MINISTRY OF EDUCATION

AGRICULTURE EDUCATORS AND TRAINERS ASSOCIATION OF GHANA

AETAG

Agriculture

for Senior High Schools

Year 2

Anthony Mensah

Stephen Owusu-Danso

Dr. Esther Fobi Donkor

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Contents

FOREWORD

Ghana's new Senior High School Curriculum aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, knowledge, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, progress to further studies and enter the world of work. This is the first time that Ghana has developed a Senior High School Curriculum which focuses on national values, attempting to educate a generation of Ghanaian youth who are proud of our country and can contribute effectively to its development.

The Ministry of Education is proud to have overseen the production of these Learner Materials which can be used in class and for self-study and revision. These materials have been developed through a partnership between the Ghana Education Service, teacher unions (Ghana National Association of Teachers- GNAT, National Association of Graduate Teacher -NAGRAT and the Coalition of Concerned Teachers- CCT) and National Subject Associations. These materials are informative and of high quality because they have been written by teachers for teachers with the expert backing of each subject association.

I believe that, if used appropriately, these materials will go a long way to transforming our Senior High Schools and developing Ghana so that we become a proud, prosperous and values-driven nation where our people are our greatest national asset.

Haruna Iddrisu MP

Minister for Education

SECTION

1

AGRICULTURAL DEVELOPMENT IN AN INDUSTRALISING SOCIETY

CONCEPT OF AGRICULTURE IN AN INDUSTRIALISING SOCIETY

Agriculture and Society

INTRODUCTION

Welcome to Year Two, Section 1! This section explores the significance and importance of agricultural development in Ghana, Africa, and the world, as well as the stages and challenges associated with agricultural development. The roles of governmental and non-governmental organisations in agricultural development are also addressed in this section. Additionally, you will learn about land tenure systems in agricultural production, focusing on the various land tenure systems practised in Ghana, their advantages and disadvantages, as well as how these land tenure systems affect agricultural production. You will be involved in well-designed activities that are interactive and engaging, taking place both in the classroom and outside. These activities will enhance your critical thinking, communication, digital literacy and collaborative skills, as you surf the internet, interact with peers and share your ideas and experiences. Come along as we dive into this exciting learning journey!

KEY IDEAS

- Agricultural development is the process of making farming better and more efficient to help the economy grow, reduce poverty and make sure everyone has enough food to eat.
- The five stages of agricultural development are Traditional/ Subsistence Agriculture, Transitional Agriculture, Commercial Agriculture, Industrial/ mechanised Agriculture and Sustainable Agriculture, respectively.
- Some roles of governmental organisations in agricultural development are making policies, **providing financial** support for farmers, research and innovation, educating and training farmers, **infrastructural** development, food safety and quality control, and support for farmers during crises.
- Some roles of Non-Governmental Organisations in agricultural development are providing support for farmers, education and training of farmers, advocating for policies, research and development, connecting farmers to markets, community development and environmental protection.
- The land tenure system refers to a set of laws and rules that determine who owns land, how the land can be used and managed.
- Land Tenure Systems practised in Ghana include customary, statutory, government/ state-owned, leasehold, freehold, tenancy and sharecropping land tenure systems.

MEANING, IMPORTANCE AND STAGES OF AGRICULTURAL DEVELOPMENT

Agricultural Development

Agricultural development is the process of making farming processes better and more efficient to help the economy grow, reduce poverty and ensure national and household food security. This includes using new technologies, sustainable farming methods, improving infrastructure and educating farmers. Agricultural development is important for economic growth, reducing poverty, ensuring food security, protecting the environment and empowering communities.

Agriculture can be said to have developed when there is higher crop and livestock productivity, better input-use efficiency (e.g., water, fertilizer, and labour), expanded and improved rural infrastructure (such as roads, irrigation, storage facilities), increased farmer incomes, greater access to modern technology and enhanced sustainability of natural resources.

Importance of Agricultural Development

The following are reasons for agricultural development:

1. Increased food production: It helps produce more (quantity) and better-quality food, ensuring food security for everyone.
2. Economic growth: It boosts the economy by creating jobs and increasing incomes, especially in rural areas.
3. Poverty reduction: It raises the standard of living for farmers and their communities by providing better earnings and resources.
4. Environmental sustainability: It promotes farming practices that protect the environment and conserve resources for future generations.
5. Innovation and Technology: It encourages the use of new technologies and methods, making farming more efficient and productive.
6. Farmer empowerment: It provides farmers with education, training and access to resources, enabling them to improve their skills and livelihoods.

Stages and Challenges of Agricultural Development

Agricultural development has gone through several stages, each marked by specific changes in technology, production methods and economic dynamics. Here are the five major stages of agricultural development:

Stage 1 - Traditional/ Subsistence agriculture

This is the first stage of agricultural development. It involves small farms mainly growing food just for the farmer's family. There is little extra to sell or trade. Farmers use simple,

traditional tools and methods, rely on family members for labour, and use few fertilisers or pesticides. This stage has low productivity and minimal economic growth, but it is essential for survival in rural and developing areas.

Challenges

1. Low productivity: Farmers often grow just enough food for their families, which means there isn't much left to sell or trade. This makes it hard to earn extra money.
2. Limited resources: Many subsistence farmers lack access to modern tools, fertilisers and seeds that could help them grow more food.
3. Vulnerability to environmental conditions: Since they rely on natural rainfall, adverse climatic conditions such as droughts or floods can seriously affect their crops and food supply.
4. Limited access to market: Farmers often struggles to get their products to market where they can sell them for a fair price, limiting their income.
5. Poverty and food insecurity: As population increases, there may not be enough land or resources to support everyone, leading to poverty and food shortages.

Figure 1.1: Farmers in Subsistence Farming

Stage 2 - Transitional agriculture

This stage marks a change from farming to just feed the family to growing extra crops to sell. Farmers start using better farming methods, some machines and improved seeds and fertilisers. They also have better access to markets to sell their produce. This results in higher crop yields, more income for farmers and closer ties to the local economy.

Challenges

1. Investment costs: Farmers may need to spend a lot of money to switch from traditional methods to more modern practices, which can be difficult for those with limited funds.
2. Access to technology: Not all farmers have access to the new tools, machines or seeds needed to improve their farming, making it harder to transition successfully.

3. Knowledge and Training: Farmers may lack the necessary training or education to use new farming techniques effectively, which can lead to mistakes.
4. Market challenges: Farmers might struggle to find good markets to sell their surplus produce, affecting their income and motivation to improve.
5. Environmental impact: Introducing new technologies and chemicals can lead to environmental issues if not managed properly, such as soil degradation or water pollution.
6. Balancing traditions: Farmers may have difficulty letting go of traditional practices that their families have used for generations, leading to conflict between old and new methods.

Stage 3 - Commercial agriculture

At this stage, farming turns into a business aimed at making the most profit. Farmers focus on producing crops and animals for sale. Farmers invest a lot in new technology and tools, using advanced machines and high-yield seeds and animal breeds. They also use plenty of fertilisers and pesticides and have organised supply chains to get their products to market. As a result, productivity and efficiency increase significantly, leading to large-scale production that greatly benefits the national economy.

Challenges

1. High costs: Starting and running a commercial farm can be very expensive due to costs for land, machinery, seeds and fertilisers.
2. Dependency on technology: Farmers rely heavily on technology, so if equipment breaks down or fails, it can lead to significant losses.
3. Environmental impact: Commercial agriculture can harm the environment through overuse of chemicals, soil degradation and loss of biodiversity.
4. Climate change: Changes in weather patterns can affect crop yields, making it harder for farmers to plan.
5. Labour issues: Finding and keeping workers can be challenging, especially during busy planting and harvest seasons.

Figure 1.2: Farmers in Commercial Farming

Stage 4 - Industrial/ Mechanised Agriculture

In this stage, farming is done on a large scale, focusing on producing a lot of crops and livestock. It uses advanced machines and technology for farming. There is a heavy reliance on tools such as biotechnology (e.g. using tissue culture to produce disease-free planting materials like bananas and yams) and precision farming techniques (e.g. using drones to monitor crops, apply pesticides, or map fields), which help farmers grow more efficiently. While this stage leads to very high productivity and lower costs due to large-scale production, it can also cause problems like pollution, loss of wildlife and issues with jobs in rural areas.

Challenges

1. High initial costs: Buying advanced machinery and technology can be very expensive, making it difficult for some farmers to get started.
2. Environmental concerns: Using a lot of chemicals and heavy machinery can harm the soil, water and local wildlife, leading to pollution and loss of biodiversity.
3. Dependence on technology: Farmers rely heavily on machines and technology, so if something breaks down or fails, it can disrupt the entire farming operation. d. **Climate vulnerability**: Large-scale farming can be very vulnerable to climate change effects, such as droughts and floods, which can affect crop yields.
4. Market dependency: Farmers are often reliant on global markets, which can be unpredictable and may not always pay fair prices for their products.

Note: Use this link to learn more about Mechanised Farming: https://youtu.be/xtH6_logd8I

Stage 5 - Sustainable Agriculture

This stage focuses on environmentally friendly practices, conservation of resources and long-term productivity. In this stage, foods are produced while the environment is taken care of. It includes practices of organic farming, agroecology (e.g. practicing crop rotation to maintain soil fertility and reduce pests), conservation agriculture (protecting the land) and better management of pests and diseases. This approach helps maintain high productivity in the long run, reduces harm to the environment, improves soil health and helps farms adapt to climate change.

Agricultural mechanisation and sustainability are central to Ghana's agricultural policies, such as FASDEP II, which promotes efficient use of resources and improved agricultural infrastructure, and in the Planting for Food and Jobs (PFJ) initiative, which supports farmers with modern machinery and climate-smart practices to boost productivity while protecting the environment.

Challenges

1. Higher initial costs: Sustainable practices can be more expensive at first, as they often require special seeds, organic fertilisers and new techniques.
2. Limited knowledge: Farmers may not have enough knowledge about sustainable methods of farming methods and how to implement them effectively, making the transition difficult.
3. Access to market: Farmers practising sustainable agriculture may struggle to find markets that pay fair prices for organic or sustainably grown products.
4. Resistance to change: Some farmers may be hesitant to change from traditional methods they have always used, making it hard to adopt sustainable practices.
5. Resource competition: Sustainable agriculture requires careful management of resources like water and soil, which can be challenging in areas where those resources are already limited.

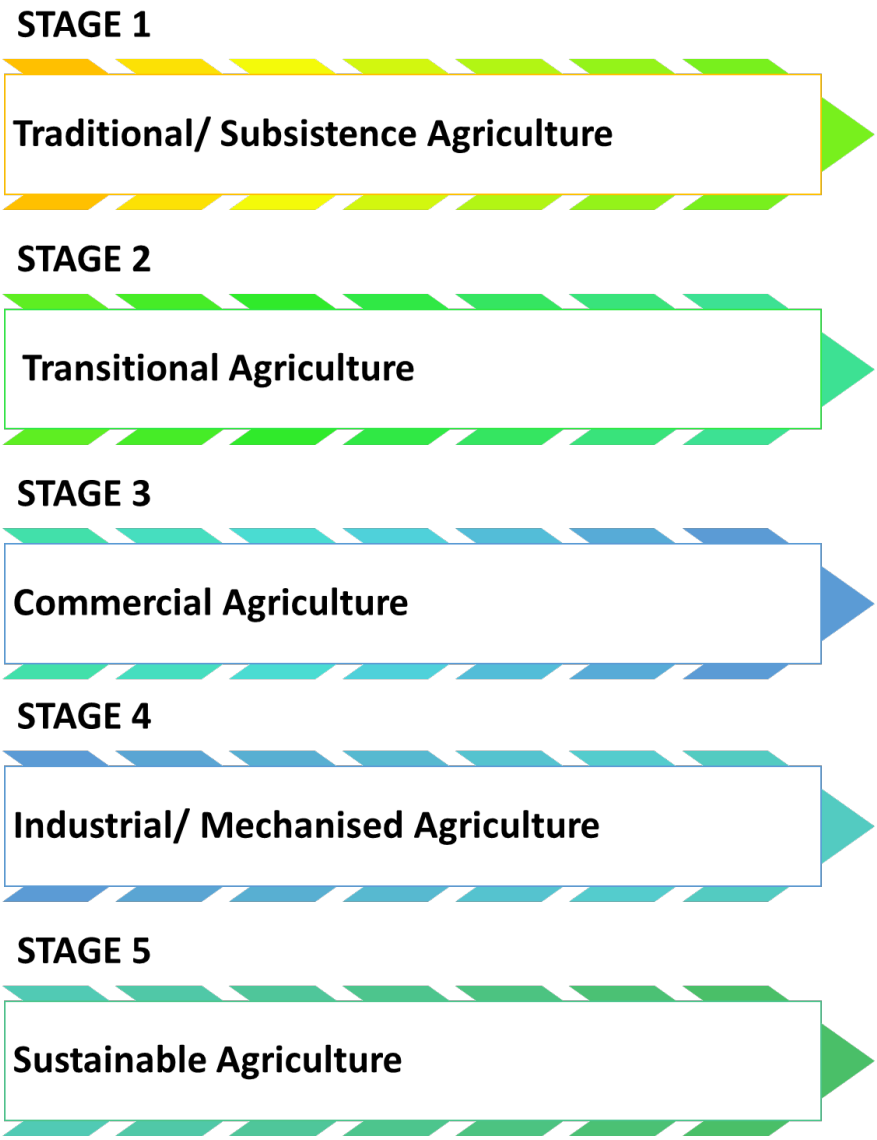


Figure 1.3: Stages in Agriculture development

Activity 1.1 Meaning of Agricultural Development

1. What comes to mind when you hear the term 'agricultural development'? Write down your definition in your notebook. Think about the following:
   a. Purpose
   b. Tools and methods
   c. Productivity and economic growth
   d. Benefits and challenges
2. Share your idea with a peer for feedback and fine-tune your definition of Agricultural development.

Activity 1.2 Importance of Agricultural Development

1. In pairs, explain the importance of agricultural development in Ghana, West Africa and the world You can use the internet and other resources to inform your exploration. Write your explanation in your notebook.
2. Present your findings to the class for feedback.
3. In pairs, discuss the roles of men, women and persons with disabilities in the agricultural development process.
4. Present the salient points from your discussion to your peers for feedback.

Activity 1.3 Stages of Agricultural Development

1. Watch a documentary or pictures after documentary on agricultural development with your peers.
   a. In groups, discuss the stages of agricultural development. Use the following points to guide your discussion: How technology and innovations have influenced agricultural practices.
   b. How farming techniques and practices have changed from ancient days to the present day.
   c. Ways that agricultural development has been influenced at different historical periods
   d. The roles that environmental sustainability has played in shaping agricultural practices over time.
   e. How global events such as the green revolution and climate change initiatives have contributed to the changes in agricultural practices.
   f. Write your findings in your notebook.

2. Present the salient points from your discussion to the class.
3. In the same groups, discuss how rural farmers manage the transition from one stage to the other. Write your findings in your notebook.
4. Share the salient ideas from your discussion with the class for feedback.

Activity 1.4 Challenges of Agricultural Development

1. Using the internet and other resources, describe some challenges that agricultural development faces. Write these in your notebook.
2. Present your findings to the class.
3. In pairs, come up with possible solutions to the challenges of agricultural development. Write these in your notebook.
4. Present your solutions to the class for feedback.
5. Write an essay of approximately 600 – 800 words on how Ghana's agriculture has developed over the years. In your writing, be guided by the following questions;
    a. What were the early farming techniques that were commonly practised in Ghana, and how did they sustain the local populations?
    b. How did the introduction of cash crops like cocoa, coffee and rubber influence the agricultural landscape in Ghana?
    c. What is the influence of government policies and initiatives such as land reforms, farm input subsidies and agricultural programs (planting and rearing for food and jobs), on agricultural development in Ghana?
    d. How does the adoption of technologies such as improved seeds, irrigation systems and farm mechanisation affect Ghana's agriculture output and sustainability?
    e. What role has international collaborations, foreign aid and global market access played in driving changes and improvements in Ghana's agriculture sector?
6. Read your easy to a peer for feedback.

ROLES OF GOVERNMENTAL AND NON-GOVERNMENTAL ORGANISATIONS IN AGRICULTURAL DEVELOPMENT

The Roles of Governmental Organisations in Agricultural Development

The following are some roles of governmental organisations in agricultural development:

1. Policy making: Governments create laws and rules that help support farmers and improve agricultural practices. The Ministry of Food and Agriculture (MoFA) in Ghana oversees creating and carrying out plans and policies to help the agricultural sector grow and develop. They focus on making farming better and supporting farmers in the country.
2. Financial support: Government provide loans, grants and subsidies to farmers to help them buy equipment, seeds and fertilizers. Example; Ghana Cocoa Board (COCOBOD) provide bonuses and lower prices on inputs like pesticides and fertilisers to help farmers grow more cocoa.
3. Research and Innovation: Government organisations conduct research to develop new farming techniques and improve crop varieties to increase productivity. Example; Council for Scientific and Industrial Research (CSIR) does research in different areas of agriculture, such as improving crops and animals, making soil healthier and managing pests. Their work helps solve problems that farmers face and makes farming more productive.
4. Education and Training: Government offer training programs and workshops to teach farmers about best practices, new technologies and sustainable methods. Example; the extension services of MoFA teaches and trains farmers on modern farming methods, pest and disease management and how to use resources efficiently. These services help farmers learn better practices that can increase their productivity.
5. Infrastructure development: Governments invest in building roads, irrigation systems and storage facilities to help farmers transport their products and reduce waste.
6. Access to market: Government help farmers connect with consumers and processors, where they can sell their products and get fair prices.
7. Food safety and Quality control: Government agencies set standards to ensure the foods produced are safe and of good quality for consumers. Example; Ghana Standards Authority (GSA) makes rules about the quality and safety of agricultural products. This helps keep consumers safe and makes sure that Ghanaian agricultural products meet international standards. Ghana Cocoa Board (COCOBOD) also oversees the cocoa industry in Ghana, ensuring that the quality of cocoa beans is maintained from the farm all the way to export.

8. Support during crises: In times of natural disasters or economic hardship, governments help farmers recover and continue their work. Example; when there was an outbreak of bird flu in poultry, government supported farmers whose farms were affected financially to purchase new day-old chicks.

Figure 1.4: Roles of governmental organisations in agricultural development

The Roles of Non-Governmental Organisations (NGOs) in Agricultural Development

The following are some roles of non-governmental organisations in agricultural development:

1. Providing support: NGOs offer help and resources to farmers, including seeds, tools and other farm inputs.
2. Education and Training: Some NGOs teach farmers about best farming practices, sustainable methods and how to manage pests and diseases on their farm, helping to improve farmers' yield.
3. Advocacy: NGOs work to promote the rights of farmers and push for policies that benefit the agricultural community.
4. Research and Development: Some NGOs conduct research to find new ways to improve farming and help solve problems that farmers face.

5. Connecting farmers: NGOs help farmers connect with markets, so they can sell their products and earn fair prices.
6. Community development: NGOs support projects that improve the overall well-being of farming communities, such as access to clean water and education.
7. Environmental protection: NGOs promote sustainable practices that protect the environment and help maintain natural resources for future generations.

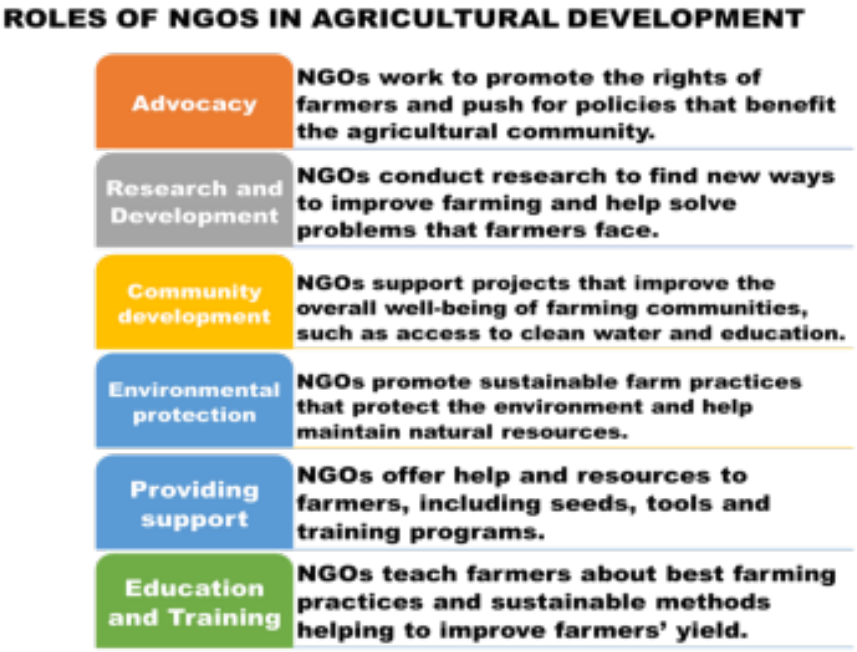


Figure 1.5: Roles of non-governmental organisations in agricultural development

Table 1. 1 Governmental and NGO roles in Agricultural Development

Government Roles	NGO Roles
Education and Training Government trains farmers on new technologies, good practices, and sustainable methods to increase	NGOs train farmers at the community level, often focusing on practical skills, gender empowerment and climate-smart agriculture
Infrastructure Development Builds roads, irrigation systems, storage facilities, and market centres to support farmers	**Community Development** NGOs develop community projects such as boreholes, farmer groups, small irrigation schemes, and
Food Safety and Quality Control Through agencies like GSA and COCOBOD, government enforces quality and safety standards	**Environmental Protection** NGOs promote soil conservation, tere planting, and sustainable farming practices to protect natural resou-
Financial Support Provides loans, grants, subsidies, and input support to farmers	**Providing Support** NGOs often offer small grants, farm inputs, extension services, and relief support during crises

The roles of government and NGOs in farming help achieve important global goals, especially the SDGs. By improving food production, supporting farmers, and making sure food is safe, they help achieve SDG 2 (Zero Hunger). Their work in planting trees, protecting the environment, and teaching farmers climate-smart practices supports SDG 13 (Climate Action). These efforts also help reduce poverty (SDG 1) and promote responsible use of resources (SDG 12), making farming more sustainable for the future

Activity 1.5 Governmental Agencies and NGOs Involved in Agricultural Development

1. Using the internet and other resources, list the governmental agencies and Non-Governmental Organisations (NGOs) involved in agriculture in Ghana and the communities they work in.
2. Present your findings in a table form as below:

Name of organisation	Type of organisation	The communities they work in

You can complete the table using the following guidance notes:

a. Write the name of the organisation in the column labelled name of the organisation.

b. Write the type of organisation that is a governmental agency or NGO in the column labelled type of organisation.

c. Write the communities in which the organisations work in the column labelled the communities that they work in.

3. Present your table to a peer for feedback.

Activity 1.6 Mandate and Activities of Governmental Organisations and NGOs

1. Visit the office of a governmental organisation involved in agriculture in your community or a project site of an NGO in agriculture in your community. During your visit observe ethical guidelines for fieldwork such obtaining permission, respecting privacy, speaking politely etc.
2. Document the activities and the mandate of the organisation.
3. Write a report of your visit and present the report to your class.
4. In writing your report, be guided by the following:

a. Introduction to the Organisation (what is the name of the organisation, when it was founded and its mission or vision)
b. Structure of the organisation (the main departments or divisions within the organisation, the key leaders or figures in the organisation)
c. Mandate and objectives of the organisation (the primary mandate of the organisation and how the organisation's mandate aligns with broader national goals in agriculture)
d. Key activities and programs of the organisation (the main activities and programs conducted by the organisation, list some specific projects or initiatives they are currently working on in agriculture).
e. Impact and outcomes (The impact of the organisation's activities on the local agriculture sector).

Activity 1.7 Roles of Governmental Agencies and NGOs in Agricultural Development in Ghana

1. In groups, discuss the roles of governmental agencies and non-governmental organisations in Agricultural development in Ghana. In your discussions, focus on the following:
   a. How NGOs contribute to agricultural development in Ghana, particularly in areas where government support may be limited.
   b. Ways that governmental agencies and NGOs collaborate to enhance agricultural development in Ghana.
   c. Examples of successful agricultural projects or programs led by governmental agencies and NGOs in Ghana.
   d. How funding and resource allocation by governmental agencies and NGOs impact agricultural development in Ghana.
   e. How women, the rural poor and persons with disabilities are involved in Agriculture, benefit from government policies and activities of non-governmental organisations.
2. Present the salient points from your discussion to the class in a plenary session for feedback.

LAND TENURE SYSTEMS IN GHANA

Land Tenure System

Land tenure system refers to a set of laws and rules that determines who owns land, how the land can be used and managed.

Description of Land Tenure Systems in Ghana

Customary land tenure

This is where land is owned according to traditional rules and customs. This means that families or communities have rights to the land based on history and tradition rather than written documents.

Advantages

1. It allows local people to access land easily, as ownership is often based on family or community rights rather than formal legal documents.
2. It respects and preserves cultural practices and values related to land use, making it important for many communities.
3. There are usually low costs involved, as people do not need to pay for legal fees or formal land registration.
4. Since it's based on traditions and customs, it strengthens community ties and ensure that land is used in ways that benefit everyone.

Disadvantages

1. Because land is not formally owned, it can be difficult for people to use it as collateral to get loans or financial support to expand their production.
2. Traditional rules can sometimes lead to conflicts over land rights, especially when different groups claim ownership.
3. In some cases, women may not have equal rights to land under customary systems, limiting their access to resources and opportunities.
4. Customary practices can be slow to adapt to new agricultural techniques which might hinder development.

Statutory land tenure system

This system involves laws made by the government. It includes land that can be bought and sold, often with legal documents. It is mainly for urban areas where land ownership is officially recorded.

Advantages

1. The statutory land tenure system provides clear legal ownership of land, making it easier to prove who owns what.

2. Farmers can use their land as collateral to get loans from banks, which helps them invest in their farming activities.
3. Landowners have legal rights protected by the government, reducing the risk of land disputes or being unfairly evicted.
4. With secure land rights, landowners are more likely to invest in improving their farming practices.

Disadvantages

1. Registering land and getting legal documents can be expensive, making it difficult for small scale farmers to afford.
2. The process of obtaining land ownership can be complicated and time-consuming, which may discourage farmers from pursuing it.
3. Statutory systems may not consider local customs and practices, making communities to lose their lands which were traditionally used for farming.
4. In some cases, landowners may sell their land to companies or developers, leading to the displacement of famers who are tenants.

Government/ State owned land tenure system

This is where the government owns some land, which can be used for public purposes, such as agricultural projects, schools and roads. These lands can sometimes be leased to private individuals or businesses.

Advantages

1. The government can provide land for farmers who may not have the means to buy their own, helping them to grow food and earn a living.
2. Government-owned land can be used for public services like schools, farming projects, botanical parks and roads, benefiting the whole community.
3. The government can manage land use to prevent environmental damage and ensure resources are used sustainably.
4. The government can plan for long-term agricultural development projects, which can help improve food security over time.

Disadvantages

1. Dealing with government agencies can be slow and complicated, making it difficult for small scale famers to have access to land for their farming activities.
2. If the land is not managed well, it can lead to waste, neglect or environmental issues.
3. Government projects, like building roads, agro-processing factories and silos can displace communities or famers who are farming on the land.
4. Since the government owns the land, individuals may have less motivation to invest in improvements, knowing they do not fully own the property.

Leasehold land tenure system

In this system, people can rent land from the owner for a certain period. They can use it for farming or other purposes but must follow the rules set by the landowner.

Advantages

1. Leasehold allows farmers to use land without having to buy it, which makes it easier for them to start farming easily.
2. Since the farmer does not need to buy the land outright, he/she can save money upfront and invest in his/her farming practices.
3. Leases often include rights to make improvements on the land, allowing leases to invest in better farming methods or buildings.
4. If the farmer's situation changes, he/she can choose not to renew the lease without the long-term commitment of owning land.

Disadvantages

1. Leaseholders do not own the land, so they may have to give it up when the lease ends, which can lead to uncertainty.
2. The landlord may have rules about how the land can be used, limiting what leaseholders can do on the land.
3. Leaseholders must pay rent regularly, which can add up and affect their cost of production.
4. Any improvements made on the land may not benefit the leaseholder, making farmers not to invest in their farms.

Freehold land tenure system

This is where a person fully owns a piece of land and has the right to use it however they want. This ownership is permanent, so the person can sell it, give it away, or pass it down to their family.

Advantages

1. In a freehold system, the landowner has complete control and ownership of the land, which means they can use it as they wish.
2. Owners can invest in land improvements, such as building farm structures and irrigation lines, without worrying about losing the land in the future.
3. Freehold landowners do not have to pay rent, which reduce the cost of production and increase the farmer's profit.
4. Landowners have legal rights to their property, giving them protection against unauthorised use or seizure and therefore they cultivate perennial crops like cocoa or palm.

Disadvantages

1. Buying freehold land can be expensive, requiring a large amount of money upfront.
2. Landowners must take care of the land and pay for its upkeep, which can be costly and time-consuming.
3. Owners must pay property taxes, which can add up to the cost of production and reduce profit.
4. Not everyone can afford to buy freehold land, which can lead to unequal access to land resources.

Tenancy land tenure system

This is when a person (the tenant) rents land from another person (the landlord) to use for farming or other purposes. The tenant pays rent to the landlord, usually in cash or a portion of the crops produced for a fixed period of time.

Advantages

1. Tenancy allows people to use land for farming or other purposes without having to buy it, making it easier for them to start producing.
2. Tenants do not have to pay a large amount of money upfront to buy land, which can be more affordable for small scale farmers
3. Tenancy agreements can vary in length, giving tenants the option to use the land for a short or long period based on their needs.
4. Tenants can grow crops on the land, allowing them to earn income without the responsibilities of ownership.

Disadvantages

1. Tenants do not own the land, so they may have to leave when the lease ends or if the landlord decides to sell the land.
2. Tenants may have to follow the landlord's rules about how to use the land, which can restrict their choice of farm practices.
3. Tenants must pay rent regularly, which can increase their cost of production and reduce their profits.

Sharecropping land tenure system

This is where a farmer (sharecropper) works on land owned by someone (landowner) and instead of paying rent with money, the sharecropper gives a part of the crops they grow to the landowner as payment.

Advantages

1. Sharecroppers can have access to land without having to buy it, allowing them to earn a living even if they don't own land.

2. Sharecroppers usually don't need a lot of money to get started since they often get land, tools and seeds from the landowner.
3. Since sharecroppers and landowners share the harvest, both parties share the risks of poor crop yields due to weather or pests.
4. Sharecropping is often based on local relationships, which can foster a sense of community among farmers and landowners.

Disadvantages

1. Sharecroppers must give a large portion of their harvest to the landowner, which means they may not earn enough money to support themselves.
2. Sharecroppers rely on landowners for land, resources and support, which can make them vulnerable to exploitation.
3. Sharecroppers do not own the land, so they have no long-term security or control over their farming decisions.
4. Some sharecroppers may be trapped in unfair agreements that favour the landowner, making it hard to break free from the system.
5. Since sharecroppers do not fully benefit from their hard work, they may have less motivation to invest in improving the land or farming techniques.

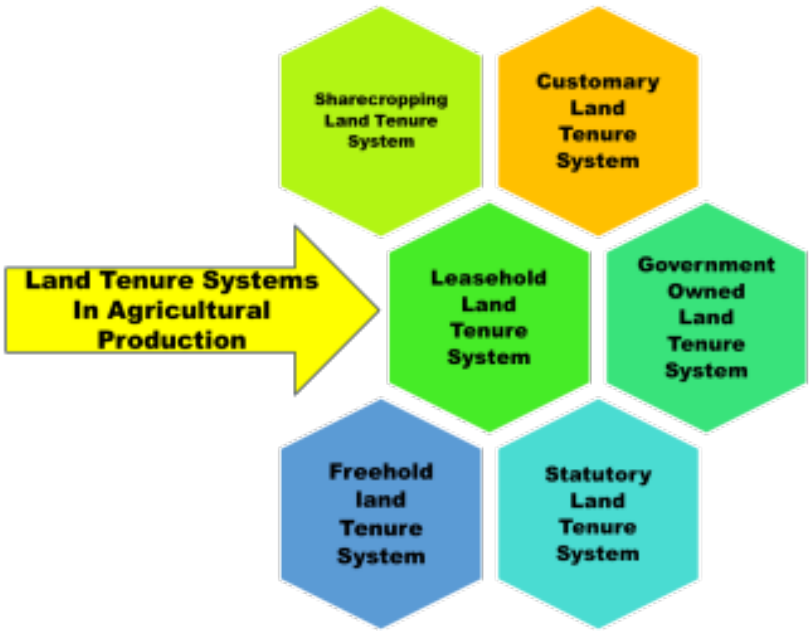


Figure 1.6: Land Tenure Systems in Agricultural Production

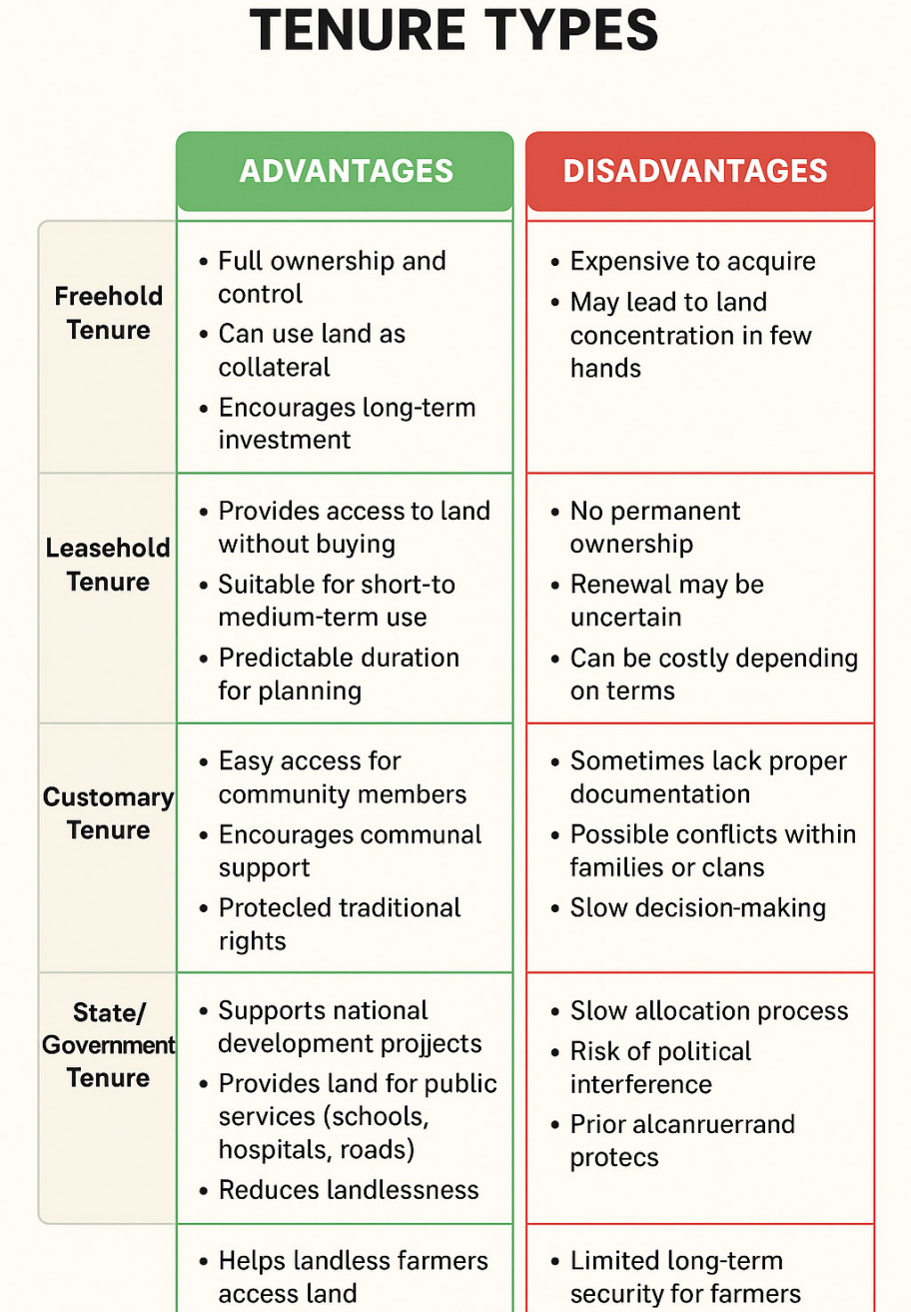


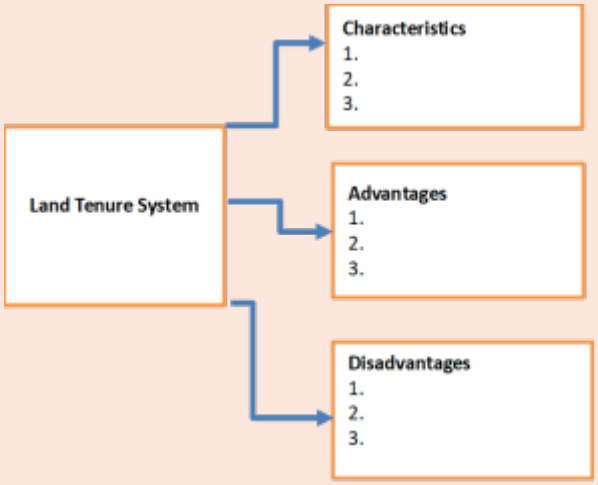
Figure 1.7: Advantages and disadvantages of some land tenure systems in agriculture

Activity 1.8 Meaning of Land Tenure Systems in Agricultural Production

1. What comes to mind when you hear the term 'land tenure system in agricultural production'? Write your definition in your notebook.
2. Share your idea with a peer.
3. In pairs, research using the internet and other resources to fine-tune the definition of land tenure systems in agricultural production.

Activity 1.9 Types of Land Tenure Systems in Ghana

1. Identify the land tenure systems practised in your community.
2. In pairs, using the internet and other resources, identify other types of land tenure systems in agricultural production in Ghana. Write your findings in your notebook.
3. In the same pair, discuss the characteristics of the land tenure systems identified and list the advantages and disadvantages of the land tenure systems in agricultural production in Ghana.
4. Present your findings in a chart below:



Tips to complete the chart

- Write the types of land tenure system in agricultural production in Ghana in the box labelled types of land tenure system.
- Write the characteristics of the land tenure system in the box labelled characteristics
- Write the advantages of the land tenure system in the box labelled advantages
- Write the disadvantages of the land tenure system in the box labelled disadvantages

5. Present your chart to the class for feedback.

EFFECTS OF LAND TENURE SYSTEMS ON AGRICULTURAL PRODUCTION

Effects of Land Tenure Systems on Agricultural Production

Land tenure systems can have both positive and negative effects on Agricultural production, which can affect productivity, investment in land and the overall well-being of farmers.

1. **Positive Effects**
   a. When farmers have secure land tenure, they are more likely to invest time and resources into improving their land, which can lead to higher crop yields.
   b. Secure land tenure encourages farmers to invest in better farming techniques, irrigation, and fertilisers, improving overall production.
   c. Farmers with secure land tenure have a stable place to farm, which can lead to better financial planning and economic growth for their families.
   d. Secure land tenure can make it easier for farmers to get loans, as they can use their land as collateral. This allows them to invest in better equipment and seeds.
2. **Negative Effects**
   a. In areas with insecure land tenure, farmers may be less willing to invest in the land, leading to poor soil quality and low crop yields.
   b. If farmers are unsure about their land rights, they are less likely to invest in improvements or new technologies, which can hinder agricultural development.
   c. In some cases, land tenure systems can favour wealthy farmers or commercial farmers, leaving small scale farmers with less access to good land.
   d. Unclear or unfair land tenure systems can lead to disputes and conflicts among farmers, communities, and landowners, disrupting agricultural activities.

Activity 1.10 Effect of Land Tenure System on Agricultural Production

1. In groups of five, develop a questionnaire to gather information on the effects of land tenure systems in agricultural production in your community. When developing the questionnaire focus on the following:

a. Demographic information of respondent such as age, gender and the type of farming the respondent practice (crop farming, livestock farming, mixed farming)

b. The land size, type of land tenure system the respondent is practicing (freehold, leasehold, communal, customary) and how the land was acquired.

c. The impact of the land tenure system the respondent is practicing on the productivity of his/her farm which could include:

   i. How the land tenure system affects the willingness to invest in land improvements,

   ii. How the land tenure system affects the ability to access credit or loans for his/her agricultural purposes

d. The type of support or policy changes that would help improve the impact of the land tenure system on agricultural production.

e. How the land tenure system affects the overall agricultural productivity of the community.

3. Ask members of the local agriculture community to complete your questionnaire (Taking into consideration the number of completed questionnaires needed for data collection=30). Before collecting data, politely explain your study and the information will be used, and ask for the person's permission to take part. Make sure they know participation is voluntary, they can stop at any time, and always treat them with respect and honesty.

4. Review the data collected, compare the data collecting looking for patterns, similarities and differences. Analyse the data gathered using statistical software such as Microsoft excel.

5. Write a report on your research and present it to your class for feedback. In writing your report, consider the following:

   a. Introduction (background of the research and the significance of the research). b. Description of the land tenure systems practiced in the community.

   b. Methodology used for the research (description of the respondents involved in the research, data collected and how the data were analysed).

   c. Results (the findings from the research).

   d. Conclusion (summary of your key findings from the research).

   e. References (list of all references and sources cited in the report using APA citation style).

   f. Appendices (pictures and other information gathered during the research).

6. In pairs, discuss the effects of the land tenure systems practiced in your community on the operations of women and persons with disabilities involved in agriculture.
7. Present the salient points from your discussion to the class for feedback.

EXTENDED READING

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- Food and Agriculture Sector Development Policy (FASDEP II) for Ghana (2007)
- Ghana Agriculture Sector Policy Note (2017). Transforming Agriculture for Economic Growth, Job Creation and Food Security. The World Bank Group Agriculture Global Practice West Africa (AFR01).
- Sasu, G. M., Kwarteng, E.N. & Baffour-Antwi, A. (Revised edition). General Agriculture for Senior High School. Adwinasa series

REVIEW QUESTIONS

Answer the following questions by circling the correct answers from the options A - D provided

1. Which of the following is a primary benefit of agricultural development?
   - **A.** Decreased job opportunities
   - **B.** Higher food prices
   - **C.** Increased food security
   - **D.** Reduced agricultural productivity
2. Agricultural development can contribute to economic growth by:
   - **A.** Decreasing the use of modern technology
   - **B.** Increasing the export of agricultural products
   - **C.** Limiting farmer education programs
   - **D.** Reducing the variety of crops grown
3. Which governmental organisation is primarily responsible for agricultural policies in Ghana?
   - **A.** Ministry of Education
   - **B.** Ministry of Environment
   - **C.** Ministry of Food and Agriculture
   - **D.** Ministry of Health
4. Non-Governmental Organisations (NGOs) in agricultural development typically focus on:
   - **A.** Creating agricultural policies
   - **B.** Enforcing land tenure laws
   - **C.** Providing training and resources to farmers
   - **D.** Regulating food prices
5. Which land tenure system involves renting land for a specific period?
   - **A.** Customary land tenure
   - **B.** Freehold tenure
   - **C.** Leasehold tenure
   - **D.** Sharecropping
6. Explain how agricultural development contributes to economic growth.
7. Compare the roles of governmental and non-governmental organisations in supporting farmers.

REVIEW QUESTIONS

8. Explain the difference between freehold and leasehold land tenure systems.
9. Explain how the security of land tenure influences a farmer's willingness to invest in long-term agricultural improvements.
10. Evaluate the impact of communal land tenure systems on agricultural productivity and innovation.
11. Compare and contrast the advantages and disadvantages of customary land tenure and statutory land tenure in Ghana regarding agricultural development.
12. Discuss the potential social and economic impacts of transitioning from customary to freehold land tenure systems in Ghana.
13. Describe the socio-economic impacts of introducing industrial agriculture in a rural area previously dependent on subsistence farming, focusing on the potential benefits and drawbacks, and how policies could be designed to maximise benefits while mitigating drawbacks.
14. Discuss how sustainable agricultural practices can address the challenges of environmental degradation and resource depletion by providing specific examples of sustainable practices and their benefits.
15. Compare and contrast the challenges of early-stage agricultural development with those of modern industrial agriculture and describe how the nature of the challenges has evolved.

SECTION

2 INDUSTRIES IN AGRICULTURAL PRODUCTION

CONCEPT OF AGRICULTURE IN AN INDUSTRIALISING SOCIETY

Agriculture and Industry

INTRODUCTION

In this section, we will be dealing with industries in crop and animal/fish production, raw and waste materials from crops and animals/fish production. The section also deals with the identification of some companies who use the raw and waste materials from agricultural production in Ghana. You will also learn about the processes that agricultural produce goes through for value addition, which will help you to appreciate the businesses in agricultural production and employment opportunities that are available in the crop and animal/fish industry. As you go through the well-crafted activities, you will appreciate the importance and uses of waste and raw materials from crops and animal/fish production which are important ingredients for industrial drive.

KEY IDEAS

- Some industries in crop production are the food and beverage industry, textile industry, sugar industry, pharmaceutical industry, oilseed processing industry and cosmetic industry.
- Examples of raw materials from crop production that are used by industries are grains such as maize and millet, fruits such as oranges and pineapples, vegetables such as tomatoes and peppers, oilseeds such as soybeans and sunflower seeds, sugarcane, sugar beets and fibre such as cotton, hemp.
- Examples of waste materials from crop production that are used by industries are corn stalks, wheat bran and rice husks for animal bedding and feed, bioenergy and organic fertilisers. Brewers' spent grains for animal feed, biogas production and composting. Sugar bagasse is used for packaging materials and building materials.
- Some companies in Ghana that use raw and waste materials from crop production are Blue Skies Holdings Ltd, which produces fruit juice, and Cargill Ghana processes cocoa beans into cocoa liquor, butter and powder. Asutuare and Komenda Sugar Factories produce granulated white sugar, brown sugar and molasses. Tobinco Pharmacy and Kinapharma process herbs into medicines and supplements. Benso Oil Palm Plantation (BOPP) and Twifo Oil Production Company produce palm oil, palm kernel oil and palm sludge oil. Savannah Fruits Company and Akoma Cooperative Multipurpose Society process shea nuts into shea butter
- Some industries in animal production are the livestock industry, poultry industry, aquaculture industry, beekeeping (apiculture) industry, grasscutter industry, rabbit industry, snail industry and processing and packaging industry.

- Raw and waste materials from animal and fish industries are processed into various products like sausages, burgers, leather, feathers, fur, organic fertiliser, fish oil, and skincare products. Meat and offal are processed into sausages, burgers, and canned meats, hide and skin are tanned into leather, feathers and fur are used in bedding and insulation, and manure is used as organic fertiliser. Fish oil is used in supplements and pharmaceuticals for heart and joint health.
- Some companies in Ghana that use raw and waste materials from animal/ fish production are WAMCO (West African Mills Co. Ltd.) processes fish into canned fish products such as tuna and mackerel. Myroc Food Processing Company Limited processes fish, including tuna and sardines. Ghana Agro Food Company (GAFCO) processes fish into fishmeal and fish oil. Savana Pride Tamale, Ghana processes meat products into meat cuts, minced meat, meatballs and kebabs. Pioneer Food Cannery Ltd. processes tuna into canned tuna and other fish products.

INDUSTRIES OF CROP PRODUCTION

The following are some industries in crop production:

1. **Food and Beverage Industry:** The food and beverage industry takes raw materials from agriculture, like grains, fruits and vegetables, and turns them into packaged foods and drinks for people to enjoy locally or for export. For instance, cocoa beans are processed to make products like Milo and various liquors, such as whisky and gin. Wheat is processed into flour, which is used in many grain-based foods. Some examples of companies in Ghana that work in the food and beverage industry are:
    a. **Blue Skies Holdings Ltd:** They turn fresh fruits into packaged fruit salads, juices and other fruit-based products that are sold locally and internationally.
    b. **Wienco Ghana Limited:** This company improves the quality of locally grown rice for the Ghanaian market.
    c. **Cargill Ghana:** They process cocoa beans to produce cocoa liquor, butter and powder for both local use and export.
    d. **Nsawam Agro-Processing Company:** This company processes maize into corn flour and other maize-based products, which are sold in Ghana and other countries.

Figure 2.1: Food and Beverage Industries in Ghana

2. **Textile Industry:** The textile industry takes cotton and turns it into yarn and fabrics, creating printed cloth for both local and international markets. Examples of textile factories in Ghana include:
   a. **Ghana Textile Printing Company (GTP):** They process cotton into fabrics and make printed textiles that are sold in Ghana and internationally.
   b. **Akosombo Textiles Limited (ATL):** This company also processes raw cotton into finished fabrics, especially focusing on African print designs.

Figure 2.2: Textile Industries in Ghana

3. **Sugar Industry**: The sugar industry processes sugarcane and sugar beets into products such as refined sugar, molasses and other sweeteners, along with ethanol for use at home and in various industries. Examples of sugar factories in Ghana are Asutuare and Komenda Sugar Factories. They produce different types of sugar, including granulated white sugar, brown sugar, and molasses (a by-product used in baking, cooking, or as a sweetener). They also make sugar syrup

(a thick sugar-water solution used in food and drinks), industrial sugar (various types of sugar used in food manufacturing and drinks), and bagasse (the leftover fibre from sugarcane that can be used as biofuel or in making paper).


Figure 2.3: Sugar Factories in Ghana

4. **Pharmaceutical Industry:** The pharmaceutical industry processes agricultural products, such as herbs, roots and plant leaves, to make medicines and supplements for people and animals. Examples of companies in Ghana that produce pharmaceutical products include:
   - Tobinco Pharmacy
   - Ernest Chemist
   - East Cantonments Pharmacy
   - Kinapharma



Figure 2.4: Pharmaceutical Industries in Ghana

5. **Oilseed Processing Industry:** The oilseed processing industry takes seeds such as soybeans, groundnuts and shea butter and turns them into products, for example edible oils, margarine and biodiesel. Coconut and palm nuts are also processed to make edible oils. Examples of companies in Ghana that process oilseeds include Benso Oil Palm Plantation (BOPP) and Twifo Oil Production Company. They produce several products from palm nuts, including:

- palm oil
- palm kernel oil
- palm sludge oil
- empty fruit bunches
- kernel shells.

Figure 2.5: Oilseed Processing Industry in Ghana

6. **Cosmetic Industry:** The shea industry processes shea nuts into shea butter, which is mainly used in cosmetics such as lotions and creams. Examples of factories in Ghana that process shea butter are Savannah Fruits Company and Akoma Cooperative Multipurpose Society. They produce organic and fair-trade shea butter for both local and international markets.

Figure 2.6: Cosmetic Industry in Ghana

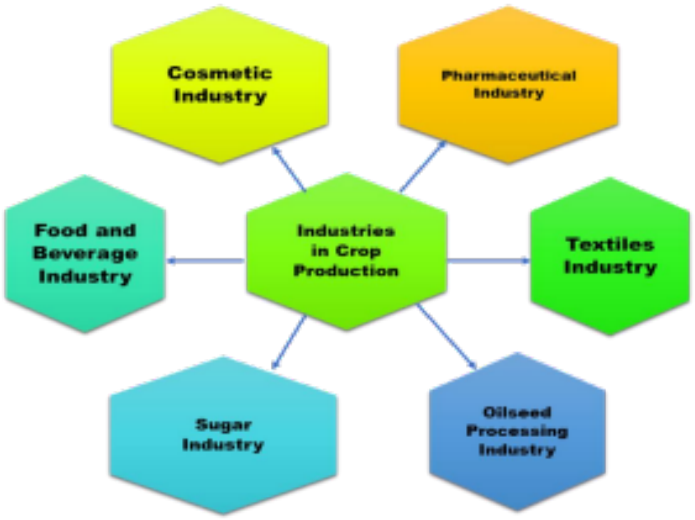


Figure 2.7: Industries in Crop Production

Activity 2.1 Industries in Crop Production

1. In pairs, identify the companies in your community that use crop produce, the type of crops they use and the products that they produce. Present your findings in the table below. Discuss your findings with your peers.

Company	Industry	Crop used	Crop produced

Tips to complete the table:

- Write the name of the company in the column labelled company, e.g. Blue Skies.
- Write the industry in crop production that the company fall under in the column labelled industry e.g. food and beverage industry.
- Write the types of crops that they use in the column labelled crops used e.g., pineapple.
- Write the name of their products in the column labelled with what they produce e.g. fruit juice.
- Share your findings with your class.

2. Using the internet and other sources, research the factories in the food and beverage industry on your table and what they produce. Present your report to the class for their input.

Importance Of Raw and Waste Materials from Crop Production to the Industry

1. Raw Materials from Crop Production Used by Industry

   The following are examples of raw materials from crop production that are used by industries:

   a. **Grains** such as wheat, rice, and corn.
   b. **Fruits** such as apples, oranges, and bananas.
   c. **Vegetables** such as tomatoes, potatoes, carrots.
   d. **Oilseeds** such as soybeans, sunflower seeds, canola, etc.
   e. Sugarcane and sugar beets.
   f. **Fibre** such as cotton and hemp.

2. Waste Materials from Crops Used by Industry

   The following are examples of waste materials from crop production that are used by industries, and their uses:

   a. **Crop Residues** such as corn stalks, wheat straw, rice husks for animal bedding and feed, bioenergy, biomass fuel, mulching and composting.
   b. **Processing By-products** such as wheat bran, fruit pulp, vegetable peels for bioenergy, organic fertilisers and animal feed.
   c. **Spent Grains** such as brewers' spent grains for animal feed, biogas production and composting.
   d. **Press Cake** such as soyabean meal, canola meal for animal feed and organic fertilisers.
   e. **Bagasse** from sugarcane processing: Bioenergy for electricity generation, paper and packaging materials and building materials (fibreboard).
   f. **Fruits** and vegetable scraps such as peels, cores, seeds for animal feed, composting and bioenergy (biogas).

3. Importance of Raw Materials from Crops to Industry

   a. **Food and Beverage Industry**:

      Basic crops like wheat, corn, rice and sugarcane are important raw materials used to make many food products for people and animals. Other crops, such as cocoa beans, coffee, grapes, barley and hops, are key ingredients for making drinks, for example wine, beer and other beverages.

Cocoa

Coffee

Figure 2.8: Some Raw Materials for the Food and Beverage Industry.

b. Pharmaceutical and cosmetic Industry

Medicinal plants such as aloe vera, chamomile and herbs (for example, shea nut and neem) are used in making medicines and cosmetic products because of their healing properties. Plants such as lavender, eucalyptus and peppermint are used to make essential oils, which are popular in skincare, aromatherapy, and health products.

