Yard:** A compost yard is an essential structure in organic farming, where organic residues such as animal dung, crop residues, weeds, and household organic waste are decomposed into nutrient-rich compost. A well-managed compost yard provides a steady supply of organic manure, reducing dependence on external fertilisers. It should be located near cattle sheds for easy collection of dung and urine, and on slightly elevated ground to prevent waterlogging. The compost yard represents the heart of nutrient cycling in organic farms, ensuring soil fertility and long-term productivity.

Box 5.1: Dhabolkar Method for Fertility Enhancement

Named after a Maharashtrian farmer, the Dhabolkar Method presents the following steps:

1) Select a field that needs improvement in its fertility. Ensure that there is enough water for irrigating the field.
2) Apply Farm Yard Manure, poultry manure or vermicompost before the ploughing.
3) Grow on the chosen field any four types of plants from each of the following five groups. Use the types of plants that are locally available.
   - Grains (*Examples:* Sorghum, Millet, Finger Millet).
   - Pulses (*Examples:* Black gram, Green gram, Bengal gram, Lablab).
   - Oilseeds (*Examples:* Sesame, Groundnut, Castor, Sunflower)
   - Green Manure Crops (*Examples:* Dhaincha, Sun hemp, Horse gram, Clovers).
   - Spices (*Examples:* Mustard, Coriander, Fenugreek, Cumin Seeds).
4) Collect seeds of these plants up to 20 to 25 kg of seed to be sown in one acre of land area.
5) After 30 to 35 days apply manure and beneficial microorganisms.
6) This can be either in liquid form through irrigation or solid mixture as soil application.
7) After 50 to 60 days of vegetative growth of these plants, they are cut and ploughed in the soil (or use a rotavator) *in situ*.

Such practices will improve the physical condition of the soil, creates an ideal surrounding for earthworms and soil microorganizms that feed on this biomass. These creatures help break the complex biomass and decompose it into furthermacro and micronutrients for the crops. Thus, crops can be grown with much less water. This process has to be carried out three times. It enhances soil fertility within a short period of 200 days.

Check Your Progress 5.1

Note: a) Write answers in the space given below.

b) Match your answers with those given at the end of the unit.

1) How does biodiversity contribute to organic farming systems?

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2) Differentiate between agro-forestry and farm forestry in the context of organic farming.

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3) What is the role of compost yards in the organic farm?

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5.4 LAND PREPARATION

We know, tillage is the fundamental concept used in agriculture to denote the manipulation or stirring of the soil with tools and implements for loosening the surface crust and to bring favourable conditions for germination of the seeds and growth of crop plants. Primary tillage is the initial deep operation that breaks open hard soil to bury residues and improve aeration, creating a rough foundation. In contrast, secondary tillage is the subsequent shallow process that refines this soil into a smooth, fine seedbed suitable for planting. The equipment for primary tillage includes heavy implements like the mouldboard plough and sub-soiler, while secondary tillage relies on lighter tools such as disc harrows and cultivators to achieve the final tilth. The soil condition resulting from tillage is called tilth. Good soil tilth provides a congenial environment for seed germination and crop growth. Different implements are used one after another in a series to build up the soil tilth. The plough is used to open up the soil and leave the land in a cloddy condition (primary tillage). The cultivators break down the clods; the harrows break down the small clods further by combing the land; the rollers are used to compact the seed-bed (secondary tillage).

The land preparation is influenced by several factors like the crops to be grown, soil types and the type of farming and the available resources with the farmer. The crop determines the type and extent of land preparation. Hardy crops like millets do not require fine tilth, delicate crops like tobacco and chilli require a fine tilth, and the land has to be worked properly. The crops like sugarcane and tuber crops require deep cultivation, and for such crops, disc plough and spades are often used to loosen the soil to the required depth.

Buffer Zone

A buffer zone is a strip of land that separates organic fields from non-organic fields. It is essential for organic certification as it prevents contamination

from prohibited substances like chemical fertilizers, pesticides, or unwanted organisms. The width of the buffer zone depends on soil, topography, and vegetation. Planting hedgerows, trap crops, or tall trees (about 5.5 times the height of the main crop) can make the buffer more effective. Buffer zones protect against pesticide drift and runoff, especially during heavy rains. Perennial grasses or legume-grass mixtures can be grown in buffer zones to reduce contamination risk, and the grass may be used as livestock feed. However, crops grown in buffer zones cannot be sold as organic. If both organic and non-organic crops are grown, farmers must keep them visually distinct and maintain separate records, as parallel production is restricted. Importantly, good relationships with neighbouring farmers can also strengthen buffer zones, as awareness about organic farming encourages neighbours to avoid contamination across field boundaries.

Fig. 5.2: Buffer Zone in the Vicinity of a Cropped Area

5.5 SEED AND PLANTING

We know, seed is the most important input in crop cultivation. Good quality seeds/planting materials have high germination and vigour that form the basis for obtaining high yields. Good quality seeds/planting materials should be reasonably pure and free from insect damage and diseases. Only healthy seeds of a suitable variety should be selected. There should not be any mixture of seeds of other varieties or weeds. The seed should be purchazed from a reliable source, and it should be organically certified. Before sowing, the seed lot must be tested for its germination percentage, while sowing, the seed quantity should be adjusted accordingly. Time of sowing is one of the important aspects in obtaining good germination of the seeds. It also has a marked influence on the yield.