Aloe vera

Neem

Figure 2.9: Some Pharmaceutical and Cosmetic Plants.

c. Textile Industry

Natural fibres like cotton, flax, hemp and jute are important materials used to make fabrics and textiles. These fibres are the foundation for making clothes and other textile products that are sold locally and internationally.

Cotton

Silk

Figure 2.10: Some Textile Manufacturing Plants

d. **Biofuel Industry**

Corn and sugarcane are important sources of ethanol, a renewable energy used to make biofuel. Biodiesel, another fuel alternative, is made from crops like soybeans and jatropha, and can be used instead of fossil fuels.

Jatropha

Soyabean

Figure 2.11: Some biofuel industry plants

e. Construction Industry

Bio-composite materials such as straw and bamboo are used to create eco-friendly building materials. Cork, which comes from cork oak trees, along with other plant-based materials, is used for insulation and flooring. Thatch plants are often used for roofing.

Bamboo

Thatch

Figure 2.12: Some Building and Construction Industry Plants.

4. Importance of Waste Materials from Crops to Industry

The following explains the importance of waste materials from crop production to industry:

a. Crop residues, for example straw, husks and stalks, are used as feed for livestock, which means that wastes from crops are turned into useful food for animals.

b. Crop waste, such as manure and corn stalks, can be used to create biogas, which can be turned into electricity and heat. Agricultural waste can also be compacted into pellets and briquettes for use as a renewable and efficient energy source.

c. Composting crop residues helps make the soil richer and more fertile, which supports sustainable farming. Adding organic material from crop waste improves the soil's structure, allowing it to hold more water and stay healthy.

d. Agricultural leftovers, for example bagasse (the leftover from sugarcane), are used to make paper and biodegradable packaging. This helps reduce the use of wood and plastic materials. Additionally, crop waste is being turned into bioplastics, offering an eco-friendlier alternative to regular plastics.

e. Crop residues can help prevent soil erosion by using methods like mulching, which protects the soil. Some crops and their leftover materials can also be used to clean polluted soils and water, aiding in environmental restoration.

f. Crop waste can be a source of valuable chemicals, such as pectin from citrus peels and lignin from corn stalks. These chemicals are used in different industrial processes.

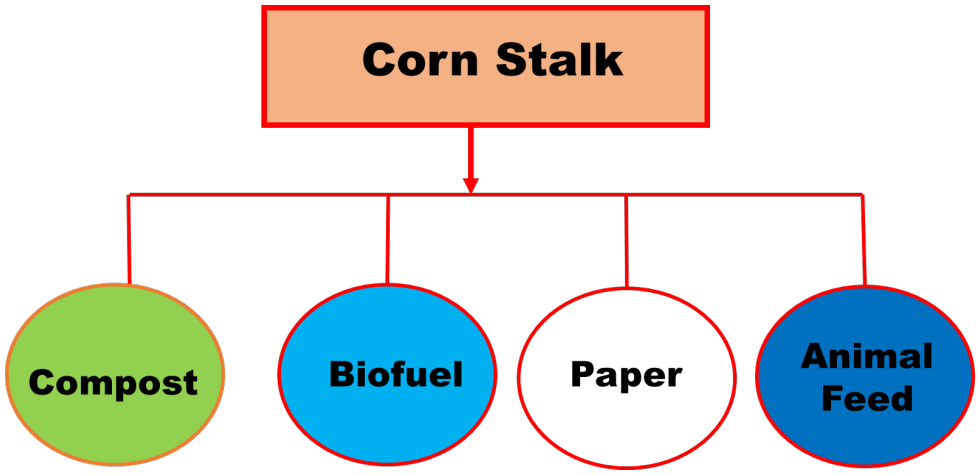


Figure 2.13: Flow chart showing some materials can be produced from waste in Crop production

Activity 2.2 Importance of Raw and Waste Materials from Crop Production

1. In groups, visit a nearby agro-based industry or watch videos/pictures on the use of some raw materials and agricultural waste from crop production. Write a two-page report on your visit to the agro-based industry and present it to your class in a plenary session.

   In your report, focus on the following:

   a. Details about the industry you visited (name, type of products made, size of the industry and location).

   b. The main processes involved in using the raw materials and agricultural wastes (e.g., how crops are processed, what products are made).

   c. The raw materials used in the industry, such as specific crops or by-products.

   d. Where the raw materials come from and how they are obtained.

   e. The agricultural wastes observed at the industry (e.g., crop residues, husks).

f. How these wastes are processed or used (e.g., composting, energy production).

2. In the same groups, discuss the importance of raw and waste materials from crop production to the industries.
3. Present the salient points from your discussion to your class for feedback.

INDUSTRIES OF ANIMAL/FISH PRODUCTION

Factories in Ghana That Process Animal and Fish Products

Below are some factories in Ghana that currently process animal and fish products:

1. **WAMCO (West African Mills Co. Ltd.) Takoradi, Ghana**: This company processes fish into canned fish products such as tuna and mackerel.
2. **Myroc Food Processing Company Limited, Tema:** Processed fish including tuna and sardines.
3. **Ghana Agro Food Company (GAFCO) Tema, Ghana**: They process fish into fishmeal and fish oil.
4. **Savana Pride Tamale, Ghana**: Processed meat products into meat cut, minced meat, meatballs, kebabs etc. for both local and international market.
5. **Pioneer Food Cannery Ltd. Tema, Ghana**: Process tuna into canned tuna and other fish products.
6. **Meat Processing and Distribution Company Limited (MEPDCOL) Tema, Ghana:** They processed meats, including beef, goat, and pork for both local and international market.
7. **Sosak Meat Processing Limited Kumasi, Ghana:** Process meats into sausages (chicken sausages, spicy sausages), bacon, ham, minced meat (ground beef, pork and chicken), meatballs, cold cuts, kebabs etc. for both local and international markets.
8. **Fan Milk Limited Accra, Ghana**: They produce wide range of dairy products including yogurt, ice cream, and frozen dairy desserts.
9. **Accra Dairy Company Limited (Producers of Cowbell) Accra, Ghana**: Process milk into powdered milk, flavoured milk drinks, and yogurt.
10. **Nestlé Ghana Limited**: Producers of Nido (powdered milk fortified with essential vitamins and minerals) for children and families. Ideal Milk (evaporated milk) used in baking and as a creamer for beverages. Carnation (evaporated milk) fortified with essential minerals for consumption.

Industries in Animal and Fish Production

1. **Livestock Industry:** This industry with producing meat (beef, mutton, chevon and pork), milk and dairy products such as cheese, butter and yogurt to meet the protein needs of humans. Animals also give us other products, for example wool and leather. Wool is used to make clothing, while leather is used to create things such as like shoes, belts, and leather bags.
2. **Poultry Industry**: The poultry industry deals with producing meat and eggs from different types of birds, including chickens (domestic fowls), turkeys, ducks, ostriches, guinea fowl and quail. These products are sold in both local and international markets.
3. **Aquaculture Industry:** This industry focuses on breeding, raising and harvesting fish, shellfish and aquatic plants. Freshwater aquaculture involves raising fish such as tilapia, catfish and trout in rivers and streams. Marine aquaculture on the other hand, involves raising fish such as salmon, sea bass and shrimp in saltwater environments such as the sea and ocean.
4. **Beekeeping (Apiculture) Industry**: This involves keeping bee colonies in hives to produce honey, beeswax and provide pollination services. Honey is an important food product and is also used in medicine as a sweetener. Beeswax has various industrial uses.
5. **Grasscutter Industry:** Grasscutters, also known as cane rats, are large rodents native to Africa. They are considered a delicacy in many African countries and are farmed for their meat, which is high in protein and low in fat. Grasscutter fur can be used to make warm accessories like hats, gloves and scarves, and it can also be used to line coats and jackets. Additionally, the fur can be made into decorative items like throw pillows, rugs or wall hangings.
6. **Rabbit Industry**: Rabbits are raised all over the world for their meat, fur and as pets. They are also bred for research purposes in laboratories. Rabbit meat is lean and nutritious and can be sold fresh, frozen or processed into products like sausages and pâté. Rabbit fur is used in fashion for clothing and accessories. Additionally, there is a market for pet rabbits and their supplies.
7. **Snail Industry**: The snail industry, particularly the farming of edible snails (called heliculture), is popular in regions where snails are considered a delicacy. Snails are raised in captivity and need specific conditions to thrive. Snail meat is seen as a gourmet food and can be sold fresh, frozen or canned. Snail slime is also used in cosmetics because of its supposed skin benefits.
8. **Processing and Packaging Industry:**
    - **Meat Processing:** This involves slaughtering, butchering and packaging meat products.
    - **Dairy Processing:** This includes turning milk into various dairy products such as cheese, yogurt and butter.
    - **Fish and Seafood Processing:** This includes filleting, canning, smoking and freezing of fish and seafood.

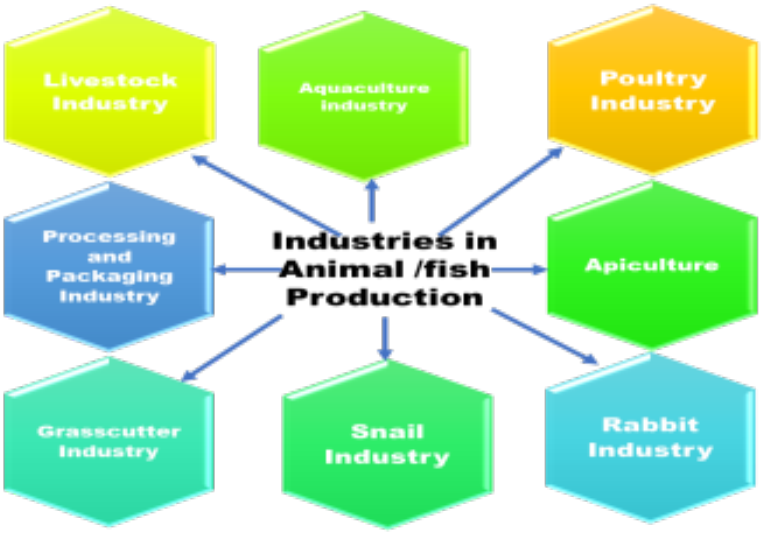


Figure 2.14: Industries in Animal and Fish Production

Activity 2.3 Industries in Animals/Fish Production

1. Identify factories in your community that use animal/fish products. Document the raw material that they use and what they produce.
2. Present your findings in a table below and present them to your peers for feedback.

Company	Industry	Raw material	Products

Tips for completing the table

- Write the name of the factory identified in the company
- Write the animal/fish industry that the factory belongs to in the column labelled industry
- Write the raw materials that the company uses in the column labelled raw materials.
- Write examples of the products that the company produce in the column labelled what their products are.

3. In pairs, discuss the importance of animal/fish raw materials to industries. Present the salient points of your discussion back to the class.

Importance of Raw and Waste Materials from Animal/Fish Production to the Industry

The following are some of the important uses of raw and waste materials from animal/fish to industries:

1. Livestock (Cattle, Sheep, Goat, and Pigs)
    - **Meat and Offal**: For human consumption as fresh meat or processed into various products such as sausages, burgers and canned meats.
    - **Hide and Skin**: Tanned and processed into leather used for shoes, bags, belts, and upholstery.
    - **Bones:** Ground into bone meal for livestock feed or processed into gelatine used in food products, pharmaceuticals, and cosmetics.
    - **Pharmaceuticals**: Some organs are used in medical research and the production of pharmaceuticals.
    - **Manure**: Used as organic fertiliser to improve soil fertility and crop yields.
2. Poultry (Chicken, Ducks, Turkeys, Guinea fowl etc.)
    - **Meat and Eggs:** Chicken and other poultry meat are staple foods consumed fresh, frozen or processed into nuggets, burgers and deli meats. Fresh eggs eaten or used as ingredients in baked goods, sauces and other food products.
    - **Feathers**: Down feathers are used in bedding and clothing insulation. Other feathers may be used in crafts and decorative items.
    - **Manure:** Poultry manure is utilised as organic fertiliser for crops due to its high nutrient content and very good for soil remediation.
3. Fish (Catfish, Tilapia and Mudfish)
    - **Meat:** Fish is a major source of protein. It is consumed fresh, frozen, smoked, dried or canned.
    - **Fish Oil:** Rich in omega-3 fatty acids, fish oil is used in supplements and pharmaceuticals for heart health, joint health and other benefits.
    - **Fish Meal**: Ground fish used as a protein-rich ingredient in livestock, poultry and aquaculture feed.
    - **Fish Skin and Scales**: Collagen-rich fish skin and scales are used in cosmetics for skin care products and in biomedical applications.
    - **Fish Bones**: Fish bones are processed into gelatine used in food products, pharmaceuticals and cosmetics.
4. Grasscutter and rabbit
    - **Fur**: Grasscutter and rabbit fur can be used to make clothing items like hats, gloves, and scarves, as well as decorative accessories. Rabbit fur and wool from certain breeds are also used to make sweaters, toys, decorative items, and handmade crafts.

- **Skins**: The skins can be tanned and processed into leather, which can be used to make small leather goods such as wallets, belts and other accessories.
- Manure from grasscutters is an excellent organic fertiliser that can be used to enrich soil in gardening and farming. It improves soil structure and provides essential nutrients for plant growth.
- **Organs and Offal**: In some cultures, the organs and offal are used in traditional dishes and considered delicacies. The organs can also be processed into high-quality pet food and treats.
- **Rabbit Blood and By-products:** Rabbit blood and certain by-products are used in biomedical research and the production of vaccines. Rabbits are also used in research for developing treatments and studying diseases.

5. Snails
   - **Snail Mucin**: A secretion produced by snails, also known as snail slime. It is used in skincare products for its moisturising, anti-aging, and healing properties. It is used in wound healing and scar treatment products due to its regenerative properties.
   - **Snail Meat**: The edible flesh of snails is a delicacy in many cultures, especially in French cuisine (escargot).
   - **Snail Shells**: The hard, protective outer layer of snails. It is grounded into powder and used as a calcium supplement in animal feed.
6. Honey Bees
   - **Honey**: A sweet, viscous food substance produced by bees from floral nectar. It is used as a natural sweetener, for baking and in various food products.
   - **Beeswax**: This ingredient is used in lip balms, lotions and creams because it helps to soften and moisturise the skin. It's also used in furniture polish, shoe polish and as a lubricant. Additionally, it's important for making natural, high-quality candles. In cosmetics, it's added to skincare products for its moisturising and antibacterial benefits. It's also used in traditional medicine as a natural remedy for sore throats and coughs.
   - **Propolis**: This is a sticky mixture made by honeybees when they combine saliva and beeswax with sap collected from tree buds. It is known for its germ-killing, anti-inflammatory, and healing qualities, and is used in many health supplements. It's also added to skincare products for its healing and protective effects.
   - **Royal Jelly**: A secretion used to nourish larvae and the adult queen bee. Valued for its potential health benefits, including boosting the immune system and improving skin health.

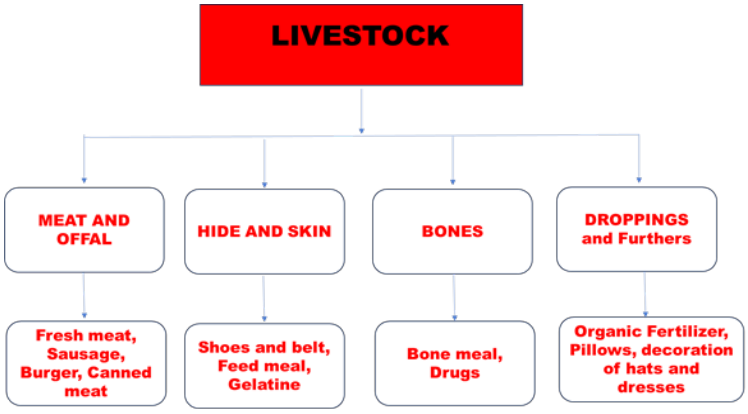


Figure 2.15: flow chart showing waste to products in animal production.

Activity 2.4 Importance of Raw and Waste Materials from Animal Production

1. In pairs, use the internet / other sources to research the importance of raw and waste materials from animal/fish production to industries. Discuss this topic. Use the following prompts to guide your discussion:
   a. Examples of raw materials we get from animals/fish and how they are used in different industries.
   b. How animal by-products (e.g. wool, leather, or bones) benefit industries like clothing, cosmetics and pharmaceuticals.
   c. The main uses of fish by-products, such as fish oil and fishmeal, in industries or agriculture.
   d. How the processing of animal waste, like manure, contributes to energy production and agriculture.
   e. The role of animal waste in creating biofuels or biogas, and why is this important?
   f. How recycling of animal/ fish waste into useful products reduce environmental pollution?
   g. How do products made from animal by-products or waste compare in sustainability to those made from synthetic materials?
2. Present the salient points from your discussion to the class for feedback.

EXTENDED READING

- Eric Amoah (2018) General Agriculture for Senior High Schools
- Fellows, P. (2009). Food Processing Technology: Principles and Practice. Publisher: Woodhead Publishing.
- General Agriculture textbook for senior high schools.

REVIEW QUESTIONS

1. Which of the following is an example of an industry involved in crop production?
   - **A.** Wax processing
   - **B.** Biofuel processing
   - **C.** Dairy processing
   - **D.** Meat processing
2. Which of the following best explains why corn is a valuable raw material for industry?
   - **A.** Corn can be processed into ethanol, a renewable fuel.
   - **B.** Corn is only used in the food industry.
   - **C.** Corn is only used as animal feed.
   - **D.** Corn is used exclusively for composting.
3. Which industry focuses on the production of eggs and meat from birds?
   - **A.** Apiary
   - **B.** Dairy
   - **C.** Fishery
   - **D.** Poultry
4. Which material from animal production is often used in the fashion industry?
   - **A.** Bones
   - **B.** fur
   - **C.** Manure
   - **D.** Milk
5. Why is animal manure valuable to the agriculture industry?
   - **A.** It can be turned into biofuel.
   - **B.** It serves as a natural fertiliser, adding nutrients to the soil.
   - **C.** It is a primary food source for livestock.
   - **D.** It is a non-renewable resource.
6. List four industries under the industries of animal/fish production.
7. Critically examine the role of waste products from animal/fish production to soil fertility and crop growth.
8. Discuss the importance of two raw materials from animal production to industry and what they are used to produce.

REVIEW QUESTIONS

9. Evaluate the environmental and economic implications of integrating aquaponics in fish farming. How would this system benefit both the fish farming industry and the crop production industry?
10. A country wants to improve its agricultural sector to boost the textile, energy and food industries. Evaluate which crops would be strategic to cultivate, considering economic benefits and sustainability, and explain how each crop would serve these industries.

SECTION

3

CONCEPT OF SURVEYING AND MAPPING IN AGRICULTURE

MODERN TECHNICAL AND MECHANISED AGRICULTURE

Modern Technical Agriculture

INTRODUCTION

Welcome to Section 3. In this section, you will be introduced to surveying and mapping, an essential component of agricultural development, enabling farmers to optimise land use, improve crop yields, and reduce costs. Surveying involves measuring and recording the physical characteristics of the land, while mapping visualises this data to inform decision-making. Accurate surveying and mapping help farmers identify soil types, terrain, water resources, and other critical factors affecting crop growth. Effective surveying and mapping also facilitate farm planning, monitoring, and evaluation, leading to increased productivity and sustainability. Conducting surveys and mapping of farmsteads equally requires careful planning, precise instrumentation, and accurate data analysis. This section outlines the procedures for conducting surveys and mapping farmsteads, which will equip you with the needed skills and familiarity with most tools.

KEY IDEAS

- Mapping is the process of creating a visual representation of an area, concept, or idea, using symbols, colours, and spatial relationships to convey information.
- Surveying is the science and art of measuring and mapping the Earth's surface to determine its shape, size, and boundaries.
- GIS (Geographic Information System) is a computer-based tool for analysing, visualising, and managing geographic data.
- GPS (Global Positioning System) is a network of satellites orbiting the Earth that provide location information to GPS receivers on the ground.
- A farmstead is a group of buildings and structures that form the centre of a farm.
- SWOT analysis is a strategic planning technique used to identify and evaluate the Strengths, Weaknesses, Opportunities, and Threats of an organisation, project, or individual.

MEANING AND IMPORTANCE OF SURVEYING AND MAPPING IN AGRICULTURE

Meaning of Surveying and Mapping in Agriculture

Survey and mapping in Agriculture refer to the integrated processes of data collection, spatial analysis and visualisation to enhance crop management, soil conservation and resource allocation. These activities assist agriculturists to make informed decisions, improve land management, and increase productivity.

Surveying in Agriculture is the process of measuring and mapping farmland to determine its size, shape, boundaries, and physical features. It involves measuring distances and elevations using tools such as total stations and GPS. Examples are; Measuring the size of a maize farm using a GPS device to know the exact acreage for fertilizer application, · Marking farm boundaries with a total station to avoid land disputes between neighbouring farmers. Setting out irrigation lines by measuring land elevation to ensure water flows properly across rice fields. This includes:

1. **Land Assessment**: It is also known as land evaluation or land appraisal, it is the process of determining the value, potential uses and characteristics of a parcel of land.
2. **Soil Analysis**: It is the process of examining the physical, chemical and biological properties of soil to understand its composition, fertility and overall health in crop selection and soil management practices.
3. **Water Resources**: Looking at available and quality of water sources (e.g., rivers, lakes, groundwater) as well as irrigation needs.
4. **Topography**: Is the study of the shape and features of the earth`s surface. It entails the measuring and mapping of the natural and artificial features of an area including relief, water bodies, landforms and vegetation.
5. **Climate Data**: Entails the collection of historical and current information on earth's climate including temperature, rainfall and other climatic conditions that affect agriculture.

Mapping in Agriculture involves creating visual representations of farm- related data to improve decision-making, efficiency and productivity. This includes:

1. **Topographic Maps**: Is a detailed two-dimensional (length and widths) representation of the earth`s surface, showcasing natural and artificial features including relief, water bodies, landforms, vegetation, roads, buildings, bridges, dams and canals.
2. **Soil Maps**: Indicate a visual representation of the spatial distribution of different soil types, properties and characteristics across the agricultural land.
3. **Land Use Maps**: Are visual representation of various ways land is used within a specific area such as crop areas, pastures, and forested regions.

4. **Irrigation Maps**: Entail visual representations of irrigation systems, water distribution networks and crop water requirements used to optimise water management and crop growth.
5. **Pest and Disease Maps**: Visual representations of the distribution, prevalence and intensity of pests and diseases affecting crops, livestock and forests to aid in targeted interventions.

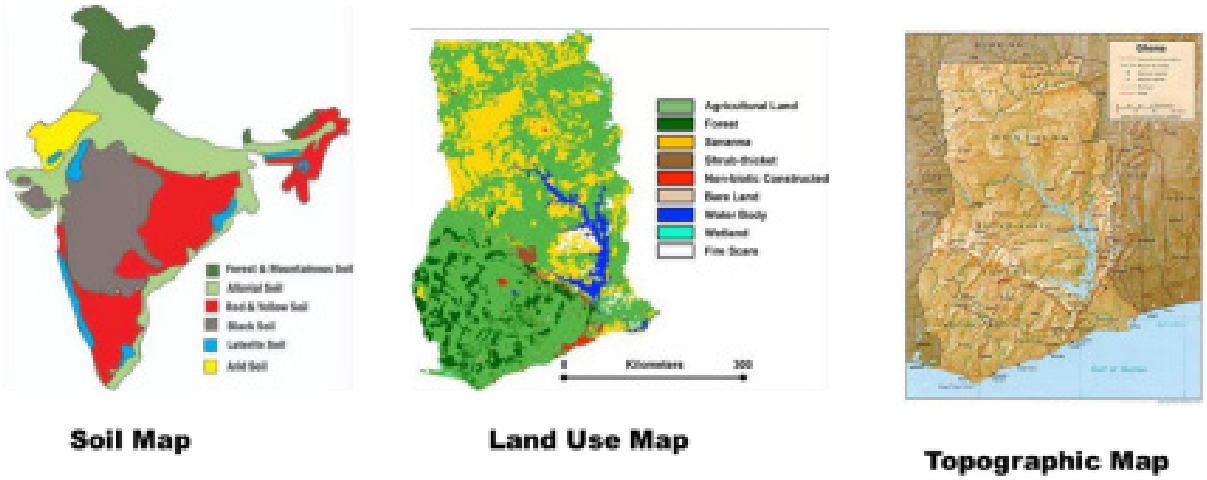


Figure 3.1: Different types of Maps in Surveying

Importance of Surveying and Mapping in Agriculture

Survey and mapping are critical components in modern Agriculture, providing numerous benefits including:

Precision and Sustainable Agriculture Practices

1. Surveying and mapping allow for strategic use of resources (inputs) such as fertilisers, pesticides, irrigation water, seeds to achieve maximum efficiency, productivity and sustainability in Agricultural systems and reduces waste.
    a. Surveying and mapping play a crucial role in identifying ecologically vulnerable areas, enabling the implementation of sustainable practices that safeguard soil and water quality. Techniques such as contour farming and buffer zones help mitigate environmental degradation, promoting soil conservation, water resource protection, erosion control, habitat preservation and biodiversity conservation.
    b. Detailed maps are essential tools for conservation, supporting sustainable resource management, habitat preservation, biodiversity protection, for a more resilient and thriving environment.
2. Improved Land Management and Enhanced Resource Management
    a. By using detailed maps, land use planning optimises agricultural land use, integrating crop rotation, irrigation management and infrastructure development to achieve higher productivity, reduced environmental impact and improved sustainability.

b. Soil maps serve as a critical tool for soil management, providing insights into soil characteristics, guiding precision agriculture practices, and informing evidenced based decisions to enhance soil fertility, structure and productivity.

c. Surveys and irrigation maps are essential tools in water resource management, enabling the assessment of water resources, efficient distribution and reduced waste, contributing to a sustainable water future.

3. Risk Management

   a. Accurate mapping of pets-and-disease-affected areas enables precise control strategies, reducing crop losses and halting the spread of harmful organisms.

   b. Climate data maps help farmers understand local weather patterns, prepare for extreme events and protect their crops from climate change.

4. Increased Productivity and Profitability

   a. By analysing yield maps, farmers spot good and bad areas, fix problems and boost crop production.

   b. Farmers save money and increase profits by using exactly what's needed, when and where it's needed.

5. Informed Decision Making

   a. Farmers having access to accurate and detailed data on soil, weather and crops allows them to make smart choices boosting yields and profits.

   b. Maps and surveys help farmers plan ahead, make informed decisions and build a stronger farm for the future.

6. Technological Integration

   a. Surveys and maps help farmers use cutting-edge tech such as GPS, GIS, drones and satellite imaging to modernise their farming.

   b. The integration of survey and mapping data with cutting-edge tech like artificial intelligence and machine learning drives innovation in precision agriculture and smart farming solutions.

7. Regulatory Compliance

   a. Surveys help clarify land ownership and borders, preventing disputes.

   b. Mapping helps farmers follow agricultural rules and regulations, thus meeting standards.

Importance of Survey and Mapping in Agriculture	• Precision and Sustainable Agricultural Practices • Improved Land Management and Enhanced Resource Management • Risk Management • Increased Productivity and Profitability • Informed Decision Making • Technological Integration • Regulatory Compliance • Compliance with Agricultural Policies

Figure 3.2: Importance of Surveying and Mapping in Agriculture

Activity 3.1 Meaning of Surveying and Mapping in Agriculture

1. In pairs, generate ideas to come up with the meaning of surveying and mapping in Agriculture by responding to these questions:
   a. What comes to mind when you hear the terms "surveying" and "mapping" in Agriculture?
   b. How do you think surveying and mapping are used in farming or agricultural practices?
   c. Can you provide an example of how surveying and mapping might be applied in a real-world agricultural scenario?
2. Write your responses in your notebook and share with your peers to fine-tune your thoughts.

Activity 3.2 Importance of Surveying and Mapping in Agriculture

1. In groups, use the internet and other relevant resource materials for information on the meaning and importance of surveying and mapping in agriculture.
2. Write down your detailed findings in your notebook.
3. Present your findings to the class for thorough discussion and note down all salient points.

Surveying and Mapping Instruments and Their Uses in Agricultural Production

Surveying and Mapping Instruments Used in Agricultural Production

Agricultural surveying and mapping instruments are essential tools used to measure and record spatial data such as distances, angles and positions to create accurate maps and plans for efficient farm management, precision agriculture and environmental sustainability. Key agriculture surveying and mapping instruments and their uses are:

1. **Global Positioning System (GPS) Devices**
    a. **Field Mapping**: Using GPS devices provides accurate and efficient mapping of field boundaries, irrigation systems optimal crop management, improved decision making, reduced waste and other important features.
    b. **Precision Navigation**: Thus, using GPS to guide and control movements with high accuracy in carrying out farming activities like planting, spraying, and harvesting.
    c. **Variable Rate Technology (VRT)**: Uses GPS to identify field conditions (soil type, moisture) adjust input rates (seed, fertilisers, pesticides) and apply precise amounts where needed to reduce waste, increased efficiency, improved yields, save costs.

    Examples of GPS Use in Ghanaian Agriculture

    1. Field boundary and farm size measurement (MoFA extension work)

    Extension officers commonly use handheld GPS units or smartphone GPS apps to:

    Measure farm sizes for subsidy targeting (e.g., fertilizer distribution).

    Demarcate accurate field boundaries for land tenure arrangements and farmer registration.

    GPS-based mapping of plots in the Northern Region (yield and production surveys)

    During crop-cutting surveys and harvest assessments in the Northern, Upper East and Upper West Regions, officers use GPS to:

    Record exact coordinates of sampled maize, rice or sorghum plots.

    Improve accuracy of production estimates and reduce double-counting.

    GPS tracking for extension services

    Some districts pilot the use of GPS-enabled mobile apps to:

    Track extension worker routes, ensuring farmers in remote communities receive visits.

Verify when extension agents reach specific farms.

GPS for monitoring fertilizer demonstration plots

Agricultural projects (e.g., USAID ADVANCE, CSIR field trials) use GPS to:

Record the position of each demo plot.

Track performance of fertilizer blends, seed varieties or agronomic practices across locations.

GPS coordinates for pest and disease reports

Plant protection officers and farmers submit GPS-tagged pest alerts, especially for:

Fall Armyworm outbreaks and other viral diseases outbreak.

2. **Geographic Information Systems (GIS)**

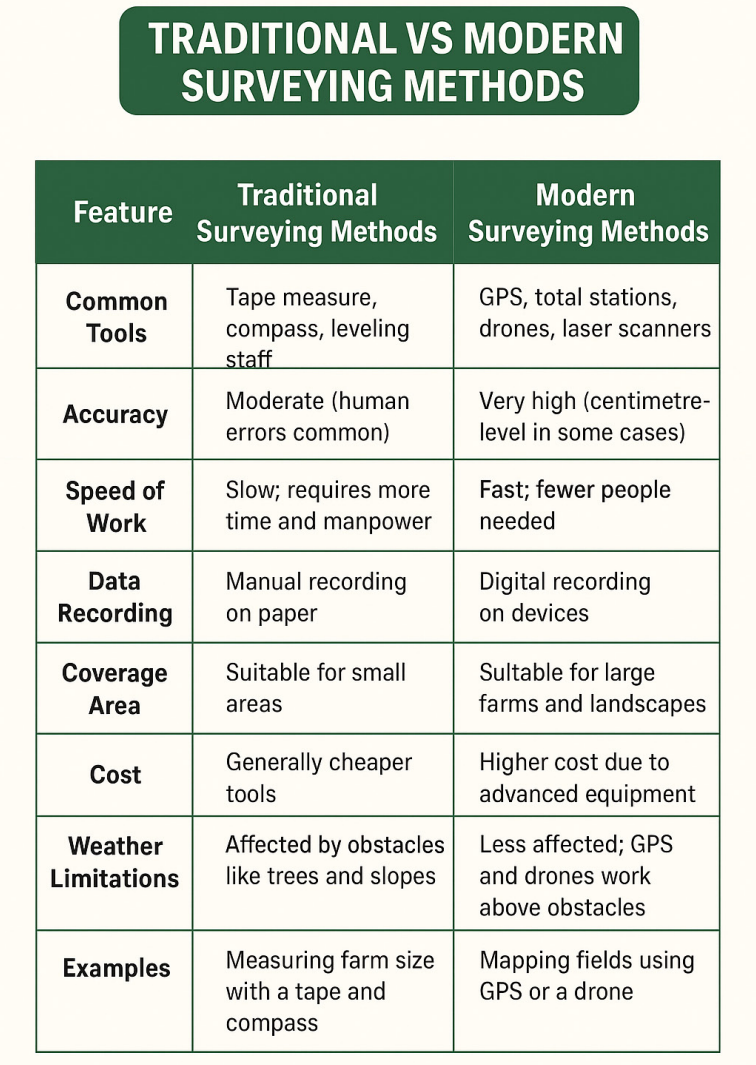
   a. **Data Management**: Enables farmers to store, analyse, and visualise spatial data on soil health, crop growth and environmental conditions, leading to informed decisions and improved yields.

   b. **Land Use Planning**: Enables farmers to make most of their land by identifying the best areas for different crops, livestock and conservation practices.

   c. **Mapping and Analysis**: By mapping and analysing farm data, farmers can make informed decisions on crop placement, resource distribution and land use, optimising yields and reducing waste.

   d. **Environmental Monitoring**: GIS technology helps monitor and manage environmental factors ensuring the conservation of natural resources, protection of habitat and mitigation of land degradation.

Table 3.1 Comparison between traditional and modern surveying methods



Feature	Traditional Surveying Methods	Modern Surveying Methods
Common Tools	Tape measure, compass, leveling staff	GPS, total stations, drones, laser scanners
Accuracy	Moderate (human errors common)	Very high (centimetre-level in some cases)
Speed of Work	Slow; requires more time and manpower	Fast; fewer people needed
Data Recording	Manual recording on paper	Digital recording on devices
Coverage Area	Suitable for small areas	Sultable for large farms and landscapes
Cost	Generally cheaper tools	Higher cost due to advanced equipment
Weather Limitations	Affected by obstacles like trees and slopes	Less affected; GPS and drones work above obstacles
Examples	Measuring farm size with a tape and compass	Mapping fields using GPS or a drone

Examples of GIS Use in Ghanaian Agriculture

a. Crop-yield mapping and spatial analysis (Northern Region)

- Researchers use satellite imagery + field data to create GIS-based maps showing:
- Variations in maize and rice yields
- Yield gaps
- Areas needing more fertilizer, water, or improved seed
- These maps guide extension officers on where to target support.

b. Soil fertility and soil property mapping (CSIR–Soil Research Institute)

- GIS is used to create spatial soil maps showing:
- pH levels
- Organic matter

- Nitrogen, phosphorus, potassium levels
- Soil texture and erosion risk
- These maps help recommend the right fertilizer for each agro-ecological zone.

c. Land suitability mapping for different crops
- MoFA and universities use GIS to overlay:
- Soil type
- Rainfall
- Elevation
- Temperature
- Land cover
- To identify suitable areas for crops such as:
- Cashew (Brong Ahafo, Savanna Zone)
- Rice (Northern, Volta, Ashanti regions)
- Cocoa (Western, Ashanti, Eastern regions)

d. Mapping irrigated areas (Volta Basin & Northern Ghana)
- GIS and remote sensing are used to:
- Identify irrigated fields
- Map dry-season vegetable production
- Monitor water availability in dams and dugouts
- This supports Ghana Irrigation Development Authority (GIDA) planning.

e. Agricultural value-chain mapping (CERSGIS data portal)
- GIS layers include:
- Storage facilities
- Markets
- Agro-dealers
- Road networks
- Processing centers
- This helps agribusinesses and policymakers locate gaps in service delivery.

f. Land-use/land-cover change detection

- GIS analysis is used to detect:
- Expansion of farmlands
- Deforestation in cocoa-growing areas
- This informs environmental protection and land-use planning.

g. Pest and disease risk zone mapping

- GIS is used to map hotspots for:
- Fall Armyworm

The maps combine climate, vegetation, and reported cases to predict future outbreaks.

3. **Remote Sensing Technology**

   a. **Satellite Imagery**: Provides high-resolution images or photographs of agricultural fields taken from satellite orbiting the planet to monitor crop health, soil moisture, vegetation cover, and changes over time.

   b. **Drones**: By using drones to capture high-resolution aerial images, farmers can conduct detailed analysis of crops conditions, identify areas affected by pests and soil erosions and make data-driven decisions to optimise their farming practices.

   c. **LiDAR (Light Detection and Ranging)**: Uses laser technology to create high resolution 3D maps of terrain, vegetation structure and canopy height for precision agriculture by reducing waste and improving yields.

4. **Soil Testing Kits**

   a. **Soil Composition Analysis**: It is the process of determining the physical, chemical and biological properties of soil. It involves measuring various parameters to understand soil`s structure, texture, fertility and overall health.

   b. **Nutrient Testing**: Also known as soil fertility testing is the analysis of soil samples to determine the availability and levels of essential nutrients (nitrogen, phosphorus, potassium) for plant growth.

   c. **pH Measurement**: It is the process of determining the acidity and alkalinity of a solution, such as soil, water or other liquids.

   d. **Crop Sensors**: These are devices that track various factors such as chlorophyll content, biomass, and nutrient deficiencies, aiding in timely interventions that ensures farmers grow healthier crops and increase yields.

5. **Laser Land Levellers**

   a. **Field Preparation**: It is the process of preparing the soil and land for planting crops. It involves various activities to create a conducive environment for optimal growth which includes levelling, ploughing, land clearing etc.

b. **Surface Smoothing**: Thus, the process of levelling and smoothing the soil surface to enhance crop growth, reduce soil erosion and improve irrigation efficiency.

6. **Weather Stations**

   a. **Climate Data Collection**: It is the process of gathering and recording of information about the weather and climate conditions such as temperature, humidity, rainfall, wind speed, and other weather conditions.

   b. **Microclimate Monitoring**: It is the measurement and analysis of localised atmospheric conditions within a specific area, such as farm, orchard, or vineyard.

7. **Yield Monitors and Harvest Mapping**

   a. **Yield Monitors**: These are devices or systems that measure and record crop yields and moisture content in real-time during harvest. They provide valuable insights into crop performance, helping farmers to optimise yields, reduce waste and improve profitability.

   b. **Harvest Mapping**: It is the creating of spatially referenced maps of crops yields, quality and other parameters during harvest. It helps farmers analyse and understand crop performance, identify areas for improvement and make data-driven decisions.

8. **Pest and Disease Detection Tools**

   a. **Field Scouting Tools**: These are devices, software or techniques used to collect data on crop health, growth and development in agricultural fields. These tools help farmers, agronomists and crop advisors.

   b. **Remote Sensors**: These are devices that detect and measure crop, soil and weather conditions from a distance, providing valuable insights for informed decision-making.

9. **Surveying Equipment**

   a. **Total Stations**: These are electronic surveying instruments that measure distances, angles and coordinates to determine the position of points on the earth's surface.

   b. **Theodolites**: These are optical instruments used to measure angles, heights and distances. Its primary use includes angular measurement, distance measurements and levelling and alignment.

   c. **Tape measure**: It is a flexible ruler used to measure distances, lengths, and widths in various applications.

   d. **Ranging pole**: Also known as surveyor's staff or levelling rod, it is a versatile tool used for boundary demarcation, marking and offset measurement, and measuring small distances from reference points.

Figure 3.3: Some Survey and Mapping Instruments

Activity 3.3 Visiting a Surveying Site

In groups, visit a survey site/watch videos/pictures on the surveying process of a land. Identify the names of the various survey instruments used and write them in your notebook.

Activity 3.4 Explanation of the Surveying Instruments Used in Agriculture

1. In groups, use the internet and other relevant resources to come up with an explanation on the uses of the survey and mapping instruments identified in Activity 3.3.
2. Write them down in the table below and share with your peers to cross-check your work.

S/N	Instruments Identified	Explanation/Uses

Activity 3.5 Finding Surveying and Mapping Instruments Used in Agriculture

1. In groups, research and identify surveying and mapping instruments.
2. Create a categorised list of instruments and develop a presentation highlighting the instrument's features, applications and benefits.
3. Design an infographic illustrating instrument usage and prepare a written report. Present these to the class and discuss.

PROCEDURE FOR CONDUCTING SURVEY AND MAPPING OF FARMSTEAD

The Procedure for Conducting Survey and Mapping of a Farmstead

1. Planning and Preparation
    a. **Define Objectives**: It is clear by identifying and articulating specific, measurable, achievable, relevant and time-bound goals for a project, task or initiative (e.g., field boundaries, infrastructure, soil types, water resources).
    b. **Gather Existing Data**: Collect existing maps, aerial photos, and historical data about the farm to help plan the survey.
    c. **Equipment and Tools**: Ensure you have the necessary tools and equipment, such as: GPS devices, measuring tools, drones, soil testing skills and mapping software.
    d. **Field Personnel**: Assign trained staff familiar with survey equipment and methods to conduct the fieldwork.
2. Field Survey
    a. **Field Boundary Survey**: Measure and mark the farm's boundaries using GPS or specialised equipment. Record the exact coordinates and double-check them against official property records if necessary.
    b. **Infrastructure Mapping**: Locate and map the farm's existing features, including buildings, roads, fences, watering systems, and drainage channels. Measure distances between them and note their condition.
    c. **Topographic Survey**: Create a detailed map of the farm's landscape, including elevation (high and low points), slopes, hills and valleys. Use specialised equipment (total stations or drones) to take precise measurements, create 3D models and generate contour maps.
    d. **Soil Sampling and Mapping**: Take soil samples from different areas of the farm to test soil texture, pH levels and nutrient levels. Use special tools to collect and analyse soil samples at various depths and locations.
    e. **Water Resources Assessment:** Find and map the farm's water sources, including: wells, ponds, streams and assess water flow rates, water quality and irrigation system. Document how water is distributed across the farm.
    f. **Crop and Vegetation Mapping**: Use aerial images (from satellites or drones) to identify crop types, measure vegetation coverage, check crop health. Observe and record crop growth stages, pest and disease issues and overall vegetation condition.

3. Data Processing and Analysis
   a. **Data Integration**: Combine all data (surveys, field measurements, and aerial images) into one digital map. Ensure all data is accurate, consistent and location-specific.
   b. **Map Creation**: Create detailed maps using digital tools to show farm boundaries, roads and buildings, hills and valleys, soil types and water sources. Also, create specialised maps to focus on soil fertility areas, irrigation coverage and crop growth zones. These maps help visualise and understand the farm's features.
   c. **Analysis and Interpretation** to farm management: Analyse maps to identify patterns, understand relationships between factors (e.g., soil quality and crop yield). Use findings to identify strengths (what's working well), weaknesses (areas for improvement), opportunities (potential benefits) and threats (potential risks). This helps make informed decisions for the farm.
4. Reporting and Implementation
   a. **Documentation**: Create a comprehensive report that includes how the survey was done, what data was collected, key findings and recommendations for improvement. Use visuals such as maps, charts and tables to help stakeholders easily understand the results.
   b. **Recommendations**: Offer practical advice to improve farm management, use resources more efficiently and fix problems found during the survey. Recommendations should be Specific, Measurable, Achievable, Relevant and Time bound (SMART) to help the farm increase productivity, reduce waste, overcome challenges and reach its full potential.
   c. **Implementation**: Put recommended changes into action with farm owners, managers and stakeholders. Implement improvements based on survey results. Track progress over time to measure success and identify areas for further improvement. Ensure changes make a lasting, positive impact on the farm.

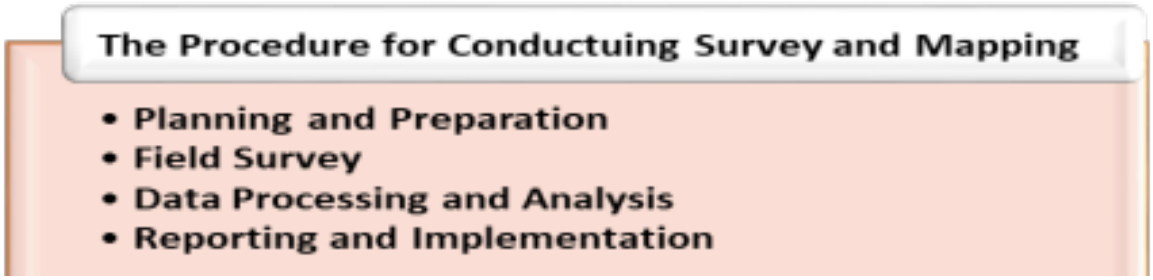


Figure 3.4: The Procedure for Conducting a Survey and Mapping of a Farmstead

Activity 3.6: Identification of Locations.

1. In groups, choose at least 3 landmarks on the school compound example the school gate, school farm, science laboratory, football field etc.
2. Using a smart phone or a tablet with internet (turn on GPS/location services on their phones, open Google Maps and tap "My Location.") or a printed map of the school locate each place on the map.
3. Record the coordinates of the location that is the latitude and longitude
4. Present your findings to the class.

Activity 3.7 Explaining the Procedures for Conducting a Survey and Mapping

In groups, be guided by the following instructions from the resource person to conduct a survey and map a farmstead:

Pre-survey (guided instruction)

1. Introduction to farmstead surveying
2. Objectives, scope and data requirements
3. Review of sample farmstead survey report.

Field Survey (Guided Practices)

1. Conduct a mock survey on a sample farmstead.
2. Using GPS Devices.
3. Aerial imagery and sampling equipment
4. Record observations, measurements

Data analysis (Guided Practice)

1. Import data georeferencing layers
2. Creating base and thematic maps
3. Identifying patterns, correlations

Presentation and Reflection (Guided feedback)

1. Sharing survey findings, maps
2. Documenting lessons learned
3. Discussing challenges, best practices

Develop a farmstead survey plan, conduct a farmstead survey and create a farmstead map for presentation to the class.

Activity 3.8 Conducting a Survey and Mapping Using a Case Study

Afriyie and Afriyie Acres Farmstead, a 100-acre farm in Atonsu, needs to update its survey and mapping records to improve crop management, irrigation and land use planning.

Conduct a comprehensive survey and mapping of Afriyie and Afriyie Acres Farmstead and present to the class for discussion.

Be guided by the following:

Pre-survey

1. Review farm records and aerial imagery
2. Consult the farm manager and stakeholders
3. Define survey objectives, scope and data requirements

Field survey

1. Conduct a GPS survey using GPS software. You can also try your hand at this activity using Trimble GeoXT.
2. Collect aerial imagery using drone technology
3. Gather soil samples and water quality data.

Data analysis

1. Import data into Excel. You can also try your hand at this activity using ArcGIS Software.
2. Geo-reference data layers
3. Analyse spatial relationships.

Mapping

1. Create base maps (topography, boundaries)
2. Design thematic maps (soil fertility, irrigation)
3. Conduct a SWOT analysis of the farmstead.

Procedure for Preparation of a Map of a Farmstead

1. Define Objectives and Scope
   a. **Identify Purpose**: Define the purpose of the map, to include planning land use, managing infrastructure, optimising crop growth and allocating resources effectively. Identify specific goals, such as increasing efficiency, reducing costs, improving crop yield and enhancing sustainability. Clarify what you want to achieve with the map.

b. **Scope of Mapping**: Identify the farm's borders and what to include in the map, such as fields and crops, buildings (barns, homes, etc.), roads and paths, water sources (ponds, streams, etc.) and other important features (irrigation systems, fences, etc.). Determine the map's scope to ensure everything necessary is included.

2. Gather Existing Information

   a. **Collect Existing Maps and Data**: Collect existing information about the farm, including old maps, aerial photos, survey reports and historical records. Use these resources as a starting point, reference guide and basis for comparison to save time and ensure accuracy in the mapping process.

   b. **Verify Boundaries:** Make sure the farm map shows the correct property lines. Check official records (e.g., deeds, titles) if needed to confirm accuracy, avoid disputes ensure compliance and to guarantee, the map reflects the farm's legal boundaries.

3. Conduct Field Survey and Data Collection

   a. **Equipment Preparation**: Get equipment ready for surveying to includes devices, measuring tools (tapes, total stations) and drones. Ensure that everything is calibrated and working properly. Also, prepare notebooks for notes, data sheets for recordings and mapping software for field data to ensure accurate and efficient data collection.

   b. **Field Survey**:

      i. **Boundary Mapping**: Use GPS or survey tools to precisely measure and mark the farm's boundaries. Record boundary coordinates (latitude/longitude) and key features (gates, fences, corners) to create an accurate map of the farm's perimeter.

      ii. **Infrastructure Mapping**: Map and measure the farm's infrastructure, including buildings (barns, houses, etc.), roads and paths, fences and gates, water sources (wells, ponds), irrigation and drainage systems. Record distances between key points, exact locations (GPS coordinates) to create a detailed and accurate map of the farm's layout.

      iii. **Topographic Mapping**: Measure the farm's landscape elevation changes (hills, valleys), slopes and terrain features (ridges, depressions). Use advanced tools to include total stations (precise measuring devices) and drones with special cameras (LiDAR, photogrammetry) to create detailed maps of the farm's terrain.

      iv. **Soil Sampling**: Take soil samples from different areas of the farm to test soil type (sand, clay, loam), acidity/alkalinity (pH), nutrient levels (fertiliser needs) and organic matter (health and fertility). Record where each sample was taken and how deep each sample was to understand the farm's soil health and optimise crop growth.

      v. **Vegetation and Crop Mapping**: Use aerial technology (satellites, drones) to identify crop types, measure vegetation coverage and monitor

crop health. Track crop growth stages and signs of pests or disease to optimise crop management and yields.

c. **Water Resources Assessment**: Identify and map water sources to include wells, ponds, streams and irrigation systems. Gather data on water flow rates, water quality and distribution networks to manage water resources efficiently.

4. Data Processing and Map Creation

   a. **Data Integration**: Combine all farm data into one digital map thus field measurements, soil samples, crop health, water sources and infrastructure. Use specialised software (GIS) to match data to exact locations, ensure accuracy and align with geographic coordinates to create a comprehensive digital farm map**.**

   b. **Map Design and Creation**: Create interactive farm maps using GIS software, showing: Property boundaries, roads and buildings, hills and valleys, soil types, water sources and crop coverage. Design customised maps to focus on specific farm aspects, such as soil fertility zones, irrigation areas and crop distribution. Visualise farm data to inform decisions.

5. Analysis and Interpretation

   a. **Spatial Analysis**: Analyse farm data connections: Soil type vs. crop yield, water sources vs. irrigation and terrain vs. erosion. Combine map layers to reveal Patterns, correlations and insights. Uncover hidden trends to optimise farm management.

   b. **Interpretation and Reporting**: Analyse map findings to: Identify farm strengths, pinpoint weaknesses, spot opportunities and anticipate threats (SWOT analysis). Create a detailed report covering mapping process data collection, key findings and actionable recommendations for informed farm management and planning.

6. Implementation and Monitoring

   a. **Implementation of Recommendations**: Put farm map insights into action by collaborating with farm managers and stakeholders and implementing recommended improvements. Track progress to monitor implementation and evaluate effectiveness for continuous farm improvement.

   b. **Periodic Updates:** Keep farm maps up-to-date by adding new data and Reflecting changes in infrastructure, land use, and crops. Use updated maps for informed decision-making, continuous improvement and for optimal farm performance.

See Figure 3.5 for example of the Layout of a Farmstead Map

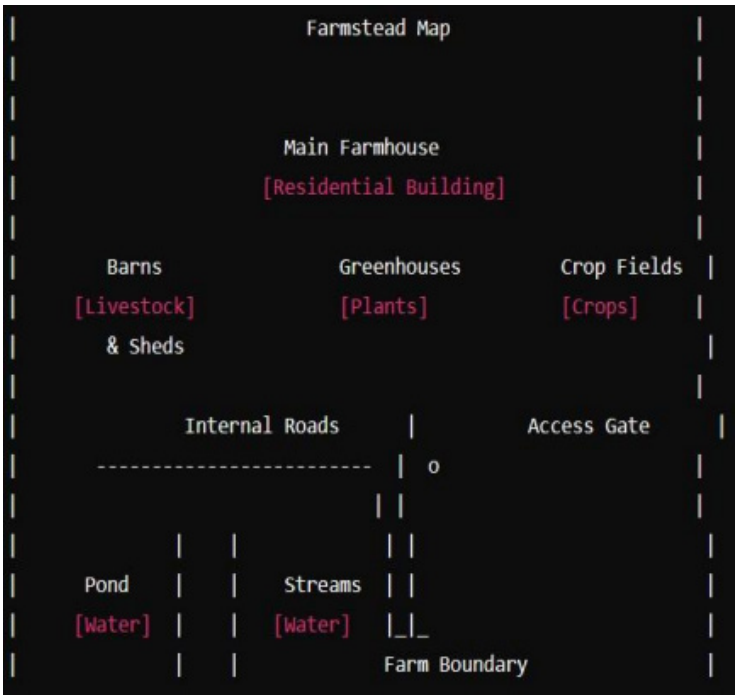


Figure 3.5a: A typical farm stead for crops and animals

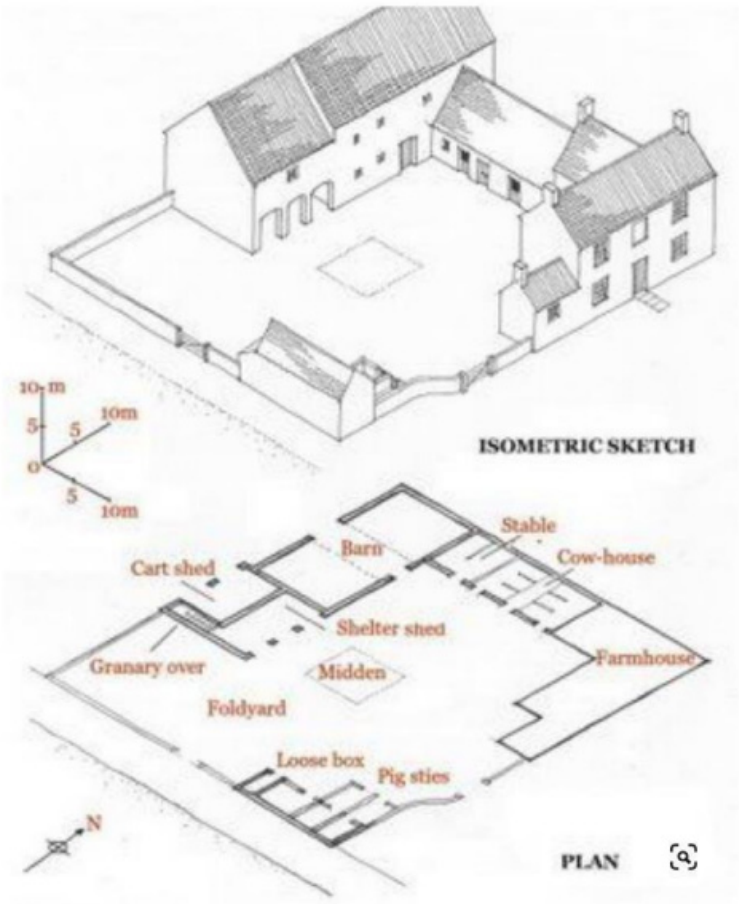


Figure 3.5b: A typical layout and farm stead for farm animals

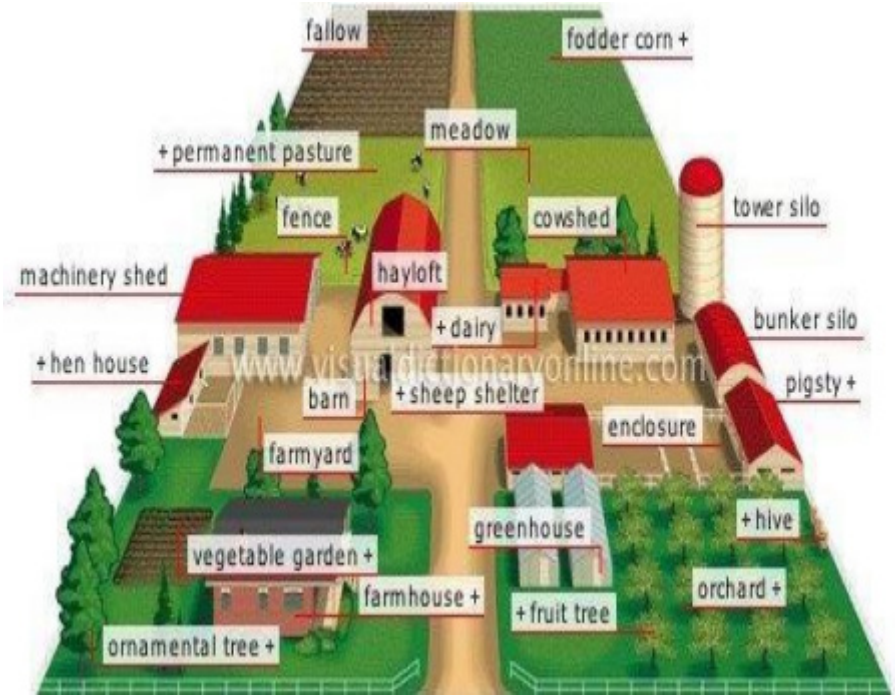


Figure 3.5c: A typical farmstead

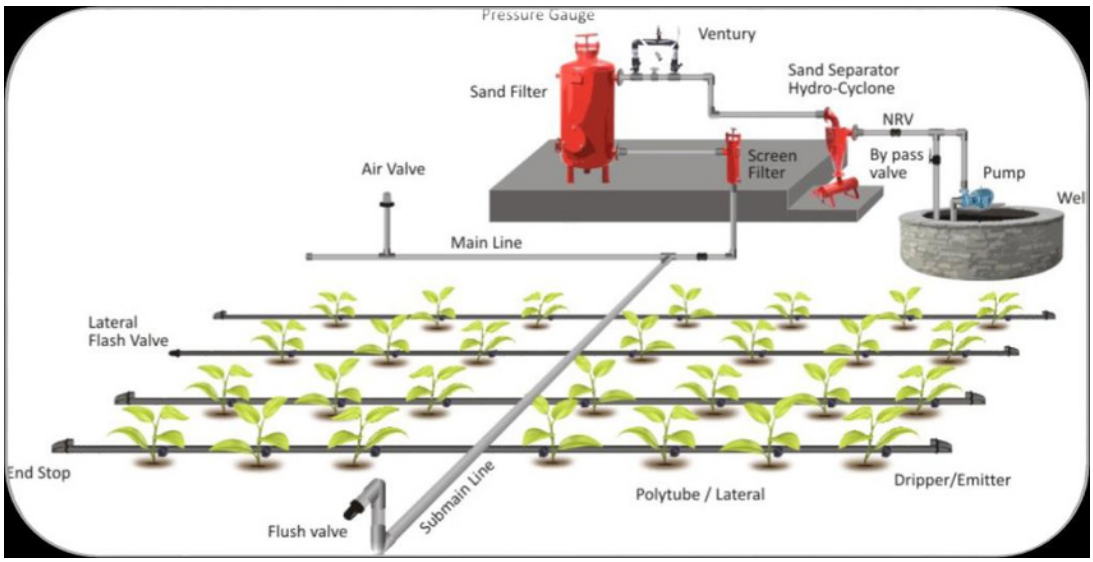


Figure 3.5d: A typical layout of drip irrigation system

How SWOT Analysis Connects to Farm Mapping

1. What is SWOT analysis?

SWOT stands for:

Strengths – things the farm is good at

Weaknesses – problems on the farm

Opportunities – chances for improvement

Threats – dangers that can affect the farm

2. What is farm mapping?

Farm mapping is the process of drawing a simple map of the farm to show:

- Fields and plots
- Soil typesWater sources
- Slopes and erosion areas
- Roads and buildings
- Problem areas (pest zones, flood areas, etc.)

3. How the two are connected

The farm map provides the information needed to identify strengths, weaknesses, opportunities, and threats.

SWOT analysis then helps the farmer decide what to improve on the map.

Example

Map shows a fertile lowland → Strength

Importance

Using SWOT together with farm mapping helps the farmer to:

- Plan crop arrangement
- Map shows an eroded slope → Weakness
- Map shows unused land → Opportunity
- Map shows an area close to a bushfire zone → ThreatSelect good areas for production
- Reduce risks
- Improve the overall farm layout

Activity 3.9 Explaining the Procedure of Preparing a Map of a Farmstead

1. In pairs, visit a farmstead or use the internet and watch a video documentary on mapping a farmstead and gather information/data on mapping.
2. Document your findings in your notebook and share with your peers to fine-tune your thoughts.

Activity 3.10 Farmstead Mapping Project

In groups, create an accurate and informative map of a farmstead and present it to the class. Be guided by the following:

Planning

1. Research farmstead mapping principles
2. Define project scope, objectives and deliverables
3. Identify stakeholders (farm managers, owners). Develop a project outline and workflow

Data collection

1. Conduct field observations and measurements.
2. Collect GPS coordinates and aerial imagery
3. Gather soil samples and water quality data
4. Interview farm stakeholders

Data analysis

1. Import data into Excel or GIS software (e.g., ArcGIS, QGIS)
2. Geo-reference data layers
3. Analyse spatial relationships.
4. Identify patterns and trends.

Map creation

1. Design map layout and compositions
2. Create base maps (topography, boundaries
3. Add thematic layers (soil fertility, irrigation)
4. Include legends, labels and annotations.

EXTENDED READING

- "GIS Fundamentals" by Bolstad (eBook)
- "GIS Mapping: A Guide to Understanding and Creating Maps" by Amy E. Frazier (eBook)
- "Map Projections: Theory and Applications" by Frederick J. Doyle (eBook)
- "Surveying Fundamentals" by Larry P. Morman (eBook)
- "Surveying: A Guide for Beginners" by Richard L. Elgin (eBook)

REVIEW QUESTIONS

1. The primary purpose of surveying is to ...
   - **A.** create maps
   - **B.** determine property boundaries
   - **C.** study Earth's shape
   - **D.** analyse spatial data
2. What type of surveying involves measuring vertical distances and heights?
   - **A.** Levelling
   - **B.** Triangulation
   - **C.** Trilateration
   - **D.** Geodesy
3. What is the difference between a map projection and a geographic coordinate system?
   - **A.** Scale and accuracy
   - **B.** Datum and reference frame
   - **C.** Spatial relationships and distortion
   - **D.** All of the above
4. What is GIS?
   - **A.** **a.** Geographic Information System
   - **B.** Global Positioning System
   - **C.** Geospatial Intelligence System
   - **D.** Geographic Imaging System
5. The purpose of georeferencing in GIS is to ...
   - **A.** assign spatial coordinates
   - **B.** create map projections
   - **C.** analyse spatial relationships
   - **D.** visualise data
6. Triangulation improves surveying accuracy by ...
   - **A.** reducing measurement errors
   - **B.** increasing measurement precision
   - **C.** establishing a network of reference points
   - **D.** using GPS technology

REVIEW QUESTIONS

7. What is the difference between a topographic map and a thematic map?
   - **A.** Scale and detail
   - **B.** Purpose and content
   - **C.** Projection and coordinate system
   - **D.** All of the above
8. Remote sensing contributes to surveying and mapping by …
   - **A.** providing real-time data
   - **B.** increasing measurement accuracy
   - **C.** enabling large-scale data collection
   - **D.** reducing fieldwork requirements
9. What is the difference between surveying and mapping?
10. State four important aspects of surveying and mapping in Agriculture.

SECTION

4

IRRIGATION DRAINAGE AND POST-HARVEST IMPLEMENTS IN AGRICULTURAL PRODUCTION

MODERN TECHNICAL AND MECHANISED AGRICULTURE

Modern Mechanised Agriculture

INTRODUCTION

Irrigation and drainage systems are critical components of modern agriculture, enabling the efficient management of water resources to ensure optimal crop growth and soil health. Learning these systems in agriculture will provide students like you, the knowledge and skills necessary to manage water in agricultural settings to boost productivity, conserve resources and protect the environment. This section will enable you to understand the concept of irrigation and water management. This will equip you with the knowledge to appreciate the different water requirements of crops at different growth stages, their soil preference, as well as nutrient management. This section will further expose you to the tools, implements and machines used in harvesting and post-harvesting handling of crops. This section has links with subjects such as applied technology, robotics, engineering, aviation and aerospace. Welcome to the section.

KEY IDEAS

- Irrigation refers to the artificial application of water to land to support the growth of crops, landscape plants, and lawns.
- Drainage refers to the natural or artificial removal of excess water from an area or surface. Waterlogging occurs when the ground becomes so soaked with water that air spaces in the soil are filled with water instead of oxygen, creating an environment where plants, crops, or infrastructure may be damaged.
- Installation refers to the process of setting up or placing something in its correct position or making it functional, whether it is a system, equipment, art piece, or software.
- Harvest refers to the season or process of gathering and collecting crops that have reached maturity.
- Equipment is the set of tools, machinery, devices, or other items necessary for a specific purpose or activity.

MEANING AND BENEFITS OF AGRICULTURAL IRRIGATION AND DRAINAGE SYSTEMS

Exploration of Agricultural Irrigation and Drainage Systems

Agricultural Irrigation System

Agricultural irrigation systems are designed to provide water to crops in a controlled manner to ensure optimal growth and maximise yields, especially in areas with insufficient or irregular rainfall. These systems are put in place to correct shortfalls or irregular patterns of rainfall.

Agricultural Drainage Systems

Agricultural drainage systems are designed to remove excess water from soil surface and subsurface to improve soil conditions for optimal crop growth and productivity. These systems play a vital role in enhancing agricultural production by addressing two primary objectives: the removal of excess surface and subsurface water, and the management of excess soluble salts in the soil.

Integration of Irrigation and Drainage

Integration of irrigation and drainage refers to the coordinated management of both water supply (irrigation) and water removal (drainage) systems in agriculture to optimise crop growth, soil health, and water use efficiency. These two systems work together to control the moisture content in the soil, ensuring that crops receive the right amount of water without excess accumulation that can lead to waterlogging, salinisation, or soil erosion.

The following factors should be considered when operating under this system:

- **Topography of the land**: The gradient of the land effects both water flow and drainage. Steeper slopes may cause water runoff, requiring irrigation methods like drip systems to prevent erosion, while flat or low-lying areas may need better drainage systems to avoid waterlogging.
- **Soil characteristics**: some characteristics of the soil must also be considered under this system such as the soil texture (the composition of sand, silt, and clay affects how well the soil holds or drains water), soil structure (well-structured soils with good aeration and porosity allow for better water infiltration and drainage, whereas compacted soils may require more intensive drainage solutions).
- **Water availability and quality:** The amount of water available for irrigation influences the choice of system. Limited water resources call for efficient systems like drip irrigation combined with well-managed drainage to prevent water waste.
- **Climate and weather patterns:** In regions with heavy rainfall, drainage systems must be prioritised to prevent water accumulation and waterlogging. In contrast,

in arid areas, irrigation systems should be designed to make the best use of limited water resources.

- **Environmental impact:** An integrated system should prioritise the efficient use of water, minimising waste, and preventing over-irrigation or excessive drainage. It should promote long-term agricultural productivity without degrading natural resources or affecting nearby ecosystems.

Benefits of Agricultural Irrigation and Drainage Systems

Benefits of Agricultural Irrigation Systems

The following are some benefits of agricultural irrigation systems:

1. Irrigation systems can significantly reduce water waste and improve water efficiency, allowing farmers to use water more judiciously.
2. Proper irrigation helps maintain optimal soil moisture levels, leading to healthier plant growth, higher crop yields, and better-quality produce.
3. Irrigation ensures crops receive the necessary water, even during dry spells, improving the overall success and reliability of agricultural production.
4. Irrigation expands the range of crops that can be grown, allowing farmers to diversify their yields.
5. Irrigation enables longer growing seasons, providing more opportunities for harvests throughout the year.
6. Higher and more consistent crop yields, along with the ability to grow high-value crops, lead to increased profitability for farmers. The use and maintenance of irrigation systems often require additional labour, leading to job creation in rural areas.
7. Irrigation and other systems allow for fertigation, the process of delivering nutrients to crops through the irrigation system. This promotes more efficient nutrient uptake and improves soil fertility.
8. Irrigation ensures even distribution of water across the field, leading to uniform crop growth. This results in better crop quality, which can command higher market prices.

Benefits of Agricultural Drainage Systems

The following are some benefits of agricultural drainage systems:

1. It helps prevent the saturation of soil, which can suffocate plant roots due to reduced oxygen availability. By removing excess water, drainage systems prevent the development of shallow root systems and encourage deeper, stronger roots, which enhance plant stability and nutrient absorption.
2. Proper drainage removes the issue of reducing compaction of the soil caused by waterlogging. By preventing waterlogging, drainage systems help preserve

organic matter and beneficial microorganisms that thrive in well-drained soils thereby improving soil fertility over time.

3. Effective drainage ensures that crops receive the ideal moisture level without experiencing stress from excess water. This leads to better crop growth and higher yields. Excess water in soil promotes the growth of fungi, bacteria and root rot, which can devastate crops.
4. Drainage systems make previously unusable, waterlogged land useful for agricultural production, increasing the available land area for farming.
5. Proper drainage systems can prevent localised flooding, particularly during heavy rains, which can devastate crops and lead to large-scale losses.
6. With reduced waterlogging, roots can grow deeper into the soil, accessing nutrients and water from a broader area. This leads to stronger, healthier plants.

Combined Benefits of Integrated Irrigation and Drainage Systems

1. The system prevents soil from becoming too dry or too wet, reducing the risk of soil compaction, erosion and salinisation, which can destroy the soil structure.
2. By combining irrigation with drainage, farmers can better plan when and how much water to apply, adjusting water levels based on both current weather conditions and field water levels.
3. An integrated system allows for more flexible and efficient planting, cultivation and harvesting operations, reducing delays caused by excessively wet or dry fields.
4. Integrated systems allow farmers to adapt to unpredictable weather conditions, whether it's too much rainfall or an extended dry period, by providing tools to manage both extremes effectively.
5. By combining irrigation and drainage, farmers can control both the addition and removal of water, ensuring that crops receive the right amount of water for healthy growth at all times.

Activity 4.1 Meaning and Importance of Irrigation and Drainage

1. What comes to mind when you hear the term 'irrigation and drainage systems in agricultural production'?
2. Write your idea in your notebook and share it with your peers for feedback.

Activity 4.2 Importance of Drainage and Irrigation Systems

1. Using the internet and other resources, come up with the reasons why irrigation and drainage systems in agricultural production are important.
2. Write your findings in a table below and present them to the class for feedback.

NB: You should have a minimum of 5 reasons for each (irrigation and drainage).

Table 4.1

Importance of an irrigation system	Importance of a drainage system

Activity 4.3 Problems Associated with Irrigation and Drainage Systems

1. In groups, discuss the problems associated with irrigation and drainage in agricultural production. Use the following questions to guide your discussion:
   a. How might the use of too much water in irrigation affect both the crops and the surrounding environment?
   b. What do you think could happen to crops if fields are not properly drained after heavy rainfall or irrigation?
   c. How might poor irrigation and drainage systems affect local water sources like rivers and lakes?
   d. What do you think could happen to crops if fields are not properly drained after heavy rainfall or irrigation?
2. Present the salient points from your discussion to the class for feedback.

METHODS AND USES OF IRRIGATION AND DRAINAGE SYSTEMS IN AGRICULTURAL PRODUCTION

Methods of Irrigation Systems in Agricultural Production

The following are some methods of irrigation and drainage systems in agricultural production:

Surface Irrigation

Surface irrigation is the most common form of irrigation where water is applied and distributed over the soil surface by gravity. It involves the application of water to the entire field or in controlled channels through the field. Types of surface irrigation includes:

1. Flood irrigation

Flood irrigation, also known as surface irrigation, involves applying water to the entire field surface and allowing it to flow and spread naturally across the land. This method does not channel the water into specific furrows or trenches.

Advantages of flood irrigation

- Flood irrigation requires minimal infrastructure or equipment, making it accessible to small and resource-constrained farmers.
- Flood irrigation can cover large fields quickly with minimal effort.
- Flood irrigation uses gravity to spread water directly to the plants' root zone, minimising water loss due to evaporation and runoff.
- Runoff water from flood irrigation can be recycled, improving the overall efficiency of the system.

Disadvantages of flood irrigation

- A significant amount of water can be lost through evaporation, runoff, or deep percolation, particularly in sandy soils or uneven fields.
- If drainage is poor or water is applied excessively, it can lead to waterlogging, which harms many crops by suffocating roots and reducing oxygen availability.
- Flooding large areas may cause soil erosion, especially if the water flow is too fast or the soil structure is weak.
- In poorly drained soils or areas with saline groundwater, flood irrigation can contribute to salt buildup in the soil, reducing soil fertility over time.

2. Furrow irrigation

Furrow irrigation involves channelling water through small, evenly spaced trenches or furrows running along the length of the field. The water flows down these furrows and infiltrates the soil around the crop roots. Furrow irrigation avoids flooding the entire field surface.

Advantages of furrow irrigation

- Furrow irrigation tends to be more efficient than flood irrigation because water is applied directly to the root zone rather than the entire field.
- By limiting the water to the furrows between rows, the risk of waterlogging is minimised, especially for crops sensitive to excess water.
- Water is kept off the leaves and stems of crops, reducing the risk of diseases that thrive in wet conditions.
- It works well on a variety of soil types, particularly clay soils that allow for slow water movement, ensuring better absorption**.**

Disadvantages of furrow irrigation

- It has lower application efficiency compared to other irrigation methods like sprinkler and subsurface drip irrigation. This leads to higher labour costs.
- It is not efficient on sandy soils, as the water tends to soak in before reaching the end of the furrows.
- It can trigger environmental problems related to deep percolation, runoff, and soil erosion.
- The initial capital investment, other than land grading, is relatively low compared to other irrigation systems.

Sprinkler Irrigation

This is a method of applying water to crops, lawns and other areas through a network of pipes and sprinkler heads. The sprinklers release water under high pressure, similar to rainfall, allowing for efficient and even distribution across the target area. The two types of sprinkler irrigation are:

1. Centre pivot

This method of sprinkler irrigation uses a rotating arm to distribute water across large, circular fields. The system revolves around a central pivot point, and it is widely used in large-scale agriculture for a variety of crops. This irrigation method is particularly effective in regions with flat or gently sloping land and is commonly seen in arid and semi-arid areas. Some components include; pivot point, wheeled tower and sprinkler nozzles.

Advantages of centre pivot

- Minimised soil erosion.
- Very effective with fertigation.
- Covers large farm area.
- Uniform water distribution.

Disadvantages of centre pivot

- High initial cost.
- Not suitable for small farms.
- Lot of energy is required to operate.
- Much attention is needed.

2. Lateral move

It is also known as linear move irrigation, is a type of mechanised irrigation system that moves in a straight line across a field, providing uniform water distribution. Unlike centre pivot irrigation, which rotates around a fixed central point, lateral move systems travel horizontally, making them ideal for rectangular or irregularly shaped fields.

Advantages of lateral move

- Uniform water distribution
- Efficient water use
- Effective for fertigation
- Can be used on different field shapes.

Disadvantages of lateral move

- High initial cost.
- Regular maintenance is necessary.
- Requires energy to pump water which can increase operational cost.

Drip Irrigation

Drip irrigation is a highly efficient method of watering plants and crops by delivering water directly to the roots through a network of tubes and emitters. This system is designed to minimise water usage and maximise plant growth by providing a slow, steady supply of water and nutrients directly to the plant's root zone. It is suitable for row crops such as vegetables and soft fruits, as well as tree and vine crops.

Advantages of drip irrigation

- Drip irrigation can save up to 60% of water compared to traditional irrigation methods.

- Fertilisers and other nutrients can be easily incorporated into the drip system, ensuring optimal delivery to the plants.
- The localised water application minimises moisture in between plants, hindering weed germination and growth.
- Consistent moisture and nutrient supply promote stronger root systems and overall plant vigour.
- Drip irrigation reduces the physical, time, and health burdens of water-carrying for women and girls.
- This leads to better school attendance for girls and greater productivity and well-being for women.

Disadvantages of drip irrigation

- High initial cost.
- High maintenance requirement.
- Requires clean water.
- Require high level skill and technical know-how of the farmer**.**

Subsurface Irrigation

Subsurface irrigation is a highly efficient method of delivering water and nutrients directly to the crop root zone by burying the irrigation system beneath the soil surface.

Advantages of subsurface irrigation

- High water use efficiency
- Reduced weed growth
- Improved plant health
- Decreased evaporation and runoff

Disadvantages of subsurface irrigation

- High energy costs.
- Not suitable for all soil types.
- Clogged emitters and pipes are difficult to detect.
- High initial installation costs.

Manual Irrigation

Manual irrigation refers to the process of watering crops, gardens or landscapes by hand or with simple tools, rather than using automated or mechanical systems. It is typically done using watering cans, hoses, buckets, or other basic devices that allow the person performing the irrigation to control the flow and amount of water applied. This method

is commonly used in small-scale agriculture, home gardens, or in areas where there is limited access to automated irrigation systems.

Advantages of manual irrigation

- Low cost, especially in small-scale settings.
- Simple to implement without need for advanced equipment.
- Complete control over the amount of water delivered to specific areas.
- Farmers can easily adjust the amount and frequency of watering.

Disadvantages of manual irrigation

- Labor-intensive and time-consuming, especially for large areas.
- Difficult to ensure even water distribution.
- Risk of over- or under-watering plants.

See **Figure 4.1** for the various methods of irrigation systems

Figure 4.1: Methods of Irrigation System

Methods of Drainage Systems in Agricultural Production

See **Figure 4.2** for methods of drainage systems in agriculture.

Surface Drainage

This refers to the diversion or controlled removal of excess water from the land surface. It involves constructing shallow channels or ditches to direct runoff water away from the land and into natural watercourses or drainage systems.

The types of surface drainage are:

1. **Open ditches:** Open ditches are a common method used in surface drainage systems to remove excess water from the land surface. They work by creating excavations in the soil that collect and channel away water that has accumulated, often due to a high-water table or shallow slopes that do not allow for proper drainage.

Advantages of open ditches

- Low initial cost.
- Easy to maintain.
- Increased soil moisture.
- Much equipment is not needed.

Disadvantages of open ditches

- Water loss through evaporation and seepage (refers to the slow movement or leakage of water through soil or other porous materials)
- Can cause soil erosion.
- It requires large land and space.
- High maintenance needs.

2. **Land grading:** It refers to the process of altering the slope and contours of land to direct water flow away from structures, fields, or other areas that need protection from water accumulation.

Advantages of land grading

- Prevent water accumulation and flooding
- Reduces water erosion.
- Reduces maintenance cost.
- Prevents waterlogging and optimises soil moisture

Disadvantages of land grading

- High initial cost.
- Risk of over- or under- grading.
- Disruption of soil structure.

Subsurface Drainage

This method is used to remove excess water from beneath the soil surface. This system involves the installation of underground pipes or tiles to lower the water table and prevent waterlogging, which can negatively affect plant growth, soil structure, and the usability of land.

Advantages of subsurface drainage

- It prevents waterlogging
- Improves soil aeration and structure
- Reduces surface erosion
- Prevents salt build-up.

Disadvantages of subsurface drainage

- High initial cost.
- Much attention is needed for maintenance.
- Soil structure can be disturbed.
- Soil nutrients can be leached easily.

Examples of subsurface drainage are ***tile drainage*** *and* ***mole drainage.***

Tile drainage: It involves the installation of perforated pipes (often referred to as "tiles," though they are typically plastic) below the soil surface. These pipes collect excess water from the soil and channel it away to a nearby outlet (a ditch or waterway). The installation depth is 2-4 feet (0.6-1.2 meters).

Advantages of tile drainage

- It helps prevent waterlogging, especially in clay-heavy soils.
- Improves aeration in the root zone.
- Reduces the risk of soil erosion and runoff.
- Enhances access to fields during wet periods**.**

Disadvantages of tile drainage

- Can increase runoff of fertilisers and other chemicals.
- It can lead to loss of essential soil nutrients.
- Costly installation and maintenance.
- It can lower the water table.

Mole drainage: It is a cheaper, temporary method of drainage commonly used in heavy clay soils. It involves pulling a bullet-shaped device through the soil to create unlined channels (or "mole drains") that allow water to flow out of the field. A tractor pulls a mole Plow through the soil, creating cylindrical channels. Water drains into these channels and flows out to a main ditch or drainage area.

Advantages of mole drainage

- Cost-effective compared to tile drainage
- Helps improve drainage in areas where installing tile drains is impractical or too expensive
- Temporarily improves soil structure and water movement in heavy clay soils.

Disadvantages of mole drainage

- It requires regular maintenance; they have a relatively short lifespan.
- Only effective in specific soil types.
- Improper installation can cause soil erosion.

Vertical Drainage

This is a method of removing excess water from waterlogged soils using vertical wells or boreholes that allow water to flow from the surface to deeper underground aquifers (is a method of removing excess water from waterlogged soils using vertical wells or boreholes that allow water to flow from the surface to deeper underground).

Advantages of vertical drainage

- Effective for deep water removal
- Suitable for large areas
- Minimises soil salinity
- Reduce surface waterlogging.

Disadvantages of vertical drainage

- High cost
- Energy-intensive
- Regular maintenance of equipment
- Potential for groundwater contamination.

Controlled Drainage

This involves using water control structures such as gates and weirs to raise the depth of the drainage outlet.

Advantages of controlled drainage

- Allows for water table management
- Can enhance water conservation
- Prevent nutrient leaching.

Disadvantages of controlled drainage

- Requires careful monitoring and management
- Initial setup cost
- Cannot be done on uneven landscape
- Regular monitoring and adjustment.

Uses of Irrigation Systems in Agricultural Production

- It enhances crop growth and yield as cultivated crops receive adequate water, especially in regions with irregular or insufficient rainfall. It also helps maintain optimal moisture levels during these dry spells, promoting healthy crop development.
- Irrigation enables farming in areas that would otherwise be unsuitable due to lack of rainfall or arid conditions, significantly expanding the amount of cultivable land.
- Many irrigation systems can be combined with fertilisation, allowing water and nutrients to be delivered simultaneously to plants. This method ensures that crops receive the necessary nutrients in a timely and efficient manner, improving growth and reducing fertiliser waste**.**
- It ensures that animals have sufficient water during dry periods. In some cases, irrigation systems are used to fill ponds for aquaculture, allowing farmers to integrate crop and fish farming for diversified food production and income streams.
- In hot climates, sprinkler irrigation systems can be used to cool crops by applying water during the hottest parts of the day, protecting sensitive plants and animals from heat stress.
- Regular irrigation maintains optimal soil moisture, reducing the risk of soil compaction, which can limit root growth and water infiltration.
- Advanced irrigation systems like drip irrigation and sprinkler irrigation minimise water waste by delivering water directly to the root zone or through controlled sprays, reducing evaporation and runoff.
- In areas prone to drought, irrigation systems help sustain crops by providing a reliable water source, reducing the risk of crop failure due to water shortages.

Surface Drainage

Controlled Drainage

Vertical Drainage

Subsurface Drainage

Figure 4.2: Methods of Drainage Systems

Uses of Drainage Systems in Agricultural Production

- Drainage systems help remove excess surface and subsurface water from agricultural fields. This prevents waterlogging and maintains optimal soil moisture levels for crop growth.
- Excess surface water can lead to soil erosion, nutrient loss, and runoff. Drainage systems collect and remove this rainwater and surface water, preventing flooding and ensuring that water doesn't accumulate on fields.
- Drainage can help protect local waterways by intercepting and removing excess nutrients, pesticides, and other pollutants that might otherwise leach into nearby rivers, lakes, and groundwater.
- In arid and semi-arid regions, subsurface drainage systems are used to lower the water table and remove excess salts, allowing the reclamation of previously unproductive, saline-affected lands for agricultural use.
- By maintaining optimal soil moisture and aeration, drainage systems support robust root growth and nutrient uptake. This leads to improved crop health, higher yields, and better product quality. Drainage also helps avoid problems like stunted growth, nutrient deficiencies, and crop loss due to waterlogging.
- Proper drainage ensures that fields are trafficable and can be easily accessed by farm machinery, especially during wet seasons. This facilitates the use of modern, efficient agricultural equipment and techniques, further boosting productivity and reducing labour requirements.

Calculation Box — Irrigation Volume & Run-off (simple)

Given (common values used in both examples)

Field size = 50 m × 40 m

→ Area = $50 \times 40 = 2000\ m^2$

1 mm of water depth = 1 L per m^2 = 0.001 m depth

A. Estimate irrigation volume for one watering

Goal: Find how much water is needed if the crop needs 5 mm of water and the system efficiency is 70%.

Step 1 — Convert depth to metres

5 mm = 5 ÷ 1000 = 0.005 m

Step 2 — Volume needed on the ground (m^3)

Volume = Area × Depth = 2000 m^2 × 0.005 m = 10.0 m^3

Step 3 — Convert to litres (L)

1 m^3 = 1000 L → 10.0 m^3 = 10 000 L

Step 4 — Account for irrigation efficiency (to supply losses)

If efficiency = 70% (0.70), water to supply = Volume ÷ Efficiency = 10.0 ÷ 0.70 = 14.2857 m^3

Step 5 — Convert to litres

14.2857 m^3 × 1000 = 14 286 L (rounded)

Answer (one watering):

Supply ≈ 14.3 m^3 or ≈ 14 286 L of water.

Table 4.1: Common Problems in irrigation and How to Fix Them

Fault (Problem)	Likely Cause	Remedy (What to Do)
Low pressure at the end of the line	Filter or emitters clogged; leak in pipe	Clean filter, flush the line, repair leaks
Uneven water distribution	Bent pipe, blocked emitters, weak pump	Straighten pipe, unclog emitters, check pump
No water in some sections	Valve closed, pipe kinked, air trapped	Open valves, straighten pipe, release trapped air
Water leaking at joints	Loose or cracked fittings	Tighten or replace fittings and seal joints
Pump not starting	No power, faulty switch, burnt fuse	Check power supply, replace switch/fuse
Water pooling in field	Poor slope, blocked drainage channels	Improve slope, clear drainage channels
Filter getting dirty often	Dirty water source with silt or algae	Clean source, add pre-filter, clean filter regularly
Emitters spraying instead of dripping	Pressure too high	Fix or install pressure regulator, reduce pump speed

Activity 4.4 Methods of Irrigation and Drainage Systems

1. In groups, visit a farm in your community and document the various methods of irrigation and drainage used on the farm. Alternatively, you can watch a relevant video and complete this exercise. Click here (https://youtu.be/7xL417-V60o) to watch a video on irrigation systems in Agriculture.
2. Write a report on your visit and present it in a plenary session in class.
3. Be guided by the following in writing your report:
    a. The types of irrigation systems that you observe on the farm.
    b. How the irrigation systems help spread water across the farm.
    c. How excess water on the farm was removed when there was too much.
    d. Tools, equipment and machines on the farm that helped the farmer control the amount of water to the plants.
    e. Ways that the water was handled to prevent the plants from getting too wet.

Activity 4.5 Types of Irrigation and Drainage Equipment

1. In groups, visit an agricultural facility in your community to observe different irrigation and drainage systems in use. Or watch videos or take a virtual tour of farms that utilise various types of irrigation and drainage equipment.
2. Document your observations, paying particular attention to the practical applications and real-world challenges faced on the farm.
3. Write a report on your visit and present it to the class for feedback. Your report should include:
    a. An introduction to the importance of irrigation and drainage in agriculture.
    b. A detailed description of at least three types of irrigation equipment and two types of drainage equipment.
    c. Comparative analysis of their benefits and challenges.
    d. Conclusion on the most effective irrigation and drainage methods for sustainable agricultural production.

Activity 4.6 Uses of irrigation and drainage systems

1. In pairs, discuss the uses of irrigation and drainage systems in agricultural production. In your discussion, be guided by the following questions;
   a. How does each type of irrigation system help farmers do their work more easily and grow more crops?
   b. Which types of drainage systems are best for keeping plants healthy?
   c. How can modern irrigation tools or machines make farm work easier for women?
   d. What tools or equipment could help people with disabilities use irrigation or drainage systems more easily?
2. Write down your findings in your notebook and present them to your class for feedback.

PARTS AND FUNCTIONS OF IRRIGATION AND DRAINAGE SYSTEM IN AGRICULTURAL PRODUCTION AND THEIR OPERATION

Parts of Irrigation System

The following are some parts of irrigation and drainage system in agricultural production and their operation:

1. **Water Source:** The origin of the water used for irrigation. It can be a natural or man-made source. Examples include rivers, lakes, reservoirs, wells, groundwater, or stored rainwater.
2. **Pump:** A pump is used to lift or move water from the source to the irrigation system, especially when the water needs to be transported over long distances or elevated terrain. Types of pumps include centrifugal pumps, submersible pumps or booster pumps, depending on the system's needs and the distance or height the water needs to travel.
3. **Pipelines (Mainline and Laterals):** Mainline (Primary Line): The main pipeline that carries water from the pump or source to different parts of the field. Lateral Lines (Secondary Line): Smaller pipes branching off from the mainline to distribute water directly to the irrigated areas or individual plants. Materials for manufacturing Pipes are usually made of PVC, HDPE, or steel, depending on the pressure requirements and durability needed.
4. **Valves:** Control Valves are used to regulate the flow of water through the system, allowing farmers to control when and where water is delivered. The types are

manual valves (hand-operated) and automated valves (controlled by timers or sensors). Shutoff Valves are installed to stop the flow of water completely to certain sections for repairs or water-saving purposes.

5. **Filters:** Filters remove debris, sediments, and particles from the water to prevent clogging of irrigation pipes and nozzles, especially in drip and sprinkler systems. The types are Sand filters, screen filters, or disc filters, depending on the water quality and the specific irrigation system in use.
6. **Pressure regulators:** These devices ensure that the water pressure is kept at a consistent and optimal level throughout the system to prevent damage and ensure even water distribution.
7. **Emitters (or Sprinklers):** Drip Irrigation Emitters: In drip irrigation systems, these small devices release water slowly and directly to the root zone of the plants. Emitters can be adjustable or fixed, depending on the desired flow rate. Sprinklers (for Sprinkler Irrigation): Sprinklers spray water over the crop, simulating rainfall. Different types include fixed sprinklers, rotary sprinklers, and traveling sprinklers. Sprinkler types include impact sprinklers, micro-sprinklers, centre-pivot systems, etc., depending on the system design and crop requirements.
8. **Fertigation and chemigation units:** These units allow fertilisers, nutrients, and chemicals to be injected into the irrigation water, ensuring that plants receive nutrients as they are watered (fertigation) or for pest control (chemigation). The components include injectors, tanks, and control systems for precise dosing of fertilisers or chemicals.
9. **Backflow preventer:** A device used to prevent contaminated water from flowing back into the clean water supply (e.g., during fertigation or chemigation). This is a critical safety feature in systems where chemicals are applied via irrigation.
10. **Flow meters:** Flow meters measure the volume of water passing through the system, helping to monitor water usage and ensure that the correct amount of water is being applied to the crops.
11. **Timers and controllers:** Automatic Timers; These allow farmers to automate the irrigation schedule, ensuring that water is delivered at the right time without manual intervention. Smart Controllers; Advanced controllers can adjust the irrigation schedule based on weather data, soil moisture levels, or plant needs to improve water efficiency.
12. **Drainage and flush valves:** These are installed to flush out sediments or debris that may collect in the pipes, particularly in drip irrigation systems. In some systems, drainage valves are used to remove excess water from the system after irrigation, preventing over-saturation.

Figure 4.3: Some parts of Irrigation Systems

Functions of Irrigation Systems

- Water supply to crops**.**
- Soil moisture regulation.
- Enhancement of crop yield and quality.
- Nutrient distribution.
- Reduction of crop stress due to drought.
- Can be used to control microclimates around crops.

Parts of Drainage System

1. **Surface Drains:** These are shallow channels or ditches constructed on the surface of the field to carry excess water away. The types are:
   a. **Open Ditches or Channels** they are Wide, shallow depressions that guide water to a disposal point.
   b. **Furrows** are Small, parallel channels between rows of crops that help direct water away from plant roots.
2. **Subsurface drains**: These are underground systems that remove excess water from the root zone by collecting and channelling it to an outlet.
3. **Drainage outlets**: The endpoint where collected water is discharged from the drainage system into a safe location such as a stream, canal, or water body. There are two types:
   a. **Open Outlet:** Discharges water directly into natural water bodies or reservoirs.
   b. **Closed Outlet:** Discharges into closed pipe systems or underground sewers.

4. **Filter materials**: Filters are used to prevent soil particles from entering drainage pipes, which could lead to blockages.
5. **Manholes and inspection chambers:** These are access points along the drainage system, used for inspection, maintenance, and cleaning of the drainage pipes.
6. **Control structures (for controlled drainage):** These devices regulate the flow of water in and out of the drainage system, allowing farmers to control the water table level**.**
7. **The types of weirs:** Structures that control the height of the water by adjusting the outflow**.**
8. **Gates or Valves:** Manually or automatically operated gates that open or close to control water discharge.
9. **Main drain (Collector Drain):** This is a larger channel or pipe that collects water from smaller drains (surface or subsurface) and transports it to the drainage outlet (e.g., river, canal, or reservoir)

Figure 4.4: Some parts of Drainage Systems

Functions of Drainage System

1. They efficiently remove excess water from areas prone to flooding, including rainwater and runoff.
2. Drainage systems prevent water accumulation that can damage landscapes and structures, ensuring healthy soil and vegetation.
3. They safeguard foundations by preventing erosion and maintaining the load-bearing capacity and stability of structures.
4. Drainage systems channel wastewater, including sewage and greywater, away from buildings to prevent contamination and maintain sanitation.
5. They help prevent salt accumulation in soil, which can adversely affect plant growth and soil health.
6. By managing water effectively, drainage systems protect buildings from potential foundation damage caused by excessive moisture.

7. Well-drained soils encourage deeper root growth as roots can penetrate more easily when soil moisture is managed properly. This allows plants to access a larger soil volume for water and nutrients.

Operation of Irrigation System

The following are the operation outlines for irrigation systems:

1. Planning and Design
    a. Evaluate the water requirements of crops, taking into account factors such as crop type, growth stage, soil characteristics, and climate conditions.
    b. Develop a layout for the irrigation system, including the positioning of pumps, pipes, valves, and emitters, to ensure uniform water distribution.
2. Water Source Management
    a. Regularly monitor the water levels in reservoirs, wells, or other sources to guarantee an adequate supply.
    b. Analyse water for salinity, pH, and contaminants to avoid harming crops and irrigation equipment.
3. Pump Operation
    a. Manage pumps to extract water from the source and pressurise the irrigation system.
    b. Modify pump settings to maintain the necessary water pressure throughout the system.
4. Water Distribution
    a. Control the flow of water to various sections of the field using valves.
    b. Set the flow rates of sprinklers or drip emitters to align with the water requirements of the crops.
5. Scheduling Irrigation
    a. Program timers to manage the duration and frequency of irrigation cycles.
    b. Utilise sensors to monitor soil moisture levels and adjust irrigation schedules as needed.
6. Maintenance and Monitoring
    a. Regularly examine pipes, emitters, and pumps for leaks, clogs, and signs of wear.
    b. Clean or replace filters to prevent debris from obstructing the system.
    c. Track the system's performance and water usage to identify and rectify inefficiencies.
7. Seasonal Adjustments
    a. Modify irrigation schedules according to weather conditions, such as rainfall or temperature fluctuations.

b. Conduct maintenance tasks, such as winterising equipment, to prevent damage during off-seasons.

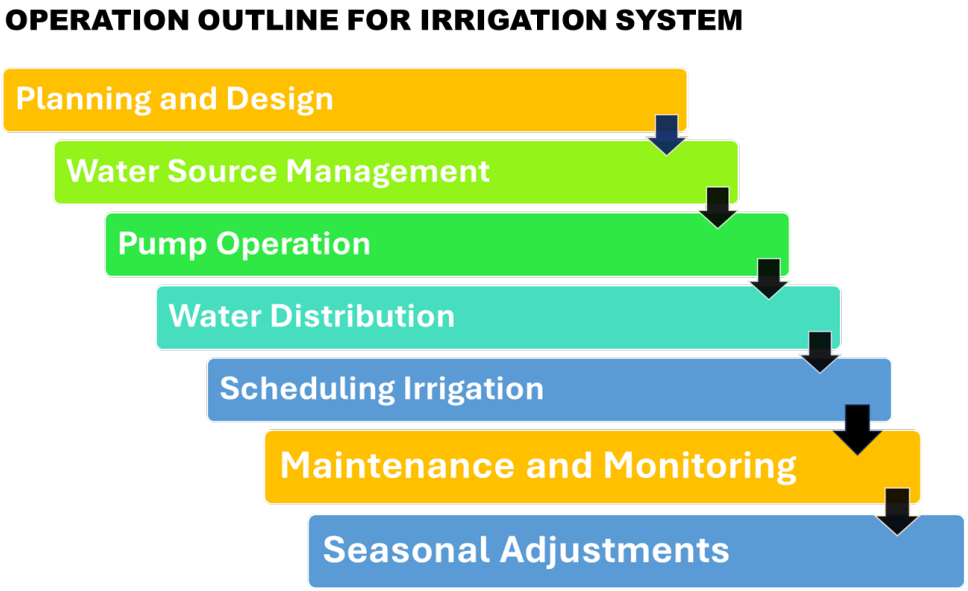


Figure 4.5: Operation outlines for Irrigation System

Operation of Drainage System

The following are the operation outlines for drainage system:

1. Monitoring and Assessment
   a. Regularly check water levels in reservoirs, ditches, wells, and other drainage components to assess water accumulation and determine the need for drainage operations.
   b. Use soil moisture sensors or manual checks to evaluate the moisture content in the soil. This helps in deciding when drainage is needed to prevent waterlogging.
2. Control of Water Flow
   a. Operate control valves to regulate the flow of water. This involves opening valves to allow water to drain when levels are high and closing them when levels need to be maintained.
   b. Manage water levels with structures like weirs and gates that control the outflow and help maintain desired water table levels.
3. Installation
   a. Create ditches and trenches for both surface and subsurface drainage systems.
   b. Position tile drains or perforated pipes in the trenches and cover them with permeable materials such as gravel.

4. Water Collection
    a. Gather excess surface water from fields using ditches and contour drains.
    b. Extract excess water from the root zone with buried drainage systems.
5. Water Discharge
    a. Use gravity to channel water from the drains to discharge points, such as drainage ditches or wells.
    b. Employ pumps to raise water to drainage outlets in locations where gravity flow is inadequate.
6. Control Structures Operation
    a. Operate control structures to regulate water levels and flow within the drainage system.
    b. Ensure that discharge points are functioning properly and are not obstructed.
7. Maintenance and Monitoring
    a. Regularly check for blockages, sediment buildup, and damage in both surface and subsurface drains.
    b. Clean ditches, replace damaged tiles, and remove debris to maintain system efficiency.
    c. Track water table levels to ensure effective drainage and prevent waterlogging.
8. Seasonal Adjustments
    a. Enhance drainage capacity during wet seasons to manage excess water effectively.
    b. Perform maintenance and repairs during dry periods when the system is less utilised.

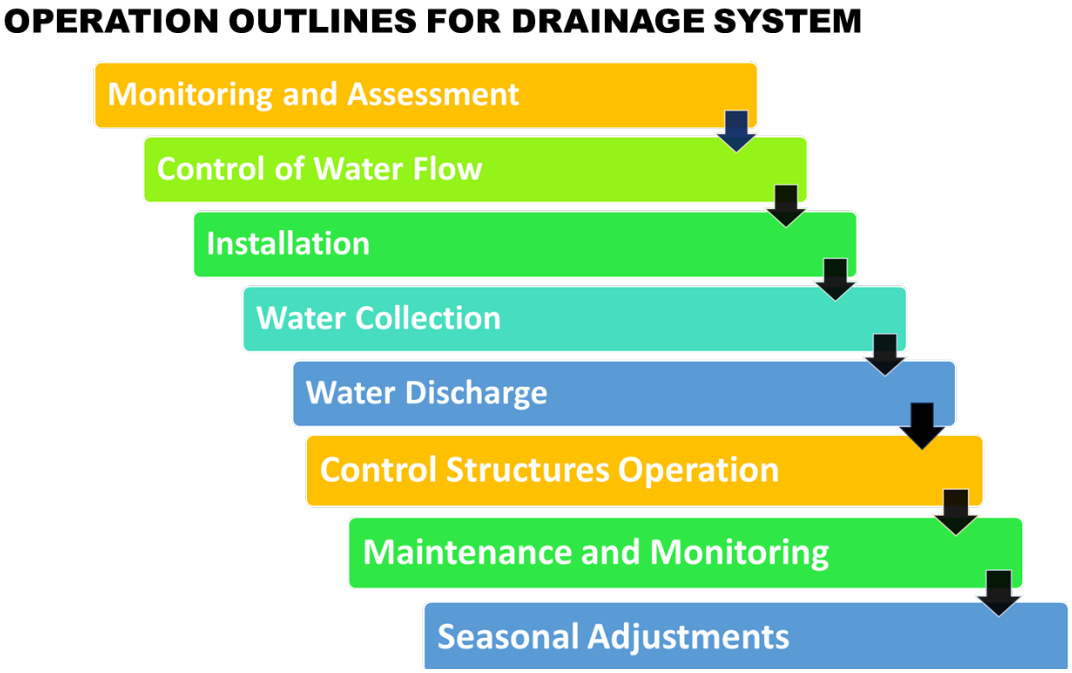


Figure 4.6: Operation outlines for the drainage system

Activity 4.7 Parts and Functions of an Irrigation and Drainage System

1. Use the internet to research the parts and functions of an irrigation and drainage system in agricultural production. Present your findings in the table format below:

Part of the irrigation and drainage system	Function
E.g., 1. Pump	Moves water from the source to the fields, essential for a pressurised system.

Table 4.2

2. Exchange findings with your peers for feedback.

Activity 4. 8 Applications of irrigation and drainage systems

1. Watch a short documentary on the application of irrigation and drainage systems in agricultural production (Click here) OR (type: https://youtu.be/Z9HAy9EYKKs)
2. In pairs, discuss the Application of irrigation and drainage systems in agricultural production.
   a. Use the following questions to guide your discussion: Why are irrigation and drainage important in agricultural production
   b. The various ways that irrigation and drainage systems are used in agricultural production.
   c. How irrigation and drainage systems work together to maximise agricultural production.
   d. How does proper drainage impact soil health and crop yield
   e. The environmental impacts of irrigation and drainage in agricultural production, considering water conservation, soil health and energy use.
   f. How technology improves the efficiency of irrigation and drainage systems in agricultural production, consider the role of sensors, automated systems and remote monitoring.
3. Present the salient points from your discussions to the whole class for feedback.

CLASSIFICATION OF HARVEST AND POST-HARVEST IMPLEMENTS AND MACHINERY

Classification of Harvest Implements and Machinery

Farm equipment and harvesting implements come in a wide variety of types to meet the needs of different agricultural operations, from small-scale to large industrial farms. They include:

Manual Harvest (Hand) Tools

They are handheld instruments used by farmers and workers to gather crops without the use of machinery. They are often used in small-scale farming or in remote areas where mechanised harvesting is not feasible. Examples: sickle, pruning shears, knife, cutlass, scythe, hoes. See Figure 4.7

Mechanised Harvest Tools

These are machines or equipment designed to automate the process of harvesting crops, improving efficiency, reducing labour and speeding up the harvesting process. Examples are: combine harvester, reapers, potato harvester, fruit harvester, tomato harvester, cotton harvester, forage harvester, sugarcane harvester. See Figure 4.8

Combined and integrated harvest tools

Combined and integrated harvest tools are advanced agricultural machines designed to perform multiple tasks simultaneously during the harvesting process. These tools streamline operations by combining several functions, such as cutting, threshing, and cleaning, into a single machine or system, improving efficiency and reducing the need for multiple pieces of equipment. Examples are: combine harvester, multi-crop harvester, mower and windrower, cotton strippers with module builders, and forage harvester. See **Figure 4.9**

Figure 4.7: Some Manual Harvest (Hand) Tools

Figure 4.8: Some Mechanised Harvest Tools.

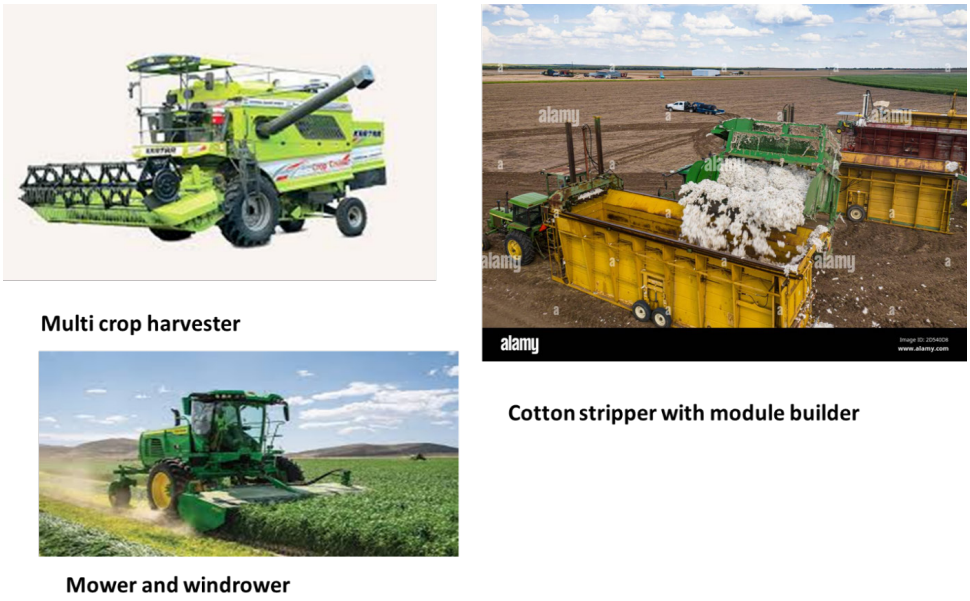


Figure 4.9: Some Combined and Integrated Harvest Tools

Classification of Post-Harvest Implements and Machinery

Post-harvest implements and machinery refer to tools and equipment used in handling, processing, and storing crops after harvesting. These machines are crucial for reducing post-harvest losses, improving quality, and preparing agricultural products for market or further processing. They include:

Cleaning and sorting tools

Cleaning and sorting equipment is used in post-harvest operations to remove impurities, debris, and foreign materials from harvested crops and to categorise them based on size, weight, or quality.

- **Cleaning equipment:** Examples are air blowers, grain cleaners, seed cleaners, destoners, winnowing machines, magnetic cleaners, sieve cleaners, etc.
- **Sorting equipment:** Examples are colour sorters, size graders and weight graders, belt sorters and gravity sorters.

Figure 4.10: Some Cleaning and Sorting Tools

Drying Equipment

Drying equipment is used in post-harvest processes to reduce the moisture content of crops to safe levels, preventing spoilage, mould growth, and pest infestations during storage. Effective drying improves the quality, shelf life, and marketability of agricultural products.

1. **Natural drying tools**: Examples are drying mats and drying racks.
2. **Mechanical dryers**: Examples are grain dryers, dehydrators and solar dryers.

Figure 4.11: Some Drying Equipment

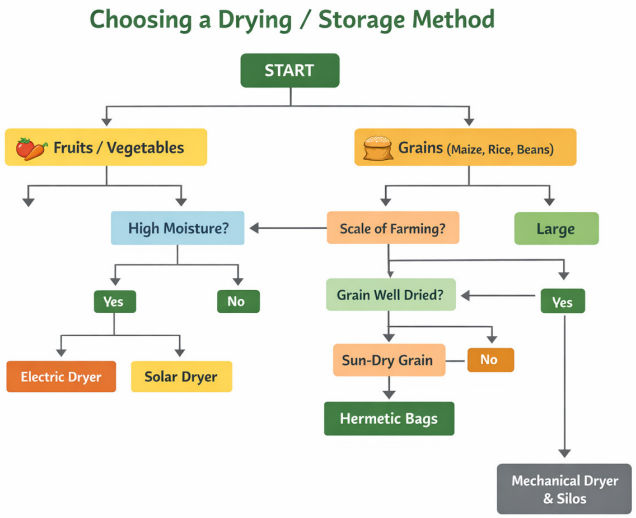


Figure 4. 12: Simple decision tree for choosing a drying/storage method based on scale, crop moisture, and access to power

Storage Equipment

This is essential for preserving harvested crops and ensuring they remain in good condition until they are consumed, sold, or processed. Proper storage equipment helps prevent spoilage, reduces waste and extends the shelf life of agricultural products by protecting them from moisture, pests, temperature fluctuations, and contamination.

1. **Temporary Storage**: Examples are harvest bags and silage bags, baskets, jute bags, plastic or wooden crates.
2. **Long-Term Storage**: Examples are grain bins/silos, cold storage units, hermetic bags, storage crates.

Figure 4.13: Some Storage Equipment

Processing Equipment

They are machines and tools used to transform raw agricultural products into forms that are easier to handle, store, transport, or sell. These machines help enhance the value, quality, and usability of crops by cleaning, sorting, grading, milling, drying, and packaging them.

1. **Primary processing:** Examples are threshers, shellers, cleaners, winnowing machines, dehuskers and dryers.
2. **Secondary processing**: Examples are milling machines, juicers, presses pulverisers, grinders, dehydrators, crushers, roasters, packaging machines and mixers.