Farmers have been producing seeds and planting materials over the years to suit their ecological, nutritional, taste, medicinal, fodder, fuel and other demands. These are called Farmer's varieties or Land Races. Farmer's varieties are also referred to as indigenous seeds, native seeds, organic seeds (if farm is certified), heritage seeds, *jwaari, nate, desi,* etc.

Seeds and Sowing/Planting in Some Crops

A. Rice

The seedbed is prepared on a raized bed in the main field itself. Compost or organic manure at the rate of 1 kg/m^2 is mixed into the soil in the seed-bed during final ploughing. As an alternative, seedlings can also be raized on a plastic sheet by spreading compost and topsoil mixed in equal proportion to a 1-2 cm thickness. The seeds are soaked in water for 12 hours and kept in wet gunny bags for another 24 hours to initiate germination. For protecting the seedlings against diseases, *Pseudomonas fluorescens* (4 g/litre) should be mixed with the water used for soaking the seeds. The germinating seeds are broadcast into the seed-bed at the rate of 200 g per 3 $m^{2,}$ and then the seeds are covered with a fine layer of soil. The seedbed is irrigated daily in the evening with a light sprinkle. After 20 to 25 days, vigorous and healthy seedlings are ready for transplanting. While transplanting, 1-2 seedlings should be used per hill. The seedlings should be lifted gently from the seed-bed and should be transplanted immediately.

a) Seed Treatment:

Seed treatment is an essential component in organic farming. The treatment protects against insect pest attacks and helps the establishment of healthy seedlings. We should use the following methods and inputs for the seed treatment in different crops:

i) **By Neem Seed Kernel Extract:** About 25 kg shade shade-dried *neem* seeds kernel is crushed, and the coarse powder is tied in a cotton cloth and immersed in 50 litres of water overnight. The next morning, the cloth containing the soaked seeds is squeezed to separate the extract. Again, the remaining *neem* seeds are dipped in 50 litres of water and extracted completely. This extract is coated over the paddy seeds. The seeds should be dried in shade for 6 hours before sowing.

ii) **By Biofertilizers:** *Azospirillum, Azotobacter* and phosphobacteria are the common biofertilizers used for paddy. For seed treatment, 200 g of *Azospirillum* is suspended in one litre of water. This mixture is sprinkled over 25 kg of seed spread on a clean surface and mixed thoroughly to coat uniformly. If *Azotobacter* is available, 750 g of *Azotobacter* is mixed in one litre of water, and the slurry is uniformly coated over the seeds needed for one hectare. Phosphobacteria at the rate of 5.25 kg dissolved in 5 litres of water may also be used. This paste is uniformly coated over the seeds. The treated seeds should be dried in the shade and sown within six hours of treatment.

Detailed description of the biofertilizers is presented in the next Unit of this Course.

iii) **Seedling Dip:** The seedlings before transplanting may also be treated with biofertilizers. *Azospirillum* at the rate of 150 g is mixed in 20 litres of water, and the roots of the seedlings are dipped in the mixture for ten minutes. Two and Half kilograms of *Azospirillum* will be sufficient to treat the seedlings needed for one hectare. If *Azotobacter* is available,

600 g of *Azotobacter* inoculant is mixed in 20 litres of water, and then the seedlings are dipped in the slurry for 5 minutes.

b) Methods of Sowing:

i) Direct Seeding Behind the Plough or Drilling: In this method, the seed is sown with a seed drill or behind the plough with the help of a funnel in the rows. The row-to-row distance should be 20 - 25 cm. About 30 kg of seed is sufficient for one hectare.

ii) Transplanting: In areas where there is an assured water supply, a nursery may be raized, as given in the previous section, and the seedlings are transplanted at the proper age. The transplanting is accomplished in a puddled field.

iii) System of Rice Intensification (SRI) Technique: Under the SRI system, 6 to 8 kg of rice seed is sufficient for raizing nursery planting in a one-hectare area. Normally, seedlings are raized by the modified mat nursery method. The 10-12-day-old seedlings are transplanted singly in a puddled field at a wider spacing in a rectangular shape (25 cm × 25 cm). The root damage should be minimized during transplanting. The seedlings should not be beaten or washed in water to remove the soil, as practized traditionally. Seedlings should be placed at a depth of 1 to 2 cm in the soil.

B. Wheat

The optimum sowing time of wheat varies widely over the growing areas. It depends upon (i) the type of variety, (ii) weather conditions, (iii) soil temperature, (iv) irrigation facilities and (v) land preparation. In general, the maximum productivity potential of promising wheat varieties under irrigated conditions is attained by sowing them between 1st and 25th November in most climatic zones other than the peninsular zone. Rainfed wheat is generally sown during the second fortnight of October to early November. Under specific circumstances, wheat is sown in the month of December too. In late-sown wheat, only short-duration varieties should be used.

Seed Rate and Spacing

Seed rate varies with the variety used. It also depends upon seed size, germination percentage, tillering ability, time of sowing, moisture content in the soil and method of sowing. Usually, a seed rate of 100 kg per hectare is sufficient for normal sowing. For late sown conditions, the seed rate should be increazed to 125 kg per hectare. In case wheat is to be sown by dibbler, a seed rate of 25 to 30 kg per hectare is sufficient. For a normal sown crop, a spacing of 20 to 22.5 cm between two rows is recommended. When sowing is delayed, a closer spacing of 15 to 18 cm should be adopted.