Figure 4.14: Some Processing Equipment

Packaging and labelling equipment

They are machines used to prepare products for transportation, sale, and consumption by packaging them into containers and applying labels. These machines play a critical role in ensuring product protection, extended shelf life, brand presentation, and regulatory compliance.

- **Packaging:** Examples are bagging machines, boxing machines, sealing machines, filling machines, cartoning machines, case packing machines, etc.
- **Labelling:** Examples are label printers, label applicators, print-and-apply labels, etc.

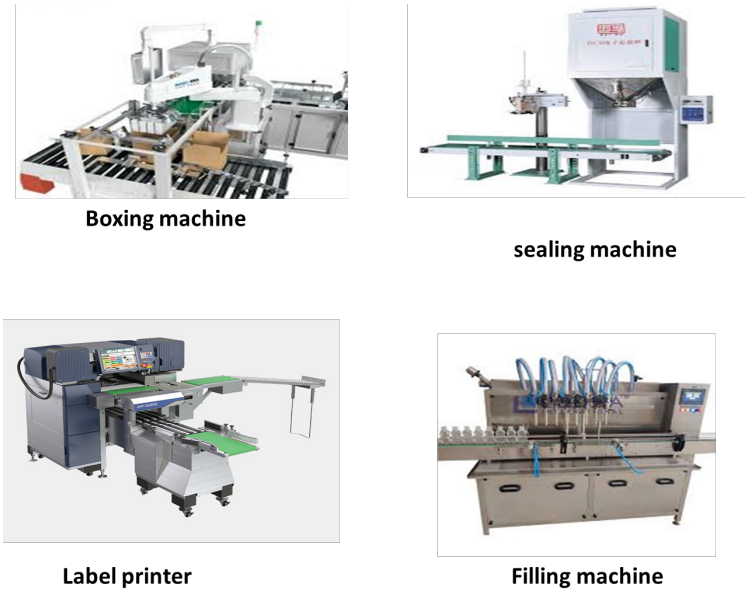


Figure 4.15: Some Packaging and labelling Equipment

Handling and Transportation Equipment

Handling and transportation equipment in agriculture and food production is essential for moving raw materials, produce, and packaged goods efficiently and safely from one place to another, both within farms and processing facilities and during distribution to markets.

- **Handling:** Examples are conveyors, elevators, loaders, vacuum lifters and cranes.
- **Transportation:** Examples are forklifts, transport vehicles, trolleys, backhoe, skid-steer loader and wheelbarrow.

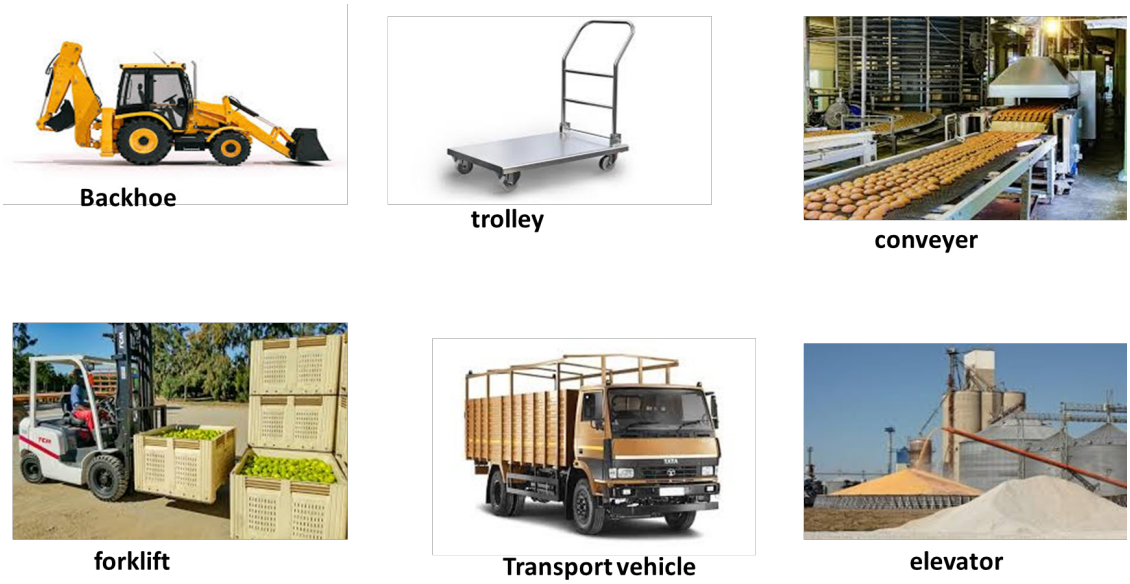


Figure 4.16: Some Handling and Transportation Equipment

Activity 4.9 Harvest and Post-Harvest Tool, Implements and Machinery

1. In groups of not more than five, using the guided questions below and the internet and other resources, come up with examples of harvest and post-harvest tools, implements and machinery in agriculture.
   a. What simple tools do farmers use to pick or cut crops during harvest?
   b. What machines can help gather large amounts of crops quickly?
   c. What types of machines or tools help keep harvested crops fresh during storage?
   d. What tools or machines help remove husks or peels of crops?
2. Prepare a PowerPoint presentation of your findings with pictures and videos and present to your class for feedback.

Activity 4.10 Classifying Harvest and Post-Harvest Tools, Implements and Machinery Agriculture Production

1. Use the information from Activity 4.9 to complete the table format below:

Classification	Examples	Functions	Images/Pictures
E.g. Harvesting tools	Sickles, scythes, and knives	For cutting and picking plants from the field	

2. Present your work to the class for feedback.

Activity 4.11 Description of Harvest and Post-Harvest Tools, Equipment and Machinery

1. Visit a nearby agro-processing factory or watch a video on harvest and post-harvest tools, equipment and machines on the internet. Click here or use https://youtu.be/hbQEJwr1jLM to watch a video on harvest and post–harvest equipment and machines.
2. Document your findings. Use the following prompts to guide you:
   a. Describe the harvest and post-harvest tools, equipment and machinery documented.
   b. Prepare a picture album of the harvest and post-harvest tools, equipment and machinery.
3. Present your work using the format below:

Table 4.3

Section	Photo	Description/reflections
e.g., Harvesting	 Tomato Harvester	It is a machine designed to efficiently pick ripe tomatoes from the plants, often using rotating drums, conveyor belts, and gentle shaking mechanisms to minimise damage to the fruit.

USES OF HARVEST AND POST-HARVEST TOOLS, IMPLEMENTS AND MACHINERY IN AGRICULTURAL PRODUCTION

Uses of Harvest Tools, Implements and Machinery in Agricultural Production

Manual Harvest (Hand) Tools

- **Sickles:** These are tools with a curved blade used to cut plants like wheat, barley, and rice.
- **Scythes:** Bigger than sickles, they are used to cut grass and big crops like cereal plants.
- **Shears/Pruning Shears:** These are like big scissors used to pick fruits and vegetables or trim plants and vines.
- **Knives:** Different kinds of knives are used for cutting crops, like a special curved knife for cutting sugarcane.
- **Hoe:** They are used to loosen the soil around root crops like potatoes or yams to make it easier to pull them out of the ground**.**
- **Cutlass:** The cutlass is used to cut through plants like sugarcane, bananas, or even to harvest coconuts. It's good for chopping down crops with thick stems or cutting through heavy plants.

Refer to **Figure 4.7** for examples of manual harvesting tools

Mechanised Harvest Tools

- **Combine harvesters**: These machines cut, separate, and clean crops like wheat, rice, and corn all at once.
- **Forage harvesters**: They chop plants such as grass and alfalfa to make food for animals.
- **Potato harvesters:** These machines dig up potatoes from the ground and separate them from the dirt.
- **Cotton pickers**: They pick cotton from the plants.
- **Vegetable harvesters**: These are used to pick vegetables like carrots and onions.
- **Fruit harvesters:** These machines use arms or shake trees to pick fruits, for examples apples and oranges.

- **Tomato harvester:** This machine helps pick tomatoes from the plants. It gathers the tomatoes, takes off the leaves, and sorts them so they can be used for food.
- **Reapers:** A reaper is a machine that cuts down crops like wheat or rice. It helps farmers harvest faster by cutting the plants in the field.
- **Sugarcane harvester:** This machine cuts down tall sugarcane plants, removes the leaves, and cuts the sugarcane into pieces, making it easier to collect and use for making sugar.

Combined and Integrated Harvest Tools

- **Multi-crop harvesters**: These machines can pick different kinds of crops by switching parts or adjusting how they work.
- **Mowers and windrowers**: These machines cut hay and grass, then lay them in rows so they can dry before being collected.
- **Combine harvester**: This machine cuts and separates crops like wheat and corn all in one go, making the job faster and easier.
- **Cotton stripper**: A machine that pulls off the cotton from the plants, cleaning them up for use.

Uses of Post-Harvest Tools, Implements and Machinery in Agricultural Production

Post-harvest tools can be classified based on their specific functions in the post-harvest process, which includes cleaning, sorting, drying, storage, processing, and packaging. Here is a detailed classification:

Cleaning and Sorting Tools

Cleaning Equipment

- **Air blowers/ winnowing machine:** These blow away light stuff like dust and leaves from grains and seeds.
- **Grain cleaners**: These machines take out things like dirt, stones, and other unwanted bits from grains.
- **Seed cleaners**: These are special machines that clean seeds by removing dust and tiny pieces of unwanted stuff.
- **Magnetic cleaner:** This machine uses magnets to pick up tiny metal pieces that might be mixed in with the grains. It helps make sure the grains are safe and clean to eat.
- **Sieve cleaners:** These are special tools with holes that let smaller things fall through while keeping bigger things. They help sort out dirt, stones, and other unwanted bits from the grains or seeds.

Sorting Equipment

- **Colour sorters:** These machines look at the colour of grains, seeds, or fruits and take out the ones that are damaged or discoloured.
- **Size graders**: These machines sort fruits and vegetables based on how big or small they are.
- **Weight graders**: These machines sort produce based on weight, so everything is the same size when packed and sold**.**
- **Gravity sorters:** These machines use the weight of things to separate them. Heavier items fall to the bottom, while lighter ones stay on top. This helps sort out different grains, seeds, or fruits based on how heavy they are.
- **Belt sorters:** These machines have moving belts that carry items along. They can be set up to sort things by size, shape, or even colour as they move along the belt. This helps organise fruits, vegetables, or grains quickly and easily.

Drying Equipment

Natural Drying Tools:

- **Drying Mats:** These are flat mats that help dry grains, seeds, and other foods in the sun.
- **Drying Racks:** These are shelves that are raised off the ground, used to dry fruits, vegetables, and herbs in the sunlight.

Mechanical Dryers:

- **Grain Dryers:** Machines that take out moisture from grains so they can be stored safely without getting spoiled.
- **Dehydrators:** These machines dry fruits, vegetables, and herbs by blowing hot air around them.
- **Solar Dryers:** They use sunlight to dry food and have special covers to keep bugs and bad weather away.

Storage Equipment

Temporary Storage:

- **Harvest bags:** Big bags used to collect and hold fruits and vegetables right after picking them in the field.
- **Silage bags:** Bags used to store silage, which is special food made from fermented plants for farm animals.
- **Jute bag:** These bags are often used for carrying things like fruits and vegetables because they are sturdy and can hold a lot of weight. They are also reusable.

- **Basket**: Baskets can be used to carry or store items, such as fruits, vegetables, or crafts. They come in many shapes and sizes and are often used for picnic outings or organising things at home.

Long-Term Storage:

- **Grain bins/silos:** Huge containers that keep large amounts of grains safe by controlling the temperature and humidity inside.
- **Cold storage units:** Refrigerated boxes that help keep fresh foods like fruits, vegetables, and dairy products from going bad.
- **Storage crates and bins:** Boxes used to store fruits and vegetables, allowing air to flow around them for freshness and making them easy to carry.
- **Hermetic bags:** These are special bags that can be sealed tightly to keep air out. They are often used to store food, grains, or other items to keep them fresh for a long time. Because they block air and moisture, they help prevent spoilage and protect the contents from pests.

Processing Equipment

Primary Processing:

- **Threshers:** These machines help separate grains from the plants by hitting them, making it easier to collect the food we eat.
- **Shellers**: They take off the outer layer, or shell, from crops like corn and nuts so we can use the tasty part inside.
- **Dryers**: They are machines or tools that help remove water from food like grains, fruits, or vegetables. They make sure the food is dry so it can be stored longer without spoiling.
- **Cleaners**: They are machines that remove dirt, dust, and other unwanted things from crops. They make sure the food is clean before it's stored or sold.

Secondary Processing:

- **Milling machines**: These machines grind grains into flour, which we use to make bread and other foods.
- **Juicers and presses**: They squeeze fruits and vegetables to get juice out so we can drink it.
- **Pulverisers:** These machines grind spices and grains into very fine powders, which can be used in cooking.
- **Mixers:** Mixers are machines used to blend or mix different ingredients together. In farming, they might mix grains, animal feed, or even different types of seeds to create the right combination for feeding animals or preparing food products.
- **Roasters**: Roasters are machines that heat and cook food like nuts, coffee beans, or seeds to give them a toasted flavour. They roast the food until it's crispy or ready to eat, like roasted peanuts or coffee beans.

Packaging and labelling equipment

Packaging:

- **Bagging machines**: These machines fill bags with grains, seeds, and other products so they can be sold and transported easily.
- **Boxing machines**: They put fruits and vegetables into boxes for shipping to stores.
- **Sealing machines**: These machines seal packages tightly to keep food safe and fresh.
- **Filling machine**: This is used to automatically put products, like liquids, grains, or powders, into containers such as bottles, bags, or boxes. It helps make sure the right amount of the product is put into each container, making the process faster and more accurate.
- **Case packing machine**: machine that automatically packs products, like bottles, bags, or boxes, into larger boxes or cases for shipping. It helps organise and securely place items into cartons or crates, making it easier to transport them safely without damage.

Labelling:

- **Label printers:** They print labels that tell us important information about the food, like its name, weight, and when it should be eaten by.
- **Label applicators**: These machines put labels onto packages automatically, making sure everything is labelled correctly**.**
- **Print-and -apply labels:** They are machines that first print labels with important information, for example the product name, barcode, or expiration date, and then automatically place those labels onto products or packages.

Handling and Transportation Equipment

Handling:

- **Conveyors:** These are machines that help move crops around inside factories or storage places, so people don't have to carry them by hand.
- **Elevators:** These lift grains and other crops up to higher places in buildings where they are stored or processed.
- **Vacuum lifters** are special machines that use suction (like a vacuum cleaner) to lift and move heavy things. They create a strong grip on items like boxes or bags and help carry them from one place to another without needing to pick them up by hand.
- **Cranes:** they are large machines used to lift and move very heavy things, such as big containers or equipment, from one place to another. They have long arms that can reach high places and can lift objects that are too heavy for people or smaller machines to carry.

Transportation:

- F**orklifts:** Forklifts are vehicles that pick up and move heavy boxes or containers of food inside storage places.
- **Transport Vehicles:** These are trucks or trailers that take the harvested crops from the farm to places where they can be stored or processed.
- **Trolley**: This is a small cart with wheels that is used to move things easily from one place to another. You can push or pull it, and it helps carry heavy or multiple items without needing to lift them.
- **Backhoe**: It is used to move dirt or soil and heavy materials using the bucket. They help do jobs difficult to do by hand.

Activity 4.12 Harvest, Post-Harvest and Storage Tools, Implements and Machinery Used in Agro-Processing Factory

1. Either as part of a class trip, or whilst you are home, visit an agro-processing factory or watch videos of agro-processing factories to gather information on the harvest, post-harvest and storage tools, implements and machinery used in the agro-processing.
2. During the visit, or while watching the video (click here or use this link: https://youtu.be/l0bpy857deM), take note of the following:
    a. The name and location of the agro-processing factory visited, or a link to the video watched, and the main products processed in the factory
    b. Harvest tools and machinery have been used at the factory (tools and machinery used during the harvesting process, and to improve the efficiency and quality of the harvest)
    c. Post-harvest tools and machinery have been used at the factory (tools and machinery used for cleaning, sorting and grading the produce).
    d. Storage tools and machinery have been used at the factory (methods and machinery used for storing the processed products, the storage conditions used to extend the shelf life of the products, and any special techniques or technologies used in the storage process).
3. Write a report and present it to your class for feedback. Your report should follow the following format
    a. Introduction (the name and location of the agro-processing factory visited or link to the video watched, and the main products processed in the factory)
    b. Content:

i. Description of harvest tools and machinery used at the factory

ii. Description of post-harvest tools and machinery used at the factory

iii. Description of storage tools and machinery used at the factory.

c. Conclusion (key takeaways from the visit or video regarding the use of tools, implements, and machinery in agro-processing).

Activity 4.13 Uses of Harvest, post-harvest and storage tools, implements and machinery

1. Using the table below, show the uses of at least five harvest, post-harvest and storage tools, implements and machinery in agricultural production.

Table 4.4

Tool/implement/machinery	Stage (harvest, post-harvest, storage)	uses
e.g. sickle	harvest	Cutting crops

2. In pairs, discuss the physical challenges that women and people with disabilities face in the use of harvest and post-harvest tools, implements and machinery in agricultural production.
3. Come up with solutions to address the challenges that women and people with disabilities face in the use of harvest and post-harvest tools, implements and machinery.
4. Present the salient points from your discussion to the class for feedback.

OPERATION OF SIMPLE HARVEST IMPLEMENTS AND MACHINERY USE IN AGRICULTURAL PRODUCTION

Operation of Manual Harvest Tools

Safety & Ergonomics Tips for Manual Surveying Tools

1. Recommended Posture

- Stand with feet shoulder-width apart when using measuring tapes or leveling rods.

- Bend at the knees, not the back, when lifting tools or equipment.
- Keep the tool close to your body to reduce strain.

2. Personal Protective Equipment (PPE)
   - Wear closed-toe shoes or boots to protect feet.
   - Use gloves to prevent blisters or cuts when handling ropes, stakes, or metal tools.
   - Safety glasses if working near flying debris or using hammers/poles.
3. Tool Care & Maintenance
   - Inspect tools before and after use for damage or wear.
   - Keep metal parts clean and dry to prevent rust.
   - Store equipment safely to avoid tripping hazards or tool damage.

Tip: Always take short breaks when doing repetitive tasks to reduce fatigue

Sickles

How to use:

- Make sure the sickle's blade is sharp and clean.
- Hold the sickle in one hand and the plants in the other. Swing the sickle quickly to cut the plants near the ground.
- Wear gloves to protect your hands and always keep the sharp part of the sickle away from your body.

Scythes

How to use:

- Make sure the blade is sharp and check the handle to see if it's cracked or has rough spots.
- Stand with your feet apart, then swing the scythe in a big, smooth curve close to the ground to cut plants.
- Make sure no one is close by when you're using it, and wear gloves and clothes that protect you.

Shears/Pruning Shears

How to use:

- Sharpen the blades and put some oil where the handles come together so they move easily.
- Use the shears to cut small branches or plant stems without hurting the main plant. For pruning, cut the branch at an angle so the plant stays healthy.
- Wear gloves to protect your hands and keep your fingers away from the sharp blades.

Knife

How to use:

- Make sure the knife is sharp and clean.
- Hold the handle and carefully cut things like fruits, vegetables, or small plants.
- Always cut away from your body and keep your fingers away from the sharp part. Wear gloves if needed.

Cutlass

How to use:

- Sharpen the cutlass and make sure the handle is strong.
- Hold it firmly and use it to cut bigger plants, clear bushes, or chop through thick branches.
- Keep both hands steady, wear gloves, and always cut away from your body. Make sure no one is too close when you swing it.

Operation of Mechanised Harvest Tools

Combine Harvesters

How to use:

- Check the fuel, oil, and tires. Make sure everything is working well, that all safety covers are in place and make sure you are fit to operate the machine.
- Turn on the engine and let it warm up.
- Set the height of the cutting part and how fast it spins, based on the crop.
- Drive through the field, and the combine will cut the crops, shake out the grains, and get rid of the extra plant parts.
- When the grain tank is full, empty it into a trailer.
- Make sure no one is nearby, follow the machine's instructions, and wear ear and eye protection, follow safety and warning signs on the farm.

Forage Harvesters

How to use:

- Check the fuel, oil, and blades to make sure everything works.
- Turn on the engine and start the cutting blades.
- Set the cutting height and rollers based on the type of plants you're harvesting.
- Drive through the plants, and the harvester will chop them up and blow the pieces into a wagon or truck.
- Keep people far away, wear safety gear, and follow the instructions.

Potato Harvesters

How to use:

- Clean the machine and check that everything works. Set how deep it should dig and how fast it moves.
- Turn on the harvester and let it get to the right speed.
- Set how deep to dig and how it shakes to get rid of soil.
- Drive through the field, and the machine will dig up the potatoes.
- Make sure no people or animals are around and wear the right safety gear.

Tomato Harvester

How to use:

- Check the machine for fuel, oil, and any problems. Make sure the blades and belts are working well.
- Turn on the machine and let it warm up.
- Set the height of the machine so it can pick the tomatoes without damaging them.
- Drive through the field, and the machine will pick the tomatoes, remove the leaves, and send the tomatoes to a container.
- Make sure no one is too close while the machine is working, and wear gloves and other safety gear.

Reapers

How to use:

- Check fuel, oil, and the condition of the blades to make sure they're sharp and ready.
- Turn on the engine and let it warm up.
- Set the cutting height based on the crop you're harvesting (like wheat, rice, or barley).
- Drive the reaper through the field, and it will cut the crops close to the ground, gathering them into bundles.
- Keep people and animals away, wear safety gear, and follow the machine's instructions.

General Safety Tips of Using Mechanised Harvesting Tools

1. Always wear safety glasses, gloves, and ear protection to keep your eyes, hands, and ears safe.
2. Before starting any machine, make sure the area is clear of people, animals, and obstacles to avoid accidents.

3. Always read the machine's operating manual to understand how to use it correctly and safely.
4. Check the machine for any mechanical issues, such as loose parts, leaks, or dull blades, before starting.
5. Ensure that all safety guards and shields are properly in place to protect you from moving parts.
6. Pay attention while operating the machine. Avoid distractions and don't use your phone while working.
7. Always follow the recommended techniques for operating the machine to prevent injuries and damage.
8. Never reach into the machine while it's running. Keep your hands and feet away from moving parts.
9. Be aware of what to do in case of an emergency, including how to shut off the machine quickly.
10. Avoid using harvesting tools in bad weather, such as rain or strong winds, which can make the work unsafe.

OPERATION OF POST-HARVEST IMPLEMENTS AND MACHINERY USE IN AGRICULTURAL PRODUCTION

Operation of Cleaning and Sorting Tools

Air Blowers

How to use:

- Make sure the blower is clean and not blocked. Check for any problems with the machine.
- Point the blower to blow air over the grains or seeds to remove light dirt and leftover plant parts.
- Change the airflow speed if needed.
- Wear protective goggles to keep your eyes safe from dust and debris.

Grain Cleaners

How to use:

- Look for any damage or blockages in the cleaner. Make sure the screens are right for the type of grain you're using.

- Put the grains into the cleaner.
- Turn on the machine and adjust the settings for the best cleaning results.
- Collect the cleaned grains from the output chute.
- Wear a dust mask and goggles, and make sure the area is well-ventilated.

Seed Cleaners

How to use:

- Check the seed cleaner for any problems. Choose the right screens and settings for the seeds you're cleaning.
- Load the seeds into the cleaner.
- Start the machine and watch the cleaning process, changing settings if needed.
- Collect the cleaned seeds from the output.
- Wear protective gear to avoid inhaling dust and seed particles.

Colour Sorters

How to use:

- Set the optical sensors based on the specific crop you're sorting.
- Load the product into the sorter.
- Turn on the machine and watch the sorting process.
- Adjust the sensitivity settings for accurate sorting.
- Follow the manufacturer's instructions and make sure all safety guards are in place.

Operation of Drying Equipment

Grain Dryers

How to use:

- Check the dryer for mechanical problems and confirm that fuel or power supply is sufficient.
- Load the grains into the machine.
- Set the appropriate drying temperature and duration.
- Start the dryer and keep an eye on the process.
- Frequently check for overheating and wear heat-resistant gloves when handling hot equipment.

Dehydrators

How to use:

- Clean the trays and verify that the dehydrator is functioning properly.
- Place produce in a single layer on the trays.
- Set the temperature and timer based on the specific produce.
- Start the dehydrator and periodically check progress.
- Use gloves or oven mitts when handling hot trays.

Solar Dryers

How to use:

- Clean the dryer and position it to capture the most sunlight.
- Evenly distribute the produce on drying racks.
- Cover the dryer and adjust the vents for airflow control.
- Regularly check the drying process.
- Make sure the structure is stable and secure.

Operation of Storage Equipment

Harvest Bags

How to use:

- Check that the bags are clean and undamaged.
- Fill the bags with harvested produce directly in the field.
- Transport the filled bags to storage or processing areas.
- Do not overload the bags to reduce the risk of injury.

Grain Bins/Silos

How to use:

- Inspect the structure for any signs of damage and verify that the ventilation system is functional.
- Load the grains into the bin or silo.
- Regularly monitor temperature and humidity levels.
- Wear harnesses when climbing and ensure proper ventilation to avoid respiratory hazards.

Cold Storage Units

How to use:

- Make sure the unit is clean, and the temperature controls are working **correctly.**
- Set the appropriate temperature and humidity levels. Place the produce inside the storage unit.
- Regularly monitor the storage conditions.
- Wear warm clothing when entering the cold storage and ensure the doors can be opened from the inside.

Silage Bags

How to use:

- Inspect the bags for any tears or damage, and ensure they are clean and ready for use.
- Fill the bags with chopped forage or silage material.
- Seal the bags tightly to create an airtight environment.
- Place the bags in a secure area for fermentation.
- Avoid overfilling the bags and use proper lifting techniques to prevent strain or injury when handling.

Hermetic Bags

How to use:

- Check the bags for any holes or damage that could compromise their airtight seal.
- Fill the- bags with grains or other produce.
- Seal the bags properly to ensure a vacuum-tight environment.
- Store the bags in a dry, cool place to preserve the contents.
- Be cautious when sealing the bags to avoid cuts or injuries, and ensure proper storage to prevent pests or damage.

Operation of Processing Equipment

Shellers

How to use:

- Inspect the sheller for any damage and confirm it is properly lubricated.
- Load the crop into the sheller.
- Start the machine and adjust the settings according to the specific crop.

- Collect the shelled product and dispose of the husks.
- Use protective gear and adhere to the manufacturer's safety instructions.

Threshers

How to use:

- Check the thresher to make sure there are no problems and that the blades are sharp.
- Put the crop into the thresher.
- Turn on the machine and set it to work best with the crop.
- Gather the grains and the leftover bits.
- Always wear gloves and goggles. Make sure no one is standing too close to the machine.

Milling Machines

How to Use:

- Make sure the machine is clean, and the grinding plates or blades are in good shape.
- Put the grains into the hopper.
- Choose how fine you want the grains to be ground.
- Turn on the machine and keep an eye on it while it works.
- Wear a dust mask and keep your fingers away from any moving parts.

Pulverisers

How to Use:

- Check that the pulveriser is clean and that the grinding parts are in good condition.
- Put the material into the machine.
- Set the grinding level to the desired size.
- Start the machine and watch as it pulverises the material.
- Wear protective gloves, goggles, and a dust mask. Keep your fingers and loose clothing away from the machine's moving parts.

Cleaners

How to Use:

- Make sure the cleaning machine is free of debris and that all parts are working properly.
- Load the material that needs cleaning.
- Set the machine to the appropriate cleaning mode for the material.

- Start the machine and let it clean the material.
- Wear gloves and a dust mask. Ensure no one is too close to the machine while it is running.

Juicers/Pressers

How to Use:

- Make sure the juicer or press is clean, and all parts are assembled correctly.
- Place the fruits or vegetables into the juicer or press.
- Adjust the settings for the type of produce you're using.
- Start the machine and collect the juice while discarding the pulp.
- Wear gloves, and keep fingers away from the blades or pressing parts. Make sure the area around the machine stays clean and dry to avoid slips.

Operation of Packaging Equipment

Bagging Machines

How to Use:

- Inspect the machine for any issues and confirm that the bags are the correct size.
- Load the product into the machine.
- Set the desired weight and fill levels.
- Turn on the machine and watch the packaging process.
- Keep the area clear of any obstacles and wear gloves when handling filled bags.

Sealing Machines

How to Use:

- Make sure the machine is clean, and the sealing parts are in good working condition.
- Place the filled bags or packages into the machine.
- Adjust the sealing temperature and time.
- Start the machine and check that the seal is properly made.
- Use caution when handling hot surfaces. Wear gloves if necessary.

Label Printers and Applicators

How to Use:

- Load the labels into the printer and check for any potential problems.
- Configure the printer with the correct label size and input the required information.

- Start the printer and ensure the labels are applied properly.
- Keep hands and clothing away from any moving parts of the machine

Operation of Handling and Transportation Equipment

Conveyors

How to Use:

- Inspect the conveyor belt for any damage and make sure it is properly aligned.
- Place the produce onto the conveyor belt.
- Start the conveyor and monitor the movement of the produce.
- Keep loose clothing and body parts away from the moving belt.

Forklifts

How to Use:

- Check the forklift for mechanical issues and verify fuel or battery levels.
- Start the forklift and ensure its stable.
- Use the controls to lift and transport pallets or containers of produce.
- Follow all safety protocols, such as wearing a seatbelt and securing the load properly.

Transport Vehicles

How to Use:

- Inspect the vehicle for mechanical issues and make sure it is clean.
- Carefully load the produce to prevent any damage.
- Drive at safe speeds and adhere to transportation regulations.
- Secure all loads properly and use tarps or covers when needed.

Elevators

How to Use:

- Ensure the elevator is in proper working condition by checking for any mechanical issues.
- Load the items or enter the elevator.
- Press the desired floor button and monitor the movement.
- Avoid overloading the elevator and keep hands, clothing, or objects clear of the doors.

Vacuum Flask

How to Use:

- Check that the vacuum flask is clean and free from any cracks or damage.
- Pour hot or cold liquids into the flask.
- Securely close the lid to maintain temperature.
- Handle with care, especially with hot liquids, and ensure the lid is tightly sealed to prevent spills.

Activity 4.14 Operations of harvest, post-harvest and storage tools, implements and machinery in agricultural production

1. Using the internet and other resources, gather information on the operations of a simple harvest, post-harvest and storage tools, implements and machinery in agricultural production. In your research, be guided by the following;
   a. Name, descriptions and uses of the tool or machinery under harvest, post-harvest and storage
   b. How each tool is operated and any basic maintenance required for efficient performance.
   c. The benefits of each tool in terms of efficiency, crop quality, and ease of use.
2. Write your findings in your notebook and present them to your class for feedback.

Activity 4.15 Hands-on Operation of Farm Machine/Implement

NOTE: This activity should be carried out under the supervision of a technician.

1. Observe a hands-on operation of a farm machine/implement by a technician or watch a video on the operation of farm machines. Guided by the technician, operate the farm implement provided.
2. Follow the steps below:
   a. Put on protective gear.
   b. Carry out a risk assessment (checking that all the parts are well fixed and the machine is in good condition).
   c. Follow instructions from the technician to operate the machine correctly and safely for the assigned farm activity.

Caution

- Only handle equipment under the technician's supervision.
- Do a thorough risk assessment of the machine before operating it.
- Always put on the prescribed protective gear before operating the machine.

EXTENDED READING

- Exotic Series, General Agriculture For Senior High School By Eric Amoah
- YouTube Channel: RealAgriculture - Harvest and Post-Harvest Machinery
- University of Nebraska-Lincoln: Farm Machinery Safety Guide
- https://www.youtube.com/watch?v=Z9HAy9EYKKs

- https://www.youtube.com/watch?v=weA013fjc7s

REVIEW QUESTIONS

1. The main purpose of an irrigation system in agricultural production is to...
   - **A.** remove excess water from fields
   - **B.** add nutrients to the soil
   - **C.** supply water to crops
   - **D.** harvest crops
2. Which type of irrigation system delivers water directly to the root zone of crops.
   - **A.** Flood irrigation
   - **B.** irrigation
   - **C.** Sprinkler irrigation
   - **D.** Furrow irrigation
3. The purpose of a winnowing machine in post-harvest processing is to ...
   - **A.** grind grains
   - **B.** separate grain from chaff
   - **C.** dry crops
   - **D.** pack harvested crops
4. What is a major benefit of using combine harvesters compared to manual harvesting?
   - **A.** Increased harvesting speed and efficiency
   - **B.** Reduced post-harvest losses
   - **C.** Improved grain quality
   - **D.** All of the above
5. Evaluate the importance of using refrigeration in post-harvest storage for fruits and vegetables.
6. Compare the advantages and disadvantages of drip irrigation versus sprinkler irrigation.
7. Explain two benefits of using drainage systems in farming.
8. Describe one way that post-harvest tools help prevent crop spoilage.
9. Explain why proper storage is crucial in post-harvest management.

SECTION

5 CONCEPT OF CROP AND ANIMAL PRODUCTION

FOOD PRODUCTION AND NATURAL RESOURCE CONSERVATION

Principles of Agriculture in Food Production

INTRODUCTION

In this section, we will explore the fascinating world of agriculture and animal husbandry, focusing on key crops and animals that are essential to our economy and daily lives. You will learn the meaning and economic importance of selected crops, understanding why they are important to both local and global markets. You will also learn about the latest technologies and techniques used to cultivate these crops efficiently and sustainably.

The section also deals with the economic importance of selected animals and fish, highlighting their value in food production and livelihoods. You will learn the essential management practices for rearing poultry, including how to care for chicks in the brooder house and ensure their healthy growth, feeding poultry to maturity and the vaccination regime from day-old chicks to 16 weeks. We will also walk through the steps involved in processing poultry meat for the market, ensuring it is safe, nutritious and ready for consumers. By the end of this section, you will have a comprehensive understanding of both plant and animal production, and the skills needed to manage these resources effectively. This section also has links with other subjects including Applied Technology, Business Studies, Economics, Engineering and Home Economics.

KEY IDEAS

- Vegetable crops refer to plants that are grown for their edible parts such as leaves, roots, stems and flowers.
- Ornamental crops are plants grown primarily for decorative purposes rather than for consumption.
- Arable crops are those that can be cultivated on ploughable land, typically in a regular cropping cycle.
- Incubation is a process that provides the necessary conditions for the development of embryos, cells or microorganisms.
- Brooding refers to the process of providing an optimal environment for young chicks in the early stages of their life.
- Poultry refers to domesticated birds that are raised commercially or domestically for the purpose of harvesting animal products such as meat, eggs, and feathers.

MEANING AND ECONOMIC IMPORTANCE OF SELECTED CROPS

Meaning of Some Selected Crops

Vegetable crops

Vegetable crops are cultivated primarily for their edible parts, such as leaves, roots, stems, fruits, and seeds. They are rich in vitamins, minerals and fibre, and provide numerous health benefits. Vegetables can be classified based on their parts eaten, growth cycle and botany. They can be consumed raw, cooked, or incorporated into a variety of dishes. Incorporating a wide range of vegetables into one's diet can help ensure adequate intake of essential nutrients and contribute to overall well-being. Other examples include tomatoes, carrots, lettuce, garden eggs, hot pepper, sweet pepper, okro, radish, cabbage, *kontomire* (cocoyam leaves).

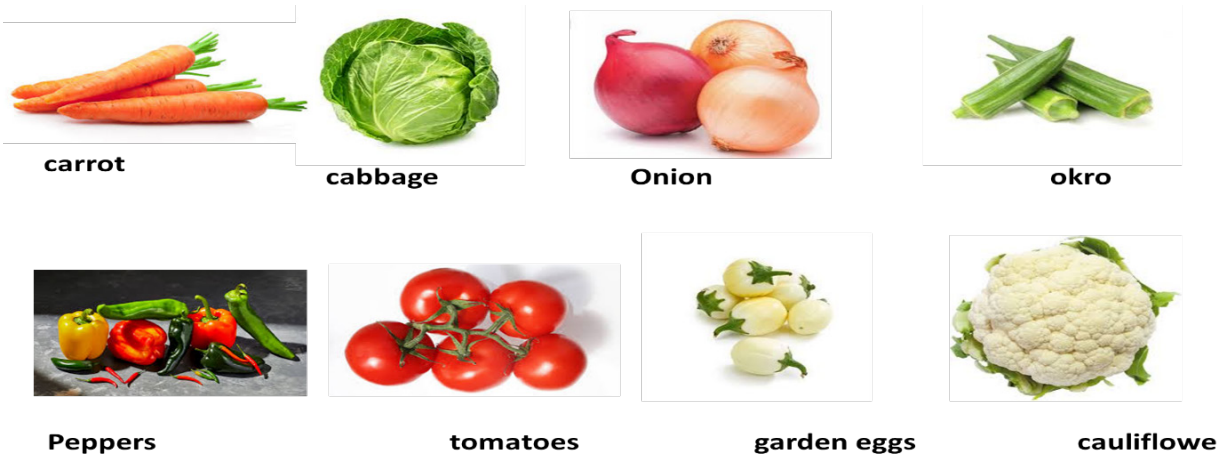


Figure 5.1: Examples of Vegetable Crops

Arable crops

Arable crops are crops that are grown on land specifically prepared and cultivated for regular planting and harvesting, usually through ploughing, tilling, and other soil preparation methods. These crops are typically grown on a large scale for food, animal feed or industrial uses. They require fertile soil and favourable climatic conditions to grow successfully. Examples of arable crops are:

- **Cereals**: Wheat, barley, maize, rice, millet and sorghum
- **Legumes**: Lentils, soyabeans, peas, cowpea, Bambara groundnut, French beans.
- **Root crops:** Potatoes, cassava, yam, cocoyam
- **Oilseeds**: Canola, sunflowers, palm nut, groundnut
- **Forage and fibre**: Cotton, fodder plants, hemp etc.

Figure 5.2: Examples of arable crops

Cash crops

Cash crops are agricultural products that are grown by farmers primarily for sale on the market or for export, rather than for personal consumption. They are cultivated with the goal of generating profit rather than being used as food crops. These crops are often cultivated on a large scale and are critical sources of income for farmers and national

economies. Common examples of cash crops include crops like coffee, cocoa, cotton, tobacco, oil palm, kola, rubber and tobacco.

Cocoa

Cashew

Kola

Oil palm

Rubber

Coffee

Figure 5.3: Examples of cash crops

Ornamental crops

Ornamental crops are plants that are grown primarily for their aesthetic value rather than for food or other practical purposes. They are cultivated to enhance the beauty and visual appeal of gardens, landscapes, and other outdoor spaces. Examples include roses, orchids, palm trees, maple, grasses, ferns, snake plant, lilies, hibiscus, whistling pine.

Royal palm

Hibiscus

Orchids

Whistling pine

Rose flower

Lily flower

Figure 5.4: Examples of ornamental crops

Economic Importance of Some Selected Crops

Vegetable crops

- Vegetables are often grown and sold which provide income to farmers by selling them in local and foreign markets. They provide a shorter growing cycle than many staple crops, allowing for multiple harvests within a season.
- Vegetables play a crucial role in human nutrition, as they are a source of essential vitamins, minerals, carbohydrates, fats, and proteins.
- It generates employment opportunities because it requires intensive labour for planting, tending, harvesting, and post-harvest handling. It also creates employment beyond the farm, with jobs in processing, packaging, distribution and retail.
- Vegetables are often grown in rotation with other crops, which helps improve soil health and reduce pests and disease.
- Vegetable farming drives the demand for high-quality seeds, fertilisers, pesticides, and farming equipment, supporting agro-input industries and research in horticulture.

Arable crops

- Arable crop production provides employment across the planting, tending, harvesting, and processing stages, particularly in rural areas where other job opportunities may be limited**.**
- Arable crops such as wheat, soybeans, and corn are major export commodities, generating substantial foreign exchange earnings for countries that produce them in large quantities.
- Staple arable crops such as wheat, rice, and maize provide essential sustenance for large populations in Ghana and globally.
- Arable crops are used as raw materials in several industries. Corn, for example, is processed into products like corn syrup, ethanol, and biodegradable plastics. Soybeans are used for oils, animal feed, and biofuels.

Cash crops

- Arable crops provide reliable income for farmers, particularly when grown on a large scale.
- Cash crops such as coffee, cocoa, and cotton make significant contributions to Ghana's GDP (Gross Domestic Product) and to the economies of many developing countries, strongly supporting Ghana's economic progress.
- Exporting cash crops such as cocoa, coffee, and cashew nuts generates essential foreign exchange, which is crucial for financing the import of goods and services.
- Arable crops such as wheat, rice, and maize are staple foods worldwide, forming the basis of diets in many regions and contributing to food security by providing an affordable, reliable food supply.

- Increased cash crop production often leads to better infrastructure, such as roads, storage facilities, and irrigation systems.
- Cash crops stimulate jobs in related sectors, such as transportation, packaging and retail.

Ornamental crops

- Ornamental plants make places look more beautiful and pleasant, helping people feel happier and enjoy their surroundings.
- Growing and selling ornamental plants, such as flowers and decorative trees, creates jobs and businesses for many people.
- People earn money by selling ornamental plants and flowers.
- Ornamental plants help clean the air by trapping dust and releasing oxygen, which helps people breathe better and stay healthy.
- Some ornamental plants act as windbreaks, protecting buildings from strong winds.
- Ornamental plants provide cool shade for people on hot sunny days.

Activity 5.1 Meaning of Vegetable, Arable, Cash and Ornamental Crops

1. What do you think of when you hear the following terms:
   - vegetable crops
   - arable crops
   - cash crops
   - ornamentals?
2. Write your definitions in your notebook and exchange with a colleague for feedback.

Activity 5.2 Examples of Vegetable, Arable, Cash and Ornamental Crops

1. In groups, come up with five examples each of vegetable, arable, cash and ornamental crops. You can use the internet and other resources in your exploration.
2. Present your work in the table below to the class for feedback.

Table 5.1

Vegetable crops	Arable crops	Cash crops	Ornamentals
E.g., onion	rice	cashew	hibiscus

Activity 5.3 Importance of Selected Crops

1. In the same groups, discuss the importance of any three of the categories of crops from vegetable, arable, cash and ornamental crops. In your discussion, be guided by the following;
   a. Economic importance
   b. Health and nutritional benefits
   c. Environmental benefits
   d. Employment and Livelihoods Impact
   e. Cultural and Social Significance
2. Present the salient points from your discussion in a chart below to the class for feedback.

   You can use the following tips to complete the chart.
3. Write the categories of crops, e.g. vegetables, ornamental, in the space labelled category 1,2 and 3.
4. Write five important items of each category in the space provided under the title importance.

APPLICATION OF TECHNOLOGIES AND TECHNIQUES TO CULTIVATE SELECTED CROPS

Stages of Crop Production

Crop production involves a series of steps that farmers follow to grow crops successfully. The first stage is land preparation, where the land is cleared and the soil is ploughed or ridged to make it suitable for planting. This is followed by seed selection, which involves choosing healthy and good-quality seeds to ensure good growth.

The next stage is planting, where seeds are sown or seedlings are transplanted into the soil. After planting, farmers carry out crop management, which includes watering, weeding, applying fertilisers, and controlling pests and diseases. When the crops are

fully grown, they are harvested. The final stage is post-harvest handling, where crops are dried, stored, processed, and transported to prevent losses and maintain quality.

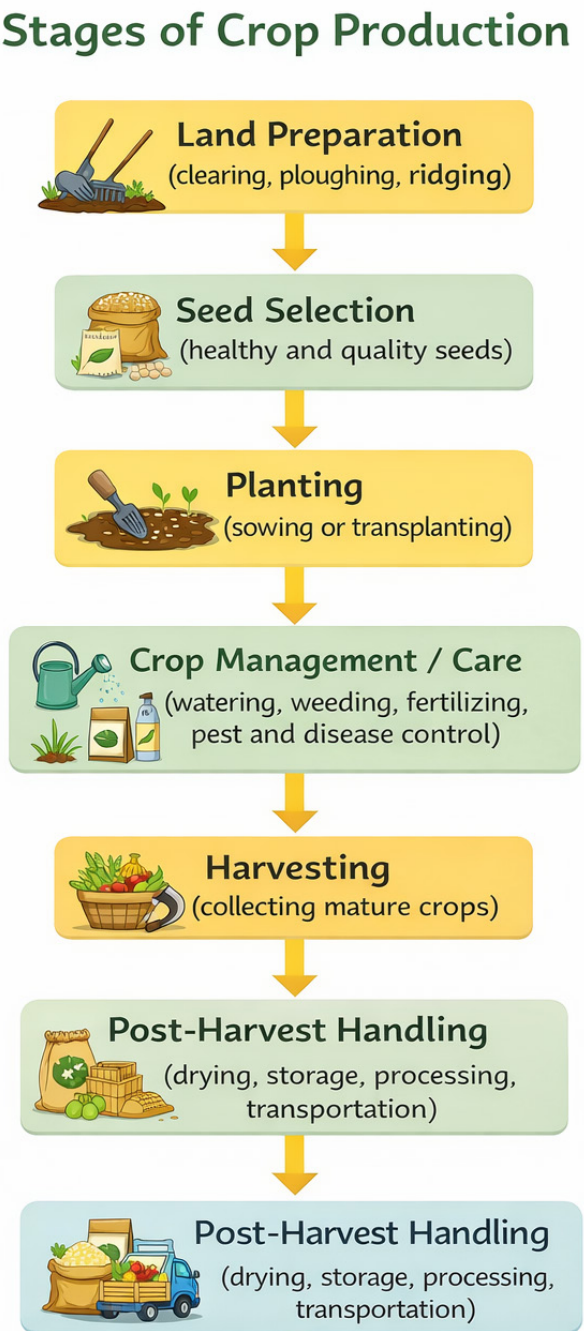


Figure 5.5: Stages in crop poduction

Table 5.2: Application of Technologies and Techniques to Cultivate Tomatoes

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation/ cultural practices	Maturity/ harvesting	Storage	uses
Tomatoes	Lycopersicon esculentum	Temperature: the ideal temperature range is 21-27oC. High temperatures result in fasciation and fruit drop. Soil: fertile loamy soil and good drainage is preferable. A pH of 5.5-7.0 is ideal.	By sowing the seeds on seed bed or in seed boxes. They are later planted on raised or sunken beds based on the rainy season.	Clearing and burning debris is necessary. Planting can then be done. In some cases, ploughing, harrowing and ridging may be done. The ideal time for land preparation is march-April and August to November. Cultural practices: Weeding; this may be done by chemical or mechanical means. Fertilisation; organic and inorganic fertiliser can be applied. Mulching; to suppress weed growth and evaporation. Staking; should be done to avoid fruit-ground contact. Pruning; is done occasionally so that nutrients are effectively used for fruit formation. Common diseases; early and late blight, leaf spot, fusarium wilt, end rot and root-knot diseases. Pests; aphids, green stink bug, whiteflies, and fruit worms. Control; use resistant varieties, proper spacing, and timely application of recommended pesticides.	First harvesting may be done 70-100 days after transplanting depending on the variety.	High temperature storage at 25oC is ideal. Ripe fruits are usually processed and canned or transported to market.	used in raw state as salad, in cooked state for stew or soup. Can also be used in the production of purees juice.

Table 5.3: Application of Technologies and Techniques to Cultivate Garden eggs

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation/ cultural practices.	Maturity/ harvesting	Storage	uses
Garden eggs	Solanum melongena or solanum esculentum	**Temperature:** they need temperature of 25-30°C **Climate:** the ideal rainfall range is 750mm-1200mm per annum. **Soil:** they require well drained sandy loam soils with pH range of 5.5-6.8.	Seeds are sown on nursery bed and transplanted either onto beds or onto "flat land." The spacing usually adopted is 75cm × 90cm.	Clear land of weeds by physical or mechanical method. Ploughing and harrowing can be made. **Weed control;** this is done with hoe and cutlass to reduce competition. **Irrigation;** it is required when there is low rainfall. Drip irrigation is preferred mostly. **Fertiliser application;** the crop requires NPK fertiliser to grow and yield properly. **Common diseases;** fusarium wilt, Anthracnose, and powdery mildew fruit**. Pests;** cutworm, red spider mites, grasshopper, and root-knot nematodes. **Control;** by growing resistance varieties, practice crop rotation, cut and burn affected plants.	Harvesting begins at about 71-100 days (10-14 weeks) after transplanting, depending on the type of variety. It should be harvested when fruits are matured but not ripened.	**N/A**	mature and immature fruits are cooked and used to prepare different recipes of food.

Table 5.4: Application of Technologies and Techniques to Cultivate Okro

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation/ cultural practices	Maturity/ harvesting	Storage	uses
Okro	Hibiscus esculentus OR Abel-moschus esculentus	**Temperature:** the ideal temperature ranges from 20-30°C for proper growth, flowering and pod development. **Climate:** requires fairly good amount of soil moisture, water logging conditions should be avoided. They can, however, tolerate dry conditions to a very high extent. **Soil:** well drained, fertile soils preferably sandy loam with an adequate content of organic materials.	Seeds are usually sown "at stake" of a planting distance of 60-90cm within rows, 2-3 seeds are sown per hole and thinned to one plant per hole.	Remove weeds, rocks, and debris from the planting area to prevent competition for nutrients and to reduce pest issues. Loosen the soil by tilling or ploughing to a depth of about 12–15 inches (30–38 cm) to improve drainage and root penetration. This is especially important for clay soils. **Thinning out;** is done when the plant is about 10-15cm. **weeding;** weeds are controlled to reduce competition for nutrients, space, sunlight etc. **fertilisation;** organic manure and inorganic fertiliser like NPK. **Irrigation;** it is done when necessary to supply the needed water for plant growth. **Diseases;** leaf curl, leaf mosaic, pod spot, leaf spot and fruit rot. **Pests;** beetle. Aphids, cotton stainer, root-knot nematodes, and leaf hoppers. **Control;** uprooting and burning affected plants, use resistance varieties and using of recommended pesticides.	Harvesting starts about three months after sowing depending on the cultivar. The fruits should be picked when young and tender as they become fibrous and tough when they are over-ripe.	Okra is best stored in the refrigerator. Okra can also be dried for long-term storage	Used for soup and stews. Young leaves and shoots are also edible.

Table 5.5: Application of Technologies and Techniques to Cultivate Pepper

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation/ cultural practices.	Maturity/ harvesting	Storage	uses
Pepper	**Sweet pepper-** Capsicum annum. **Hot pepper-** Capsicum frutescens	**Temperature:** most cultivars are adapted to a temperature range of 21-25°C. Excessive hot weather reduces fruit set. **Climate: R**ainfall levels range from 600-1200mm. Excessive rainfall affects flowering and fruit set and may encourage fruit rot and decay. **Soil:** Good drainage and fertile loamy soil are preferable with high organic materials. It prefers slightly acidic condition of 5.5- 7.0.	The seeds are raised in nursery sites and transplanting can take place within 4-6 weeks. Spacing is 60-80cm apart and 35-45cm between plants depending on the cultivar.	Clearing and burning of debris is necessary. In some cases, ploughing and harrowing and ridging may be done. **Weeding;** it should be done at least twice depending on the rate of growth. **Fertilisation;** inorganic fertiliser (NPK 15:15:15) and organic fertiliser like poultry droppings may be used. **Irrigation;** should be applied regularly during dry periods and avoid excessive irrigation. **Mulching;** it is done to suppress weeds and maintain soil moisture. **Pests;** aphids, whiteflies, fruit fly, and thrips. **Diseases;** fruit rot, leaf spot, dumping-off, mosaic, root-knot disease, and powdery mildew. **Control;** by using clean seed, removing infected fruits, by practicing crop rotation, by using fungicides, nematicides and recommended insecticides.	Depending on cultivars harvesting may be done 2-3 months after planting and when they have reach their full colour red/ green.	They can be boiled and dried. It may also be preserved in brine (concentrated salt solution). They can be stored in a refrigerator.	Used in soup and stews. Can be used in the preparation of some local herbal medicines.

Table 5.6: Application of Technologies and Techniques to Cultivate Onion

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation/ cultural practices	Maturity/ harvesting	Storage	uses
Onion	Allium cepa	**Soil;** well drained sandy loams with high amounts of organic materials. A pH of 5.8- 6.8 is considered favourable. **Temperature;** the ideal temperature for onion is 13-25°C. **Climate;** they require rainfall range of 400-600mm. Onions require 14-16 hours of daylight for bulb formation.	Onions are propagated using improved seeds that are resistant to diseases. Seeds are nursed in containers and transplanted to prepared beds after 45-60 days when seedlings are 12-18cm in height. Onions may be planted in rows 30-38cm × 12-15cm.	**Soil preparation;** weeds must be cleared and tilling or ploughing and harrowing is very necessary. **Irrigation;** it is very necessary during the dry season. Drip irrigation is preferred. **Fertilisation;** onions require high amounts of poultry manure or NPK (15:15:15). **Weeding;** to reduce competition from weeds. **Earthing up;** this is done to cover up the exposed bulbs. **Pests;** thrips, stem and bulb nematodes, and onion flies. **Diseases;** basal rot, downy mildew, purple blotch and pink rot. **Control;** using recommended fungicides, crop rotation, proper field hygiene and integrated pest management (IPM).	Onions generally reach maturity around **100-120 days** after planting, though this can vary with variety and growing conditions. When about **50-80% of the onion tops (leaves) fall over**, the onions are mature and ready for harvest. This toppling happens naturally as the onion bulb reaches full size. The leaves will start to **turn yellow and dry out** at the tips.	Store in a cool, dry, and dark place with good air circulation, ideally at 32-40°F (0-4°C). The bulbs can also be allowed to lie on the surface of the soil or transferred to curing barns.	used for soup, stew or sauces and salads. Also, for medicinal purposes because it contains antioxidants like quercetin, which have anti-inflammatory benefits and may help reduce symptoms of allergies and inflammation.

Table 5.7: Application of Technologies and Techniques to Cultivate Carrot

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation	Maturity/ harvesting	Storage	uses
Carrot	Daucus carota	**Soil;** carrot requires well drained sandy loam. Sandy soil with a number of organic materials. Soil pH is in the region of 6.0-7.0. **Temperature;** they thrive well in temperature range of 16-30°C. excessive temperature results in production of short roots tissues which result in extremely poor yield. **Climate;** carrot requires moderate amount of rainfall of 800-1200mm. excessive rainfall may cause a reduction in root formation.	**Propagation**: Directly from seeds, as carrots are grown from seed rather than transplants. -**Seed Depth and Spacing**: Sow seeds 0.25-0.5 inches deep and space 1-2 inches apart in rows 12-18 inches apart.	Remove rocks, weeds, and debris from soil; till to loosen and enrich with organic matter. **Fertilisation**: Use a balanced fertiliser; avoid high nitrogen to prevent excessive foliage. **Watering**: Water regularly to keep soil moist but not soggy. **Weeding;** this is done by hand picking or hoeing in-between rows. **Thinning out;** this is done to reduce plant population of seeds drills and to control the spread of diseases. **Earthing up;** this is done to cover the roots (tubers). **Pests;** leaf blight, root-knot nematodes, aphids, and cutworms. **Diseases;** bacterial soft rot, powdery mildew, and Alternaria Leaf Blight. **Control;** crop rotation, resistant varieties and nematicides.	**Maturity**: Carrots typically mature in **70-80 days** after sowing, depending on the variety. **Harvesting**: Harvest when carrots are 0.5-1 inch in diameter by gently pulling the stem up after loosening the soil. The roots are then bunched into groups of four, five or six for market.	**Short-term Storage**: Keep carrots in a cool, humid place at 32-40°F with high humidity (90-95%). **Long-term Storage**: Store carrots in sand or moist sawdust in a root cellar; they can last for several months this way.	Used to prepare salads and stews. Some people eat the leaves as a vegetable.

Table 5.8: Application of Technologies and Techniques to Cultivate Maize

Common name	Botanical name	Soil and environmental requirement	Method of propagation	Land preparation/ cultural practices	Maturity/ harvesting	Storage	uses
Maize (Corn)	Zea mays	**Soil:** Grows best in well-drained, fertile loamy soils, with pH of 5.5 – 7.5 **Temperatures:** Thrives in warm (18–30°C) **Climate:** moderate to high rainfall (about 600–1,200 mm per year). Needs good sunlight	Propagated by seeds sown directly in the field with planting distance of 75 cm × 25–30 cm	Clear land and plough or hoe the soil. Prepare ridges or flat beds. Plant 2–3 seeds per hole, later thinning to 1–2 plants. Fertilizer: fertilisers used in maize production include NPK (e.g. 15-15-15) at planting and urea or ammonium sulphate as top-dressing. Fertiliser is applied 2–3 weeks after planting and again at knee-high stage. Organic manure such as compost or farmyard manure can also be used to improve soil fertility. **Diseases :** Maize Streak Disease, Leaf Blight / Leaf Spot, Downy Mildew **Control:** Use resistant varieties, control insect vectors, Use treated seeds, remove infected plants, apply fungicides, and practice crop rotation **Pests :** Stem Borers, Fall Armyworm **Control:** Use insecticides, remove, destroy affected plants, use recommended insecticides, and encourage natural enemies, dry grains well, use airtight (hermetic) storage, and apply approved storage pesticides.	Maize matures in **90–120 days**, depending on variety Cobs are harvested when dry and husks turn brown For green maize, cobs are harvested earlier when grains are milky	Maize are properly dried to reduce moisture The grains are stored in cribs, sacks, silos, or hermetic bags The grains should be kept away from pests and moisture	Can be eaten boiled, roasted or prepared into flour, porridge) Can be fed to animal as feed The gains also serve as raw material for industries (starch, ethanol, corn oil)

Comparison between traditional and modern crop production practices

Traditional and modern crop production practices differ mainly in the level of technology used. Traditional crop production relies on simple tools such as hoes and cutlasses, local seeds, and natural methods of fertilising and pest control. It depends largely on rainfall and human labour, resulting in lower yields but lower production costs.

In contrast, modern crop production uses improved seeds, machinery, fertilisers, irrigation systems, and pesticides. These practices reduce labour, increase efficiency, and produce higher yields. Modern methods also make use of technology such as mechanisation and improved storage systems, helping farmers to produce more food to meet the needs of a growing population. and insert table 5.9 after the write up.

Activity 5.4 Techniques for Growing Selected Crops

1. In groups, visit a crop production farm in your community or watch a video (click here or use this link https://youtu.be/A6dwAeAZi9M) on crop production and come up with the techniques of growing crops.
2. In the same groups, discuss the techniques for growing crops.
3. Prepare a presentation on any three selected crops for the class. You can use the template below to guide your thinking:

Table 5.9

Selected crop	Techniques for growing
E.g., Tomato (vegetable crop)	Seed Selection: Use disease-resistant varieties. Land Preparation: Till the soil to loosen and improve drainage. Transplanting: Start seeds in nurseries and transplant at 4-6 weeks. Staking: Use stakes or cages to support plants. Irrigation: Regular watering to maintain consistent moisture.
E.g., Cocoa (cash crop)	

Activity 5.5 Cultivation of Vegetable Crops

1. In groups, visit a vegetable farm in your community or watch a video on vegetable production (click here) or use (https://youtu.be/FSFBPtRO4HU)
2. In the same groups, discuss the cultivation of a selected vegetable crop. In your discussion, be guided by the following:
   a. The scientific and common names of the selected crop

b. The importance of the crop (Nutritional, economic and cultural significance)

c. Climate and Soil Requirements of the crop (temperature, rainfall, humidity, soil types, pH levels, and soil fertility requirements).

d. Cultivation Practices

i. Land Preparation (how to prepare the land, including ploughing, tilling and soil amendments).

ii. Planting (planting methods, spacing, depth, and time of planting).

iii. Irrigation (irrigation needs and methods suitable for the crop).

iv. Fertilisation (The types and amounts of fertilisers required, as well as application time and methods).

v. Weed Management (strategies for controlling weeds, which include mechanical or chemical methods)

vi. Pest and Disease Management (common pests and diseases of the crop and the strategies for controlling them)

e. Harvesting (how to determine the right time to harvest and the harvesting methods, including any tools or machinery used).

f. Post-Harvest Handling (post-harvest handling of the crop, including cleaning, sorting, and storage).

g. Market and Uses (the current market demand and potential buyers and the various uses of the crop, such as fresh consumption, processing and industrial uses)

3. Present the salient points from your discussion to the class for feedback.

Activity 5.6 Cultural Practices of Crops

1. In pairs, come up with the definition of cultural practices in agriculture. Write your definition in your notebook and share your answer with your peers for feedback.

2. In groups, discuss the cultural practices for the cultivation of three selected crops. Use the following questions as guidelines in your discussions.

i. What are the common cultural practices carried out during the cultivation of each crop?

ii. How are the cultural practices carried out?

iii. At what stage of the cultivation process are the cultural practices carried out?

iv. What are the benefits of carrying out the cultural practices in cultivating the crops?

v. What negative impact does the cultural practice have on the crop and the soil?

vi. What tools or equipment are used in carrying out the cultural practice? You can use the internet and other resources in your research.

3. Present the salient points from your discussion to the class for feedback.

ECONOMIC IMPORTANCE OF SELECTED ANIMALS AND FISH

Managing Farm Animals and Fish

Livestock and Aquaculture Management involves the science and practice of raising animals on land and in water to sustainably and efficiently produce food and other resources. It includes managing health, nutrition, breeding, and overall care of livestock (such as cattle, poultry, and sheep) and aquatic species (such as fish, shrimp, and shellfish).

Objectives of Management Practices for Keeping Farm Animals/Fish

The following are some objectives of management practices for keeping farm animals and fish:

1. **Enhance productivity**: Improve the growth rate, reproduction, and yield (e.g., milk, eggs, meat, fish) to meet food demands efficiently.
2. **Ensure animal health and welfare**: Maintain optimal health and living conditions to prevent disease, reduce stress, and promote the well-being of animals and fish.
3. **Optimise nutrition and feeding**: Provide balanced diets suited to the species to ensure proper development, productivity, and product quality.
4. **Implement sustainable practices**: Minimise environmental impact through responsible resource use, waste management, and conservation efforts.
5. **Improve genetic quality**: Use selective breeding techniques to enhance desirable traits such as growth, disease resistance, and adaptability.
6. **Maintain economic viability**: Optimise operations to reduce costs and increase profitability for sustainable farm or aquaculture businesses.
7. **Promote biosecurity**: Prevent the spread of disease by implementing biosecurity measures and maintaining controlled environments.

8. **Ensure food safety and quality**: Follow best practices to produce high-quality, safe products for consumers, meeting health standards and regulatory requirements.
9. **Adapt to climate resilience**: Develop strategies that enable livestock and aquaculture operations to withstand climate variations and extreme weather events.

Economic Importance of Selected Animals

Food security and supply

Animal production provides essential food products, including meat, milk, cheese, butter, and eggs, which are rich in protein, vitamins, and minerals. By producing a steady supply of these products, animal agriculture helps ensure food security, reducing hunger and supporting healthy diets worldwide.

Employment and job creation

Animal production creates millions of jobs on farms, supporting families and communities. Jobs are created in food processing (e.g., meatpacking, dairy production) and distribution, including trucking, warehousing, and retail.

- **By-products for industries:** Animals produce materials such as leather (from cattle hides) and wool (from sheep), which are used in clothing, furniture, and industrial materials. Animal by-products, such as gelatine and certain enzymes, are used in medicines, cosmetics, and medical devices.
- **Medical and scientific research:** Animals are essential in medical and scientific research, contributing to advances in human and veterinary medicine, pharmaceuticals, and vaccine development. Laboratory animals help test new medicines and treatments, ensuring their safety and efficacy, a role critical to public health and the pharmaceutical industry.
- **Cultural and social contributions:** livestock hold significant cultural and social value, playing central roles in traditions, festivals, and ceremonies, where they often symbolise wealth and status. Additionally, livestock farming can foster stronger community bonds through cooperative farming practices and shared resources.
- **Tourism and recreation:** Wildlife and domesticated animals play key roles in tourism, attracting visitors for activities like safaris, birdwatching, and cultural heritage experiences. Zoos, aquariums, and animal parks contribute to local economies by attracting tourists, generating revenue, and creating jobs in hospitality and service sectors.
- **Agricultural productivity and crop support:** Animals contribute to agricultural productivity by providing manure, a natural fertiliser that enhances soil health and crop yields. Livestock can also serve as draft animals, helping with ploughing, transportation, and other labour-intensive tasks on farms, reducing reliance on machinery and fuel.

- **Ecological balance and ecosystem services:** Animals play vital roles in ecosystems, helping control pest populations, pollinate plants, and disperse seeds, which supports biodiversity and agricultural productivity. Ecosystem services provided by animals, such as bees for pollination, directly impact food production, agriculture, and the environment.
- **Global and local trade:** Livestock products, including meat, dairy, eggs, and wool, are major exports for many countries, providing a significant source of foreign exchange. Countries with large livestock industries have competitive advantages in global markets, supporting national economies through trade.

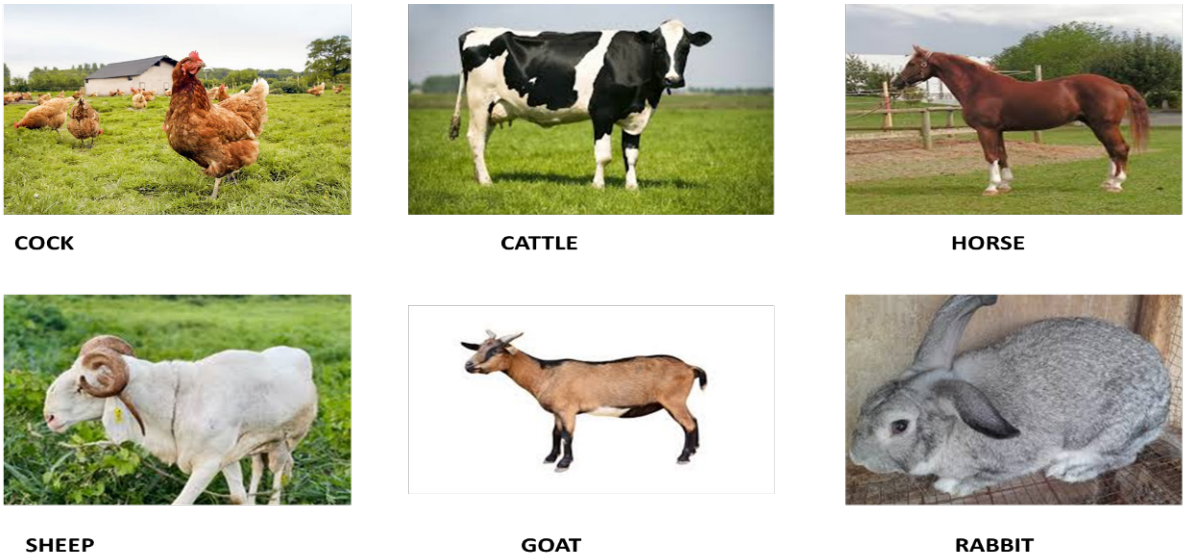


Figure 5.6: Some selected animals

Economic Importance of Fish

Food supply and nutrition

Fish are a critical source of high-quality protein, healthy fats, vitamins, and minerals, especially for coastal and island communities. Seafood provides essential nutrition to billions of people, making it an integral part of the global food supply and improving food security.

Income generation

Fish and seafood are marketed in various forms—fresh, frozen, canned, or processed—creating significant income for fish farmers and fishers. In Ghana, fish and fish product exports bring in valuable foreign exchange and contribute to the national GDP.

Global and local trade

Fish and seafood are among the most widely traded foods internationally, with high demand across diverse markets. This trade generates substantial revenue and is vital for many countries' economies, especially those with rich marine resources.

Employment generation

Jobs are created directly in wild fishing, with fishers catching fish in rivers, lakes, and oceans. This includes both small-scale, artisanal fishing and larger commercial fishing operations**.** Fish are processed and packaged for sale, which requires labour for cleaning, filleting, canning, freezing, and other forms of preparation.

Cultural and social contribution

Fishing is an integral part of the cultural traditions and practices of many communities. Sport and recreational fishing also boost tourism and support local economies.

Research and development

The aquaculture and fishing industries encourage research to find better ways to raise fish sustainably, prevent diseases, and improve breeding practices. These sectors also offer educational programs and training in areas like marine biology, fish farming, and environmental science, helping people learn the skills needed to work in these fields.

Health and nutritional benefit

Eating fish promotes public health by supplying essential nutrients that can help prevent chronic diseases. As more people become aware of the health benefits of fish, demand is rising, which in turn supports the fishing industry.

Supporting industries

The need for fish feed boosts the aquaculture feed manufacturing industry. The fish industry also supports businesses involved in processing, packaging, and preserving fish products.

Medicinal and scientific research

Fish, particularly fatty fish, like salmon, mackerel, and sardines, are rich in omega-3 fatty acids, which are essential for heart and brain health. Fish, especially zebrafish, are widely used in genetic and biomedical research due to their genetic similarities to humans and their transparent embryos, which make development and disease study easier.

Figure 5.7: Some selected fishes

Activity 5.7 Meaning and Objectives of Managing Farm Animals and Fish

1. What comes to mind when you hear the term 'management of farm animals and fish'?
2. Write your ideas or thoughts in your notebook.
3. Write at least five objectives of managing farm animals and fish in your notebook.
4. Share your findings with your peers for feedback.

Activity 5.8 Economic Importance of Animals/Fish Production

1. In groups, come up with the economic importance of farm animals and fish production. You can use the internet and other resources in your research.
2. Exchange your findings with other groups for feedback.

Activity 5.9 Economic Importance of Parts of Selected Farm Animals and Fish

1. In groups, discuss the economic importance of five parts of the selected animals and fish.
2. Present findings to the class for feedback in the table below.

Table 5.10

Animal/fish	Part	Economic importance
E.g., Chicken	Eggs	Foreign exchange, eggshells are used as organic fertiliser, job creation. Used in baking as a binding agent.
Fish	Oil	For medicinal purposes

MANAGEMENT PRACTICES INVOLVED IN THE REARING OF SELECTED ANIMAL (POULTRY)

Housing

Poultry housing is the structure and environment provided for chickens, ducks, turkeys, and other birds raised for meat, eggs, or breeding. Proper housing is essential to keep the birds healthy, comfortable, and productive.

Extensive systems

The extensive systems of keeping poultry include the ***free-running system*** *and* ***the free-range system.***

1. **Free-running system**

   With this system, the birds are allowed to scavenge for food over a large area of grassland or bush during the day and come back to roost in ill-constructed housing at night. Birds may not even come back to their houses for several days. Some even have no shelter and roost in trees.

2. **Free-range system**

   The birds are allowed access to a range of grassland over a large, fenced area, offering a more natural living environment. The birds are then confined in a hut or shed at night.

Free running system in poultry production

Free range system in poultry production

Figure 5.8: A typical free-running and free-range system in poultry production

Advantages of an extensive system

a. Birds have access to fresh green materials that provide vitamins, minerals and protein.

b. Low capital investment is involved in terms of housing and feeding.

c. Labour costs associated with these systems are low.

d. Overcrowding of birds and their associated problems, such as cannibalism, are avoided.

e. Birds have enough space for exercise.
f. Very fertile eggs are produced at all times.
g. Manure is fairly distributed on the land.

Disadvantages of an extensive system

a. The productivity of the birds is generally low.
b. Not all breeds of poultry can be reared under this system.
c. No proper records can be kept on each bird.
d. Birds are exposed to danger and adverse weather conditions.
e. It gives a low level of income to farmers.
f. They are exposed to diseases and pest attacks.
g. Eggs are dirty and may get lost.

Semi-intensive system

Run system

It involves the keeping of birds in a fixed house by giving them access to grass grown outside the pen. The birds are able to roam about on a small piece of grassland enclosed by a wire fence or other chicken-proof barriers. Food and water are supplied in troughs in the house.

Moveable Fold Unit System

This is whereby a small portable house with a run attached is used so that the birds can make use of the run during the day and are housed at night. The unit moved on to a new area of clean grass daily. For easy movement, some fold units are fixed with wheels. Tractors are sometimes used to move the fold unit daily. Egg-laying boxes are in the pen.

Advantages of the semi-intensive system

a. Culling is made easier because small groups of birds are kept.
b. Uniform distribution of manure on land.
c. The birds are safe from wild animals and predators.
d. This system is useful for all kinds and ages of birds.
e. Birds have the opportunity to exercise.
f. No expensive equipment is used as compared to an intensive system.

Disadvantages of the semi-intensive system

a. There is a high cost per house.
b. Labour requirement is significantly high.
c. Diseases and pests may easily spread among birds.
d. Difficult to keep records on each bird.

e. Fertile eggs may not be produced if both sexes are not mixed.

f. Cannibalism may occur if not properly managed.

Moveable fold unit system

Run system

Figure 5.9: A typical fold unit and run system in poultry production

Intensive systems

Deep Litter House System

With this system, the birds are kept indoors, and it is suitable for rearing layers, breeding, broilers and for brooding chicks. The floor of the pen is covered with a mass of dry and friable materials called litter. Good litter materials for poultry should absorb moisture well, break down easily by microorganisms, and have a particle size that won't block the birds' airways. Soft wood shavings are ideal, but a mix of straw and wood shavings also works well. See Figure 5.9

Advantages of the Deep Litter System

a. Less labour is required.

b. The birds are kept in relatively hygienic conditions.

c. The system requires a small piece of land.

d. Regular culling of diseased and unproductive birds is possible.

e. It requires relatively less capital as compared to the battery cage system.

f. There is less risk of predation and loss of eggs.

g. It increases the efficiency in poultry management.

Disadvantages of the Deep litter system

a. High initial cost of building deep litter houses.

b. Birds are limited to spaces for exercise if the stocking rate is high.

c. No free access to natural vegetation.

d. Diseases caused by organisms are easy to spread.

e. It requires greater attention and skills to handle

f. The cost of feeding and structure maintenance is very high.

g. Eggs can get dirty when litter is wet.

Battery cage system

This system is primarily used for laying birds. It can be built from plastic, wood, wire or metal. This system is designed in such a way that each hen has a space to permit very limited movement and allows her to stand and sit comfortably. The cages could be arranged in one, two or three tiers and a provision for sloping so that eggs can roll forward from each of the fowls. See Figure 5.9

Advantages of the Battery cage system

a. There is less risk of predation and loss of eggs.
b. Accurate records can be kept of each bird.
c. The birds are kept in relatively hygienic conditions.
d. Less trouble from parasitic diseases such as worms and coccidiosis because the birds don't come in contact with their droppings.
e. This system is used as labour labour-saving device.
f. Eggs are not eaten by fowls as they do not have access to them.
g. Farmers can more easily monitor the health, behaviour and productivity of the hens.
h. Controlled and scientific feeding can easily be practised to avoid feed wastage.

Disadvantages of the Battery cage system

a. It is more expensive and also deteriorates very quickly.
b. It is suitable for only one purpose, i.e. for laying eggs.
c. Possibilities of technical and higher maintenance costs.
d. Birds do not have access to natural vegetation.
e. Birds have less space for movement and, as a result, less exercise to keep them healthy.
f. More eggs are cracked as a result of contact with hard surfaces such as metal or wire floors.

Battery cage system | Deep litter system

Figure 5.10: Battery cage and deep litter system in poultry production

Table 5.11: comparison between Traditional and Modern Crop Production Practices

Aspect	Traditional Production Practices	Modern Production Practices
Land Preparation	Hand tools such as hoes and cutlasses are used	Tractors and ploughs are used (mechanisation)
Seed Type	Local or saved seeds	Improved and hybrid seeds
Planting Method	Manual planting by hand	Mechanical planters and seed drills
Fertiliser Use	Organic manure and compost	Chemical fertilisers and controlled nutrient application
Weed Control	Hand weeding and slash-and-burn	Herbicides and mechanical weeders
Pest Control	Traditional methods (ash, neem leaves)	Modern pesticides and integrated pest management
Irrigation	Rain-fed farming	Irrigation systems (drip, sprinkler)
Yield	Low to moderate yield	High yield
Labour Requirement	Labour-intensive	Less labour due to machinery
Harvesting	Manual harvesting	Mechanical harvesters
Storage	Traditional barns and cribs	Improved storage (silos, hermetic bags)
Technology Use	Little or no technology	Use of machines, ICT, and GPS tools

Incubation

Incubation in poultry is the management of fertilised eggs to ensure the satisfactory development of the embryo inside them to form a normal and healthy chick. Incubation may be achieved by natural method with a hen sitting on the eggs or by artificial method using special machines known as incubators.

Natural incubation

This is the traditional or common method where a hen will naturally go into a “broody” state, meaning she has a strong instinct to sit on her eggs to hatch out chicks. They will keep them warm, turn them regularly, and maintain the necessary conditions for the embryos to develop. After about 21 days, the chicks will begin to peck their way out of the shell.

Advantages of natural incubation

- It is suitable for hatching a few eggs.
- More eggs are likely to be hatched relative to the number of eggs set under the broody hen.
- The hen turns the eggs regularly, which is crucial for healthy embryo development**.**
- It does not need much capital to run.
- It does not require any technical skills to achieve success.
- Since there’s no need for an incubator, natural incubation eliminates electricity costs.

Disadvantages of natural incubation

- It cannot be used to produce commercial quantities of chicks.
- Broody hens may not be available to sit on eggs at the time incubation is critical.
- Broody hen may not provide precise and constant temperature.
- Eggs can sometimes be accidentally broken or damaged by the hen moving around.
- Hatching eggs are exposed to the danger of pest attack and bad weather conditions.

Figure 5.11: Example of natural incubation.

Artificial incubation

This is the hatching of eggs using a machine called an ***incubator.*** It is the best method of producing day-old chicks on a large scale for commercial poultry farms. This method of incubation is based on the working principles of natural incubation, such as ensuring desirable temperature, moderate humidity, ventilation and regular turning of eggs. Small incubators have a capacity of 50-300 eggs, while mammoth incubators can take 3000- 30,000 eggs.

Advantages of artificial incubation

- Incubation can be done at any time when eggs are available.
- Eggs are safe from pest attack and unfavourable weather conditions.
- It is a reliable method for commercial chick production.
- It does not involve providing feed and water for broody hens.
- Automated features such as automatic turning and monitoring systems reduce the need for constant manual intervention, saving labour costs and effort.
- It can take care of a large number of eggs to produce commercial quantities of chicks.
- The danger of eggs becoming infected is minimised.

Disadvantages of artificial incubation

- It is uneconomical for hatching a few eggs.
- It requires more money to establish and run the artificial incubation.
- It requires good technical skills in the operation of the incubator.
- The percentage of chicks hatched can be lower than expected.
- Maintenance costs are very high.
- Since it requires electricity to operate, it can lead to increased energy costs.

Figure 5.12: Example of artificial incubation

Brooding

Brooding in poultry refers to the care and management of young chicks from hatching until they are fully feathered and capable of regulating their body temperature, typically around 4–6 weeks of age. This stage is critical as chicks are highly vulnerable to temperature fluctuations and environmental stressors. Brooder houses are designed and equipped to provide the rearing environment or requirements of chicks.

Caring for chicks at the brooder house

1. **Temperature Control**: Newly hatched chicks require a warm environment, typically starting at around 32-35°C (90-95°F) using a heat lamp or brooder heater and gradually decreasing as they grow. Each week, reduce the temperature by about 5°F (2-3°C) until it reaches ambient room temperature, which is usually around 70°F (21°C) by week 6.

2. **Bedding:** Straw, pine shavings, or paper towels are good options. Avoid cedar shavings, as the oils can be harmful. Bedding should be kept dry and clean to prevent bacterial growth; change it as needed.
3. **Nutrition and water:** Provide a high-quality chick starter feed with the right balance of nutrients, including protein (around 18-20%). Always provide fresh, clean water. Use shallow containers to prevent drowning. You can add marbles or pebbles to help prevent chicks from falling in. Ensure that food is always available, especially in the first few days, when chicks are rapidly growing.
4. **Ventilation:** Proper ventilation in the brooder house is needed to keep air fresh and prevent ammonia build-up from waste. Ensure that chicks are not exposed to cold drafts, as they can become stressed or sick.
5. **Space:** Adequate space is necessary to avoid overcrowding, which can lead to stress and disease. Give each chick enough space to move around comfortably. A good rule of thumb is about 0.5 square feet (about 45 cm^2) per chick for the first few weeks.
6. **Lighting:** Ensure the brooder is well-lit, but not overly bright, as chicks need a cycle of light and darkness. A 12–16-hour light cycle is ideal during the first few weeks to help them grow properly. Chicks also need some darkness at night for proper rest.
7. **Health monitoring:** Keep an eye on your chicks for any signs of distress, lethargy, or unusual behaviour, which could indicate illness. If needed, ensure that your chicks are vaccinated for common poultry diseases, as per your veterinarian's advice.
8. **Safety:** Make sure the brooder is secure from predators, such as rats, cats, or other animals, and that there are no sharp edges or harmful objects they could injure themselves on.
9. **Sanitation:** The following strict sanitation measures can be put in place in the brooder house to ensure chicks are healthy and safe:
    - Thoroughly clean the brooder house on a routine basis, removing any accumulated litter, waste, and debris.
    - Use approved disinfectants to clean and sanitise all surfaces, including walls, floors, and equipment, to kill any harmful bacteria or viruses that may be present.
    - Wash surfaces, feeders, and drinkers with detergent and water.
    - Isolate and treat sick birds promptly and consult a veterinarian if needed.
    - Limit entry to the brooder house to essential personnel and ensure they wear protective clothing.
    - Place disinfectant footbaths at the entrance and change the solution regularly.

Brooder house for chicks

Figure 5.13: Example of brooder house

Feeding of Poultry to Maturity

Key nutrients for poultry for poultry birds

1. **Proteins**: Crucial for growth, feather development, and egg production, proteins are composed of amino acids. Essential amino acids like lysine, methionine, and threonine play key roles in poultry health. Common protein sources include soybean meal, fish meal, and alfalfa.
2. **Carbohydrates**: A primary energy source for poultry, carbohydrates support metabolic functions. They are commonly derived from ingredients like corn, wheat, and barley.
3. **Fats**: Fats provide concentrated energy, aid in cell structure maintenance, hormone production, and facilitate the absorption of fat-soluble vitamins. Typical sources include vegetable oils and animal fats.
4. **Vitamins**:
   - Vitamin A: Essential for vision and immune function.
   - Vitamin D: Important for calcium absorption and bone health.
   - Vitamin E: Acts as an antioxidant, promoting cell health and immunity.
   - B vitamins (like B1, B2, B6, B12): Crucial for metabolism, growth, and feathering.
5. **Minerals**:
   - Calcium: Vital for strong bones and eggshell production.
   - Phosphorus: Works alongside calcium for bone development and energy metabolism.
   - Magnesium: Supports enzyme function and muscle function.
   - Sodium and Potassium: Important for fluid balance, nerve function, and muscle contraction.
   - Iron: Necessary for blood oxygen transport.

6. **Water**: Water is a critical nutrient, influencing digestion, temperature regulation, and metabolic processes. Adequate fresh water is essential for all poultry, especially during periods of high heat or stress.
7. **Fiber**: While not a major energy source, fibre is essential for proper digestive function and gut health. Ingredients like wheat bran, alfalfa, and other fibrous plants contribute fibber to the diet.

Feeding stages

1. **Starter Stage**
   - Age: 0 to 4–6 weeks (varies by bird type).
   - Focus: High protein and energy levels to support rapid growth and development.
   - Key Nutritional Requirements:
     - Protein: 20–24% for broilers; 18–20% for layer chicks.
     - Enriched with essential vitamins and minerals.
   - Feed Type: Fine crumbles or mash for easy consumption.
2. **Grower Stage**
   - Age: 5–12 weeks (layers) or 5–8 weeks (broilers).
   - Focus: Gradual growth, muscle development, and preparation for the next stage.
   - Key Nutritional Requirements:
     - Protein: 16–18% for layers 18–20% for broilers.
     - Balanced levels of calcium and phosphorus for bone development.
   - Feed Type: Pellets or crumbles for older birds.
3. **Developer/Pre-Lay Stage (for layers only)**
   - Age: 13–18 weeks.
   - Focus: Preparing pullets for egg production by supporting reproductive organ development.
   - Key Nutritional Requirements:
     - Protein: 14–16%.
     - Calcium: Increased to 2–2.5% for eggshell formation.
   - Feed Type: Mash or pellets.
4. **Layer Stage**
   - Age: 19+ weeks (onset of laying).
   - Focus: Maximising egg production, quality, and maintaining bird health.

- Key Nutritional Requirements:
  - Protein: 16–18%.
  - Calcium: High levels (3.5–4%) for strong eggshells.
- Feed Type: Mash, pellets, or crumbles.

5. **Finisher Stage (for broilers only)**
   - Age: 6–8 weeks or until market weight.
   - Focus: Maximising weight gain and muscle deposition.
   - Key Nutritional Requirements: Protein: 16–18%.
   - Feed Type: Pellets or crumbles.
6. **Breeder Stage (for breeders)**
   - **Age**: From sexual maturity (18–20 weeks) to the end of breeding.
   - Focus: Supporting fertility, hatchability, and overall health.
   - Key Nutritional Requirements:
     - Protein: 15–16%.
     - Enhanced with vitamins (A, D, E) and minerals like selenium for reproductive health.
   - Feed Type: Mash or pellets.

Special considerations

1. **Supplementation**:
   - Grit: Aids digestion, particularly for layers and older birds.
   - Calcium: Crucial for laying hens to form strong eggshells.
   - Vitamins and Minerals: Premixes can ensure birds receive all essential nutrients.
2. **Feeding Management**:
   - Keep feeders clean and free of mould or contaminants.
   - Provide adequate feeder space to prevent overcrowding.
   - Monitor feed intake and adjust as needed to reduce waste.
3. **Water Management**:
   - Always supply fresh, clean water.
   - Keep drinkers clean and easily accessible to birds.

Practical Tips to Support Feeding

- **Feed quality**: Use fresh, high-quality feed stored in a cool, dry place to prevent spoilage and contamination. Regularly check for mould, pests, or any signs of feed degradation.
- **Feed timing**: Provide feed at consistent times daily to promote regular feeding patterns. Offer feed in multiple smaller portions if possible, reducing waste and ensuring access.
- **Feed form**: Use appropriate feed forms (mash, crumbles, or pellets) based on the bird's age and stage to maximise nutrient intake.
- **Transition gradually**: When changing feed types or formulations, transition gradually over 7–10 days to prevent digestive issues.
- **Avoid overfeeding**: Measure feed quantities accurately to avoid wastage and maintain bird health. Monitor bird weight regularly to ensure proper growth and adjust feed accordingly.
- **Supplement when needed**: Use additional supplements like grit, calcium, and vitamins if feed alone doesn't meet specific nutritional needs.
- **Clean equipment**: Regularly clean feeders and drinkers to prevent the spread of disease and contamination.
- **Observe birds**: Watch for feeding behaviours and adjust as necessary. A sudden drop in feed consumption may indicate stress, illness, or poor feed quality.
- **Water availability**: Always ensure clean, fresh water is available alongside feed, as water intake directly affects feed consumption.
- **Minimise stress**: Avoid overcrowding and provide a calm environment to encourage proper feeding and growth.

Diseases and Pest Control

1. **Newcastle disease (viral disease):** Affects respiratory, digestive, and nervous systems.

   Symptoms: Coughing, sneezing, twisted necks, and diarrhoea

   Prevention: Vaccinate chicks as per recommended schedules, implement strict biosecurity measures, limit contact with wild birds and new poultry.

2. **Avian Influenza (Bird Flu) (viral disease)**

   Symptom: Respiratory distress, sudden death, decreased egg production.

   Prevention: Vaccination, biosecurity measures, and monitoring wild bird populations.

3. **Marek's Disease (viral disease):** Caused by a herpesvirus.

   Symptoms: Paralysis, tumours, and immune suppression.

Prevention: Vaccination of chicks at day one

4. **Infectious Bursal Disease (Gumboro Disease) (viral disease):** it is a highly contagious viral disease affecting young chickens, primarily between 3 and 6 weeks of age. It is caused by the **Infectious Bursal Disease Virus (IBDV**), which targets the immune system, particularly the **bursa of Fabricius**, an organ critical for developing immunity in birds.

   Symptoms: Birds appear depressed and lethargic, ruffled feathers, particularly around the vent area, reluctance to move or feed**.**

   Prevention: vaccination, biosecurity and environmental hygiene.

5. **Fowl cholera (bacterial disease):** caused by Pasteurella multocida.

   Symptoms: Sudden death, swelling of wattles, respiratory issues.

   Prevention: Vaccination and maintaining cleanliness in the environment.

6. **Pullorum Disease (bacterial disease)**: Caused by Salmonella pullorum.

   Symptoms: Diarrhoea conditions; The fowls become dehydrated; The fowls become Lethargic (sluggish, dull or inactivity).

   Prevention: Practice good farm hygiene; Vaccinate the fowls at early age; Apply good biosecurity measures.

7. **Coccidiosis (protozoa)**

   Symptoms: Bloody diarrhoea or stained droppings, weight loss, birds may appear anaemic, pale combs and wattles, stunted growth or poor development.

   Prevention: Incorporate coccidiostats into feed, maintain clean and dry litter to reduce infection, vaccinate birds to build immunity.

8. **Fowl pox (Avian Diphtheria) (viral disease):** Fowl pox is caused by the **Avi poxvirus**, which is highly contagious.

   Symptoms: Birds may exhibit mild discomfort but typically remain active**,** difficulty in breathing, eating or drinking, reduced activity and significant weight loss, Secondary infections due to damaged skin or mucosa

   Prevention: strict hygienic conditions, vaccination, mosquitoes and insect control, biosecurity.

9. **Mycoplasmosis (Mycoplasma gallisepticum)**

   Symptoms:

   - Respiratory issues such as coughing, sneezing, and nasal discharge.
   - Drop in egg production.
   - Swollen joints in affected birds.

   Prevention:

   - Implement strict biosecurity practices to minimise infection risks.
   - Vaccinate birds to reduce susceptibility to the disease.

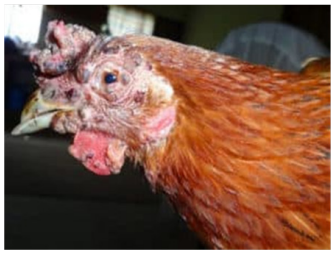
Table 5: 12 Common Poultry Diseases – Symptoms, Causes and Control

Disease	Symptoms	Causes	Control Measures
Newcastle Disease	Sneezing, coughing, greenish diarrhoea, twisted neck, sudden death	Virus	Vaccination, isolate sick birds, maintain good hygiene
Avian Influenza (Bird Flu)	Sudden death, swollen head, breathing difficulty, drop in egg production	Virus	Strict biosecurity, cull infected birds, restrict movement, report outbreaks
Marek's Disease	Paralysis of legs or wings, weight loss, uneven pupils	Virus	Vaccination of chicks, good sanitation
Fowl Cholera	Sudden death, fever, swollen wattles, nasal discharge	Bacteria	Antibiotics as prescribed, good hygiene, vaccination
Pullorum Disease	White diarrhoea in chicks, weakness, high chick mortality	Bacteria	Test and remove infected birds, maintain hygiene, use clean stock
Coccidiosis	Bloody diarrhoea, weakness, reduced growth	Parasite	Keep litter dry, use anticoccidial drugs, good sanitation
Mycoplasmosis	Sneezing, coughing, nasal	Bacteria-like organism (Mycop	Antibiotics, good ventilation, use disease-free birds

Mareks Disease

Newcastle Disease

Gumboro Disease



Fowlpox Disease

Figure 5. 14: Poultry showing symptoms of some diseases

Vaccination regime from day-old to 16 weeks

A vaccination schedule depends on the type of poultry (broilers, layers, or breeders), disease prevalence in the area, and management system. It is important to consult with a veterinarian to tailor it to specific conditions and local disease risks.

Table 5.13

Age	Vaccinate against	Application
Day 1	**Marek**	Subcut (neck)
Day 1	**Newcastle**	Eye or nasal drop
Day 7-9	**Gumboro**	In drinking water
Day 10-14	Newcastle + infectious bronchitis	In drinking water or eye/nostril drop
Day 16-18	**Gumboro**	In drinking water
6th week	Newcastle + infectious bronchitis	In drinking water
6-8th week	**Fowl typhoid**	Injection
8-9th week	Deworming	In drinking water
8-10th week	**Fowl pox**	Wing stab
12-14th week	**Fowl typhoid**	Injection
16-18th week	Renewed Newcastle (then repeat every 3 months)	Optional

NB: *Vaccination regime recommended for commercial layer and broiler chicks, but the bold printed ones are also applicable to improved management of indigenous chicken (modified from Sigma recommendations).*

Notes:

1. **Customisation:** Adapt the schedule based on regional disease risks and veterinary recommendations.
2. **Water Application:** Ensure drinking water for vaccines is clean and free of chlorine. Add stabilisers if needed.
3. **Booster Shots:** Layers and breeders often require additional boosters to maintain immunity throughout their production cycles.

4. **Handling Vaccines:** Maintain the cold chain (2–8°C) to preserve vaccine efficacy.
5. **Veterinary Guidance:** Always consult a poultry veterinarian for a customised vaccination plan.

How to Process Poultry Meat for the Market

Preparation

- **Equipment and Materials:** Ensure you have all necessary equipment (knives, scissors, scales, thermometers) and materials (cleaning supplies, packaging materials).
- **Sanitation:** Clean and disinfect the processing area and equipment to prevent contamination.

Receiving and Inspection

- **Live Birds:** Inspect live birds for signs of disease or injury before processing.
- **Handling:** Handle birds gently to minimise stress and injury.

Stunning

Method: Use electrical stunning or gas stunning to render birds' unconscious quickly and humanely before slaughter.

Slaughtering

Bleeding: Hang the birds by their feet and bleed them by cutting the carotid artery and jugular vein. Allow adequate time for blood to drain.

Scalding

- **Purpose:** Scalding helps loosen feathers for easier removal.
- **Temperature:** Submerge birds in hot water (around 140-160°F or 60-71°C) for a specified time, depending on the type of poultry.

Plucking

Mechanical Plucker: Use a mechanical plucking machine to remove feathers or manually pluck feathers if necessary.

Evisceration

- **Opening the Body Cavity:** Carefully cut open the body cavity to remove internal organs (viscera).
- **Organ Removal:** Remove the intestines, heart, liver, and gizzard. Inspect organs for signs of disease.

Chilling

- **Cooling the Meat:** Immediately chill the carcasses in cold water or a chilling tank to bring the temperature down to below 40°F (4°C) to prevent bacterial growth.

- **Duration:** Chill for several hours or as recommended by food safety guidelines.

Cutting and Packaging

- **Cutting:** Cut the carcass into desired portions (whole, halves, quarters, or specific cuts like breasts, thighs, and wings).
- **Packaging:** Use food-safe packaging materials. Vacuum sealing is preferred for extending shelf life.
- **Labelling:** Label packages with product information, including weight, processing date, and any necessary food safety information.

Storage and Distribution

- **Refrigeration:** Store processed poultry in a refrigerated environment at or below 40°F (4°C).
- **Transport:** Ensure proper temperature control during transport to markets or retailers.

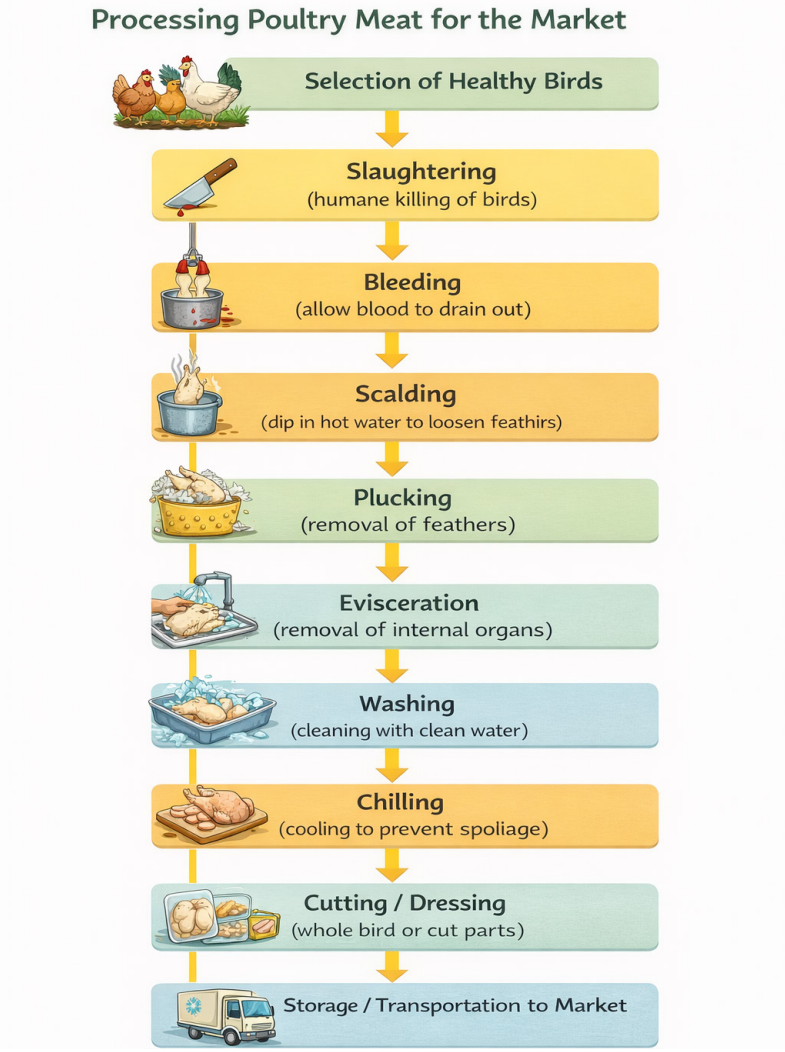


Figure 5. 15: Steps in processing poultry meat

Activity 5.10 Management Practices in Poultry Production

1. In groups, discuss the management practices involved in poultry production. In your discussion, focus on the following;

a. Housing and Environment

i. Design and layout of a poultry house,

ii. Environmental conditions are optimal for poultry production

b. Brooding Management

i. Care that chicks need during the brooding period

ii. Signs of good and poor brooding conditions

c. Nutrition and Feeding

i. Nutritional requirements of poultry at different stages of growth,

ii. How feed is formulated and administered to meet poultry birds,

d. Health Management

i. Common diseases and health issues that affect poultry, and how can they be prevented,

ii. Importance of a vaccination regime, and what vaccines should be administered from day-old to 16 weeks.

iii. How biosecurity measures can be implemented to protect poultry from diseases.

e. Waste Management

i. Best practices for managing poultry waste,

ii. How poultry manure can be processed and utilised as a resource

f. Record Keeping: The importance of record-keeping in poultry production, and what information should be recorded,

g. Marketing and Sales: factors to be considered when planning to market and sell poultry products,

h. Processing and Quality Control

i. The steps involved in processing poultry meat for the market,

ii. Measures to ensure the quality and safety of poultry products)

You can use the internet and other resources in your exploration.

2. Present the salient points from your discussion to the class for feedback.

Activity 5.11 Techniques in Managing Domestic Fowls

1. In groups, visit a poultry farm in your community or school. Alternatively, watch a documentary on the techniques used in managing domestic fowl (click here).
2. In the same groups, discuss your observations from the visit/ documentary.
3. Present five management practices observed and discussed in the table below to your class for feedback.

Table 5.14

Management Practice	Techniques used

4. You can use the following guidelines to complete the table:
   a. Write the management practices observed under the column labelled management practice
   b. Write how the management practices were done in the column labelled techniques used

Activity 5.12 Hands-on practice on managing poultry

NB: The activity should be conducted under the strict supervision of a farm technician, and all safety protocols observed.

1. Visit your school poultry farm or a poultry farm in your community and perform any of the techniques or activities in managing poultry.
2. Write a report on the activities performed at the poultry. Your report should contain the following:
   a. Title Page (title of the report, period of the visit, name of the poultry farm visited
   b. Introduction (purpose of the visit, background information on the poultry farm, size of the poultry farm, type of poultry kept (broilers, layers, etc))
   c. Description of five activities Performed such as feeding (type of feed used, feeding schedule, techniques observed), cleaning and maintenance (cleaning procedures for the coops and equipment, waste management practices), health management (observation of health checks, vaccination procedures, common diseases and their management, egg collection and handling (if applicable) (methods of egg collection, storage and handling practices), etc.
   d. General Observations during the visit

e. **Challenges faced and how they were handled**

f. **Conclusion** (summary of the visit, key takeaways)

g. **Appendices** (pictures and other visuals taken during the visit)

3. Prepare a presentation of your report and present it to your class.

EXTENDED READING

- https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://classnotes.ng/lesson/new-lesson-409/&ved=2ahUKEwi2i-3_neiJAxUvZ0EAHZhsHgwQFnoECCcQAQ&usg=AOvVaw3HwSSZqFegOckKFuKfLz_g

- Exotic series, General Agriculture for SHS by Eric Amoah, pages 259-405
- https://www.youtube.com/watch?v=A6dwAeAZi9M

REVIEW QUESTIONS

1. What is the primary economic benefit of growing crops?
   - **A.** Aesthetic appeal
   - **B.** Soil health
   - **C.** Habitat creation
   - **D.** Food production
2. Which of the following is a major source of protein for humans?
   - **A.** Corn
   - **B.** Fish
   - **C.** Cotton
   - **D.** Wheat
3. Which factor affects the economic value of cash crops?
   - **A.** International market demand
   - **B.** Local food preferences
   - **C.** Government policies on irrigation
   - **D.** Number of farmers growing the crop
4. What role does poultry farming play in addressing protein deficiency?
   - **A.** It replaces the need for plant-based proteins.
   - **B.** It provides a cost-effective source of high-quality protein.
   - **C.** It eliminates the need for aquaculture.
   - **D.** It prevents the over-consumption of red meat.
5. How do crops contribute to local economies?
   - **A.** By reducing biodiversity
   - **B.** By increasing pollution
   - **C.** By providing jobs and income
   - **D.** By depleting soil nutrients
6. How do cash crops influence rural livelihoods and employment opportunities?
7. Define arable crops and provide two examples of each category of arable crop.
8. Evaluate the impact of climate change on vegetable production.
9. Examine the role of staple crops like rice, maize, and wheat in ensuring global food security.
10. Evaluate the role of poultry farming in combating malnutrition and unemployment in rural areas of a developing country.

SECTION

6

NATURAL RESOURCE CONSERVATION IN AGRICULTURE

FOOD PRODUCTION AND NATURAL RESOURCE CONSERVATION

Principles of Natural Resource Conservation in Agriculture

INTRODUCTION

In this section, we will dive into exciting topics that connect farming, wildlife and soil health. We will look at what game and wildlife are, their importance to our environment and culture, and why we must protect them. We will also explore the world of mushrooms looking at the parts and importance of mushrooms, and how they're cultivated. You will have the opportunity to cultivate mushrooms yourself. You will also learn about soil and what makes it healthy for growing crops. You will discover what soil nutrients are, their importance and deficiency symptoms in plants. The section also covers fertilisers, the types of fertilisers and their application methods. We will also look at the positive and negative impact of fertiliser application and strategies to avoid using them. By the end of this section, you will have clear understanding of how to manage natural resources and boost agricultural productivity.

KEY IDEAS

- Game refers to wild animals that are hunted for meat, recreation, sport, meat, fur or other by-products. Wildlife also refers to all non-domesticated animals, plants, fungi and other organisms that live in natural environments. Some important game and wildlife reserves in Ghana include Mole National Park, Kakum National Park, Shai Hills Resource Reserve and Digya National Park.
- Mushrooms belong to the kingdom Fungi and vary widely in shape, size, colour and texture. Mushrooms have economic, social, health, nutritional and medicinal benefits. Management practices involved in mushroom production are site selection and preparation, substrate preparation, spawn production and inoculation, environmental control, monitoring and maintenance, disease and pest management, harvesting, post-harvest handling and marketing and sales.
- Soil nutrients are the essential elements required for plant growth and development. Soil fertility refers to the soil's ability to provide essential nutrients to crops in adequate amounts and proper proportions for plant growth and development. Soil productivity, however, is the ability of the soil to support plant growth and yield.
- Soil nutrients can be classified into macronutrients and micronutrients. Examples of macronutrients are Nitrogen(N), Phosphorus(P), Potassium(K), Calcium (Ca), Magnesium (Mg) and Sulphur(S). Examples of micronutrients are Iron (Fe), Manganese

(Mn), Zinc (Zn), Copper (Cu), Boron(B), Molybdenum (Mo) and Chlorine (Cl).

- Fertilisers are either natural (organic) or manufactured (inorganic) substances that are added to soil or plants to supply essential nutrients required for plant growth and development. Enhanced nutrient supply, increased crop yields, accelerated plant development, increased stress resistance of crops and increased economic benefits are some of the positive impacts of fertilisers. Soil degradation, water pollution, greenhouse gas emissions, plant health issues, human health risks, disruption of soil microbial communities and biodiversity loss are some of the negative impacts of fertilisers.
- The negative impacts of fertilisers can be mitigated by adopting precision agriculture, integrated nutrient management, establishing buffer zones and education and training on sustainable fertiliser application methods. Fertilisers can be applied by broadcasting, banding, foliar application, side-dressing and fertigation.

MEANING AND IMPORTANCE OF GAME AND WILDLIFE

Game and Wildlife

Game refers to wild animals that are hunted for meat, fun, sport, fur or other products. There are often rules and laws about hunting these animals to make sure their populations stay healthy, hunting is done responsibly, and some species are protected from being hunted too much. You can find game animals in many places such as forests, grasslands, wetlands and mountains. There are two types of games:

1. **Big game**: These are large animals that hunters often target. Examples include deer, elk, moose, bear, bison, buffalo, cheetah and antelope.
2. **Small Game:** These are smaller animals and birds that hunters often target. Examples include rabbits, squirrels, pheasants, quail, guinea fowl, and ducks.

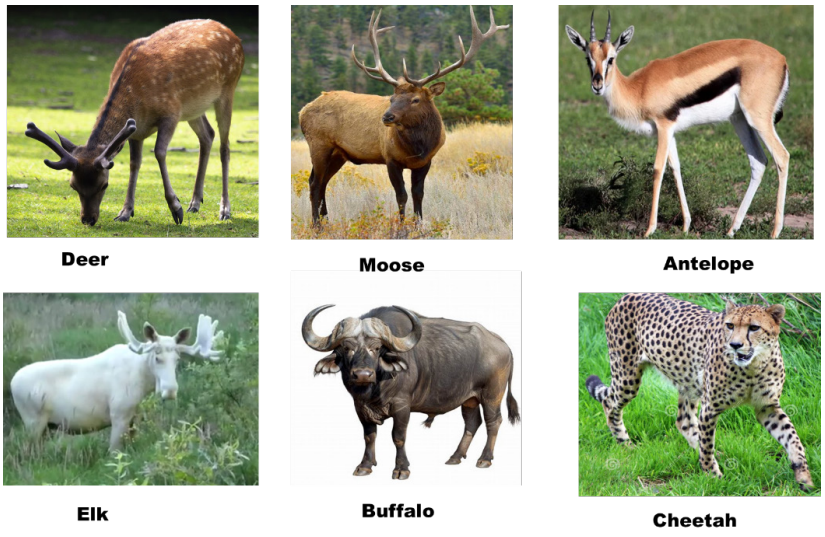


Figure 6.1: Examples of big game animals

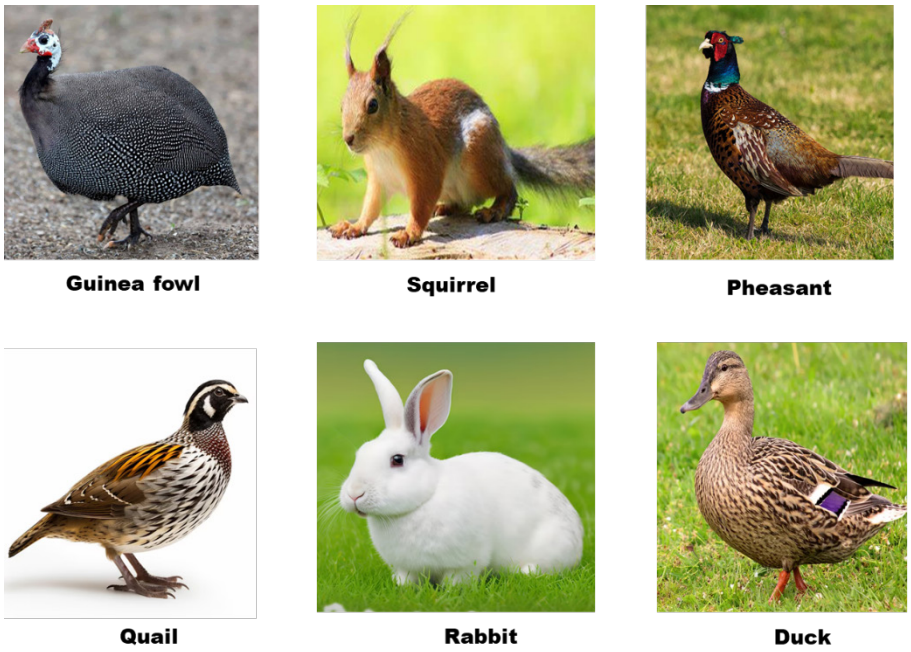


Figure 6.2: Examples of small game animals

Wildlife: These are animals, plants, fungi and other living things that are not tamed and live in nature. This includes mammals, birds, reptiles, amphibians, fish, insects, plants and even micro-organisms. Wildlife can be found in many different environments such as forests, deserts, grasslands, wetlands, mountains and oceans. It is very important for keeping the natural balance and diversity of life. The existence of wildlife is threatened by the following:

1. Urbanisation, farming, cutting down forests and building roads and buildings can destroy and break up the natural habitats of wildlife.
2. Pollution from factories, farms and cities can harm wildlife by contaminating the air, water and soil
3. Climate change affects wildlife by changing their habitats, distorting migration patterns and causing more extreme weather conditions.
4. Overhunting, overfishing and illegal wildlife trade can reduce populations and even cause species to go extinct.
5. Non-native species introduced to new environments can outcompete prey or bring diseases to native wildlife.