Methods of Sowing

i) Broadcasting: The seeds are broadcast and then mixed in the soil using harrows. Generally, uniform seed distribution cannot be achieved, leading to irregular plant stands and poor germination. When the broadcast seeds are not covered properly, they are picked up by birds,

resulting in the wastage of seeds. Hence, this method is generally discouraged.

ii) **Behind Local Plough:** The seeds are dibbled by hand into the furrows that are opened with the plough. This is called the 'kera'(hand) method. When it is dropped through a *Pora* or *Nai* or *Hazara*, a special attachment with a local plough, it is called the *'Pora'* method. The seeds are dropped at a depth of 5 to 6 cm. The germination is satisfactory under this method of sowing.

iii) **Drilling:** Before sowing the seeds by drilling, the seedbed should be thoroughly prepared. It should be well levelled, free from clods and weeds. The seeds are sown by seed drilling at a uniform depth. It results in uniform germination and a regular stand.

iv) **Dibbling:** When there is limited seed availability, this method is used for sowing. Dibblers have a wooden or iron frame with pegs. The frame is pressed in the field and lifted, and then one or two seeds are dropped by hand in each of the holes. It is a time-consuming process.

v) **Zero Tillage Technique:** This method is useful under the "rice-wheat" cropping system. After harvesting of rice crop, the field requires at least 6-8 tillage operations (ploughing and harrowing) to make the field ready for sowing of wheat. A zero-till-seed drill machine is used for direct sowing of wheat in rice fields without field preparation. This helps in advancing the sowing of wheat. Under zero tillage, there should be proper moisture in the field at the time of sowing. The rice crop should be harvested close to the ground. The field should be free from weeds. Sowing depth of about 5 to 6 cm should be maintained. A light plank may be used behind the machine.

These are a few *examples* of sowing seed/planting in organic farming.

5.6 WATER MANAGEMENT

In organic farming, the irrigation water should be drawn from a safe source. Also, during conveyance, the water should not pass through any hazardous materials. India's NPOP (National Programme for Organic Production) advocates that soil and water resources should be used in a sustainable manner.

Water management in organic farming is closely integrated with soil fertility enhancement, scientific crop planning, and ecological engineering practices. This holistic approach ensures that water is used in a manner that supports healthy soils, resilient crops, and sustainable ecosystems. The overarching objective of water management is to maximise water use efficiency (WUE) by improving infiltration, storage, and availability of water in the root zone, while at the same time minimizing wastage through unnecessary irrigation, reducing runoff losses, and limiting evaporation from the soil surface.

Efforts are required to conserve the water in soil, use available irrigation water judiciously, minimizing losses during and after irrigation, and avoid

contamination of irrigation water with fertilizers, pesticides, other chemicals and contaminants. The following practices are important for enhancing water use efficiency on an organic farm.

5.6.1 Soil-Based Water Conservation

Together, these practices create a resilient soil environment that conserves water naturally and supports the long-term sustainability of organic farming systems:

- Building organic matter through the regular application of farmyard manure, compost, vermicompost, biochar, neem cake, and other organic amendments greatly enhances the soil's water-holding capacity, improves aggregation, and increazes the rate at which water infiltrates the soil profile.
- Mulching with dry grasses, straw, leaves, and crop residues further strengthens this system by reducing evaporation losses, moderating soil temperature, and enhancing moisture retention.
- Green manuring and the use of cover crops such as sunnhemp, dhaincha, and cowpea help improve soil structure, increaze organic carbon content, and maintain higher available soil moisture by protecting the soil surface and enriching it with biomass.
- Minimum tillage practices also play a vital role by preventing the breakdown of soil aggregates, preserving soil pore continuity, and reducing unnecessary water loss, which ultimately improves root penetration and allows crops to utilize soil moisture more efficiently.

5.6.2 On-Farm Water Harvesting and Storage

It is an essential component of organic farming, particularly in regions that face irregular rainfall or prolonged dry spells. The water-harvesting interventions create a more stable and dependable water regime, which is crucial for the long-term sustainability of organic agriculture.

- Farm ponds and tanks are widely used to collect and store rainwater, which can later be utilized for supplemental irrigation during critical crop growth stages.
- Contour bunds and terraces are equally important, as they help reduce the velocity of surface runoff, promote higher water infiltration, and prevent soil erosion; these structures are particularly valuable in hilly and semi-arid regions where rapid runoff is common.
- Check dams and percolation tanks further strengthen the farm's water resources by facilitating groundwater recharge, increazing the moisture available in the soil profile, and sustaining wells and boreholes for a longer period.

5.6.3 Efficient Irrigation Techniques

Certain irrigation techniques play a vital role in organic farming by optimizing the use of available water while maintaining soil health and

supporting crop productivity. Collectively, these techniques help organic farmers use water more judiciously while maintaining ecological balance and healthy plant growth.

- Drip irrigation is particularly suitable for organic horticultural crops, as it delivers water directly to the root zone, saves 40-60% of total water use, suppresses weed growth by limiting moisture to non-crop areas, and minimises foliar diseases by avoiding wetting of leaves.
- Sprinkler irrigation is another effective method, especially for vegetables, oilseed crops, and fodder species, as it provides uniform water distribution and reduces water loss compared to conventional flood irrigation.
- Pitcher irrigation or clay pot irrigation, a traditional and highly organic-friendly technique, is extremely advantageous in arid and semi-arid regions for orchards and vegetables because it ensures a slow, steady releaze of water and achieves very high water-use efficiency.
- Alternate furrow irrigation also contributes to water saving by irrigating every alternate furrow rather than every row, allowing farmers to conserve 30-40% water without significantly affecting crop growth.

5.6.4 Monitoring Soil Moisture

The regular assessment of the soil moisture is a crucial component of water management in organic farming, as it helps farmers make timely and accurate irrigation decisions based on actual field conditions. By using the following practical and cost-effective approaches, organic farmers can avoid unnecessary irrigation, conserve water, and ensure that crops receive moisture only when genuinely required.

- Organic farmers often rely on simple yet reliable tools and techniques such as tensiometers, which measure soil water tension and indicate when plants begin to experience moisture stress.
- Gravimetric moisture estimation is another method that involves collecting soil samples, drying them, and calculating moisture levels to assess the soil's water-holding status.
- Some farmers use the traditional feel-and-appearance method, where soil texture, stickiness, and colour are evaluated by hand to judge moisture levels.
- Observing leaf turgor, wilting symptoms, and overall crop behaviour also provides valuable clues about moisture sufficiency.

5.6.5 Crop Planning for Water Economy

It is an important strategy in organic farming, as it helps align crop choices and field management with the available water resources. Good crop planning strategies help organic farmers use water more efficiently while maintaining productivity and ecological balance.

- Selecting suitable crops and varieties is the first step, with drought-tolerant crops such as millets, pulses, mustard, and sorghum being

particularly valuable because they require less irrigation and can thrive under limited moisture conditions.

- Opting for short-duration varieties further reduces cumulative water demand by shortening the crop cycle and lowering the stress on soil moisture reserves.
- Crop rotation also contributes significantly to water conservation; *for example*, incorporating legume-cereal rotations not only improves soil fertility but also enhances soil structure and moisture retention, creating a more balanced and resilient production system.
- Intercropping offers additional benefits by distributing root systems across different soil layers, improving ground cover, reducing the rate of evaporation, and allowing better overall use of available water.

5.6.6 Irrigation with Poor-Quality Water

In simple terms, poor quality irrigation water is water that contains dissolved salts, specific ions, or other contaminants at levels high enough to reduce crop yield, degrade soil health, or cause operational problems. Salinity, sodicity, toxicity, or alkalinity may be associated with poor-quality irrigation water. It can be safely used in organic farming only if treated, diluted, and applied correctly, while maintaining strict food safety and soil health standards. Techniques like biofiltration, drip irrigation, organic amendments, gypsum application, crop rotation, and periodic leaching make such water usable without harming crops or the environment.

- Test water for salinity (EC), pH, microbes, and heavy metals before use.
- Dilute poor-quality water with clean water to reduce salt or pollutant concentration.
- Use simple organic filters such as sand, gravel, biochar, or reed-bed systems to improve quality.
- Prefer drip or micro-irrigation to limit leaf contact and reduce contamination risks.
- Apply water through furrows rather than over the plant canopy.
- Add compost, FYM, vermicompost, or biochar to buffer salts and improve soil health.
- Use natural gypsum if the water has high sodium levels (high SAR).
- Use marginal water mainly for fodder, oilseed, and non-edible crops.
- Periodically flush salts using fresh water and maintain good drainage.
- Never use sewage, industrial effluent, or untreated wastewater at organic farms.

Preventing irrigation water contamination in organic farming requires a holistic set of practices that protect both water quality and ecological health. This subject is being discussed in subsequent sections.

5.7 CONTAMINATION AND ITS CONTROL

Organic farming not only excludes the use of chemicals but also emphasises protecting the farm and all operations from any form of contamination, whether coming from outside or within the farm. If prohibited materials enter an organic field, contamination occurs, and the produce cannot be certified as organic. Contaminants are substances or organisms that unintentionally enter the farm system, and contamination control refers to practices that prevent or reduce their contact with crops and soil. These contaminants may originate from point sources such as pipes or pits, or from non-point sources like runoff from nearby fields or urban areas. In agriculture, common contaminants include excess nutrients, pesticides, sediments, salts, and trace elements that can move into surface and groundwater through natural water flow. Control measures focus on limiting the movement of such pollutants in soil and water. Practices related to tillage, irrigation, drainage, input timing, crop rotation, soil characteristics, and weather conditions all influence contamination risk. The overall aim of these measures is to ensure that organic products meet certification requirements while maintaining the sustainability and safety of the farming system.

Now, we shall look at the major contaminants that can threaten organic farming if not properly prevented. Often, contamination risks arise from activities on adjacent farms, such as pesticide spray drift from horticultural crops. Government treatments for malaria control or eradication of weeds and pests can also lead to unintentional contamination. Additional risks come from importing compost, tools, or other materials from non-organic fields, and from the presence of Genetically Modified Organisms (GMOs) such as seeds or inputs. Therefore, it is essential to develop a comprehensive contamination risk management strategy for an organic farming system.