Wildlife and Game Conservation Strategies

To protect and conserve wildlife and game, the following strategies can be used.

1. Creating national parks, wildlife reserves and marine protected areas to safeguard habitats and species.
2. Making and enforcing laws to protect endangered species and their habitats.
3. Encouraging sustainable farming, forestry and fishing methods to reduce harm to wildlife.

4. Fixing damaged habitats and reintroducing species to places where they have disappeared.
5. Involving and educating local communities in conservation efforts so they benefit from and support wildlife protection.

Some Important Game and Wildlife Reserves in Ghana

Mole National Park

Location: Savannah Region

Wildlife: Elephants, antelopes, buffaloes, warthogs, hyenas, various birds, lions, and leopards (rarely seen)

Features: Largest national park in Ghana, diverse ecosystems (savannah, forest, wetlands), guided safari tours, walking safaris, bird watching

Kakum National Park

Location: Central Region

Wildlife: Forest elephants, bongo antelopes, Diana monkeys, over 200 bird species

Features: Famous canopy walkway (350 meters long, 40 meters above the forest floor), unique rainforest views

Shai Hills Resource Reserve

Location: Greater Accra Region

Wildlife: Olive baboons, kobs, antelopes, various birds

Features: Rocky hills, savannah vegetation, historical caves inhabited by the Shai people

Digya National Park

Location: Brong-Ahafo and Ashanti Regions, along Lake Volta

Wildlife: Elephants, antelopes, leopards, various birds

Features: One of Ghana's oldest protected areas (established in 1900), diverse habitats (savannah, forests, wetlands)

Bia National Park and Biosphere Reserve

Location: Western Region

Wildlife: Forest elephants, chimpanzees, various primates, numerous birds

Features: UNESCO biosphere reserve, rich biodiversity, conservation importance

Ankasa Conservation Area

Location: Western Region

Wildlife: Forest elephants, bongo antelopes, leopards, various primates and birds

Features: Ankasa and Nini-Suhien Forest Reserves, one of Ghana's most biologically diverse areas, tropical rainforest

Kyabobo National Park

Location: Oti Region, near the Ghana-Togo border

Wildlife: Buffaloes, Kobs, bushbucks, various birds

Features: Mountainous terrain, diverse flora and fauna

Boabeng-Fiema Monkey Sanctuary

Location: Bono Region

Wildlife: Mona monkeys, black-and-white colobus monkeys

Features: Sacred relationship between local community and monkeys

Figure 6.3: Some game and wildlife reserves in Ghana

Importance of Game and Wildlife

Ecological Importance

1. Wildlife increases biodiversity, which helps keep ecosystems stable and healthy.
2. Wildlife provides essential services like pollination, seed dispersal, pest control and nutrient cycling.
3. Predators, herbivores and decomposers help maintain ecosystem balance by controlling population sizes and nutrient flow. For example, predators keep herbivore populations in check, preventing overgrazing.

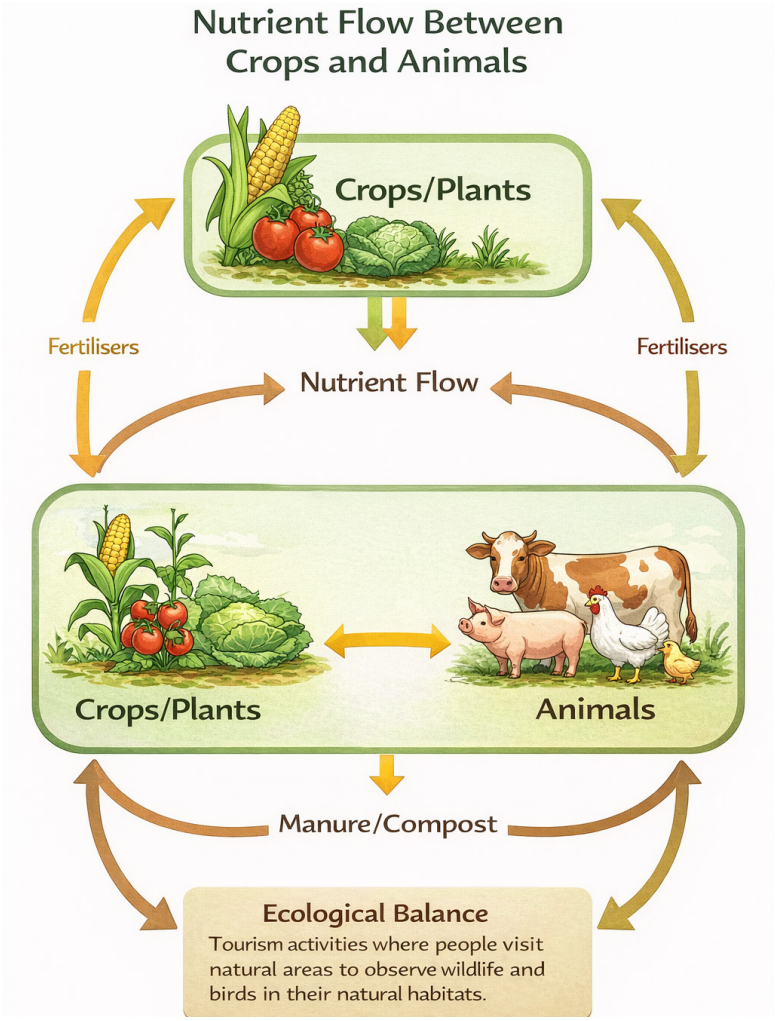


Figure 6.4 : nutrient flow chart between crops and animals in an ecosystem.

Economic Importance

1. Wildlife attracts tourists, boosting eco-tourism industries and generating income for local and national economies. Activities like safaris, bird watching and game hunting contribute to economic growth.
2. Managed game species provide sustainable sources of meat, leather and other products, supporting livelihoods and food security.
3. Healthy ecosystems supported by diverse wildlife contribute to agriculture, fisheries and forestry, which are essential for economic stability.

Cultural Importance

1. Many cultures have strong connections to wildlife, reflected in myths, traditions, and practices. Indigenous people in particular, have deep cultural ties to local wildlife and land.
2. Wildlife often holds spiritual and religious importance, appearing in rituals and beliefs. Some animals may be considered sacred or symbolic in various religions.
3. Wildlife inspires art, literature and folklore, enriching human culture and creativity.

Recreational Importance

1. Wildlife supports recreational activities like birdwatching, hunting, fishing and hiking, which contribute to physical health and well-being.
2. Wildlife provides opportunities for environmental education, fostering a connection with nature and promoting conservation awareness.
3. Interactions with wildlife and natural environments can reduce stress, anxiety and depression, improving mental health.

Activity 6.1 Meaning of Game and Wildlife

1. What comes to mind when you hear the terms game and wildlife? Write your definitions in your notebook.
2. Share your definitions with a peer for feedback and fine-tune your definitions of game and wildlife.

Activity 6.2 Important Game and Wildlife Reserves in Ghana

1. In groups, visit a game and wildlife reserve nearby or watch a video on the internet (Click here) about game and wildlife reserves and discuss your findings. In your discussion, focus on:
   a. The types of wildlife or game conserved in the reserve.
   b. How the research is protected to avoid hunting of the animals.
   C. Behaviours of the animals in the research.
2. Share the salient points from your discussion in class for feedback.
3. In the same groups, identify five notable game and wildlife reserves in Ghana. You can use the internet and other resources to inform your exploration. Present your findings in a table below:

Table 6.1

Name of the reserve	Location of the reserve (town and region)	wildlife	Unique feature

4. You can complete the table using the following guidance notes:
   a. Write the name of the reserve in the column labelled name of reserve
   b. Write the town and region where the reserve is located in the column labelled location of the reserve.
   c. Write at least 3 wildlife that can be found in the column labelled wildlife

d. Write any unique feature of the reserve in the column labelled unique feature.

5. Present your table to the class for feedback.

Activity 6.3 Importance of Game Reserve and Wildlife

1. In pairs, discuss the importance of game reserves and wildlife. In your discussions, be guided by how game and reserve:
   a. Protect endangered species
   b. Safeguard crucial habitats such as forests, wetlands and grasslands
   c. Provide controlled environments for scientific research
   d. Generates income, supporting local economies and creating jobs
   e. Preserve the traditions and culture of the people
   f. Serve as a venue for recreational activities such as hiking, bird watching and safaris.

You can use the internet and other resources in your research.

2. Present the salient points from your discussion to your class.

The Need to Conserve Game and Wildlife

Conserving game and wildlife is important for many reasons, including ecological, economic, cultural, scientific and ethical reasons. Here are some key reasons why we need to conserve game and wildlife**:**

Ecological Importance

1. Conservation helps keep a variety of life forms, which is crucial for ecosystem stability and recovery from problems like natural disasters and climate change.
2. Wildlife provides essential services like pollination, seed dispersal, pest control and nutrient cycling. These services are vital for the health of ecosystems and agriculture.
3. Every species has a role in its ecosystem. Losing one species can cause imbalances and negatively affect other species, disrupting the whole ecosystem.
4. Protecting wildlife often means preserving their habitats, which benefits all species living there and maintains essential ecological processes.

Economic Benefits

1. Wildlife and natural landscapes attract tourists, bringing significant revenue to local and national economies.
2. Many communities rely on wildlife for sustainable hunting, fishing and harvesting. Conservation ensures these resources remain available for future generations.
3. Wildlife and their habitats provide natural products like food, medicine and raw materials, which have economic value and contribute to human well-being.

Cultural and Social Value

1. Wildlife holds deep cultural significance for many communities, featuring in traditions, folklore, and spiritual beliefs. Conserving wildlife helps preserve these cultural heritages.
2. Wildlife-related activities like bird watching, hiking, hunting and photography provide recreational opportunities that enhance well-being and foster appreciation for nature.

Scientific and Educational Contributions

1. Wildlife offers opportunities for scientific research, leading to discoveries in medicine, agriculture and environmental science.
2. Conservation efforts promote environmental education and awareness, encouraging responsible use of natural resources and inspiring future generations to protect wildlife.

Health and Well-being

1. Healthy ecosystems help regulate diseases by controlling populations of vectors like mosquitoes and rodents, reducing the likelihood of disease outbreaks.
2. Exposure to nature and wildlife improves mental health, reduces stress and enhances overall well-being.

Climate Change Mitigation

1. Forests, wetlands and other wildlife habitats absorb and store carbon dioxide, helping to mitigate climate change.
2. Biodiverse ecosystems are more resilient to climate change impacts, providing natural buffers against extreme weather and environmental changes. This helps protect both wildlife and human communities.

Ethical Responsibility

1. Many people believe that all species have a right to exist. Conserving wildlife respects this belief and recognises the inherent value of all living beings.
2. Understanding that all life forms are interconnected highlights our responsibility to protect wildlife. Human health and well-being are closely linked to the health of natural ecosystems.

Activity 6.4 Importance of conserving game and wildlife

1. Using the internet and other resources, discuss the importance of conserving game and wildlife in groups. In your discussion, focus on any 4 of the following;
   a. Ecological importance
   b. Economic importance
   c. Cultural and social importance
   d. Scientific and educational importance
   e. Health and nutritional importance
   f. Climate change mitigation
2. In pairs, write an essay on the pros and cons of keeping game and wildlife for human sustenance. Your essay should be approximately 1000 words.
3. Read your essay to your class for feedback.

ECONOMIC IMPORTANCE AND MANAGEMENT PRACTICES IN MUSHROOM PRODUCTION

Mushroom Production

Mushrooms are a type of fungus with a stem, cap and gills or pores underneath the cap. They belong to the Fungi kingdom and come in many different shapes, sizes, colours and textures. Mushrooms can be grown on farms (cultivated) or collected from the wild. They are popular around the world for both cooking and medicinal uses. Here are the parts of a mushroom and where they are located:

Parts of a Mushroom

- **Cap (Pileus):** The top part of the mushroom.
- **Gills (Lamellae):** The thin, blade-like structures under the cap.
- **Spores**: The tiny reproductive units released from the gills.
- **Stem (Stipe):** The stalk that holds up the cap.
- **Ring (Annulus):** A ring around the stem, often left from the mushroom's growth.
- **Volva:** A cup-like structure at the base of the stem.
- **Mycelium:** The network of thread-like structures (hyphae) usually found below the ground or within the growth medium.

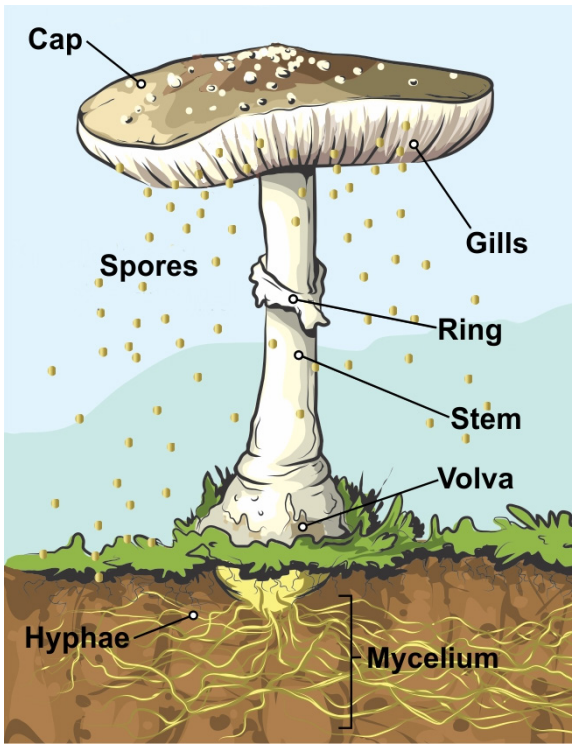


Figure 6.5: Parts of mushroom

Importance of Mushroom Production

Here are the economic, health and social benefits of mushroom production:

1. **Economic Benefits**
    a. Mushroom farming can give farmers an extra source of income alongside traditional crops.
    b. Countries that grow mushrooms commercially can earn a lot of money by exporting them. Major exporters include China, the Netherlands and the United States.
    c. Mushroom farming creates jobs in preparing, growing, harvesting and packaging mushrooms.
    d. Mushrooms can be turned into products like dried mushrooms, mushroom powder, sauces and canned mushrooms which increases their market value.
    e. Medicinal mushrooms are used to make health supplements, benefiting the pharmaceutical and wellness industries.
2. **Social Benefits**
    a. Mushroom farming needs minimal land and investment, making it accessible to small and poor farmers.
    b. In many areas, women are heavily involved in mushroom farming, promoting gender equality and economic empowerment.

3. **Sustainable Agriculture**
    a. Mushrooms can grow on agricultural by-products like straw, sawdust and coffee grounds, helping recycle waste.
    b. Mushroom farming uses less water and doesn't need pesticides, making it environmentally friendly.
4. **Health and Nutritional Benefits**
    a. Mushrooms are rich in proteins, vitamins (like B vitamins and vitamin D), minerals (such as selenium and potassium), and antioxidants.
    b. Adding mushrooms to diets can improve food and nutritional security, especially in areas with limited access to a variety of foods.
    c. Medicinal mushrooms such as Reishi, Shiitake and Lion's Mane have potential health benefits, including boosting the immune system, reducing inflammation and enhancing cognitive function.
    d. Using medicinal mushrooms can help improve overall health and potentially reduce healthcare costs by preventing illnesses.

Management Practices in Mushroom Production

Producing mushrooms involves several important steps to ensure a good yield and high-quality mushrooms. Here is a simple guide:

Site Selection and Preparation

1. Choose a place with good drainage, good airflow and access to clean water.
2. Make sure the area is free from chemical sprays or industrial pollution.
3. Build mushroom houses or sheds that can control temperature, humidity, and light.
4. Use materials that are easy to clean and disinfect.

Substrate Preparation

1. Use agricultural by-products like straw, sawdust, coffee grounds or composted manure.
2. Ensure the substrate is clean and properly processed.
3. Sterilise or pasteurise the substrate to kill harmful organisms using steam pasteurisation, chemical treatments, or hot water treatment.

Spawn Production and Inoculation

1. Get high-quality spawn from trusted suppliers to ensure good yields and disease resistance.
2. Store the spawn in cool, dark conditions to keep it viable.
3. Mix the spawn well with the substrate to distribute it evenly.
4. Maintain cleanliness during this process to prevent contamination.

Environmental Conditions

Keep the temperature between 20-25°C for mycelium growth and 15-20°C for fruiting.

Maintain humidity levels between 85-95% for optimal growth.

Use humidifiers or misting systems to control humidity.

Ensure proper ventilation to provide fresh air and remove excess CO2.

Install fans or ventilation systems.

Provide indirect light for fruiting stages, as some light helps mushrooms start to fruit.

Avoid direct sunlight to prevent drying out the substrate.

Monitoring and Maintenance

1. Regularly check temperature, humidity, CO2 levels, and light.
2. Inspect for signs of contamination or disease.
3. Clean and disinfect equipment and growing areas regularly.
4. Repair any damaged infrastructure quickly.

Disease and Pest Management

1. Keep high levels of cleanliness throughout production.
2. Use disinfectants and sanitisers to clean surfaces and tools.
3. Identify and control common diseases like green mould and bacterial blotch.
4. Remove contaminated materials and apply fungicides if necessary.
5. Control pests such as flies, mites and rodents using barriers, traps and biological controls.
6. Keep the environment clean to reduce pest infestations.

Harvesting

1. Harvest mushrooms at the right stage of maturity for best quality and yield.
2. Use sharp tools to cut mushrooms cleanly without damaging the substrate.
3. Handle mushrooms gently to avoid bruising.
4. Place harvested mushrooms in clean, dry containers.

Post-Harvest Handling

1. Clean mushrooms by brushing off debris; avoid washing them.
2. Sort mushrooms by size and quality for market consistency.
3. Use suitable packaging materials to protect mushrooms during transport and storage.
4. Use breathable materials to keep mushrooms fresh.
5. Store mushrooms in cool, humid conditions (0-2°C and 90-95% humidity) to extend shelf life

Marketing and Sales

1. Identify potential markets and understand what consumers want.
2. Build relationships with buyers, retailers and distributors.
3. Create a brand for your mushrooms to stand out in the market.
4. Use attractive packaging and promote your mushrooms to increase visibility.
5. Consider making value-added products like dried mushrooms, mushroom powders, and ready-to-cook mushroom meals.
6. Diversify your products to reach different market segments.

Activity 6.5 Meaning and Importance of Mushrooms

1. What do you understand by the term mushroom? Write your definition in your notebook and share it with your peers for feedback.
2. With the help of the internet and other resources, draw and label the parts of a mushroom. Put your drawing on the classroom walls for peer assessment.
3. In groups, discuss the importance of mushrooms. In your discussion, be guided by the following:
   a. The economic benefits of the mushroom
   b. Social Benefits of the mushroom
   c. How does mushroom cultivation contribute to sustainable agriculture?
   d. Health and nutritional benefits of mushrooms
4. Present the salient points from your discussion to the class for feedback.

Figure 6.6: Oyster mushrooms produced from a substrate

Activity 6.6 Management Practices in Mushrooms the Production

1. In pairs, discuss the management practices involved in mushroom production. In your discussion be guided by the following:
   a. How sites are selected and prepared.
   b. How substrates are prepared.
   c. How spawns are produced and inoculated.
   d. The environmental conditions necessary for mushroom production.
   e. How monitoring and maintenance are done during the production.
   f. How disease and pest are managed during the production.
   g. How the mushrooms are harvested.
   h. How the mushroom is handled after harvesting.
   i. How the mushroom will be sold and marketed.
   j. You can use the internet and other resources in your research.
2. Present the salient points from your discussion to the class for feedback.

SKILLS IN MUSHROOMS CULTIVATION

Steps for Successful Mushroom Cultivation

To grow mushrooms successfully, follow these steps:

Substrate Preparation and Management

Use materials like straw, sawdust, wood chips, coffee grounds or a mix of these.

Pasteurise or sterilise the substrate to kill harmful bacteria and fungi.

Inoculation

1. Let the substrate cool down after pasteurisation.
2. Inoculate the substrate with any of these:
   - Grain Spawn: Mycelium on sterilised grains like millet.
   - Liquid Culture: Mycelium in a liquid medium.
   - Plug Spawn: Wooden dowels with mycelium, used for logs.

Incubation

1. Put the inoculated substrate in plastic bags, jars or trays.
2. Incubate in a dark, warm and humid place (20-25°C) with good air exchange.

Environmental Control

1. Keep the temperature and humidity at optimal levels (80-95% humidity).
2. Ensure good airflow to prevent Carbon dioxide buildup.

Monitoring and Maintenance

1. Look for contamination such as mould or bad smells and remove any contaminated parts immediately.
2. Keep humidity at 85-95% to help mycelium grow.

Colonisation

Let the mycelium fully colonise the substrate. This usually takes several weeks. The substrate should turn white and dense when fully colonised.

Fruiting

Fruiting can be induced by changing the environmental conditions for mushrooms to start forming. This includes:

1. Dropping the temperature slightly.
2. Providing more light to mimic day-night cycles.
3. Keeping the humidity around 90-95%.
4. Increasing fresh air to reduce Carbon dioxide

Pest and Disease Management

Watch out for mites, flies and mould. Use Integrated Pest Management (IPM) strategies such as keeping high levels of cleanliness, using beneficial microbes and using fungicides or insecticides if necessary.

Harvesting

Pick mushrooms when they reach the right size and before the caps fully open. Use a sharp knife to cut them at the base.

Post-Harvest

1. Clean up after harvesting to prepare for the next cycle.
2. Keep the best-performing cultures for future use.

Packaging and Storage

1. Package mushrooms to keep them fresh.
2. Keep them in a cool, humid place.

Record Keeping and Documentation

1. Keep detailed records of all the activities including:
   - substrate formulations
   - inoculation dates
   - environmental conditions
   - pest and disease issues
   - harvest yields
   - any changes or interventions
2. Analyse these records to improve future cultivation cycles.

Activity 6.7 Skills in Mushroom Cultivation

1. In groups, visit a mushroom production site in your community or watch a video/picture on mushroom production (click here) or (use this link https://youtu.be/40QcmMPrszE) .
2. Develop a presentation (digital or paper-based) on the findings from your visit/video to the class. In your presentation, focus on the following:
   a. The type of mushrooms being produced
   b. The substrate being used and how it is prepared
   c. How the spawning and inoculation are done
   d. The environmental conditions for the mushroom production
   e. How pests and diseases are controlled
   f. When and how harvesting is done
   g. How the mushrooms are packaged and sold
3. Include pictures and other visuals gathered during the visit or research in your presentation.

Activity 6.8 Cultivation of mushrooms

1. In groups, cultivate mushrooms that are for sale in your local market.
2. Present a report on your mushroom cultivation to the class. Your report should include the following:

   a. Introduction

   i. Purpose of the activity

   ii. Context about mushroom cultivation (types of mushrooms commonly cultivated and their uses).

   b. Materials and Methods

   i. The species of mushrooms cultivated and why it was selected

   ii. The material used as substrate and how it was prepared

   iii. How Inoculation was done

   iv. The environmental conditions maintained during the growth phase,

   c. Cultivation Process

   i. The time it took for the appearance of mycelium, pinning and fruiting.

   ii. The maintenance activities performed during cultivation

   d. Results: The quantity of mushrooms harvested.

   e. Marketing

   i. How the mushroom was packaged and marketed

   ii. Cost-benefit analysis of the cultivation (Total amount spent on the cultivation and the amount gained from the sale of the mushroom)

   f. Conclusion

   i. Summary of findings.

   ii. Challenges encountered during the cultivation and how they were resolved.

   iii. Factors that contributed to the success of your mushroom cultivation.

   iv. Areas for improvement in future cultivation attempts.

   v. The plans for future mushroom cultivation, including scaling up.

   g. References and Acknowledgements

   i. Any sources used for information on mushroom cultivation techniques, substrate preparation, or species-specific requirements.

ii. Acknowledge any assistance you received during the project, such as advice from experts.

h. Appendices

3. Include photographs and other visuals, showing the different stages of the cultivation process, from substrate preparation to harvest.

MEANING OF SOIL NUTRIENTS, FERTILITY AND PRODUCTIVITY

Soil Nutrients

Soil nutrients are essential elements that plants need to grow and develop properly. They are divided into two main groups: macronutrients and micronutrients.

Macronutrients

Macronutrients are required by plants in large amounts to support growth and yield. They are further divided into:

1. Primary Macronutrients: Nitrogen (N), Phosphorus (P) and Potassium (K)
2. Secondary Macronutrients: Calcium (Ca), Magnesium (Mg) and Sulphur (S)

Micronutrients

Micronutrients are needed in smaller amounts but are still crucial for plant health and development. Examples include Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Boron (B), Molybdenum (Mo) and Chlorine (Cl).

Soil Fertility

Soil fertility refers to the soil's ability to provide the necessary nutrients for crops to grow well and produce good yields. Factors that influence soil fertility include:

1. The amount of essential nutrients available in the soil for plant growth.
2. How acidic or alkaline the soil is, this affects how well plants can absorb nutrients and how active soil microbes are.
3. The amount of decomposed plant and animal material in the soil improves nutrient supply, soil structure and water retention.
4. How the soil particles are arranged. This allows roots to grow easily and helps with the movement of water and nutrients.
5. The presence and actions of soil organisms, like bacteria and fungi, which break down organic matter and recycle nutrients back into the soil.

Soil Productivity

Soil productivity is the ability of soil to support crop growth and produce high yields. While soil fertility is about nutrients in the soil, soil productivity includes other important factors such as:

1. The temperature, rainfall and amount of sunlight the area receives.
2. The availability of water, either through irrigation or natural rainfall, at the right time.
3. How crops are managed, including planting techniques, controlling pests and diseases, rotating crops and conserving soil.
4. The inherent ability of the crop variety to produce good yields.

So, while soil fertility is about the nutrients in the soil, soil productivity covers all the factors that affect crop yield and overall agricultural output.

Activity 6.9 Meaning of Soil Nutrients

1. What comes to mind when you hear the term soil nutrient? Write your definition in your notebook.
2. Share your definition with your peer for feedback and fine-tune the definition of soil nutrients.

Activity 6.10 Meaning of Soil Fertility and Soil Productivity

1. In pairs, come up with the meaning of soil fertility and soil productivity. You can use the internet and other resources in your research.
2. Present your definitions to the class for feedback and fine-tune your definitions using the feedback.
3. In the same pair, discuss the conditions under which fertile soils may not be productive.
4. Present the salient points from your discussion to the class for feedback.

Soil Nutrients and Their Importance in Crop Production

Importance of Soil Nutrients in Crop Production

Soil nutrients are essential for the healthy growth and development of plants. The following are some important aspects of the soil nutrients:

1. Soil nutrients are needed by plants for making new cells, which helps plants grow. Nutrient such as nitrogen is a crucial part of amino acids, which build proteins necessary for plant growth and repair.
2. Soil nutrients such as magnesium are important for making chlorophyll, which plants use to convert sunlight into energy through photosynthesis.
3. Soil nutrients such as phosphorus support the development of strong roots, enhancing water and nutrient uptake. A healthy root system improves the plant's ability to absorb nutrients from the soil.
4. Nutrients like potassium are vital for flower and fruit development, affecting the quality and quantity of the harvest.
5. Adequate nutrients help plants build strong tissues to resist pests and diseases.
6. Potassium helps plants handle stress from drought, salinity and extreme temperatures.
7. Soil nutrients support beneficial soil microorganisms, which help break down organic matter and cycle nutrients.
8. Adequate nutrient supply leads to better growth conditions, resulting in higher crop yields.
9. Soil nutrients also affect the nutritional content, taste and appearance of crops, which are important for marketability and consumer preference.

Classification of Soil Nutrients

Soil nutrients can be classified as follows:

1. **Macronutrients:** These are nutrients that plants need in large amounts to grow and stay healthy. Examples are:
    a. **Nitrogen (N):** Helps plants create proteins and chlorophyll, which are important for plant growth and photosynthesis. It also promotes leafy growth. Plants show yellowing of older leaves, slow growth and poor crop yield when there is a lack of nitrogen in the soil.
    b. **Phosphorus (P):** Gives plants energy through ATP, which is needed for cell processes. It also supports root growth and helps plants mature. Plants show stunted growth, dark green or purple leaves, weak root system and delayed maturity when there is lack of phosphorus in the soil.

c. **Potassium (K):** Helps with photosynthesis, protein synthesis and metabolism. It also helps regulate water in the plant and improves disease resistance. Lack of potassium in the soil causes yellowing or browning at the edges of leaves, weak stems and poor disease resistance of plants.

d. **Calcium (Ca):** Strengthens cell walls and is needed for cell division and growth. It also helps with enzyme activity in plants. Lack of calcium causes poor fruit development and weak or distorted growth in plants.

e. **Magnesium (Mg):** It's a key part of chlorophyll, which is used in photosynthesis. It also helps activate enzymes for plant growth. Lack of magnesium in the soil causes yellowing between leaf veins, weak growth and reduced photosynthesis in plants.

f. **Sulphur (S):** Helps form proteins and chlorophyll. It is essential for overall plant metabolism. Lack of sulphur in the soil causes yellowing of younger leaves, slow plant growth and delayed maturity.

2. **Micronutrients:** These are nutrients needed by plants in smaller amounts, but they are still very important for proper growth and development. Examples include:

a. **Iron (Fe):** It's Important for chlorophyll production and photosynthesis. Lack of iron in the soil causes yellowing between the veins of new leaves and poor plant growth.

b. **Manganese (Mn):** Involved in photosynthesis, respiration and nitrogen metabolism. Plants show yellowing between leaf veins and spots on younger leaves when there is a lack of manganese in the soil.

c. **Zinc (Zn):** Helps with enzyme functions, protein synthesis and growth regulation. Lack of zinc in the soil causes plants to have small leaves, poor growth and short internodes.

d. **Copper (Cu):** Essential for photosynthesis and enzyme function. Plants show stunted growth, pale leaves and tips of shoots dying when copper is lacking in the soil.

e. **Boron (B):** it's needed for strong cell walls, carbohydrate transport and reproductive development. Plants show brittle leaves, poor fruiting and cracked stems when boron is lacking in the soil.

f. **Molybdenum (Mo):** Helps with nitrogen fixation and processing nitrate in the plant. Yellowing of older leaves and poor plant growth are some of the symptoms of lack of molybdenum in the soil.

g. **Chlorine (Cl):** Helps with plant water balance and photosynthesis, and improves disease resistance. Wilting leaves, yellowing, and reduced plant growth are some of the symptoms of lack of chlorine in the soil.

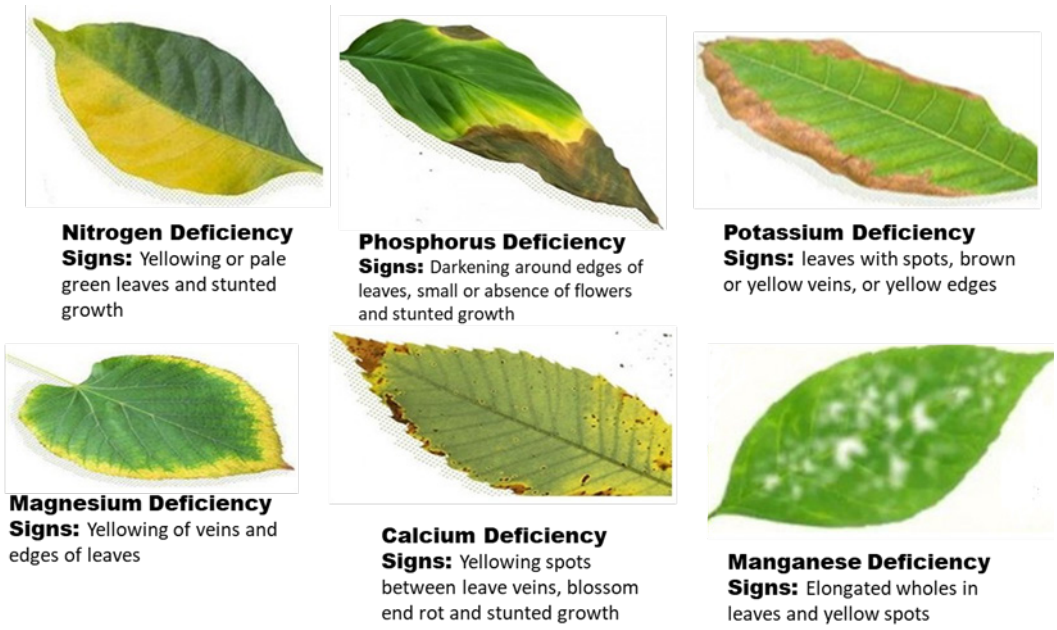


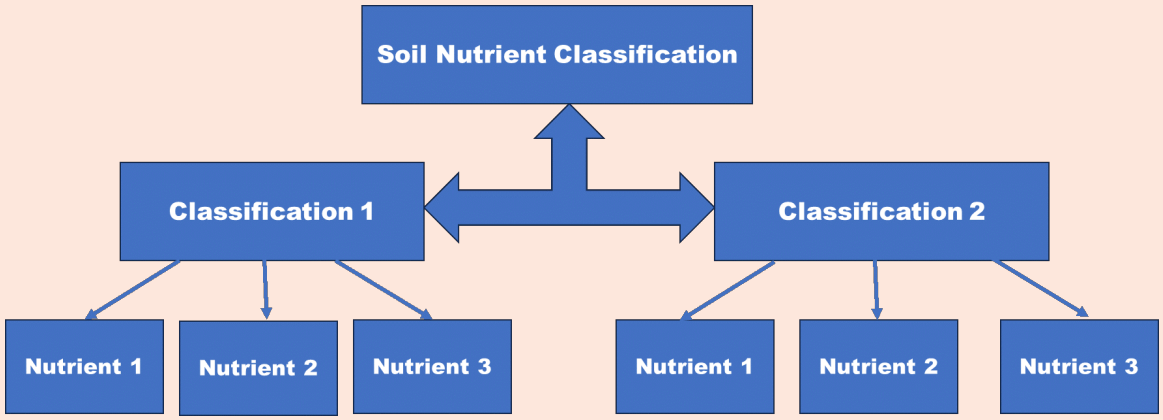
Figure 6.7: Deficiency symptoms of soil nutrients in plants

Activity 6.11 Importance of Soil Nutrients

1. In groups, come up with sources and examples of fertilisers in crop production.
2. Present your findings to your class for feedback.
3. In the same groups, discuss the importance of soil nutrients to crop production. In your discussion, focus on the:
   a. Role of soil nutrients in plant growth
   b. Impact of soil nutrients on crop yield and quality
   c. Impact of nutrients on soil health and fertility
   d. Impact of soil nutrients on farmers' profitability
5. Present the salient points from your discussion to the class for feedback.

Activity 6.12 Classification and Roles of Soil Nutrients

1. In groups, come up with the classification of soil nutrients and three examples of soil nutrients in each classification. You can use the internet and other sources in your research.
2. Present your findings in the chart below:



3. You can complete the chart using the following guidance notes:
   a. Write the classifications of the nutrients in the box labelled classification 1 and 2.
   b. Write the three examples of nutrients for each classification in the box labelled nutrient 1, 2 and 3.
4. In the same groups, come up with the roles of each of the six soil nutrients mentioned in the chart above in plant growth and development. You can use the internet and other resources in your research.
5. Present your findings in a table below to your class for feedback.

Table 6.2

Soil nutrients	Roles

Activity 6.13 Soil Nutrient Deficiency Symptoms

1. In groups, visit a crop production farm in your community or watch videos and look at pictures (click here or use https://youtu.be/dO2uz8C1-0U) to observe plant showing soil nutrient deficiency symptoms.
2. Discuss your observations. In your discussions be guided by the following:
   a. The visual symptoms observed in the plants, such as discoloration (yellowing, purpling), leaf spots.
   b. The parts of the plant showing the symptoms (leaves, stems, fruits).
   c. Whether the symptoms appear on older or newer plant part.
   d. The possible types of soil nutrient deficient (you can use the internet and other resources in your search).
   e. The impact of the nutrient deficiency on plant health and growth such as stunting, delayed maturity or reduced yield.

3. Present your five findings in a table below to the class for feedback.

Table 6.3

Deficiency symptoms	Plant part affected	Soil nutrient lacking	Picture showing the deficiency symptom	Impact on plant health and growth

MEANING, TYPES AND EFFECTS OF FERTILISERS ON CROP PRODUCTION

Meaning of Fertilisers

Fertilisers are substances that provide essential nutrients to plants to help them grow better and produce more crops. Fertilisers improve soil fertility and ensure healthy plant growth. Fertilisers can be:

Natural (Organic): These come from natural sources like compost, manure or bone meal. They slowly release nutrients into the soil as they decompose.

Manufactured (Inorganic): These are made in factories and contain specific nutrients in exact amounts. They provide nutrients quickly to plants.

Types of Fertilisers

Fertilisers can be grouped in different ways depending on their origin and the nutrients they provide. The following are some groupings of fertilisers:

1. Based on Origin
   a. Organic Fertilisers: They are from natural materials such as plants or animals. Examples:
      - Compost (decomposed plant material)
      - manure (animal waste)
      - bone meal (ground animal bones)
      - green manure (plants grown specifically to be ploughed into the soil).
   b. Inorganic (Chemical) Fertilisers: They are made in factories through industrial processes. Examples: Ammonium nitrate, superphosphate and potassium chloride.
2. Based on Nutrient Composition

a. Single-Nutrient Fertilisers (Straight Fertilisers): They provide just one primary nutrient. Examples:
   - Nitrogen Fertilisers (Urea, ammonium sulphate)
   - Phosphorus Fertilisers (Single superphosphate (SSP)
   - Triple superphosphate (TSP)
   - Potassium Fertilisers (Potassium chloride (muriate of potash), potassium sulphate).

b. Multi-Nutrient Fertilisers (Compound or Complete Fertilisers): They provide two or more primary nutrients. **Example**: NPK Fertilisers (contain nitrogen (N), phosphorus (P), and potassium (K)).

3. Based on Method of Application

a. Soil Application

- Granular Fertilisers: They are dry, solid fertiliser granules spread over the soil. Examples: Urea, ammonium nitrate, potassium chloride.
- Powdered Fertilisers: They are finely ground fertilisers that are spread over the soil and sometimes mixed with water. Examples: Rock phosphate, bone meal.
- Pelleted Fertilisers: They are compressed pellets that release nutrients slowly over time. Examples: Slow-release nitrogen fertilisers, organic manure pellets.

b. Foliar Application

- Liquid Fertilisers: they are fertilisers that are dissolved in water and sprayed directly onto plant leaves. Examples: Liquid fish emulsion, seaweed extract.
- Soluble Powder Fertilisers: They are powdered fertilisers that are mixed with water and sprayed on foliage. Examples: Soluble NPK mixes, chelated iron.

Figure 6.8: Types of organic fertilisers

Figure 6.9: Types of inorganic fertilisers

Effects of Fertiliser on Crop Production

Positive Effects of Fertilisers

1. Fertilisers add important nutrients to the soil, helping plants grow healthy and strong.
2. Proper use of fertilisers increases the yield of crops produced by supplying the nutrients plants need for growth and development.
3. Good nutrient management enhances the quality of crops, improving their size, color, taste and nutritional value.
4. Fertilisers can speed up the growth process, allowing plants to mature faster and enabling multiple harvests in a year.
5. fertilisers such as potassium helps plants manage water more efficiently, making them more resistant to drought.
6. Balanced nutrition strengthens plants' immune systems, making them less susceptible to pests and diseases.
7. Fertilisers cause higher crop yields and better-quality produce which can lead to more income for farmers.
8. Using fertilisers efficiently can lower costs and provide better returns on investment.

Negative Effects of Fertilisers

1. Using too much chemical fertilisers, especially nitrogen, can lower soil pH, making the soil more acidic and less fertile.
2. Runoff from fertilised fields can carry nutrients into rivers and lakes, causing eutrophication, which harms aquatic life.

3. Nitrates from fertilisers can seep into groundwater, posing health risks to humans and animals.
4. Using nitrogen-based fertilisers can release nitrous oxide, a powerful greenhouse gas that contributes to climate change.
5. Excessive amounts of certain nutrients, like boron and manganese, can become toxic to plants and hinder their development.
6. Farmers and agricultural workers handling fertilisers may face health issues such as respiratory problems and skin irritation.
7. Overusing fertilisers can lead to harmful substances, such as heavy metals, accumulating in crops, which can be dangerous to human health when consumed.
8. High levels of synthetic fertilisers can disrupt the balance of beneficial microorganisms in the soil, affecting nutrient cycling, soil health and plant growth.
9. Fertiliser runoff can change the nutrient balance in natural ecosystems, leading to reduced biodiversity as sensitive species are outcompeted by those thriving in nutrient-rich environments.

Mitigation Measures for Fertiliser Use

The following are some mitigating measures for fertiliser use:

1. Using precision agriculture techniques to apply fertilisers more efficiently, ensuring crops get the nutrients they require while minimising excess.
2. Using more organic fertilisers and amendments, such as compost and manure, to improve soil health and reduce reliance on synthetic fertilisers.
3. Creating buffer zones around water bodies to reduce nutrient runoff and protect aquatic ecosystems from pollution.
4. Educating farmers and agricultural workers on proper fertiliser use, including the right amounts, timing and methods, to minimise negative impacts and promote sustainability.

Fertiliser Application Methods

The following are some fertiliser application methods in crop production:

1. **Broadcasting:** Spreading fertilisers evenly over the soil surface.
2. **Banding:** Placing fertilisers in bands close to the seed or plant roots.
3. **Foliar Application:** Spraying liquid fertilisers directly onto plant leaves.
4. **Side-Dressing:** Applying fertilisers along the sides of growing plants.
5. **Fertigation:** Delivering fertilisers through irrigation systems.

Best Practices for Fertiliser Use

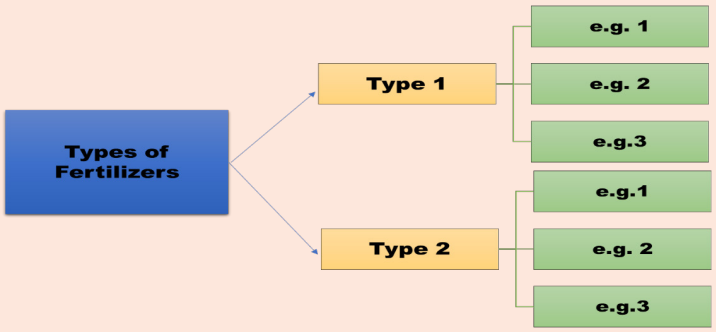
1. Regularly test the soil to understand its nutrient needs and apply fertilisers accordingly.
2. Use a balanced mix of essential nutrients tailored to the specific crop and soil conditions.
3. Use the right application methods, such as banding, side-dressing or fertigation, to improve nutrient uptake.
4. Combine chemical fertilisers with organic amendments like compost and manure to maintain soil health and fertility.
5. Regularly monitor how crops respond and adjust fertiliser requirements accordingly to avoid applying too much or too little.

Activity 6.14 Meaning of Fertiliser

1. In pairs, discuss the meaning of fertiliser in crop production.
2. Write your definition in your notebook.
3. Read your definition to other pairs for feedback and fine-tune your definition of fertiliser.

Activity 6.15 Types of fertilisers used in crop production

1. In groups, watch a video on the types of fertilisers used in crop production (click here)
2. Discuss your observations with the class. In your discussion, focus on the following:
   a. The types of fertilisers used in crop production
   b. Examples of each type of fertiliser
3. Present your findings in the chart below to your class for feedback.



4. You can complete the table using the following guidance notes:
   a. Write the types of fertilisers in the box labelled type 1 and type 2.

b. Write the examples of each type of fertiliser in boxes labelled e.g. 1, 2, 3.

c. Add more boxes if your groupings demand that.

Activity 6.16 Advantages and disadvantages of fertilisers

1. In groups, discuss the advantages and disadvantages of each type of fertiliser used in crop production.
2. With the help of the internet and other resources, come up with ways that the negative impact of fertilisers used in crop production can be avoided.
3. Present the salient points from your discussion to the class for feedback.

Activity 6.17 Fertiliser Application Methods

1. Your teacher will organise a visit to the school farm. In groups, visit the school farm and demonstrate three fertiliser application methods. This activity should be carried out with the assistance of the farm technician, and the appropriate PPE worn.
2. Write a report on the activities carried out on the school farm. Your report should contain:
   a. Introduction (The purpose and importance of the activity)
   b. Materials and Methods (Materials used, such as application tools, specific fertilisers used in the demonstration and methods of fertiliser application demonstrated)
   c. Procedure (step-by-step description of how each fertiliser application method was performed, safety precautions taken during the demonstration, such as wearing protective gear)
   d. Conclusion (Summary of the key findings from the demonstration)
   e. Appendices (pictures and other visuals from the demonstration)
3. Present your report to the class for feedback.

Activity 6.18 Compost Preparation

1. In groups, prepare compost for use at the school farm as a project. You can seek assistance from the school farm technician.
2. Build and present a portfolio of all your activities during the compost preparation for assessment. Your portfolio should be made up of:

a. Title Page made up of
   i. Title of project
   ii. Names of students in the group with their signatures
   iii. Content of the portfolio (items contained in the portfolio)
   iv. Date of portfolio submission
b. Report on the compost preparation with the following content:
   i. Introduction (purpose and importance of the project)
   ii. Materials and methods (all the materials used in the preparation of the compost, including tools used)
   iii. Procedure for the compost preparation (description of the step-by-step procedure for the compost preparation, safety measures taken during the preparation, including PPEs used)
   iv. Conclusion (summary of the activity)
c. Sample of the compost prepared
d. Pictures and other visuals taken during the compost preparation
e. Field book, which contains all the activities carried out during the compost preparation with dates.

EXTENDED READING

- General Agriculture by Eric Amoah, Exotic Series.
- Sasu, G. M., Kwarteng, E.N. and Baffour-Antwi, A. (Revised edition). General Agriculture for Senior High School. Adwinasa series
- Click here or use https://youtu.be/dtKThKBq454 to watch a video on Bio-fertiliser uses.
- Ajmal M, Ali HI, Saeed R, Akhtar A, Tahir M, Mehboob MZ (2018). Biofertiliser as an Alternative for Chemical Fertilisers. Res Rev J Agric Allied Sci [Internet], 7(1):1–7. Available from: http://www.rroij.com/open-access/biofertilizer-as-an-alternative-forchemical-fertilisers.php?aid=86649.
- Tripathi, A. (2024). Bio-fertiliser: Types, Application, Advantages, and Disadvantages. Microbe Online. Click here or use Bio-fertilizer: Types, Application, Advantages, and Disadvantages • Microbe Online

REVIEW QUESTIONS

1. Which of the following is a primary macronutrient in fertilisers?
   - **A.** Iron
   - **B.** Nitrogen
   - **C.** Manganese
   - **D.** Zinc
2. How is “game” typically defined in the context of wildlife?
   - **A.** Animals roaming in the community
   - **B.** Animals found in zoos
   - **C.** Domesticated pets
   - **D.** Wild animals are hunted for sport or food
3. Which part of the mushroom is responsible for spore production?
   - **A.** Cap
   - **B.** Gills
   - **C.** Mycelium
   - **D.** Stipe
4. The primary purpose of pasteurising the substrate in mushroom cultivation is to
   - **A.** add nutrients
   - **B.** ncrease moisture content
   - **C.** kill harmful microorganisms
   - **D.** reduce weight
5. What fertiliser will be applied to the soil when plants exhibit yellowing at the leaf margins?
   - **A.** Bone meal.
   - **B.** Calcium hydroxide
   - **C.** Poultry Manure.
   - **D.** Potassium sulphate
6. Explain the impact of human activities on wildlife populations and propose two conservation measures to mitigate these impacts.
7. Discuss the factors that affect the yield and quality of mushrooms during cultivation and suggest solutions to them.

REVIEW QUESTIONS

8. Compare and contrast the benefits of using organic fertilisers versus synthetic fertilisers under the following headings.
   - **A.** Soil health
   - **B.** Nutrient content and availability
   - **C.** Cost and application
   - **D.** Pollution risk
   - **E.** Application frequency
9. Study the scenario carefully and answer the questions below.

   You are a group of Agriculture students conducting a study on the school farm where various crops are grown, including tomatoes, maize and lettuce. Over the past few weeks, you've noticed that some of the plants are exhibiting unusual symptoms such as yellowing of older leaves, dark green or purple leaves, weak root system, yellowing between leaf veins, yellowing of younger leaves, delayed maturity, stunted growth and poor fruit development.

   Answer the following questions
   - **A.** Indicate the possible nutrients that may be deficient in the soil, causing the plants to exhibit the symptoms.
   - **B.** In what way can these soil nutrients be confirmed lacking in the soil?
   - **C.** Suggest the appropriate fertilisers that should be applied to the soil to avert the symptoms.
10. Discuss the economic and ecological impact of the continuous application of fertilisers in crop production and how these effects can be minimised.

SECTION

7

CROP AND ANIMAL HEALTH

AGRICULTURE AND HEALTH

Health Issues in Crop Production

Health Issues in Animal/Fish Production

INTRODUCTION

Welcome to Section 7! In this section, you will explore the aspects of crop and animal production, focusing on pest and disease management. You will learn how to identify common crop pests and diseases and understand their impact on crop health and yield. This knowledge is vital for maintaining a safe and abundant food supply. You will also classify these pests and diseases to better understand their characteristics. The section also delves into the prevention and control measures for crop diseases and pests for food safety.

You will identify diseases, pests and parasites affecting animals and fish, and learn about their impact on production. Understanding the classification, causes and symptoms of animal and fish diseases will equip you to identify and manage diseases in animals and fish effectively, ensuring food safety and boosting production.

This knowledge will assist you in managing your farm effectively in the near future for sustainable and safe food production.

KEY IDEAS

- A crop is a plant that is grown and harvested in large quantities for food or for profit.
- A pest is any living thing that has a negative effect on crops, food, livestock, etc.
- A disease is a disorder of structure or function in humans, animals, or plants, especially one that has a known cause and a distinctive group of symptoms, signs or anatomical changes.
- Health refers to physical and emotional well-being, especially that which is associated with normal functioning of the body, absence of diseases, pain, etc.
- Parasites live on or inside other organisms, deriving nutrition at the host's expense.
- Some signs and symptoms of diseases of crops include necrosis, stunted growth, discolouration of leaves, and wilting.
- One Health concept recognises that the health of humans, animals, and the environment is interconnected and must be protected together to prevent disease and promote overall well-being.

MEANING, COMMON CROP PESTS AND DISEASES AND THEIR EFFECTS IN CROP PRODUCTION

Meaning of Crop Pests and Diseases

Crop Pest: These are organisms that cause harm to agricultural crops, leading to reduced yield and quality. They include insects, weeds, fungi, bacteria and viruses. Examples of common crop pests are:

1. **insect pest:** Insects feed on various parts of plants, such as leaves, stems, fruits, roots, and seeds. Examples include aphids, caterpillars, whiteflies, and weevils.
2. **Fungal pest**: Fungi cause diseases that can lead to plant death or reduced yield. Common fungal pests include powdery mildew, rust, blight and fusarium wilt
3. **Weeds:** These are plants that compete with crops for nutrients, water and light, indirectly reducing yields. Examples are Parthenium (Congress weed) and Striga (witchweed).
4. **Viruses**: These are microscopic infectious agents that cause plant diseases, such as Tomato Mosaic Virus (ToMV) and Tobacco Mosaic Virus (TMV), which stunt growth and reduce crop yields.
5. **Nematodes**: These are tiny parasitic worms that harm plant roots. Examples: Root-Knot nematodes, which create galls on roots, and Cyst nematodes, which target crops like soybeans. Their damage often provides entry points for secondary infections by fungi or bacteria.
6. **Bacteria**: These are microscopic organisms that cause various plant diseases, such as Bacterial wilt, which affects crops like tomatoes and bananas by blocking water transport, and Fire blight, which damages apples and pears. Symptoms of bacterial infections include wilting, spotting, or rotting.

Pathogens: are disease-causing organisms that infect crops and lead to reduced growth, poor yield, or plant death.

Vectors are organisms—usually insects or pests—that carry and transmit pathogens from one plant to another. They do not cause the disease themselves but spread the disease-causing agent.

Disease resistance is the ability of a crop plant to prevent or reduce infection caused by pathogens.

Resistant plants either stop the pathogen from entering, slow its growth, or reduce the damage it causes.

Using disease-resistant varieties is one of the most effective and affordable ways to manage crop diseases.

Crop Diseases: These are conditions caused by pathogens (such as fungi, bacteria, viruses, and nematodes) or environmental factors that negatively affect the health and productivity of plants. They can lead to significant yield losses if not properly managed.

Characteristics of a Healthy Plant

The following are characteristics of a healthy plant.

1. **Vibrant colour:** A healthy plant having a rich green colour often signifies good health, indicating adequate chlorophyll levels. It should have bright and vibrant colours to typically indicate ripeness and vitality.
2. **Strong structure:** Healthy plants have thick, strong stems that can support leaves and flowers. They also have a well-developed root system that helps anchor the plant and absorb nutrients and water.
3. **Robust growth:** Healthy plants should have regular production of new leaves, stems, and flowers, suggesting active growth. They should reach expected sizes for their species, indicating proper growth conditions.
4. **Lush foliage:** Healthy plants should have dense leaf cover with no signs of wilting, browning, or curling, indicating good photosynthesis and overall health.
5. **Absence of pests and diseases**: healthy plants should not have holes, spots, or discolouration from pests or diseases. The leaves should be free from mould, mildew and other signs of infection.
6. **Proper leaf texture**: Healthy leaves should feel firm and pliable, not limp or brittle. It should also have a healthy sheen, which indicates good moisture levels.
7. **Consistent watering**: Soil should be adequately moist but not waterlogged, supporting healthy root function.
8. **Nutrient availability**: A healthy plant exhibits balanced growth in all parts, indicating sufficient nutrients.
9. **Resilience**: Healthy plants should withstand environmental stresses such as drought or temperature fluctuations.