5.7.1 Soil Contamination

Soil contamination refers to the presence of unwanted inorganic substances in the soil, mainly resulting from the application of fertilizers and pesticides. It can also occur through the direct discharge of industrial waste or the percolation of contaminated surface water into the sub-surface. Common contaminants include petroleum hydrocarbons, solvents, pesticides, lead, and other heavy metals. In agriculture, the usual mode of contamination is the seepage of pesticides and herbicides into the soil, involving chemicals such as DDT, lindane, organochlorines, organophosphates, carbonates, and cyclodienes. Apart from direct soil contamination, runoff water can carry pollutants into organic fields, and substances like lead, mercury, chromium, cadmium, bacteria, and hydrocarbons from waste disposal sites may leach into the soil. Dust containing zinc, cadmium, lead, and mercury from coal power plants or smelting operations can also drift and settle on organic farm soil.

5.7.2 Water Contamination

Water contamination can occur in both surface and groundwater. Surface water contamination is easier to control, whereas groundwater contamination

is more complex because water moves long distances through aquifers. In clay soils with less porous aquifers, contaminants such as bacteria may be removed through natural filtration, chemical reactions, or biological activity. However, in more permeable soils, filtration is less effective, allowing contaminants to travel freely and even move through cracks to reach surface water.

Nature of Water Contamination

Water contamination is a complex process. Excess nutrients can lead to eutrophication, and the dumping of organic wastes increazes oxygen demand, reducing dissolved oxygen and harming aquatic ecosystems. Industrial effluents containing heavy metals, toxins, oils, and solids further limit oxygen availability. Runoff carrying silt and pollutants blankets river or lake beds, blocking sunlight and damaging aquatic life.

Sources of Water Contamination

Contamination may arise from pesticides and fertilisers carried by runoff, which is a major concern for organic farming. Slash-and-burn practices like jhum contribute to sediment and nutrient loading. Industrial effluents, untreated sewage, spilt petroleum, and leaks from underground tanks are additional sources. Sulphur dioxide from fossil fuel combustion causes acid rain, and silt-laden runoff from construction sites and farms also degrades water quality.

Organic and Inorganic Contaminants

Organic contaminants include insecticides, herbicides, and other chemicals, along with bacteria from sewage or livestock and pathogens from food-processing waste. Logging debris and industrial solvents can also pollute water. Inorganic contaminants include heavy metals, industrial discharges such as sulphur dioxide, and excess nitrates and phosphates from fertilizers.

Modes of Water Contamination

Direct contamination occurs through pesticide spraying, leaks, improper disposal of containers, back-siphoning, washing sprayers, or spray drift near open water. In porous soils, pesticides seep into wells; in clay soils, rainfall may wash them downward. Indirect contamination happens when pesticides move with runoff after rainfall, especially within 24 hours of spraying, reaching ponds, streams, and wells. Persistent or soluble chemicals may leach into groundwater.

Groundwater Contamination

Groundwater stored in aquifers is essential for irrigation and drinking. It is replenished by rain or recharge zones, but can pick up contaminants during this process. Impervious layers like clay or rock may protect aquifers, while permeable deposits such as sand or gravel increaze contamination risk. *For example*, landfills in sandy soils pose a higher threat than those in clay due to greater leaching potential.

5.7.3 Contamination Control

As stated above, the contamination control refers to containing the spread of the pesticide to prevent further contamination of the environment, in particular, watercourses, reservoirs, and wells.

1. **National Guidelines:** The National Organic Certification Programme stipulates that all relevant measures should be taken to minimize contamination from outside and within the organic farm. It states that the certification programme should set limits for the maximum application levels of heavy metals and other contaminants if there is a risk or reasonable suspicion of contamination. However, the accumulation of heavy metals and other pollutants should be within the prescribed standards. If there is a reasonable suspicion of contamination, the certification programme shall carry out an analysis of the relevant products and possible sources of soil and water contamination to determine the level of contamination.

   In an organic farming system, only products based on polyethylene and polypropylene or other polycarbonates are allowed for protected structure coverings, plastic mulches, insect netting and silage wrapping. These products shall be removed from the soil after use and should not be burnt on the farmland. The use of polychloride-based products is prohibited.

2. **Protecting the Farm Ponds and Wells:** These can be protected against surface run-off water that carries contaminants by creating a berm. Berm denotes the area of level ground between the raized earthwork and the ditch surrounding it. The location and protection of the well and farm pond are also important. If the well or pond is to be located in a treated field where surface water can run off, the contamination can be reduced by excavating ditches or by providing a grassed buffer strip between the pond or well and the treated area. General recommendations on controlling soil erosion are also useful to contain the passage of pesticides to ditches and streams.

3. **Decontaminating Farm Wells:** Well waters are usually cold and alkaline, making pesticides less soluble. If small amounts enter through spray drift, frequent emptying and removing the bottom sediment may help. Toxicants spilt on well walls require washing (stone/cement) or scraping (earthen), followed by frequent emptying; contaminated surface soil around the well lip should also be removed.

   Decontamination can take 6 months to 3 years, but sometimes wells must be abandoned. Large spills near wells in sandy or gravel soils can cause long-term seepage, especially after rainfall. In cases of subterranean contamination, wells cannot be cleaned, and thus abandonment is the only solution.

4. **Contamination Control for Pesticide Spills:** If there is a leak from a pesticide container, it has to be stopped. A barrier made of soil, sawdust, newspaper, activated charcoal and vermiculite should be constructed to

soak up the pesticide. The spill-up area should be cleaned. Surplus liquid product should be pumped into drums.

Damp soil or sawdust should be used to make the dry powder or granular product lightly wet, and then this material should be put into a drum. If the spill occurs on the ground, it is necessary to dig up the contaminated area and place the soil in drums. Leaky or damaged containers should be placed in a drum or heavy plastic bag. If contamination happens inside a building, the area has to be ventilated to prevent the build-up of toxic fumes. If possible, the spill area should be decontaminated. After removing the spilt pesticide, the contaminated area should be soaked with a mixture of equal parts of bleach and water. A dike should be placed around the spill area to prevent the spread of the decontamination solution. All equipment used in the clean-up and the vehicles contaminated by the spill should be decontaminated by following the same procedures.

5. **Human Relations:** The most effective contamination control is a cordial relationship with neighbours. Organic producers may enlighten their neighbours about the organic production, certification and problems of contamination; then, the neighbours will take care and help avoid possible contaminants across the boundaries from their fields.

Table 5.1: Organic Farming: Management Planning for Contamination Control

Resources	Source of Contamination	Possible Treatments to Minimize the Risk	Monitoring Techniques
Water	Irrigation (*e.g.* contamination of the supply channel with pesticides).	Negotiate with the water authority: enforcement of restrictions on chemical use near channels; water analysis.	Water analysis.
	Fertigation (if used on non-organic blocks of a mixed enterprise).	Separate supply system, main line flushing before irrigation or water analysis during irrigation.	Document fertigation and irrigation events.
	Surface run-off from adjacent land	Water diversion or absorption buffer zone on the upper borders	Inspect for surface flow after irrigation or rain.
Soil	Windblown dust from adjacent land.	Shelter belts.	Note weather conditions; inspect for dust contamination of the crop.
	Old dip or chemical storage area within the property.	Remove contaminated soil or quarantine the area and maintain permanent ground cover to prevent dust.	Residue tests of soil from suspect sites.

	Soil carried on machinery.	Clean machinery before use.	Inspect machinery before use.
Air	Spray drift from adjacent land.	Spray drift barrier/ buffer zone; drift avoidance measures negotiated with neighbours and authorities like council or water authority (*e.g.* grower responsible for roadside weed management; no spraying under certain wind conditions).	Note weather conditions; observation of drift; notification of spray activity by neighbours and authorities; residue test of crop.
	Dust drifts from fertilizer spreading on adjacent land	As above.	As above.
	Pollen from GMO crops.	Avoid crops, cover crops and green manures related to locally-grown GMO species (*e.g.* canola) as recommended by organic certification bodies.	Ascertain local GMO crop status and choose crops accordingly; monitor and control related weeds.
Mulch & Compost Ingredients	Residues of pesticides on plant materials, drenches, etc. In animal manures, GMO plant material.	Surface clean, non-GMO materials.	Check details of the source before purchase; obtain documentation from the supplier.
Fertilizers & Soil Amendments	Prohibited ingredients or heavy metal contamination.	Confirm the acceptability of nutrient products with the certifier.	As above.
Seeds	Crop/ cover crop / green manure seeds pelletized with prohibited pesticides and/or nutrients.	Source non-treated seed or seed with acceptable treatment.	As above.
	Genetically-modified seed.	Source non-GMO seed.	As above.
Machinery	Pesticide residues in spray equipment.	Equipment dedicated to organically acceptable materials.	Confirm equipment history.
	Fertilizer residues in spreading equipment	Equipment dedicated to organically acceptable materials; approved cleaning procedure (check with certifier).	Confirm equipment use or clean-down history.

Pest/Weed Control by Authorities (*e.g.* Fruit fly)	Herbicides on roadsides or water channels; sprays for fruit fly or locusts; termite treatments for timber power poles.	Negotiate alternative approaches, *e.g.* cultivation or flaming for weed control; bait spraying in non-certified border areas of property; alternative termite treatment or sealing of treated poles.	Maintain good relations and communication with the relevant government department.
Harvest & Post-Harvest Phase			
Soil	Windblown dust from adjacent land.	Spray drift barrier/shelterbelt; buffer zone; minimize time between harvest and pick-up; use of bin covers.	Note weather conditions; inspect for dust contamination of produce.
Air	Spray drift from adjacent land.	Spray drift barrier; buffer zone; drift avoidance measures negotiated with neighbours/ authorities (e.g. council or water authority); no spraying under certain wind conditions; grower responsible for roadside weed management.	Note weather conditions; observe drift; notification of spray activity by neighbours and authorities; residue test of produce.
	Dust drifts from fertilizer spreading on adjacent land.	As above, minimize time between harvest and pick-up; bin covers.	As above.
Produce	Parallel production: same or similar varieties are produced under organic and non-organic management, or under different levels of organic certification.	Very clear documentation and labelling of bins; harvest of organic/non-organic blocks on different days.	Supervise harvest activity.
Machinery	Residues of non-organic produce in the harvester.	Approved clean-down procedure; inspection by grower.	Inspect harvester
	Residues of non-organic produce in product storage bins, silos, transport vehicles, etc.	Dedicated bins; approved clean-down procedure; inspection by grower; plastic bin liners; certified transporters.	Inspect bins; confirm clean-down and /or certification status of transporter.

[**Reference:** David Madge, Mildura (2007). *Organic Farming: Risk Management Planning for Contamination Risks*. State of Victoria, Department of Primary Industries.]