Signs of Diseased Plants

1. **Discoloured leaves**: Leaves may show yellowing (chlorosis), browning, or blackening, often displaying specific patterns.
2. **Spots and blotches**: Presence of dark, light, or dead spots on leaves, stems, or fruits.
3. **Wilting**: Leaves and stems lose their firmness and droop, even when the soil has enough moisture.
4. **Leaf drop**: Early shedding of leaves.
5. **Stunted growth**: Decreased size or lack of growth in the plant or its components.
6. **Deformed leaves or stems**: Growth that is twisted, curled, or misshapen, often suggesting viral infections or insect damage.

7. **Fungal growth**: Observable mould, mildew, or rust on leaves, stems, or the soil surface.
8. **Root rot**: Roots that are blackened and mushy, accompanied by an unpleasant odour.
9. **Cankers**: Depressed, dead areas found on stems or branches.
10. **Unusual growths**: Presence of galls, tumours, or swellings on stems, leaves, or roots.

A diseased tomato plant

A healthy tomato plant

Figure 7.1: A diseased and a healthy tomato plant

Common Crop Pests and Their Effects on Crop Production

The following are some crop pests and their effects on crop production.

1. Insect
    a. **Aphids**: These pests use their needle-like mouthparts to pierce plant tissues and extract sap. This can result in leaf curling, distortion and yellowing (chlorosis) due to nutrient loss and reduced photosynthesis. Extended feeding leads to stunted growth and diminished plant productivity and yield.
    b. **Caterpillars**: They feed on leaves, stems, and fruits, causing defoliation and significantly lowering crop yields.
    c. **Whiteflies**: These insects cause leaf yellowing and wilting while secreting honeydew that promotes the growth of sooty mould. Their feeding, honeydew production, and ability to transmit plant diseases can drastically reduce crop productivity.
    d. **Beetles**: They feed on the foliage of tuber crops like yams and potatoes, leading to defoliation and reduced tuber yields.
    e. **Locusts**: These pests attack a wide variety of crops, including cereals, vegetables, and legumes. They can decimate entire fields quickly by stripping plants of their leaves, which reduces photosynthesis and weakens the plants. Locusts also damage stalks and seeds, further impacting growth and yield.
2. Birds
    a. **Weaver birds:** Feed on grains, fruits, and seeds, and may contaminate crops with their droppings.
    b. **Crows:** Uproot seedlings, peck at fruits, and eat grains.

3. Rodents and other animals
    a. **Mice:** Eat seeds, grains and young plants, gnaw on plant parts.
    b. **Rats:** Consume and damage crops and contaminate crops with droppings.
    c. **Cane rat (Grasscutters):** These are herbivores that feed on fruits and crops such as maize, cassava, yam and sugarcane. They can cause extensive damage by consuming the leaves and stems of crops, which weakens the plants and reduces their ability to grow and produce yields. They may also feed on roots, causing further harm to crop stability and growth. The feeding behaviour of grasscutters can lead to substantial reductions in crop yields. In severe cases, they can destroy entire fields, leading to significant economic losses for farmers.
    d. **Bats**: Feed on insects but can occasionally damage fruit crops by feeding on the fruit.
    e. **Monkeys:** Consume fruits, vegetables and other crop parts; can cause significant damage in orchards and fields.
    f. **Squirrels:** Feed on seeds, fruits and nuts; can damage plants by gnawing on stems and branches.
    g. **Nematodes (Meloidogyne spp.):** Cause galls or knots on roots, disrupting water and nutrient uptake. This results in stunted growth, reduced yield and poor crop quality. Create lesions on roots, causing poor root development and reduced plant vigour.


Aphids


Thrips


Fruit Fly


White Fly

Figure 7.2: Pests of crops

Common Crop Diseases and Their Effects on Crop Production

The following are some crop diseases and their effects on crop production:

1. Fungal Diseases
    a. Powdery mildew (Erysiphe spp.): Causes white, powdery fungal growth on leaves, stems and buds. Results in reduced photosynthesis, stunted growth and poor fruit development. Reduce crop yield.
    b. Blight (Phytophthora infestans): Causes dark, water-soaked lesions on leaves, stems and fruits. Lead to rapid plant death, reduced yield, and poor quality.
    c. Rust (Puccinia spp.): Causes reddish-brown pustules on leaves and stems. Results in reduced photosynthesis and plant vigour, leading to yield loss.
    d. Fusarium wilt (Fusarium oxysporum): Causes wilting, yellowing and stunting of plants. Affects vascular tissues, leading to poor nutrient and water uptake and significant yield loss.
2. Bacterial Diseases
    a. Bacteria blight (Xanthomonas campestris): Causes water-soaked lesions on leaves, stems and fruits. Results in leaf drop, reduced photosynthesis and yield loss.
    b. Bacteria wilt (Ralstonia solanacearum): Causes wilting, yellowing and plant death. Affects the vascular system, leading to significant yield reductions.
    c. Crown gall (Agrobacterium tumefaciens): Causes tumour-like growths at the base of plants. Affects nutrient uptake and plant stability, leading to reduced growth and yield.
    d. Bacteria soft rot: It commonly affects vegetables such as carrot, tomato, cucumber, melon, cabbage, etc.

Figure 7.3: Tomato plant showing fungal disease

3. Viral Diseases
    a. Tomato Yellow Leaf Curl Virus: Leads to yellowing and curling of leaves, stunted growth, and decreased fruit yield. It affects tomatoes and related crops.
    b. Cucumber Mosaic Virus: Results in mosaic patterns on leaves, stunted growth, and deformed fruit. It impacts cucumbers, melons, and other vegetables.
    c. Maize Streak Virus: Causes yellow or white streaks on leaves, stunted growth, and lower yields. Plants with severe infections may fail to produce ears entirely.
    d. Cassava Mosaic Disease: Transmitted by whiteflies (Bemisia tabaci) and through infected planting materials. It causes mosaic patterns on leaves, leaf distortion, and stunted growth, leading to reduced tuber yields.
    e. Groundnut Rosette Disease: Spread by aphids (Aphids craccivora). It causes yellowing, stunting, and leaf deformation in plants. Severely affected plants yield few or no pods, impacting overall productivity.
    f. Rice Yellow Mottle Virus: Transmitted through mechanical means (such as handling and water) and possibly by insect vectors like beetles. It leads to yellowing and mottling of leaves, stunted growth, and significant yield losses.

Figure 7.4: Cassava leaves showing symptoms of viral infection

4. Other Diseases
    a. Damping-Off (example Rhizoctonia solani): This results in seedling death and root rot, leading to high mortality rates among seedlings and a diminished plant population.
    b. Downy Mildew (Peronospora spp.): Causes leaves to yellow and die, with greyish fungal growth appearing on the underside. This condition results in decreased plant vigour and loss of yield.

Figure 7.5: Crops showing symptoms of other diseases

Activity 7.1 Meaning of Crop Pests and Diseases

1. What comes to mind when you hear the terms crop pests and diseases?
2. Write your thoughts in your notebook.
3. Read your definition to a peer for feedback and fine tune your definition of crop pests and diseases.

Activity 7.2 Characteristics of Healthy and Diseased Crops

1. Organise yourselves into groups of no more than five. In your groups, come up with five characteristics each of healthy and diseased plants. You can use the internet and other resources in your research.
2. Present your findings to your class for feedback.

Activity 7.3 Effects of Crop Pests and Diseases on Crop Production

1. Organise yourselves into groups of no more than five. In your groups, discuss the effect of plant diseases and pests on agricultural production. In your discussion be guided by the following:
   a. How diseases and pests reduce crop yields by damaging plants or killing them outright.
   b. How the quality of produce can be affected, including physical damage, contamination and nutritional loss.

c. The impact of the costs related to the loss of crops, decreased market value and additional expenses for control measures on crop production.

d. The impact of crop pests and diseases on market prices, trade restrictions and long-term effects on farm sustainability.

e. The impact of crop pests and disease control on non-target species and overall biodiversity.

2. Present the salient points from your discussion to the class for feedback.

Activity 7.4 Characteristics of Crop Pests and Diseases

1. Organise yourselves into groups of no more than five. In your groups, visit a crop production farm to observe and take pictures of healthy and diseased plants or watch a video (click here) or look at pictures of healthy and diseased plants.
2. Prepare a photo album of healthy and diseased plants. The photo album should contain pictures of five diseases plants and five healthy plants.
3. Present your album for peer assessment in class.

CLASSIFICATION OF CROP PESTS AND DISEASES

Classification of Crop Pests

In Ghana and Africa, crop pests are diverse and can be classified based on their taxonomy, feeding habits and the type of damage they cause. Here are the main classes of common pests:

1. **Insects:** Moths and Butterflies (Lepidoptera): The caterpillars of lepidoptera are what causes destruction to crops. Examples include:
   - Fall Armyworm (*Spodoptera frugiperda*): A significant pest of maize and other cereal crops.
   - African Bollworm (*Helicoverpa armigera*): Affects cotton, tomatoes, and legumes.

Fall Armyworm

African Bollworm

Figure 7.6: Caterpillars of lepidoptera

2. **Beetles (Coleoptera)**. Examples include:
   - Cowpea Weevil (*Callosobruchus maculatus*): Damages stored cowpeas.
   - Maize Weevil (*Sitophilus zeamais*): Infests stored grains.

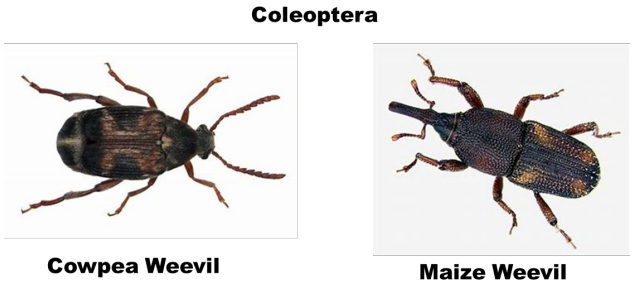


Figure 7.7: Examples of Coleoptera

3. **True Bugs (Hemiptera)**: Examples include
   - Aphids (Aphis craccivora): Impact legumes and transmit plant viruses.
   - Whiteflies (*Bemisia tabaci*): Affect a variety of crops and also transmit viruses.

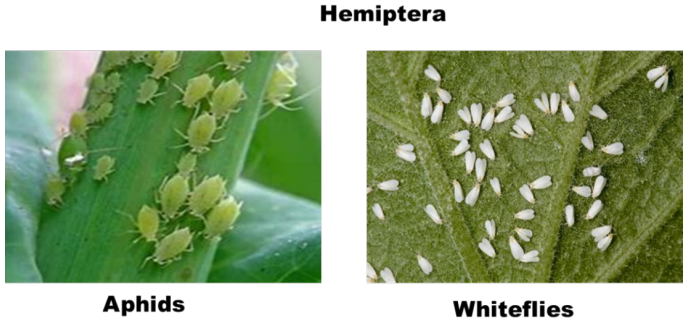


Figure 7.8: Examples of Hemiptera

4. **Grasshoppers and Locusts (Orthoptera)**. Examples include:

Desert Locust (*Schistocerca gregaria*): Causes extensive damage to various crops during outbreaks.

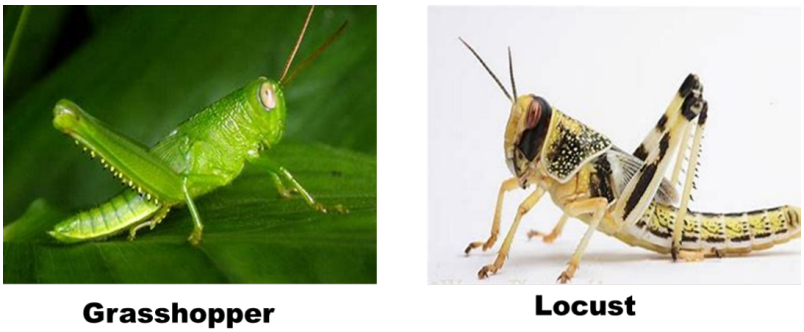


Figure 7.9: Examples of Orthoptera

5. **Flies (Diptera)**. An example include:

Fruit Flies (*Bactrocera dorsalis***)**: Impact mangoes, citrus fruits and other varieties.

Fruitfly

Figure 7.10: Example of Diptera

6. **Mites (**Arachnids acarina**).** Examples include:
   - Rust Mites (*Aceria* spp.): Affect a range of crops, leading to rust-like symptoms.
   - Spider Mites (*Tetranychus* spp.): Impact vegetables, fruits, and other crops

Spider Mites

Rust Mites

Figure 7.11: Examples of mites

7. **Nematodes.** Examples include:
   - Cyst Nematodes (Heterodera spp): Affects cereals and legumes.
   - Root-Knot Nematodes (*Meloidogyne* spp): Affects a wide range of crops, causing galls on roots.

Cyst Nematodes

Root-Knot Nematodes

Figure 7.12: Example of Nematodes

8. **Snails and slugs (Gastropods):** Feed on a variety of crops, especially in humid regions.

Figure 7.13: Examples of Gastropods

9. **Birds (Weaver birds):** Major pests of cereals like rice, sorghum and millet.

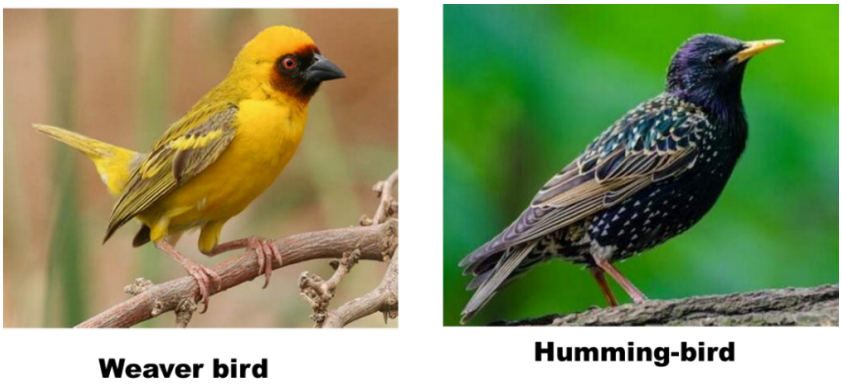


Figure 7.14: Example of birds

10. **Rats and mice (Rodents).** Examples include:
    - House Mouse (Mus musculus): Affects stored grains and field crops.
    - Multimammate Rat (Mastomys natalensis): Feed on field crops and stored products.
    - Grasscutter (*Thryonomys swinderianus*): Feed on maize, cassava, sugarcane etc.

Figure 7.15: Examples of rodents

Classification of Insects

It must be noted that insects are the most devastating pests of crops; they can be classified in various ways.

1. **Chewing insects**: These insects have mouthparts adapted for chewing and biting. Examples are:
   a. Caterpillars (Lepidoptera): The larvae of butterflies and moths that consume leaves, stems, and fruits (e.g., armyworms, corn borers).
   b. Beetles (Coleoptera): Both larvae and adult forms can be pests (e.g., Larger Grain Borer, weevils, leaf beetles, Cassava Green Mite, etc.).
   c. Grasshoppers and Locusts (Orthoptera): Feed on leaves and stems, resulting in substantial defoliation.

Grasshopper

Fall Armyworm

Figure 7.16: Some biting and chewing insect pests

2. **Sucking Insects**: These insects have mouthparts adapted for piercing and sucking plant sap. Examples are:
   a. Aphids (Hemiptera): Suck sap from leaves and stems, causing stunted growth and transmit plant viruses.
   b. Whiteflies (Hemiptera): Feed on the underside of leaves, excreting honeydew which leads to sooty mould.
   c. Scale Insects (Hemiptera): Attach themselves to stems, leaves and fruits, sucking sap and weakening the plant.
   d. Mealybugs (Hemiptera): Similar to aphids and scales, they suck plant sap and can transmit diseases.

Aphids

Mealybugs

Figure 7.17: Some piercing and sucking insects

3. **Boring insects:** These insects bore into stems, fruits or roots. Examples are
   a. Stem Borers (Lepidoptera): The larvae of moths that penetrate plant stems (e.g., European corn borer).

b. Fruit Borers (Lepidoptera): Larvae that invade fruits, leading to direct damage (e.g., codling moth).

c. Root Borers (Coleoptera): Larvae that burrow into roots, interfering with nutrient absorption (e.g., root weevils).

Maize stem borer Tomato fruit borer

Figure 7.18: Some boring insect pests

Life Cycle of Insects

Complete Metamorphosis (Holometabolous)

This type of life cycle consists of four distinct stages: egg, larvae, pupa and adult.

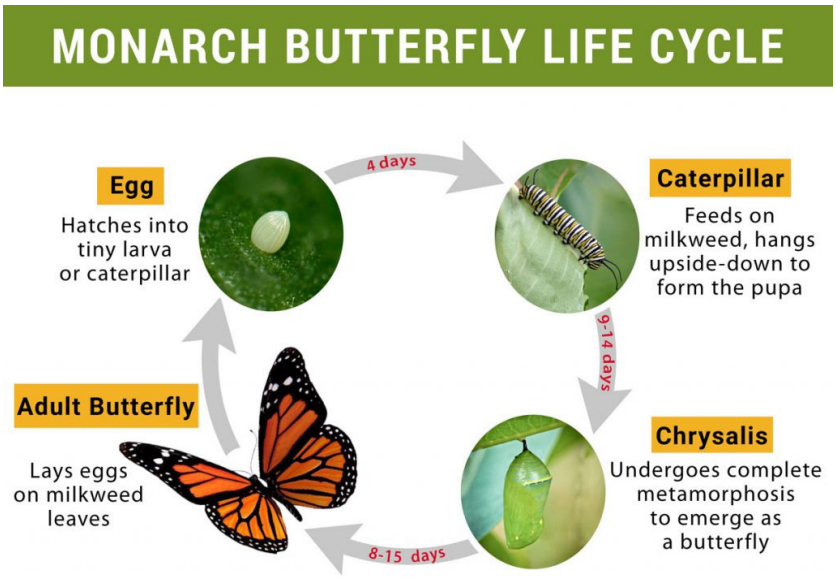


Figure 7.19: Complete metamorphosis of a butterfly

1. **Egg:** The life cycle begins when a female butterfly lays eggs on the leaves of suitable host plants. Eggs are often small, round, or oval, and may vary in colour and texture depending on the species.
2. **Larva (Caterpillar):** Once the eggs hatch, the larvae emerge as caterpillars. Caterpillars primarily feed on leaves, growing rapidly and moulting several times (instars) as they increase in size. This stage is crucial for accumulating energy for the next phase.

3. **Pupa (Chrysalis):** After reaching a sufficient size, the caterpillar forms a protective casing around itself, known as a chrysalis or pupa. During this stage, the caterpillar undergoes a remarkable transformation. Inside the chrysalis, the caterpillar's body breaks down and reorganises into the adult butterfly. This stage can last from a few days to several weeks, depending on the species and environmental conditions.
4. **Adult Butterfly:** Once the transformation is complete, the adult butterfly emerges from the chrysalis. At first, the wings are soft and crumpled. The butterfly pumps fluid into its wings to expand them and allows them to dry and harden. After a short period, it takes its first flight. The adult stage is focused on reproduction and finding food, typically nectar from flowers.

Incomplete Metamorphosis (Hemimetabolous)

This type of life cycle consists of three stages: egg, nymph and adult.

1. **Egg:** The life cycle begins when the female insect lays eggs, often in or near water or on plant surfaces, depending on the species. Eggs can vary in size, shape, and colour, typically depending on the insect species.
2. **Nymph:** After the eggs hatch, the young insects emerge as nymphs. Nymphs resemble miniature adults but lack fully developed wings and reproductive structures. Nymphs go through several moults (instars), during which they grow and develop. With each moult, they gradually gain adult features, such as larger size and more developed legs or antennae. Nymphs typically feed on the same food sources as adults.
3. **Adult:** After several moults, the nymphs mature into adults. Adults possess fully developed wings (if applicable) and reproductive organs, allowing them to reproduce. They often have a different body shape or colouration than nymphs, which can aid in camouflage or mating.

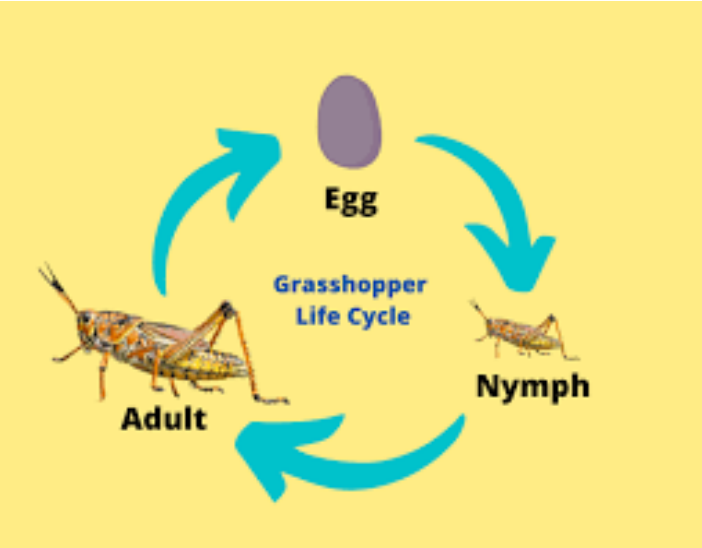


Figure 7.20: Incomplete metamorphosis

Classification of Crop Diseases

Pathogenic Crop Diseases

Pathogenic crop diseases are caused by living organisms that infect plants and cause disease. These organisms can be classified into several types.

1. **Fungi**: Fungal pathogens are a major cause of plant diseases, producing symptoms such as wilting, leaf spots, blights, and rots. Examples include **Powdery Mildew**, caused by fungi like Erysiphe spp., **Rust**, caused by fungi such as Puccinia spp., and **Late Blight**, caused by Phytophthora infestans.

Leaf showing Powdery Mildew

Late Blight on Tomato Plant

Figure 7.21: Plants showing fungal diseases

2. **Bacteria**: Bacterial pathogens infect plants and cause symptoms like leaf spots, blights, and wilting. A notable example is **Bacterial Wilt**, caused by Ralstonia solanacearum.

Plant showing Bacterial Wilt

Plant showing Bacterial Leaf Spot

Figure 7.22: Plants showing bacterial diseases

3. **Viruses**: Viral pathogens result in diverse symptoms such as stunted growth, leaf discoloration, and mosaic patterns. Examples include: Tobacco Mosaic Virus, Tomato Yellow Leaf Curl Virus, and Cucumber Mosaic Virus.

Tobacco leaves showing symptoms of Mosaic Virus

Tomato leaves showing symptoms of Yellow Leaf Curl Virus

Figure 7.23: Plants showing viral diseases

4. **Nematodes:** These microscopic worms infect plant roots, leading to the formation of galls, root knots, and overall plant decline. Examples include: Root-Knot Nematodes (Meloidogyne spp.) and Cyst Nematodes (Heterodera spp.).

Plant roots showing symptoms of Root Knot Nematode infection

Plant roots showing symptoms of Cyst Nematode infection

Figure 7.24: Plant roots showing nematode infection

Non-Pathogenic Crop Diseases

Non-pathogenic crop diseases are caused by environmental factors or cultural practices, rather than living organisms. These factors can lead to plant stress and various symptoms, but they do not involve infection by a pathogen. Examples include:

1. **Nutrient deficiencies**: Lack of essential nutrients can lead to symptoms such as chlorosis (yellowing of leaves), stunted growth and poor yield. Nutrient deficiency; Yellowing of older leaves and poor growth. Iron deficiency: Interveinal chlorosis, primarily in younger leaves.
2. **Environmental Stresses**: Harsh weather or extreme environmental conditions can lead to non-pathogenic plant diseases. **Drought stress** results in wilting, leaf drop, and stunted growth, while **frost damage** causes tissues to blacken or die due to freezing temperatures.
3. **Chemical Damage**: Improper application of herbicides, pesticides, or fertilisers can cause harm to plants. **Herbicide injury** leads to distorted growth, leaf

burn, and spotting, while **salt damage** occurs from excessive fertiliser use or irrigation with saline water, causing leaf burn and stunted growth.

4. **Physical Damage**: Mechanical injuries from activities like cultivation, wind, or hail can harm plants. **Wind damage** results in broken stems, torn leaves, and lodging, while **hail damage** causes punctured leaves and bruised fruits.

Nutritional Deficiency

Leaf showing Phosphorus deficiency

Leaf showing Potassium deficiency

Environmental Stress

Plants showing drought stress

Plants showing frost stress

Chemical Damage

Plants showing herbicide damage

Plants showing Fertilizer damage

Figure 7.25: Plants showing symptoms of non-pathogenic crop diseases

COMMON CROP DISEASES AND PESTS IN GHANA

Disease / Pest	Crops Affected	Symptoms	Control Measures
Black Pod Disease	Cocoa	Brown/black spots on pods, pod rot. reduced yield	Insrez farm sanitation prunea shade trees apply fungicides remove infected pods
Swollen Shoot Virus (CSSV)	Cocoa Swellewing leaves	Swollen branches, yellowing leaves reduced pod formation	Remove.infected trees plant resistant varieties control mealybugs
Maize Stem Borer	Maize	Holes in stems, stunted growth dead-heart symptoms	Early planting use resistant varieties destroy crop residues apply preconmone
Fall Arnyworm Cassava	Maize, sorghum	Leaf holes skelefonized leaves larvae in whorl	Handpick early larvae apply approved insecticides apply insecticŧs
Cassava Mosaic Disease	Cassava	Yellow/white mosaic patterns on leaves leaf distortion	Use biological con- trol (parasitoids) destroy infested plants apply insecticides
Cassava Mealybug Cassava	Cassava	White powdery insects on stems and leaves control wh	Plant resistant varietes avoid excessive nitrogen ensore proper spa-
Rice Blast Disease	Rice	Brown lesions on leaves neck rot	Prune trees remove infected fruits apply copper
Citrus Black Spot	Citrus	Black circular spots on frult and leaves	Dark sunken lesions on leaves and ste- me, died
Yam Anthrac– nose	Yam	Dark sunken lesions on leaves, strenes	Use cleanning material crop rotation fungicide, antram stril

Figure 7.26: common crop diseases in Ghana, symptoms and their control measure

Activity 7.5 Classification of Crop Pests and Diseases

1. Organise yourselves into groups of no more than five. In your groups, discuss the classification of crop pests and diseases. In your discussion, be guided by the following:
   a. For pest consider the categories of the plant pests (insects, mites, nematodes or rodents), their life cycles, the type of damage they cause (e.g. boring holes into the leaves), and how they feed on the plants, e.g. chewing, biting
   b. For the diseases, consider the categories of plant diseases (fungal diseases, bacterial diseases, viral diseases or nematode diseases) and the causal agent (pathogenic or non-pathogenic).

   You can use the internet and other resources in your research.
2. Present your findings to the class for feedback.

Activity 7.6 Identification of Crop Diseases and Pests

1. With the help of the internet and other resources, identify two plant pests and two diseases of vegetables, arable crops or cash crops.
2. In groups, discuss the causative agents, symptoms and mode of transmission for the diseases and mode of feeding, stage of attacking the crop, damage caused, and the effects of damage caused by the pests.
3. Prepare a presentation (digital or paper-based) on your findings for the class.

Activity 7.7 Pathogenic and Non-Pathogenic Diseases of Crops

1. In groups, develop a picture portfolio of plants showing symptoms of pathogenic and non-pathogenic diseases of vegetables, arable crops or cash crops. The portfolio should be made up of the following:
   a. Five pictures of plants showing symptoms of pathogenic diseases. Under each picture, indicate the causative agents and symptoms of the disease and the control measures.
   b. Five pictures of plants showing symptoms of non-pathogenic diseases. Under each picture, indicate the causative agent and the symptoms of the disease.
2. Present your portfolio for peer assessment in the class.

PREVENTIVE MEASURES OF PESTS AND DISEASES IN CROP PRODUCTION

Cultural Control

These are practices used by farmers to grow their crops. These practices can be used to control diseases and pests in crop production. Examples are:

1. **Crop rotation**: Changing the crops grown in a particular area each season helps disrupt the life cycles of pests and pathogens. For instance, rotating legumes with cereals can help lower populations of nematodes and pathogens.
2. **Sanitation**: Removing plant debris, weeds, and other potential sources of pest and pathogen infestations can help control their populations. For example, clearing fallen fruits and pruning infected plant parts reduces the spread of pests and diseases.

3. **Use of resistant varieties**: Planting crop varieties that are resistant or tolerant to specific pests and diseases can significantly minimise damage. For example, using rust-resistant wheat varieties can help prevent rust-related damage.
4. **Planting time and density**: Adjusting planting schedules and plant densities can avoid peak pest and pathogen populations, reducing their spread and impact. For example, planting early maturing varieties can help crops escape pests and pathogen attacks later in the season.
5. **Proper water and nutrient management**: Healthy plants are more resilient to pests. Proper irrigation practices, such as avoiding waterlogging, ensure plants do not stay wet for too long, reducing the risk of diseases. For example, using drip irrigation minimises leaf wetness and the chance of foliar diseases, while avoiding over-fertilisation prevents attracting certain pests.

Advantages of Cultural Method

1. Cultural methods often involve minimal or no use of chemicals, reducing the environmental impact of pesticide and fertiliser use.
2. Since cultural practices often rely on natural methods, such as crop rotation, proper spacing and sanitation, they can be more affordable than chemical treatments, reducing costs for farmers.
3. By using cultural practices like crop rotation and resistant varieties, farmers can manage pest populations more effectively and slow down the development of resistance to pesticides.
4. Cultural practices like crop rotation, organic fertilisation and proper irrigation can improve soil health by enhancing nutrient cycling, reducing soil erosion and promoting beneficial microorganisms. Healthier soil leads to stronger, more resilient crops that are better able to withstand pests and diseases.
5. Cultural practices, such as intercropping and crop rotations, encourage greater biodiversity in the farming system. This creates a balanced ecosystem where natural predators of pests can thrive, reducing the need for chemical pest control.
6. Many cultural practices, such as proper plant spacing, sanitation and the use of resistant crop varieties, focus on preventing pest and disease problems before they arise, offering long-term solutions rather than short-term fixes.
7. Unlike chemical pesticides, cultural methods do not harm non-target species such as pollinators, beneficial insects, and wildlife. This helps maintain the balance of the ecosystem and protects natural enemies of pests, which can further contribute to pest control.

Disadvantages of Cultural Method

Cultural methods such as weeding and pruning require significant manual effort, which can be challenging for farmers with limited labour.

1. Cultural methods take time to show results and may leave crops vulnerable in the short term compared to faster-acting chemical treatments.

2. Successful implementation depends on understanding local ecosystems, pests and best practices, which can be difficult for inexperienced farmers.
3. Some practices may not be feasible in small-scale or resource-limited farms due to space or water limitations.
4. Some crops may not work well with rotation or intercropping, limiting the effectiveness of cultural methods.
5. Cultural methods may not effectively control highly mobile or internal pests, requiring additional management strategies.
6. These methods rely on favourable conditions like weather and soil quality, which can limit their success in poor environmental conditions.
7. Practices like crop rotation or planting adjustments may reduce yields if less productive crops are used or if external conditions are not ideal.

Biological Control

1. **Natural Predators and Parasites**: Introducing or preserving beneficial organisms that prey on pests can help control their populations. For instance, using ladybugs to manage aphid populations.
2. **Biological Control Agents**: Utilising beneficial microorganisms to suppress or outcompete pathogens. An example is Trichoderma spp., which is used to control soil-borne fungal pathogens.
3. **Microbial Control Agents**: Employing bacteria, fungi, or viruses to target specific pests. For example, Bacillus thuringiensis (Bt) is used to control caterpillar pests.
4. **Biological Insecticides**: Using insecticides derived from natural sources to target specific pests. Neem oil is an example of a biological insecticide.
5. **Antagonistic Plants**: Planting crops or cover crops that help inhibit the growth of pathogens. For example, marigolds are planted to reduce nematode populations.

Advantages of Biological Method

1. Helps to maintain and restore the natural balance of ecosystems by enhancing biodiversity and supporting the health of non-target species.
2. Reduces chemical residues in food, making produce safer for consumers. Lowers the risk of exposure to toxic chemicals for farm workers, promoting safer working conditions.
3. Biological control agents, such as natural predators, parasitoids and pathogens, do not introduce harmful chemicals into the environment.
4. Once established, biological control agents can cause ongoing pest suppression, reducing the need for repeated interventions.
5. Reduces stress on plants caused by chemical applications, promoting healthier and more resilient crops.

6. Increasing consumer demand for organically grown and residue-free produce can met by using biological control methods
7. Although the initial investment in biological control agents can be higher, the long-term costs are often lower due to sustained pest control and reduced need for chemical pesticides.
8. Biological methods can be effectively integrated with other pest management strategies, such as cultural, mechanical and chemical controls, to enhance overall effectiveness.

Disadvantages of Biological Method

1. The effectiveness of biological control can vary due to environmental conditions, the presence of alternative prey or the specific interactions between pest and their natural enemies.
2. Introduced biological agents might affect non-target species, including beneficial insects, other wildlife or even the crops themselves.
3. The introduction and use of biological agents are often subject to stringent regulatory approvals, which can be time consuming and costly.
4. Not all pests have effective biological control agents available. Research and development to find suitable agents can be lengthy and expensive.
5. The initial costs of establishing a biological control program can be higher than chemical control and the economic benefits may take longer to materialise.
6. Biological control can sometimes lead to unintended ecological consequences, such as the suppressing of one pest leading to the outbreak of another pest species.
7. Biological control agents such as predators, parasites, or pathogens often take longer to reduce pest populations compared to chemical pesticides.

Mechanical and Physical Control of Pests and Diseases

1. **Traps and Barriers**: Utilising traps to capture pests or barriers to prevent their access to crops. For example, sticky traps can be used for whiteflies, and row covers can protect seedlings.
2. **Hand Picking**: The manual removal of pests from plants, especially in small-scale or home gardens. For instance, larger insects like caterpillars and beetles can be removed by hand.
3. **Tillage and Soil Solarisation**: Disturbing the soil to eliminate pest habitats and employing solar heat to decrease populations of soil pests and pathogens. An example would be ploughing and harrowing the soil to expose and eradicate soil-dwelling pests and pathogens.
4. **Pruning and Rogueing**: Cutting away infected plant parts or entire plants to prevent disease spread. Pruning also helps eliminate pests' hiding spots. For example, pruning diseased branches can help control fire blight in apple orchards.

Advantages of Physical/Mechanical Method

1. These methods minimise or eliminate the need for chemical pesticides, reducing potential environmental contamination and pesticide residues on crops.
2. Mechanical methods often provide immediate results, directly removing or killing pests without waiting for chemical or biological to take effect.
3. These methods are typically safer for humans, animals and beneficial organisms compared to chemical pesticides, reducing risks to health and biodiversity.
4. Mechanical control to help prevent the development of resistance in pest populations, a common issue with repeated chemical pesticide use.
5. Physical methods are generally more sustainable and environmentally friendly, as they do not introduce toxic substances into the ecosystem.
6. Many mechanical methods can be tailored to target specific pests, reducing collateral damage to non-target species.
7. Mechanical methods can be easily integrated into an Integrated Pest Management (IPM) strategy, complementing biological and cultural control for a holistic approach to pest management.
8. While initial setup costs can be high, mechanical methods may offer cost savings over time due to reduced chemical purchases and potential health and environmental remediation costs.

Disadvantages of Physical/Mechanical Method

1. Mechanical methods often demand considerable manual labour, which can be time-consuming and expensive, particularly for large-scale operations.
2. These methods may not be feasible for large fields or extensive infestations, as they can be difficult to apply across wide areas.
3. Acquiring and maintaining mechanical equipment, such as traps, barriers, or machinery, can involve substantial upfront expenses.
4. Mechanical control methods typically require regular maintenance and monitoring to remain effective, contributing to both labour and costs.
5. There is a potential risk of injury to workers when using mechanical equipment, especially if appropriate safety measures are not adhered to.
6. Mechanical methods can sometimes affect non-target organisms, including beneficial insects, in addition to the intended pests.
7. These methods often provide only temporary relief and may not tackle the underlying causes of pest issues, necessitating repeated applications.
8. The effective implementation of mechanical control methods requires specific skills and knowledge, which may not be accessible to all farmers or land managers.

Chemical Control

1. **Insecticides:** Chemicals used to kill or repel insects. It's important to use them judiciously to avoid resistance to non-target effects. Examples: Pyrethroids, organophosphates.
2. **Herbicides:** Chemicals are used to control weeds, which can serve as alternative hosts for pests. Example: Glyphosate for weed management.
3. **Fungicides:** Chemicals used to control fungal diseases that can weaken plants and make them more susceptible to pests. Example: Copper-based fungicides.
4. **Bactericides:** Chemicals used to control bacterial infections. Example: Applying streptomycin to control bacterial blight in beans.

Advantages of the Chemical Method

1. Chemical pesticides often provide rapid and effective control of pests and diseases, quickly reducing pest populations and minimising crop damage.
2. Many chemical pesticides can target a wide range of pests and diseases, offering comprehensive protection for crops.
3. Chemical pesticides are generally easy to apply using various methods such as spraying, dusting or soil treatment, allowing for efficient coverage of large areas.
4. In the short term, chemical pesticides can be cost-effective, providing immediate solutions to pest problems without the need for extensive labour or specialised equipment.
5. Chemical pesticides are widely available and accessible to farmers, with a variety of products to choose from depending on the specific pest or disease.
6. Chemical pesticides can be stored and transported easily, offering convenience for farmers who need to manage pests across different locations.
7. Chemical pest control methods are well-integrated into conventional farming systems, making them compatible with existing agricultural practices and machinery.
8. There is extensive research, extension services and technical support available for the use of chemical pesticides, helping farmers make informed decisions and apply products safely and effectively.
9. Chemical methods can be scaled up or down easily, allowing farmers to adjust their pest control efforts based on the size of their operations and the severity of pest infestations.

Disadvantages of the Chemical Method

1. Pests and diseases can develop resistance to chemical pesticides over time, making them less effective and requiring the use of higher doses or different chemicals, which can be more expensive and potentially harmful.
2. Chemical pesticides can contaminate soil, water and air, leading to pollution and harming non-target organisms, including beneficial insects, wildlife and plants.

3. Exposure to chemical pesticides can pose significant health risks to farmers, agricultural workers and consumers. These risks include acute poisoning, long-term health effects and chronic diseases.
4. Chemical pesticides can affect non-target species, including beneficial insects like pollinators and natural predators of pests, disrupting the ecological balance and leading to secondary pest outbreaks.
5. While initially cost-effective, the long-term costs associated with chemical pesticide use can be high due to the need for repeated applications, development of resistance and potential health and environmental remediation costs.
6. Chemical pesticides can leave residues on crops, which can be harmful to consumers and may lead to rejection of produce by markets, especially those with strict residue standards.
7. Repeated use of chemical pesticides can negatively affect soil health, reducing soil fertility and beneficial microbial activity, which can impact long-term crop productivity.
8. Chemical pesticides can disrupt natural ecosystems, leading to a reduction in biodiversity and the loss of ecosystem services such as pollination and natural pest control.
9. Misuse or overuse of chemical pesticides due to lack of knowledge or training can exacerbate their negative impacts, leading to accidental poisoning, environmental damage and ineffective pest control.

Integrated Pest/Disease Management (IPM/IDM)

IPM/IDP combine multiple control strategies to manage pest/disease pathogen populations in an environmentally and economically sustainable way. Key components of IPM/IDM include:

1. **Monitoring and identification:** Regularly inspecting crops and correctly identifying pests/pathogenic attack or symptoms to determine the need for control measures. Example: Using pheromone traps to monitor pest populations or using field scouting to monitor disease incidence and severity.
2. **Threshold levels:** Establishing economic threshold levels for pest populations or levels for disease incidence above which control measures are warranted. Example: Applying insecticides only when pest population exceeds a certain level.
3. **Combination of controls:** Integrating cultural, biological, mechanical and chemical controls to manage pests and diseases. Example: Using crop rotation, biological control agents and integrated insecticide application together.
4. **Minimising chemical Use:** Reducing reliance on chemical controls by using them as a last resort in combination with other methods. Example: Applying insecticides only when necessary and targeted to minimise impact on non-target organisms.

5. **Education and training**: Providing farmers and agricultural workers with information and training on IPM practices and pest management techniques. Example: Extension services offering workshops on pest identification and control strategies.

Advantages of IPM/IDM

1. Minimises pollution and reduces the risks of harming non-target organisms, including beneficial insects, birds and aquatic life.
2. Lowers the exposure of farmers, workers, and consumers to potentially harmful chemicals.
3. Reduces the cost associated with purchasing and applying pesticides.
4. Help prevent or delay the development of pests and disease resistance to chemical controls.
5. Considers all factors affecting crop health, including soil quality, water management, and plant genetics, leading to overall improved crop vitality.
6. Encourages a diverse agro-ecosystem, which can contribute to natural pest and disease suppression.

Disadvantages of IPM/IDM

1. Require extensive knowledge of pest and disease biology, ecology and management strategies; therefore, farmers and farm workers need continuous education and training.
2. IPM/IDM can be more labour-intensive compared to traditional chemical-based methods.
3. Requires regular monitoring and scouting of crops to make informed management decisions.
4. There can be higher initial costs for implementing IPM/IDM strategies, including costs for training, monitoring equipment and biological control agents.
5. Effectiveness of IPM/IDM strategies can vary depending on local conditions, pest populations and environmental factors.
6. Requires central government supportive policies and incentives to encourage widespread adoption.
7. Sometimes, the market may not recognise, reward or understand the benefits of IPM/IDM-grown crops.

Safe Agrochemical Handling: Safe agrochemical handling involves the correct use, storage, and disposal of pesticides, herbicides, and fertilizers to protect farmers and the environment. Users must always read labels, follow recommended dosages, and wear protective gear such as gloves, masks, boots, and goggles. Agrochemicals should be mixed and applied in well-ventilated areas, away from children, food, and water sources. After use, farmers should wash hands and clothing, store chemicals in locked cabinets, and dispose of empty containers safely according to instructions. Practicing safe handling reduces poisoning, accidents, and environmental pollution.

Biosecurity: Biosecurity refers to the measures taken to prevent the introduction and spread of pests, diseases, and harmful organisms on the farm. Good biosecurity protects crops, animals, and workers. Farmers should restrict unnecessary farm visits, clean tools and equipment regularly, isolate sick animals or infected plants, and properly dispose of waste. Wearing protective clothing and washing hands after farm activities also help reduce contamination. Effective biosecurity ensures a healthier farming environment and improves productivity.

Activity 7.8 Types of Control and Preventive Measures of Crop Pests and Diseases

1. Organise yourselves into groups of no more than five. In your groups, visit a nearby crop production farm in your community and observe the control and preventive measures of plant diseases and pests being used or watch videos/pictures (Click here or use https://youtu.be/AGtazzeCIz8) on control and preventive measures of plant diseases and pests.
2. Write a 2-page report based on the farm visit or the video you have watched. Your report should contain the following:
    a. Title
    b. Name of farm visited and its location/video where the farm was based.
    c. Type of farm (commercial or small scale) and the types of crops being cultivated on the farm.
    d. Description of the types of disease and pest control, and preventive measures being used on the farm.
    e. Challenges and effectiveness of the disease and pest control, and preventive measures being used on the farm.
    f. Conclusion (summary of the findings and what was learnt from the visit)
    g. Appendix (pictures and other visuals taken during the farm visit)
3. Present your report to the class for feedback.

Activity 7.9 Disease and Pest Control and Preventive Measures

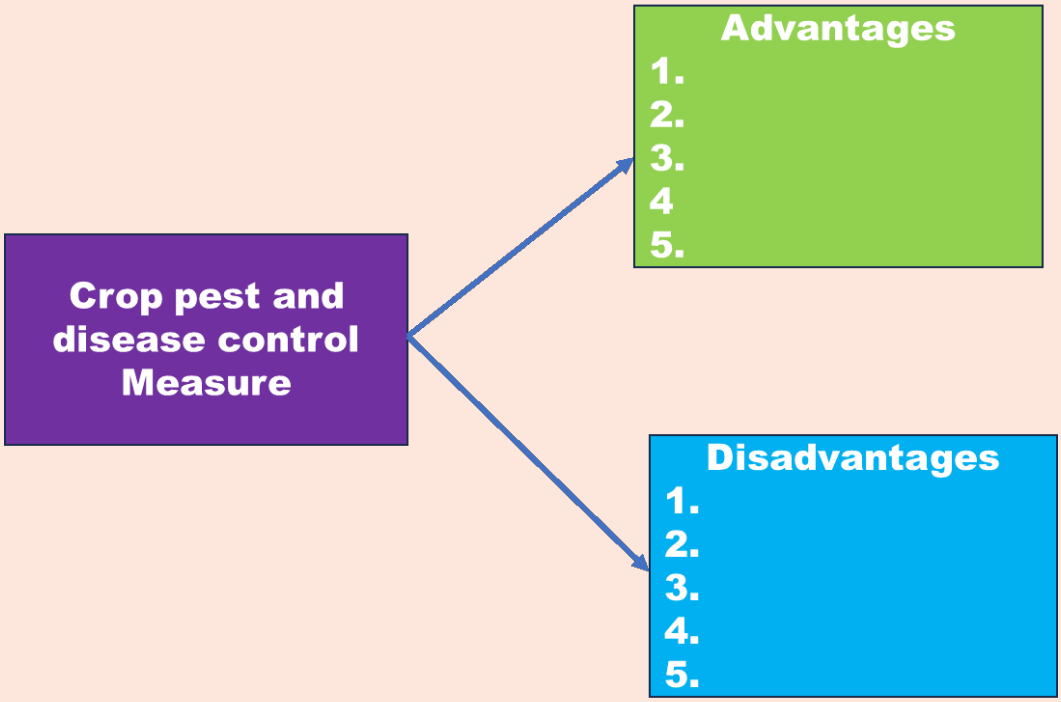
1. In groups, discuss the control and preventive measures for crop diseases and pests in crop production. In your discussion, focus on the following:
    a. Description of the method
    b. Examples of the method
    c. Tools and equipment needed for the application of the method.

d. The effectiveness and challenges of the method

2. Make a presentation on three diseases and pest control, and preventive measures in crop production from your discussion with the class for feedback.

Activity 7.10 Advantages and Disadvantages of the Control and Preventive Measures of Crop Diseases and Pests

1. In pairs, discuss the advantages and disadvantages of the methods of prevention and controlling crop diseases and pests.
2. Make a presentation on three crop diseases and pest control measures in class for feedback. Use the chart below for your presentation.



Use the following tips to complete the chart:

3. Write the disease and pest control measures in the box labelled crop pest and disease control measures.
4. Write five advantages and disadvantages of the control method in the boxes labelled advantages and disadvantages, respectively.

Activity 7.11 Practising Disease and Pest Control and Preventive Measures in Crop Production

1. Organise yourselves into groups of no more than five. In your groups, undertake one disease and pest control and preventive measures in crop production at the school farm or a crop farm near you.

   This activity should be done only under the supervision of the farm technician, and all safety measures observed, including the wearing of appropriate personal protective equipment (PPE).
2. Share your experience and learnings from this activity with the class.

MEANING, COMMON DISEASES, PESTS AND PARASITES OF ANIMAL/FISH AND THEIR SYMPTOMS AND EFFECTS ON ANIMAL/FISH PRODUCTION

Meaning of Animal/Fish Diseases, Pests and Parasites

Meaning of Animal/Fish Diseases

A disease is any condition that impairs the normal function of an animal or fish, causing ill health, characterised by specific clinical signs and symptoms. Diseases can be caused by various factors, including pathogens such as bacteria, viruses, fungi and protozoa, nutritional deficiencies, genetic disorders and environmental stresses.

A diseased animal or fish is an animal or fish that is suffering from a condition that impairs its normal physiological functions, causing ill health. A diseased animal or fish shows specific clinical signs and symptoms, which can vary widely depending on the disease and the species of the animal or fish.

Pest in animals or fish: It refers to any organism, typically insects or small animals, that cause harm, discomfort or economic loss to livestock or fish. They can directly affect animals or fish through physical damage or stress, and indirectly by spreading diseases or contaminating feed and water.

Parasite in animals or fish: Parasites are organisms that live on (ectoparasites) or inside (endoparasites) animal and fish, deriving their nutrition at the hosts' expense. They can cause significant health issues and decrease productivity in livestock and fish.

Ectoparasites (External Parasites): Ectoparasites are parasites that live on the exterior surface of their host. They attach themselves to the skin, feathers, scales or fur of the host and feed on blood, skin or other body fluids. Examples include:

a. **Ticks**: Cause skin irritation, anaemia and can transmit diseases such as Lyme disease, babesiosis, heartwater disease, anaplasmosis, tick-borne fever, etc.

b. **Fleas:** Cause itching, dermatitis, and can transmit tapeworms and Bartonella.

c. **Lice:** Cause skin irritation, hair loss and reduced weight gain.

d. **Mites**: Cause intense itching, skin lesions and secondary infections.

e. **Flies**: Cause irritation, stress and can transmit diseases.

Tick

Flea

Mite

Lice

Figure 7.26: Examples of Ectoparasite

Endoparasites (Internal Parasites): Endoparasites are parasites that live inside the body of their host. They infest internal organs or body cavities and derive their nutrition from the host tissues or body fluids. Examples include:

a. **Roundworms**: Cause gastrointestinal issues such as anaemia and weight loss.

b. **Tapeworms**: Cause digestive problems, abdominal pain, vomiting, loss of appetite, diarrhoea and nutrient absorption issues.

c. **Liver flukes**: Cause liver damage, bile duct inflammation and reduce productivity.

d. **Protozoa**: Cause diarrhoea, dehydration and in severe cases death.

e. **Lungworms:** Cause respiratory issues, coughing and reduced weight gain.

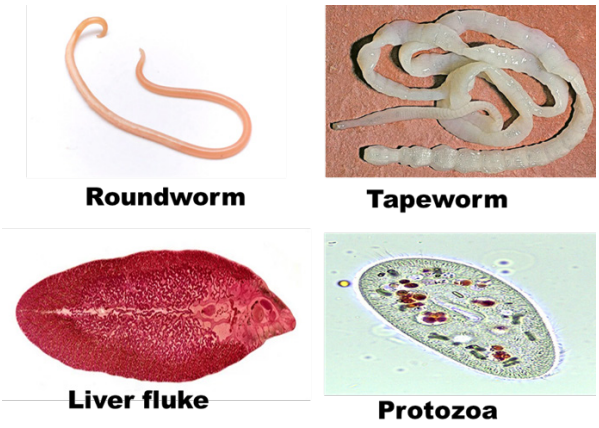


Figure 7.27: Examples of Endoparasites

General Characteristics of Healthy Animals

Appearance

1. Clear, bright and alert eyes without discharge.
2. Shiny coat, smooth skin without bald patches, sores or parasites.
3. Standing, walking and sitting in a natural posture without signs of discomfort.

Behaviour

1. Engages with the environment, curious and responsive.
2. Regular appetite and hydration, appropriate weight.
3. Regular bowel movements, normal urine colour and consistency.

Physical Condition

1. Regular unlaboured breathing.
2. Body temperature within species-specific normal range.
3. Well-proportioned body, no signs of obesity or emaciation

General Characteristics of Sick Animals

Appearance

1. Cloudy, sunken or excessively watery eyes.
2. Dull, patchy coat, flaky skin or presence of parasites.
3. Hunched, stiff or unusual posture indicating discomfort.

Behaviour

1. Lack of energy, reduced interaction, hiding or unusual aggression.
2. Refusal to eat or drink, significant weight loss.
3. Diarrhoea, constipation or abnormal urine.

Physical Condition

1. Rapid, shallow or difficult breathing.
2. High body temperature (Fever) or unusually low body temperature.
3. Sudden weight gain or loss, bloating.

Diseased cow

Healthy cattle

Figure 7.28: Diseased and healthy animals

Characteristics of Healthy Fish

Appearance

1. Bright, clear and alert eyes without cloudiness.
2. Intact, smooth scales without missing patches.
3. Bright and consistent colouring.
4. Erect and fully spread fins without any signs of damage or clamping.

Behaviour

1. Regular, smooth swimming with natural movements.
2. Steady breathing with gasping at the water surface.
3. Regular feeding behaviour and eagerness to eat.
4. Engages with other fish and shows curiosity in its environment.

Physical condition

1. Well-proportioned body without signs of extreme thinness or bloating.
2. The skin should be devoid of lesions, sores or parasites.

Characteristics of Sick/Unhealthy Fish

Appearance

1. The eyes appear cloudy, bulging or sunken
2. Missing, damage or raised scales.
3. Loss of vibrant or unusual spots and blotches.
4. Sick fish usually have torn, clamped or discoloured fins.

Behaviour

1. Lack of energy, often resting at the bottom or hiding.
2. Unusual swimming patterns, such as darting, spiralling or floating.
3. Heavy or rapid breathing, sometimes gasping at the surface.
4. Refusal to eat or a significant decrease in feeding behaviour.

Physical Condition

1. Swollen abdomen or extreme thinness.
2. Presence of sores, ulcers, or white spots (indicative of diseases like ich.
3. Visible parasites on the body, fins or gills.
4. Abnormal growth with lumps, bumps or tumours.

Figure 7.29: Diseased and healthy fish

Some Common Diseases, their Symptoms and Effects on Farm Animals

Foot-and-Mouth disease (FMD)

- Species affected: It affects farm animals such as cattle, pigs, sheep, goats and other cloven-hoofed animals.
- Symptoms: Symptoms include Fever, blisters on the mouth, tongue and hooves, lameness and decreased milk production.
- Effects: The following effects are common in foot-and-mouth disease: Loss in productivity, weight loss, decreased milk yield and in severe outbreak, large-scale culling to control the spread.

Mastitis

It is caused by bacterial infections such as Staphylococcus aureus, Streptococcus agalactiae and Escherichia coli.

- Species affected: It affects dairy cows, sheep and goats.
- Symptoms: Inflammation of the udder, swelling, redness, heat, hardness and abnormal milk.
- Effects: The following are the common effects: Reduce milk productivity, altered milk quality, increase veterinary costs and in severe cases culling of the animals.

Bovine Tuberculosis (TB)

- Species Affected: Cattle, goats and pigs.
- Symptoms: Symptoms include Chronic coughing, loss of weight, loss of appetite and general body weakness.
- Effects: The following are the common effects: Decrease in productivity, it could also infect humans (zoonotic transmission), and the entire flock may be culled to curtail the spread.

Avian Influenza (Bird Flu)

- Species affected: Poultry (chickens, turkeys, ducks, etc).
- Symptoms: Symptoms include Sudden death, respiratory distress, decreased egg production and swelling of the head, neck and eyes.
- Effects: The following are the common effects of Avian influenza: High mortality rates, reduced egg and meat production and large-scale culling to prevent the spread.

Swine Flu (H1N1)

- Species affected: Pigs.
- Symptoms: Fever, coughing, sneezing, difficulty in breathing, decreased appetite and lethargy.
- Effects: It leads to stunted growth, decreased feed efficiency, increased veterinary costs, and potential zoonotic transmission to humans.