With regard to irrigation water in an organic farm, preventing its contamination requires a holistic set of practices that protect both water quality and ecological health. Important practices that avoid water contamination are:

- Avoid synthetic fertilizers and pesticides, and use only certified organic inputs to prevent chemical runoff or hidden contaminants.
- Maintain buffer zones and vegetative barriers around water bodies to trap sediments and reduce external contamination.
- Store and handle compost, FYM, manure, and livestock waste properly, ensuring they do not leach into irrigation channels; apply only well-decomposed materials.
- Prefer water-efficient systems like drip or sprinkler irrigation and control soil erosion through contour bunds, terraces, and cover crops.
- Regularly test irrigation water and avoid using untreated sewage, industrial effluent, or other contaminated sources.
- Protect fields from neighbouring farm contamination through hedges, windbreaks, and proper drainage management.
- Keep irrigation equipment clean and adopt organic IPM practices to minimize the risk of water contamination.
- Maintain good field drains and consistently monitor and document water quality and input use for safe and compliant organic farming.

5.8 LIVESTOCK MANAGEMENT IN ORGANIC FARMING

We know that organic farming has traditionally embraced a holistic approach to food quality, covering all aspects from soil management and the environmental and social impacts at the primary production level to the processing, distribution, and sale of food. It is also well recognized that domestic livestock, such as farm animals and even household pets, form an important part of our cultural heritage. Livestock is an integral component of organic farming and helps maintain a balanced relationship between soil, plants, and animals within the production system. Cattle, buffalo, sheep, goats, poultry, and pigs are the major livestock species involved, and they provide a range of valuable inputs and services to crop husbandry, as illustrated in Figure 5.3.

National and international standards have laid down clear guidelines for maintaining livestock under organic management. In organic farming, animals must be kept in good health, provided with proper hygiene, and managed in ways that promote their natural behaviour and well-being. The essential requirements for organic livestock management include providing comfortable and well-ventilated sheds, maintaining cleanliness and hygiene, ensuring access to uncontaminated drinking water, and supplying nutritionally adequate and safe feed. These practices collectively support both animal welfare and the sustainability of the organic production system.

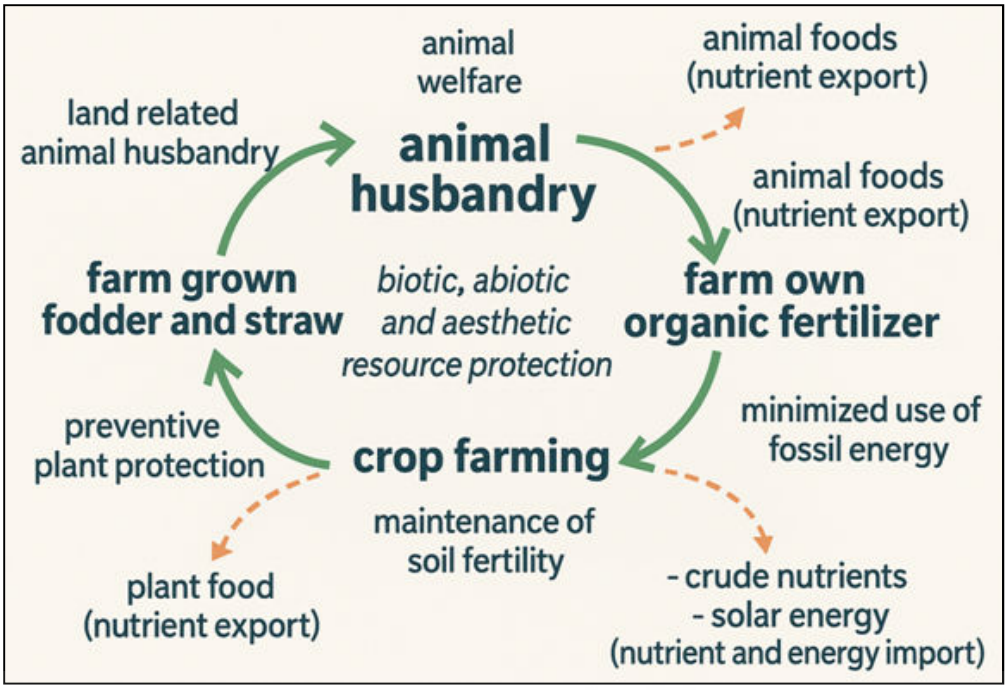

Fig. 5.3: Animal Husbandry at the Production Level of an Organic Farming System (Modified from Rahmann, 2003)

In organic farming, animal husbandry and crop farming are closely interlinked in a cyclical relationship that ensures sustainability and resource efficiency. Animals not only provide food products such as milk, meat, and eggs but also contribute to their own organic fertilizers in the form of dung, urine, compost, and slurry, which enrich soil fertility and reduce dependency on external chemical inputs. On the other hand, crop farming supplies fodder, straw, and crop residues to feed the livestock, thereby creating a closed nutrient loop. This cycle minimizes fossil energy use, maintains soil health, and promotes the utilization of farm resources in the most efficient way. By linking crops and animals, organic farming ensures the protection of biotic and abiotic resources, enhances farm biodiversity, and maintains environmental balance while securing food and nutrient needs. Thus, both crop farming and livestock complement each other, forming a self-sustaining system that embodies the essence of organic agriculture. In general, the farm livestock generates various products and functions as listed in Table 5.2.

Table 5.2: Key Products and Functions Provided by Farm Livestock

Food Products	Meat, milk, eggs, and honey
Non-Food Products	Feathers, wool, skin, hair, bones, silk, medicine, biogas, wax, propolis
Off-farm Services	Transport, therapy, recreation, landscape maintenance, hunting, protection, sports, status, research, religion
On-farm Functions	Manure production, utilisation of by-products from crop farming and processing, pollination, pest control (*e.g.,* insects, rodents, snails), herding, marketing, attraction of guests, bio-dynamic preparation processing (*e.g.*, horns).

So, you have seen that the livestock not only provide different products but also various services as well.

Check Your Progress 5.2

Note: a) Write answers in the space given below.
b) Match your answers with those given at the end of the unit.

1) What is a buffer zone in organic farming? Why is it important, and how is it managed effectively?

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2) Identify and explain three major sources of contamination in organic farming.

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5.9 LET US SUM UP

In this Unit, we have studied the farm design, farm structures and their locations, methods to prepare suitable land for different crops and also the significance of establishing and maintaining a buffer zone at the organic farms. Farm design plays a key role in ensuring the optimal utilisation of resources, providing suitable locations for crops, livestock, farm structures, and buffer zones. Establishing and maintaining a buffer zone is particularly important to prevent unintended contamination from external sources. We have also understood the importance of good-quality seeds and planting materials in organic farming. Farmers often prefer their own farm-saved seeds that are well-suited to ecological, nutritional, and cultural needs. The Unit explained the meaning and structure of seeds, organic seeds, germination, dormancy, and methods of breaking dormancy. Various methods of sowing, planting, seed rate, spacing, depth, and tools used for different crops like cereals, pulses, oilseeds, vegetables, fruits, and commercial crops were also discussed.

The role and strategies of water management in enhancing yield and crop quality were highlighted, particularly for organic farms. We also learnt the contamination control in organic farming, which is essential to ensure the production of safe and certified organic produce. Potential contaminants include nutrients, herbicides, and insecticides, which may reach the soil and water through run-off, infiltration, and groundwater flow. We have seen that

certification agencies analyze soils, water, and products for contaminants and only award certification when prescribed standards are met. Remedial measures for preventing and controlling contamination were also highlighted.

5.10 KEY WORDS

Border Trees : Tree species are planted on the border of cropped areas.

Buffer Zone : An area in the cropped field of a farm that prevents any outside contamination to the farm and crops.

Contamination : The state of occurrence of prohibited (toxic) material in a system.

Contamination Control : A collective term denoting any method that effectively controls the growth and proliferation of contamination.

Contour Farming : Cultivation across the slope. The contour line is an imaginary line connecting points of equal elevation.

Farm Planning : Planning means making decisions in advance. It stimulates thinking, broadens understanding, and challenges the farmer to move forward. It is a forward-looking approach.

Seed : A seed is a small embryonic plant enclosed in a covering called the seed coat, usually with some stored food.

Seed Treatment : Application of some external input to make the seed functional or protect against any hazards.

Water Management : All techniques for efficient utilization of water.

5.11 SUGGESTED FURTHER READINGS/ REFERENCES

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5.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 5.1

1) Biodiversity ensures ecological stability by supporting natural pest regulation, soil fertility, and resilience to extreme weather conditions. It reduces dependence on external inputs and provides multiple outputs like food, fodder, fuelwood, and ecosystem services.

2) *Agroforestry*: Integration of trees with crops and/or livestock on the same unit of land, enhancing soil fertility, biodiversity, and providing diversified outputs.

   Farm forestry: Cultivation of trees on the field boundaries and wastelands to meet the household needs like timber, fuelwood, and fodder, while reducing pressure on natural forests.

3) Compost yards recycle organic residues (animal dung, crop waste, weeds) into nutrient-rich manure. They ensure a continuous supply of organic fertilizers, maintain soil fertility, reduce dependence on external inputs, and represent the heart of nutrient cycling in organic farms.

Check Your Progress 5.2

1) A buffer zone is a strip of land that separates organic fields from non-organic fields to prevent contamination from pesticides, chemical fertilizers, or GMOs. Its width usually ranges from 10-30 meters, depending on soil, slope, and vegetation.

   Importance:

   - Protects organic fields from chemical drift and runoff.
   - Helps in meeting organic certification requirements.
   - Prevents mixing of organic and non-organic produce.

   Effective management strategies:

   - Planting hedgerows, trap crops, or tall trees (about 5.5 times crop height).
   - Using perennial grasses or legume-grass mixtures in buffer zones.
   - Avoiding the sale of crops from buffer zones as organic.
   - Maintaining cordial relationships with neighbouring farmers to reduce contamination risks.

2) Sources of contamination in organic farming and control measures:

- **Soil contamination**– caused by industrial waste, pesticide residues, and heavy metals.

  Control: Soil testing, removing contaminated soil, ground cover, and shelterbelts.

- **Water contamination**– from pesticide/fertilizer runoff, sewage, or effluents.
  Control: Buffer strips, protected water sources, and regular water testing.

- **Air contamination**– due to spray drift, fertilizer dust, or GMO pollen.
  Control: Barriers, safe distance from neighbours, residue testing, and avoiding GM crops.

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