Newcastle Disease

- Species affected: Poultry.
- Symptoms: Birds infected with Newcastle Disease show the following symptoms: Respiratory distress such as coughing, nasal discharge nervous signs such as paralysis of legs and wings, circular movement, neck twisting (torticollis), difficulty in breathing (gasping for air), decreased egg production, greenish diarrhoea and swelling of the head and neck.
- Effects: It is associated with mortality rates, significant economic losses and restrictions on poultry products. Sometimes it requires mass culling of the entire flock and other farms within the catchment area to curtail spread.

Brucellosis

- Species affected: Cattle, pigs, sheep, goats and dogs.
- Symptoms: Abortion, reduced fertility, lameness and swelling of joints.
- Effects: Reduced reproductive performance, decreased milk production, potential zoonotic transmission to humans and economic losses due to culling and veterinary costs.

African swine fever (ASF)

- Species affected: Pigs
- Symptoms: High fever, loss of appetite, red or blue skin blotches, diarrhoea and respiratory distress.
- Effects: High mortality rates, severe economic impact due to culling and trade restrictions, disruption of pork supply chains.

Bovine Viral Diarrhoea (BVD)

- Species affected: Cattle.
- Symptoms: Diarrhoea, fever, respiratory distress, reduced fertility and birth defects.
- Effects: Decreased productivity, increased veterinary costs and economic losses due to reduced growth rates and reproductive performance.

Peste des Petits Ruminants (PPR)

- Species affected: Sheep and goats.
- Symptoms: Fever, nasal and ocular discharge, mouth sores, diarrhoea and respiratory distress.
- Effects: High mortality rates, severe economic losses and disruption of livestock production.

Mycoplasmosis

- Species affected: Poultry, cattle, pigs and goats.
- Symptoms: Respiratory distress, nasal discharge, coughing and reduced weight gain.
- Effects: Decreased productivity increased veterinary costs and potential culling to control the spread.

Anthrax

- Species affected: Cattle, sheep, goats and other herbivores.
- Symptoms: Sudden death, fever, swelling and bleeding from body orifices.
- Effects: High mortality rates, severe economic losses and zoonotic potential, posing a significant public risk.

Rinderpest

- Species affected: Cattle and other cloven-hoofed animals.
- Symptoms: Fever, oral erosions, diarrhoea and dehydration.
- Effects: High mortality rates, severe economic losses due to livestock death and disruption of livestock production systems.

Fowl cholera

- Species affected: Poultry.
- Symptoms: Fever, diarrhoea, respiratory distress and sudden death.
- Effects: High mortality rates, reduced egg and meat production and significant economic losses due to culling and trade restrictions.

Common Diseases, Pests and Parasites of Fish and Their Effects

Bacterial Diseases

- **Columnaris Disease** (*Flavobacterium columnare):*
  - Symptoms: White or greyish spots on the gills, fins and mouth, fin erosion.
  - Effects: Ulceration, gill necrosis and high mortality rates.
- **Aeromonas Infection** (*Aeromonas hydrophila*):
  - Symptoms: Red spots, ulcers, haemorrhaging, swollen abdomen.
  - Effects: Septicaemia, organ failure and death.

Viral Diseases

- **Epizootic Ulcerative Syndrome** (EUS):
  - Symptoms: Ulcerative lesions on the body and fins.
  - Effects: Secondary infections, tissue necrosis and high mortality rates.
- **Tilapia Lake Virus:**
  - Symptoms: death, skin lesions; haemorrhages, abnormal swimming.
  - Effects: High mortality rates, especially in tilapia farms.

Fungal Diseases

- **Saprolegniasis** (*Saprolegnia* spp.):
  - Symptoms: Cotton-like growths on the skin, gills or eggs.
  - Effects: Tissue necrosis, impaired respiration and increased mortality due secondary infections.

Common Pests of Fish

- **Sea Lice** (*Caligus* spp.):
  - Symptoms: Visible parasites on the skin, fins and gills, lesions and sores.
  - Effects: Skin damage, secondary infections, reduced growth rates and increased mortality.

- **Fish Lice** (***Argulus*** spp.):
  - Symptoms: Visible lice on the skin and fins, irritation, rubbing against surfaces.
  - Effects: Skin damage, secondary infections and stress.

Common Parasites of Fish

- **Protozoan parasites (Ich)**
  - Symptoms: White spots on the skin, gills and fins, flashing (rubbing against surfaces).
  - Effects: Respiratory distress, reduced feeding, secondary infections and death if untreated.
- ***Trichodina*** spp.
  - Symptoms: Excessive mucus production, gill irritation and erratic swimming.
  - Effects: Gill damage, impaired respiration and increased susceptibility to other infections.
- **Monogenean Flukes** (**Dactylogyrus** spp.)
  - Symptoms: Gills heavily infested, respiratory distress, mucus production.
  - Effects: Gill damage, impaired respiration and increased mortality.
- ***Gyrodactylus*** spp.
  - Symptoms: Excessive mucus, frayed fins, skin irritation.
  - Effects: Skin damage, stress and secondary infections.
- **Cestodes (Tapeworms)**
  - Symptoms: Emaciation and swollen abdomen.
  - Effects: Nutrient depletion, stunted growth and death in severe cases.

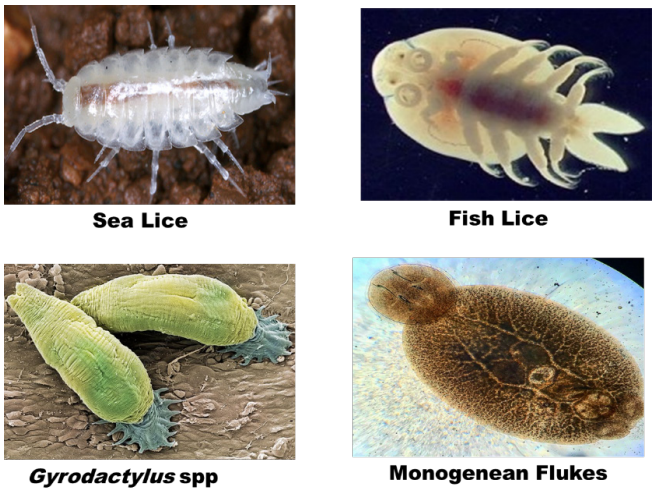


Figure 7.30: Examples of pests and parasites of fish

MAJOR LIVESTOCK AND FISH DISEASES IN GHANA

Disease	Affected Animals	Causative Agent	Key Symptoms	Control / Prevention
Newcastle Disease	Poultry	Virus	Sneezing, greenish diarrhea twisted neck	Vaccination, biosecurity, proper disposal
Gumboro (Infectious Bursal Disease)	Poultry (especia. chicks)	Virus	Watery diarrnea, vent picking weakness	Vaccination, good hysiene, disinfect equipment
Anthrax	Cattle, sheep, goat	Bacillus anthracis	Sudden death, bleeding from openings, swollen	Annual vaccination avoid opening ca casses, pror pispoal
Foof-and-Mouth Disease (FMD)	Cattle, pigs sheep, goats	Virus	Biisters in mouth and feet, loor drooling	Movement control, quarantine, vaccination plonen
Trypanosomiasis (Sleeping Sickhess)	Cattle, sheep, goat	Parasite, (teste fly)	Weight loss, fever, weakness anemia	Vector control, trypanocidal drugs.
Peste des Petits Ruminants (PPR)	Goats, SHEEP	Virus	Fever, nasal discharge mouth sores	Vaccination, strt: isolation of sick anInals
Mastitis	Dairy cattle, goat	Bacteria	Swollen udders, clots in milk reduced milkyeld	Proper milking hyglene, antiblotics.
Bacterial Glll Disease (BGD)	Fish, Tilapia FISH	Bacteria	Difficulty breathing swellen gills reduced feeding	Improve water quality, reduce stocking density
Streptococcus Infection	Fish	Bacteria	Erratic swimming swollen eyes skin darkehing	Good water manegement vacciral, abss
Columnaris Disease	Fish	Bacteria	Skin lesions, trayed fins cofton-like patces	Water sanitation salt-baths reduce 'stress

Figure 7.31: some common animal diseases in Ghana.

Activity 7.12 Meaning of Animal/Fish Diseases and Pests

1. In groups of no more than five, come up with the meaning of animal and fish diseases, pests and parasites. You can use the internet and other resources in your research.
2. Write down your definitions in your notebook.
3. Share your definitions with another group for feedback.
4. Use the feedback to fine-tune your definitions of animal and fish diseases, pests and parasites.

Activity 7.13 Pictures of Healthy and Unhealthy Animals

1. Organise yourselves into groups of no more than five. In your groups, visit a nearby animal or fish farm in your community to observe and take pictures of healthy and diseased animals or watch a video/picture(Click here or use https://youtu.be/geieu8y9TIw) of healthy and diseased animals.
2. From the visit/ video, prepare a photo album with pictures of healthy and diseased animals. Your photo album should contain the following:
    a. Pictures of five healthy animals or fish such as cattle, poultry, pig, sheep, or goat. Write the name of the animal or fish under each picture
    b. Pictures of five diseased animals or fish. Write the type of disease or sickness the animal or fish is suffering from under each picture (e.g. Newcastle, Swine flu), the causal agent and the symptoms of the disease also under the picture.
3. Present the photo album for peer assessment in class.

Activity 7.14 Effects of Animal Diseases on Animal/Fish Production

1. In groups of no more than five, discuss the effects of diseases on animal and fish production. In your discussion, be guided by the following:
    a. How diseases affect animal health and welfare
    b. How diseases affect the growth rates, reproduction, milk yield, egg production, meat quality and overall performance of the animals.
    c. How diseases affect herd or fish stock numbers
    d. How diseases affect the costs associated with treatment, veterinary services and biosecurity measures.
    e. Losses that farmers incur due to decreased productivity, trade restrictions, reduced market value and impacts on related industries.
2. Present the salient points from your discussion to the class for feedback.

CAUSES AND CLASSIFICATION OF ANIMAL/FISH DISEASES

Causes of Animal/Fish Diseases

The following are some causes of animal/fish diseases:

Infectious Agents

Bacteria:

- Brucellosis: Caused by *Brucella* spp. It causes reproductive issues.
- Tuberculosis: Caused by *Mycobacterium bovis*. This affects the respiratory system.

Viruses:

- Foot-and-Mouth Disease: A highly contagious disease of livestock which affects cloven-hoofed animals.
- Rabies: Affects the central nervous system, often fatal.

Fungi:

- Ringworm: Caused by *Trichophyton* spp. or *Microsporum* spp., leads to skin lesions.
- Aspergillosis: Respiratory disease caused by *Aspergillus* spp.

Parasites:

- Endo-Parasites: Such as roundworms, tapeworms and liver flukes.
- Ecto-Parasites: Such as lice, mites and ticks.

Nutritional Deficiencies

- Vitamin deficiencies: E.g. vitamin D deficiency causing rickets.
- Mineral deficiencies: E.g. calcium deficiency leading to milk fever in dairy cows.
- Protein deficiencies: leading to poor growth and decreased production.
- Energy deficiencies: Resulting in weight loss and decreased productivity.

Other Factors

- Exposure to pesticides, herbicides or toxic plants.
- Injuries can lead to secondary infections or other complications.
- Poor management practices such as inadequate feeding, watering or healthcare routines can lead to animal diseases.
- Poor sanitation can lead to the spread of infectious diseases.

- Overcrowding can increase stress and the risk of disease transmission.
- Extreme weather conditions such as heat stress or frostbite.
- Inherited conditions such as hip dysplasia in dogs or certain congenital defects in livestock.
- Breed-specific disorders such as porcine stress syndrome in certain pig breeds.

Classification of Animal and Fish Diseases in Animal Production

Animal diseases can be classified based on various criteria such as their cause, mode of transmission and the species they affect. Here are some common classifications:

Base on Causative Agents

- Bacterial diseases: Examples: Anthrax, Brucellosis, Tuberculosis.

  Symptoms: Fever, lesions, respiratory distress, diarrhoea.
- Viral diseases: Examples: Foot-and-Mouth Disease, Rabies, Avian Influenza.

  Symptoms: Fever, neurological signs, respiratory issues, haemorrhages.
- Fungal diseases: Examples: Ringworm, Aspergillosis, Candidiasis.

  Symptoms: Skin lesions, respiratory issues, weight loss.
- Parasitic diseases: Examples: Trypanosomiasis, Tapeworm infections.

  Symptoms: Anaemia, weight loss, digestive issues.

Base on Mode of Transmission

- Direct contact diseases: Spread through physical contact between animals. Examples: Rabies, Ringworm.
- Vector-borne diseases: Transmitted by vectors like ticks, mosquitoes or flies. Examples: Lyme Disease, Bluetongue.
- Waterborne diseases: Spread through contaminated water. Examples: Leptospirosis, Giardiasis.
- Foodborne diseases: Transmitted through contaminated food. Examples: Salmonellosis, Listeriosis.
- Airborne diseases: Spread through the air via droplets or dust. Examples: Avian Influenza, Foot-and-Mouth Disease.

Base on Duration and Severity

- Acute diseases: Sudden onset, severe symptoms, short duration. Examples: Anthrax, Foot-and-Mouth Disease.
- Chronic diseases: Long-term, persistent symptoms, slow progression. Examples: Tuberculosis, Johnes Disease.

- Subacute diseases: Intermediate severity and duration. Examples: Subacute Bacterial Endocarditis.

Based on Geographic Distribution

- Endemic diseases: Diseases that are constantly present in a particular region or population. Examples: African Swine Fever in some African countries.
- Endemic diseases: Occur at higher-than-normal levels in a specific area. Examples: Foot-and-Mouth Disease outbreaks.
- Pandemic diseases: Widespread across multiple countries or continents. Examples: Avian Influenza in poultry.

Base on Zoonotic Potential

- Zoonotic diseases: A disease that can be transmitted between animals and humans. Examples: Rabies and Salmonellosis.
- Non-zoonotic diseases: Affect only animals and cannot be transmitted to humans. Examples: canine Distemper, Feline Leukaemia Virus.

Factors Predisposing Animals to Diseases

The following are factors that predisposes animals to diseases:

Environmental factors

- Inadequate shelter, overcrowding and poor sanitation can increase stress and disease susceptibility.
- Extreme temperatures or humidity can weaken immune responses and facilitate disease spread.

Nutritional factors

- Lack of essential nutrients can impair immune function and overall health.
- Overfeeding or Underfeeding can lead to obesity or malnutrition, increasing the risk of diseases.

Genetic factors

- Inbreeding can reduce genetic diversity, making animals more susceptible to hereditary diseases.
- Certain breeds may be more prone to specific health issues due to inherited traits.

Stress factors

- Stress from capture, transport, or handling can weaken the immune system.
- Aggression from other animals or social hierarchies can lead to stress-related health issues.

Pathogenic factors

- Contact with bacteria, viruses, parasites, or fungi can lead to infections.
- Diseases that can be transmitted from animals to humans and vice versa can pose significant health risks.

Immunological factors

- Stress, poor nutrition or previous illnesses can weaken the immune system, making animals more vulnerable to infections.
- Young and elderly animals often have weaker immune responses, increasing disease susceptibility.

Chemical exposure

- Exposure to harmful chemicals, heavy metals, or environmental pollutants can compromise health and lead to disease.
- Incorrect use or overuse of medications can lead to toxicity or antibiotic resistance.

Factors Predisposing Fish to Diseases

Here are some factors that make fish more likely to get diseases:

Water quality

- Poor water conditions with Elevated levels of ammonia, nitrite, or nitrate.
- Insufficient biological or mechanical filtration systems.
- pH levels that are either too high or too low for the particular fish species.
- Sudden or extreme variations in water temperature.

Nutritional factors

- Insufficient essential nutrients or feeding inappropriate foods.
- Overfeeding or underfeeding and compromised water quality can lead to health issues.

Stress factors

- Stress caused by capture, handling and transportation.
- Aggressive tank mates can inflict injuries and create stress.

Parasitic and Pathogenic factors

- Presence of internal (e.g., worms) and external (e.g., ich) parasites.
- Opportunistic infections that exploit weakened fish.

Genetic factors

- Reduced genetic diversity, leading to greater susceptibility to diseases.

- Inherited diseases or conditions that impact health.

Immunological factors

- Stress, poor nutrition, or environmental factors that weaken the immune system.
- Past infections or diseases that affect current immunity.

Chemical exposure

- Exposure to harmful chemicals, heavy metals or pollutants.
- Incorrect use or overuse of medications resulting in toxicity or resistance.

Activity 7.15 Causes of Animal/Fish Disease

1. In groups of no more than five, discuss the causes of animal and fish diseases. In your discussion, be guided by the following:
   a. How poor feeding practices can cause diseases in animals.
   b. How environmental stress causes diseases in animals.
   c. How pathogens cause diseases in animals.
   d. How a lack of important nutrients can cause diseases in animals.
   e. How the genetic make-up of the animals can cause diseases.
   f. You can use the internet and other resources in your research.
2. Present the salient point from your discussion to the class for feedback.

Activity 7.16 Classification of Animal and Fish Diseases

1. In groups of no more than five, come up with the classification of animal and fish diseases and give examples of diseases that fall under each classification.
2. Present your findings in a table. A template has been provided below:

Table 7.1

Classification of animal and fish diseases			
Criteria A	Criteria B	Criteria C	Criteria D
Example 1			
Example 2			
Example 3			

You can use the following guidelines to complete the table:

a. Write the criteria for classification in the column labelled criteria A, B, C and D. Example: classification based on causative agents.

b. Write the three examples of diseases that fall under each classification in the rows labelled example 1, 2 and 3. Example: Bacterial diseases: Anthrax

3. Present your table to the class for feedback.
4. In the same groups, discuss the factors that predispose animals and fish to diseases and pest infestation.
5. Present the salient points from your discussion to the class for feedback.

Activity 7.17 Picture Album on Animal and Fish Diseases, Pests and Parasites

1. Build a photo album of diseases, pests and parasites of ruminants, monogastric and fish.
2. Your album should contain pictures of animals showing symptoms of five diseases in ruminants, monogastric or fish. Beside each picture, indicate the following:
   - Classification of the disease, e.g. bacterial, viral or nutritional deficiency diseases
   - Causative agents of the disease
   - Factors that predispose the animals to the disease.
3. Present your album to the class for peer assessment.

PREVENTIVE AND CONTROL MEASURES OF DISEASES IN ANIMAL AND FISH PRODUCTION

Preventive Measures of Diseases in Animal Production

These are some of the preventive measures against diseases in animal production:

1. Vaccination

Vaccinating animals against common diseases, like foot-and-mouth disease or Newcastle disease, is one of the best ways to keep them healthy. Regular vaccination schedules that fit the specific needs of the animals and their environment help strengthen their immune systems and lower the chances of getting sick.

2. Quarantine of new animals

When new animals come to a farm, they can carry diseases. To keep everyone safe, these new animals should be kept separate for about 2 to 4 weeks. This time allows farmers to watch for any signs of illness and make sure that any potential sickness doesn't spread to the other animals.

3. Biosecurity

Biosecurity means taking steps to prevent diseases from getting onto the farm. This includes cleaning equipment, keeping the farm tidy, and allowing only essential people to enter. It's also important to disinfect vehicles and tools that come into contact with animals to reduce the risk of spreading germs.

4. Proper Nutrition

Feeding animals a balanced and nutritious diet is vital for their health. Well-nourished animals are less likely to get sick and can recover more quickly if they do. Good nutrition is especially important for young or stressed animals.

5. Good hygiene practices

Keeping animal pens, barns, and equipment clean is essential to prevent diseases. Regularly cleaning and disinfecting these areas helps remove germs that can make animals sick. Animals should always have access to fresh water and food to avoid contamination.

6. Control of pests and vectors

Pests like flies, mosquitoes, and rodents can spread diseases to animals. Using pest control methods, like traps and insecticides, and keeping the environment clean helps reduce this risk. It's also important to seal barns to keep rodents out.

7. Regular health monitoring

Regular health checks and watching for signs of illness are key to catching problems early. By monitoring animal health and scheduling routine veterinary checkups, farmers can treat health issues before they turn into serious outbreaks.

8. Environmental control

Creating a comfortable living environment for animals is crucial for their health. Good ventilation, temperature control, and enough space help reduce stress. Stress can weaken their immune systems, making them more likely to get sick.

9. Culling of infected animals

If there's an outbreak of disease, it may be necessary to isolate and remove infected animals to protect the healthy ones. Though this might seem harsh, it's often the best way to contain the disease and keep the rest of the herd safe.

10. Antibiotic stewardship

Using antibiotics responsibly is important to prevent antibiotic resistance. Antibiotics should only be given when necessary and in the right amounts, as directed by a veterinarian. Overusing them can lead to bacteria that are harder to treat.

11. Farm record keeping

Keeping accurate records of animal health is essential. These records should include information about vaccinations, treatments, health checks, and any disease outbreaks. This helps farmers track health patterns and identify animals that may need extra care.

12. Animal husbandry practices

Good animal husbandry practices, like handling, breeding, and milking properly, help reduce stress and the risk of injury or disease. Proper handling ensures that animals are treated well and are less likely to become sick due to unnecessary stress.

Control Measures of Diseases in Animal Production

The following are some control measures for diseases in animal production

1. **Early detection and diagnosis**: Regular health checks and quick identification of symptoms help detect diseases early and ensure proper treatment.
2. **Isolation of infected animals:** Infected animals should be separated from healthy ones to prevent the spread of diseases.
3. **Treatment of infected animals**: Timely medication and veterinary treatment help control the severity and duration of illnesses.
4. **Culling infected animals**: In cases of contagious or incurable diseases, infected animals may need to be euthanised to protect the rest of the population.
5. **Disinfection of facilities and equipment:** Thorough cleaning and disinfecting of barns, tools, and equipment prevent disease transmission after an outbreak.
6. **Vaccination:** Regular vaccinations prevent the spread of common diseases and maintain immunity in animals.
7. **Vector control**: Reducing pests like ticks and mosquitoes through insecticides and waste management helps prevent vector-borne diseases.
8. **Movement control:** Limiting animal movement and controlling farm access help prevent disease introduction from outside sources.
9. **Proper disposal of carcasses**: Carcasses of diseased animals must be properly disposed of to avoid contamination and the spread of pathogens.
10. **Regular monitoring and surveillance**: Ongoing health monitoring and record-keeping help detect potential outbreaks early.
11. **Use of protective gear**: Workers should wear protective clothing to prevent the spread of diseases, especially zoonotic ones.
12. **Public awareness and training**: Educating farm workers and the community on disease prevention and control practices enhances overall biosecurity on the farm.

Preventive Measures of Diseases in Fish Production

Preventing diseases in fish production is essential to ensure healthy stocks, sustainable yields, and economic profitability. These are some of the ways to prevent disease in fish production

1. Monitor and maintain optimal water parameters such as temperature, pH, dissolved oxygen, and salinity. Regularly remove waste and debris to prevent the buildup of harmful pathogens.
2. Isolate newly acquired fish in a separate tank or pond for observation before adding them to the main stock.
3. Source fingerlings or juvenile fish from disease-free and certified hatcheries. Inspect fish for signs of illness before introducing them to the farm.
4. Restrict unauthorised access to fish farms. Disinfect equipment, tools, and footwear used on the farm to prevent disease introduction and spread.
5. Feed fish with high-quality, nutritionally balanced feed to boost their immune systems. Avoid overfeeding, which can degrade water quality and stress fish.
6. Avoid overcrowding, as high stocking densities increase stress and the likelihood of disease outbreaks. Ensure enough space for fish to grow and thrive.
7. Administer vaccines where available to protect fish from common diseases, such as bacterial or viral infections.
8. Observe fish daily for unusual behaviour, lesions, or other signs of disease. Test water and fish samples regularly for pathogens.
9. Regularly clean ponds, tanks, and equipment. Apply lime or other disinfectants during pond preparation to eliminate harmful organisms.
10. Prevent the access of birds, insects, and other predators that may carry or introduce diseases. Use net covers or other protective measures.
11. Reduce handling of fish and avoid sudden environmental changes. Ensure consistent water flow and aeration to prevent hypoxia (oxygen deficiency causing a very strong drive to correct the deficiency).
12. Isolate and treat any fish showing signs of illness to prevent the spread of disease to healthy stocks.

Control Measures of Diseases in Fish Production

1. Regularly check fish for signs of disease, such as unusual behaviour, lesions, or changes in appetite. Early detection is key to controlling outbreaks. Implement a routine monitoring program to identify health issues promptly.
2. If any fish show signs of illness, they should be isolated immediately. This helps prevent the spread of disease to healthy fish in the population. Quarantine practices should be in place for sick fish or those introduced from outside sources.

3. Maintain optimal water quality by regularly testing for key parameters, including temperature, pH, ammonia, nitrite, and dissolved oxygen. Good water quality is essential for fish health and can help prevent stress-related diseases.
4. Implement strict biosecurity protocols, such as sanitising equipment and maintaining clean facilities. Limit access to the fish production area to essential personnel only. Use disinfectants on items that come into contact with fish.
5. Vaccinate fish against common diseases to enhance their immunity. This proactive measure can significantly reduce the incidence of outbreaks and improve overall fish health.
6. Ensure that fish receive a balanced diet appropriate for their species and life stage. Avoid overfeeding, as uneaten food can deteriorate water quality and contribute to disease. Monitor feeding habits to identify any changes.
7. Regularly check for pests and parasites, such as lice or worms, and implement control measures as needed. This may involve using approved treatments or biological control methods to manage infestations.
8. Create a suitable habitat for fish by controlling water temperature, providing adequate space, and ensuring proper aeration. A stable and comfortable environment reduces stress and promotes health.
9. In the event of a disease outbreak, it may be necessary to remove and properly dispose of infected fish. This step is critical to preventing the spread of disease to the rest of the population.
10. Provide training for fish farmers on disease recognition, prevention, and management practices. Understanding these aspects can lead to better decision-making and improved fish health outcomes.

Advantages and Disadvantages of Prevention and Control Measures in Animal and Fish Production

Advantages of Prevention and Control Measures in Animal/Fish Production

1. Implementing effective prevention and control measures in animal and fish production has several significant benefits. Some of the benefits are as follows:
2. Prevention and control measures minimise the risk of diseases, leading to healthier animals and fish. Reduced stress and infections result in better growth and productivity.
3. Healthy animals and fish grow faster, reproduce more effectively, and yield higher-quality products like milk, meat, eggs, and fish. Reduced disease outbreaks ensure consistent production levels.
4. Preventive measures like vaccination and biosecurity are often less expensive than treating diseases or recovering from outbreaks. Avoiding losses due to mortality and decreased production saves money in the long term.

5. Disease-free animals and fish produce high-quality products that meet market and regulatory standards. Healthy stocks result in products with better nutritional value and fewer health risks to consumers.
6. Preventing and controlling diseases reduces suffering caused by infections and stress. Animals and fish thrive in healthier and more humane environments.
7. Disease outbreaks often lead to increased use of medications, which can harm the environment. Prevention minimises this need, reducing chemical runoff and pollution.
8. Healthy and disease-free products are more likely to meet export and local market standards. Consumers prefer products from farms with strong preventive and control systems, boosting sales and reputation.
9. Preventive measures promote long-term sustainability by maintaining the health of stock and reducing reliance on antibiotics and other treatments.
10. Controlling diseases in animals and fish reduces the risk of zoonotic diseases (diseases transferable to humans), ensuring public health safety.
11. Consistent production levels and lower disease-related losses help farmers maintain stable incomes. Disease prevention reduces the financial burden of treatments and recovery.
12. Healthy animal and fish production contributes to a reliable supply of protein-rich foods, supporting global food security.

Disadvantages of Prevention and Control Measures in Animal/Fish Production

1. Implementing prevention and control measures can require significant financial investment. This includes costs for vaccinations, biosecurity infrastructure, and regular health monitoring, which may be burdensome for small-scale producers.
2. Many preventive measures require regular attention and can be time-consuming. Activities such as monitoring animal health, maintaining records, and cleaning facilities demand ongoing effort and resources.
3. Designing and implementing effective prevention protocols can be complex, requiring specialised knowledge and training. Farmers may struggle to adopt new practices or technologies without adequate support.
4. Some producers may be resistant to adopting new measures due to traditional practices or scepticism about their effectiveness. This resistance can hinder the overall improvement of health management on farms.
5. Increased reliance on veterinary professionals for health monitoring and vaccination can strain local veterinary resources, especially in rural areas where access may already be limited.
6. In some regions, there may be a lack of awareness or education about the importance of these measures. Without proper knowledge, farmers may not implement them effectively, leading to poor outcomes.

7. Some markets may not recognise or reward producers for their preventive efforts. This can discourage investment in health measures if farmers do not see a clear economic benefit.
8. Frequent handling during health checks, vaccinations, or treatments can stress animals and fish, potentially affecting their growth and reproduction. Quarantine and overcrowding during disease control efforts can also cause additional stress.
9. Vaccines or medications may sometimes cause side effects in animals or fish, such as allergic reactions or temporary growth retardation. Some treatments may negatively affect the quality of animal or fish products if not managed properly.

Activity 7.18 Preventive Measures of Diseases Used in Animal Production

1. Embark on a field trip to a nearby animal or fish farm, or watch a documentary or video (Click here) on the internet, and observe the control and preventive measures of animal and fish disease.
2. Using the following as a guide, document and present your observation to the class for feedback:
    a. The common diseases that affect the animals or fish you observed on the trip or video.
    b. The control measures you observed on the animal/fish farm to manage diseases.
    c. The preventive measures that were implemented to reduce the risk of disease outbreaks.
    d. How do the farmers ensure biosecurity on the farm?
    e. Why preventive measures are important rather than solely relying on treatments.

Activity 7.19 Control and Preventive Measures Applied in Animal and Fish Production

1. In groups of no more than five, discuss the control and preventive measures applied in animal and fish production. In your discussion, be guided by the following:
    a. The difference between control and preventive measures in animal and fish production.
    b. The key control and preventive measures used in animal and fish production.
    c. How quarantine helps in controlling the spread of diseases.

d. How biosecurity measures help prevent and control diseases in animals or fish.

e. How education and training for farmers and farmworkers contribute to improved disease prevention and control in animal and fish production.

f. The challenges farmers face in implementing control and preventive measures in animal/fish production, and how they overcome them.

2. Present the salient points from your discussion to the class.

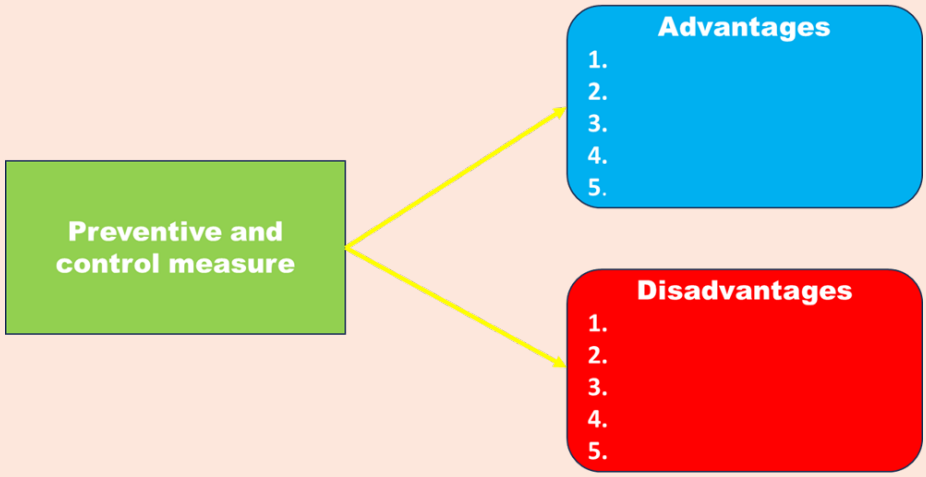
Activity 7.20 Advantages and Disadvantages of the Methods of Prevention and Control of Animal/Fish Diseases

1. In groups of no more than five, discuss the advantages and disadvantages of the methods of prevention and control of animal and fish diseases. In your discussion, focus on:

   a. How the prevention and control measures benefit the farmers, the environment and improve productivity.

   b. The challenges that the preventive and control measures can pose to the farmers, the environment and productivity.

2. Present your findings on three preventive and control measures of animal and fish diseases in a chart below for peer review:



3. Use the following guide to complete the chart:

   a. Write the type of preventive and control measures of animal and fish diseases in the box labelled preventive and control measures.

   b. Write five advantages and disadvantages of each control and preventive measure in the box labelled advantages and disadvantages, respectively.

Activity 7.21 Hands-on Experience in Controlling Diseases and Pests

1. Organise yourselves into groups of no more than five. In your groups, visit a local animal production farm or your school animal farm to undertake a control and preventive measure of animal or fish diseases in animal production. This activity should be carried out only under the supervision of the farm technician, and all safety measures observed, including the wearing of personal protective equipment (PPE).
2. Write a 2-page report on the farm activity and present it to the class.
3. The report should contain the following:
    a. Title
    b. Name of farm visited and its location
    c. Type of farm (commercial or small scale) and the types of animals being reared on the farm.
    d. Description of the control and preventive measures that were carried out.
    e. The safety measures that were put in place during the activity.
    f. Challenges and effectiveness of the disease and pest control, and preventive measures that were carried out.
    g. Conclusion (summary of the findings and what was learnt from the visit)
    h. Appendix (pictures and other visuals taken during the farm visit)

EXTENDED READING

- Eric Amoah (2018) General Agriculture for senior high schools.
- General Agriculture Textbook for secondary schools.

REVIEW QUESTIONS

1. Which of the following crop diseases is caused by a fungus and results in yellow spots on leaves?
   - **A.** Rust
   - **B.** Bacterial wilt
   - **C.** Mosaic virus
   - **D.** Nematode infestation
2. A farmer notices that his tomato plants have yellowing leaves with browning at the edges and stunted growth. Which combination of pest and disease is most likely affecting his crop, and what integrated pest management (IPM) strategy should he consider?
   - **A.** Aphids and late blight; use of chemical pesticides
   - **B.** Whiteflies and bacterial wilt; application of neem oil and crop rotation
   - **C.** Nematodes and rust; soil solarisation and resistant plant varieties
   - **D.** Thrips and powdery mildew; insecticidal soap, and removing affected leaves
3. What is the common symptom of a parasitic infestation in fish?
   - **A.** Laboured breathing and gasping at the water surface
   - **B.** Bright, clear eyes and slow swimming
   - **C.** Regular feeding patterns and inconsistent growth
   - **D.** Smooth and unblemished scales
4. What type of pathogen causes salmonellosis in poultry?
   - **A.** Virus
   - **B.** Bacteria
   - **C.** Fungus
   - **D.** Parasite
5. Which symptom would most likely indicate a viral infection in fish?
   - **A.** Fuzzy growths on fins
   - **B.** Ulcers on the skin
   - **C.** Cloudy eyes
   - **D.** Erratic swimming behaviour

REVIEW QUESTIONS

6. What is the primary symptom of nematode infestation in plant roots?
   - **A.** Galls or swellings on roots
   - **B.** Yellow spots on roots
   - **C.** Blackened roots
   - **D.** Powdery residue on roots
7. List five causes of animal/fish diseases.
8. Explain three factors that predispose animals/fish to diseases.
9. Describe how nutritional deficiencies can impact the performance of animals/fish.
10. Read the case study below carefully.

    EnockStar Farms is a mid-sized animal farm located in the Asanti region of Ghana. The farm has 100 dairy cows and 500 laying hens. Recently, the farm has experienced several health issues among its livestock. The dairy cows are showing signs of respiratory distress (coughing, nasal discharge and laboured breathing) and reduced milk production, while the laying hens have decreased egg production, and some are exhibiting signs of feather loss and lethargy. The farm management discovered that there has been increased humidity in the barns due to poor ventilation, no recent vaccinations or deworming and the introduction of three new cows without quarantine. Also, the birds are overcrowded in the coops, and there is a delay in the regular cleaning schedule.

    Answer the following questions

    - **A.** Identify the possible diseases affecting the dairy cows and laying hens based on the symptoms provided.
    - **B.** Explain the possible causes of the respiratory issues in dairy cows and the feather loss in laying hens
    - **C.** Outline the key biosecurity measures that Farms should implement to prevent the introduction and spread of diseases in both dairy cows and laying hens.
    - **D.** Describe the importance of a vaccination schedule and regular health check-ups in preventing diseases in farm animals
    - **E.** Explain how environmental factors could contribute to the health problems observed on the farm.
    - **F.** Propose an action plan for the farm to improve its disease prevention and control strategies.

SECTION

8

CONCEPT OF ECONOMICS, COMMUNICATION AND AGRIBUSINESS

AGRICULTURAL ECONOMICS, AGRIBUSINESS AND COMMUNICATION

Economics for Agriculture

Communication in Agriculture

Agribusiness Management

INTRODUCTION

This section explores the fundamental concepts and practices essential for understanding and managing agribusiness enterprises. It covers:

- The principles of demand and supply in agricultural markets
- Factors influencing demand and supply of agricultural commodities
- Price determination through demand and supply schedules and graphs
- Interactions between agricultural production sectors and enterprises
- Effective communication modes in agriculture
- Procedures for establishing agricultural enterprises
- Sources of finance for agricultural ventures
- Record-keeping systems in agricultural enterprises
- Key managerial characteristics for successful agribusiness management.

By mastering these concepts, you will gain a deep understanding of the complex interactions driving agribusiness success. You will develop the skills to analyse market trends, make informed decisions, and effectively manage agricultural enterprises. This knowledge will enable you to contribute to sustainable agricultural development and economic growth.

KEY IDEAS

- Market Analysis and Pricing Strategies: Understanding economic principles helps agribusinesses analyse market trends, set competitive prices, and make informed decisions on production and investment.
- Effective Communication for Market Penetration: Clear communication of product

value, quality, and uniqueness is crucial for capturing market share and building customer loyalty in the agribusiness industry.

- Supply and Demand Management: Agribusinesses must balance supply and demand by adjusting production, inventory, and distribution to meet changing market conditions, minimising waste and maximising profits.
- Risk Management and Mitigation: Economic uncertainty, climate change, and market fluctuations require agribusinesses to develop risk management strategies, such as diversification, hedging, and insurance.
- Value Chain Optimisation: Efficient communication and economic analysis enable agribusinesses to optimise their value chain, streamlining input procurement, production, processing, and distribution to reduce costs and enhance competitiveness.
- Sustainable Agribusiness Practices: Integrating economic, social, and environmental considerations, agribusinesses can adopt sustainable practices, ensuring long-term profitability while maintaining ecosystem health and social responsibility.
- These concepts help Ghanaian farmers make informed financial and business decisions

MEANING AND PRINCIPLES OF DEMAND AND SUPPLY

Demand

Demand refers to the amount of a product or service that people want to buy at different prices over a certain period. It is a basic idea in economics.

Demand is affected by:

- **Price of the goods**: lower price, more demand; higher price, less demand
- **Income of consumers**: more money, more demand
- **Prices of similar products**: substitutes or complements
- **Personal preferences**: likes and dislikes
- **Future price expectations**: buying now if prices may rise later
- **Number of potential buyers**: more buyers, more demand

There are two main types of demand:

- **Individual Demand:** one person's demand
- **Market Demand:** total demand from all consumers

In simple terms, demand is about how much people want to buy something at a given price, and it changes based on various factors.

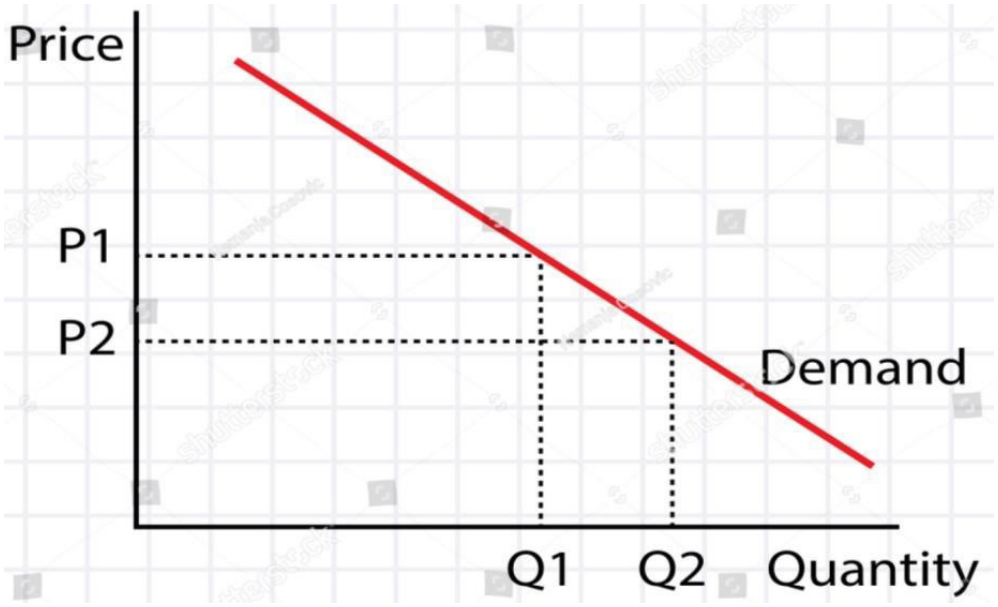


Figure 8.1: The Conventional Demand Curve

Change in Quantity Demanded

A change in quantity demanded occurs when the price changes, causing movement along the same demand curve. A change in quantity demanded is solely caused by a change in the price of the good or service.

How Price Changes Affect Quantity Demanded

- When the price increases, consumers buy less, decreasing quantity demanded (moving up the demand curve).
- When the price decreases, consumers buy more, increasing quantity demanded (moving down the demand curve).

This change in quantity demanded occurs without shifting the demand curve itself, but rather moving along the existing curve in response to price changes

Change in Demand

A change in demand happens when factors other than price affect consumer desire for a product, causing the demand curve to shift.

Factors that can increase demand

- Higher consumer income
- Positive changes in preferences
- Decrease in substitute prices
- Expectations of future price increases
- Increase in number of buyers

Factors that can decrease demand

- Lower consumer income
- Negative changes in preferences
- Increase in substitute prices
- Expectations of future price decreases
- Decrease in number of buyers

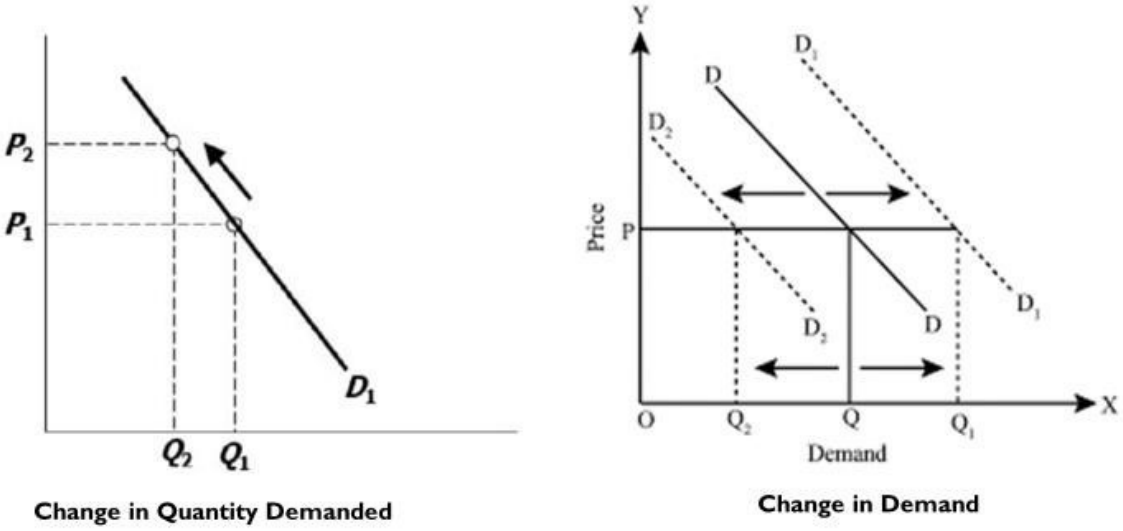


Figure 8.2: Change in Quantity Demanded and Change in Demand

Principles of Demand

The principles of demand describe how consumer purchasing behaviour responds to changing market conditions. The key principles are:

1. Law of Demand

The Law of Demand states that, assuming all things remains constant, price and quantity demanded have an inverse relationship. That is lower prices result in higher quantity demanded and higher prices result in lower quantity demanded. This occurs because consumers typically, buy more when prices drop, as goods become more affordable and buy less when prices rise, as goods become less affordable.

2. **Diminishing Marginal Utility**

This is the satisfaction gained from consuming additional units of a good decreases. Consumers willing to pay less for more units, contributes to the demand curve's downward slope.

3. Substitution Effect

A situation where consumers replace expensive goods with cheaper alternatives, e.g. higher coffee prices lead to increased tea consumption.

4. Income Effect

This is where the changes in purchasing power of the consumer due to price changes affects consumption and demand of goods, e.g. lower prices increase real income, boosting demand.

5. Tastes and Preferences

This is where changes in consumer preferences impact demand, e.g. rise in electric car popularity increases demand.

6. Expectations of Future Prices

This is a situation where an anticipated price changes influence the current demand of goods, e.g. expected housing price increases prompt current buying.

7. Number of Buyers

This is where more consumers in a market increase overall demand, e.g. new city residents boost demand for housing, groceries and services.

Meaning of Supply

Supply refers to the amount of goods or services producers are willing and able to sell at different prices within a specific time frame. It is a fundamental concept in economics and is typically represented by the supply curve, which shows the relationship between the price of a good and the quantity supplied. Key aspects of supply include:

Price of the Goods: Higher prices typically lead to increased quantity supplied, as producers seek higher profits. Conversely, lower prices reduce quantity supplied.

Cost of Production: Rising production costs decrease supply, making production less profitable.

Technology: Advances in technology boost efficiency, reduce costs, and increase output.

Number of Producers: More producers enter the market, increasing overall supply.

Expectations of Future Prices: Producers may withhold current production if they anticipate future price increases.

Government Policies: Taxes, subsidies, and regulations impact supply. Subsidies increase supply, while taxes and regulations decrease it.

Natural Conditions: Weather, natural disasters, and seasonal changes affect supply, particularly for agricultural products.

Supply can be categorised into:

- **Individual Supply**: A single producer's supply.
- **Market Supply:** The total supply of all producers in the market for a specific good or service.

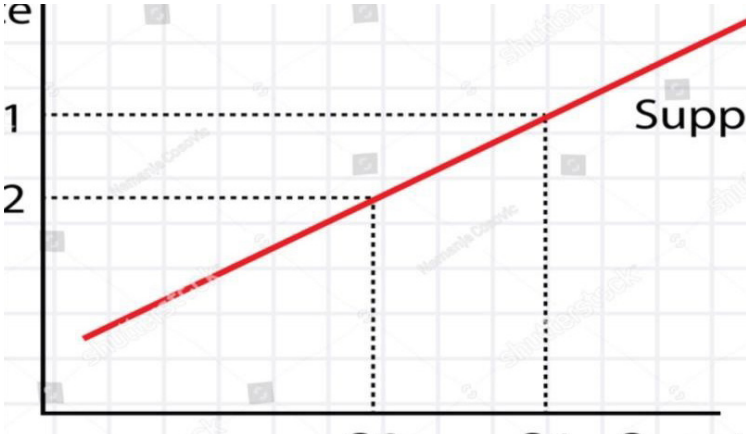


Figure 8.3: The Conventional Supply Curve

Change in Quantity Supplied

A change in quantity supplied occurs when the price changes, causing movement along the same supply curve. The sole cause of a change in quantity supplied is a change in the price of the good or service.

- **When the price rises**, producers supply more (moving up the supply curve).
- **When the price falls,** producers supply less (moving down the supply curve).

Change in Supply

A change in supply occurs when the entire supply curve shifts, either right (increasing supply) or left (decreasing supply), due to factors beyond the good's or service's price.
Factors causing supply shifts include:

- Changes in production costs, such as input costs (raw materials, labour)
- Technological advancements that boost efficiency
- Increase in sellers, typically expanding supply
- Producer expectations of future price changes
- Government interventions through taxes, subsidies, and regulations

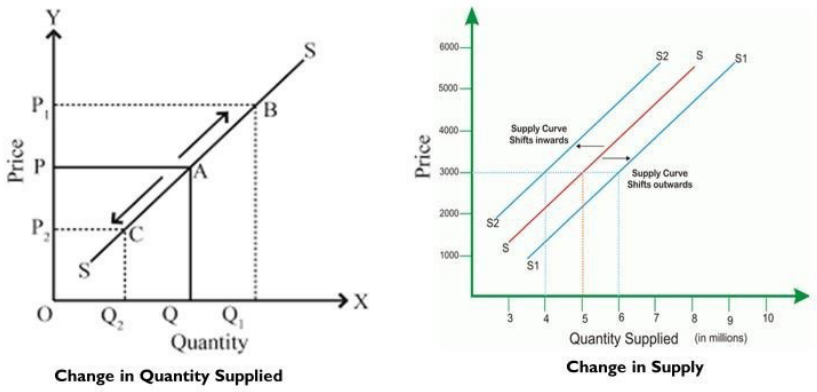


Figure 8.4: Change in Quantity Supplied and Change in Supply

The Principles of Supply

The principles of supply explain how various factors influence the quantity of goods or services producers offer for sale. The key principles include:

1. The law of Supply

The Law of Supply states that, assuming all things remains constant, price and quantity supplied have a direct relationship: thus, higher prices result in increased quantity supplied and lower prices results in decreased quantity supplied. Producers supply more goods at higher prices due to the potential for higher profits, making increased production financially attractive.

2. Cost of Production

Production costs (labour, raw materials, capital) influence quantity supplied. Rising costs may reduce supply as profitability decreases. To maintain profits, producers increase supply at higher prices to offset increased production costs.

3. Technological Advances

Technological improvements boost efficiency, reduce costs, and increase output, potentially increasing supply. Technological advancements shift the supply curve rightward, indicating increased supply across all price levels.

4. Number of Producers

An increase in producers boosts overall supply. More producers lead to greater competition and higher supply.

5. Expectations of Future Prices

Producers anticipating future price hikes may delay current production to sell at higher prices later. Future price expectations prompt producers to adjust current supply levels in anticipation.

6. Government Policies

- **Taxes**: Taxes increase production costs, reducing supply.
- **Subsidies**: Subsidies lower production costs, boosting supply.
- **Regulations** can increase costs, decrease supply and offer incentives, increasing supply

Impact: Government policies significantly impact supply by altering costs and incentives.

7. Natural Conditions

Weather, natural disasters, and seasonal changes affect supply, especially agricultural products. Favourable conditions increase supply; adverse conditions decrease it.

Activity 8. 1 Meaning of Demand and Supply

1. Use the internet and other relevant resource materials and come up with the definitions of demand and supply, and write them down in your notebook.
2. Compare your findings with your peers to fine-tune your definition of demand and supply.

Activity 8. 2 Factors Influencing the Demand and Supply of Agricultural Commodity

1. In pairs, discuss the factors that affect the demand and supply of agricultural commodities. In your discussion, be guided by the following:

   Demand:

   a. What factors affect consumers' willingness to buy agricultural products? (e.g., price, income, taste)

   b. How do seasonal changes impact demand?

   Supply:

   a. What factors influence farmers' ability to produce agricultural products? (e.g., weather, technology, government policies)

   b. How do transportation costs affect supply?

3. Present the salient points from your discussion to the class for feedback. Use diagrams and charts to illustrate how the factors affect demand and supply.

Activity 8. 3 Determinants of Prices for an Agricultural Commodity

1. Watch videos/pictures on how demand and supply affect the pricing of agricultural produce. (click here https://www.youtube.com/watch?v=2rWnmyTZQgs)
2. In groups of not more than five, discuss your findings on how prices are determined for agricultural produce.
3. Present the salient points from your discussion on the determinants of pricing for an agricultural commodity to your class for feedback.

FACTORS THAT INFLUENCE DEMAND AND SUPPLY OF AGRICULTURAL COMMODITIES

Factors That Influence Demand of Agricultural Commodities

The demand for agricultural commodities is influenced by a variety of factors, some of which are unique to the nature of agricultural products. Key factors that influence the demand for agricultural commodities include the demand for agricultural commodities being influenced by various factors, such as:

- **Price of the Commodity**: Lower prices increase quantity demanded, while higher prices decrease it.
- **Consumer Income**: Higher incomes boost demand for premium agricultural products.
- **Population Growth**: Increasing population leads to higher demand.
- **Consumer Preferences and tastes**: Changes in trends, health consciousness, and cultural factors impact demand.
- **Substitute Goods**: Availability and price of alternatives affect demand.
- **Complementary Goods**: Demand for related products influences agricultural commodity demand.
- **Seasonality**: Certain products have seasonal demand.
- **Government Policies and Subsidies**: Policies like subsidies, tariffs, and regulations impact demand.
- **Global Market Trends**: International demand, economic conditions, and trade policies influence local demand.
- **Health and Safety Concerns**: Food safety issues or health concerns reduce demand.
- **Advertising and Marketing**: Effective campaigns increase consumer awareness and preference.
- **Technological Advancements:** Innovations in processing, preservation, and transportation make products more accessible.
- **Economic Conditions**: Inflation, unemployment, and economic growth impact consumer purchasing power.
- **Availability and Accessibility**: Limited availability or accessibility constrains demand.

These factors interact to shape the demand for agricultural commodities.

Factors that Influence Supply of Agricultural Commodities

The supply of agricultural commodities is influenced by a range of factors, many of which are specific to the agricultural sector. The key factors that influence the supply of agricultural commodities include:

- **Weather and climate conditions**, which can enhance or reduce crop yields.
- **Technological advancements**, improving efficiency, quality, and quantity of production.
- **Input costs**, such as seeds, fertilisers, and labour, directly affecting supply.
- **Government policies**, including subsidies, taxes, and regulations, impacting production costs.
- **Market prices**, influencing farmers' production decisions.
- **Availability of natural resources** like arable land, water, and minerals.
- **Access to credit and financing** for farmers.
- **Pest and disease outbreaks**, affecting crop yields and livestock health.
- **Labour availability and cost.**
- **Global trade conditions**, including tariffs and trade barriers.
- **Storage and transportation infrastructure.**
- **Rate of technological adoption among farmers**.
- **Economic conditions**, including inflation, interest rates, and economic growth.

These factors interact to shape the supply of agricultural commodities.

Activity 8. 4 Factors That Influence the Demand and Supply of an Agricultural Commodity

1. In groups, use the internet and other relevant resources to research and come up with information on the factors that affect demand and supply. In your exploration, consider the following factors:
   a. Economic, e.g., income, prices
   b. Social, e.g., consumer preferences, culture
   c. Environmental, e.g., climate, seasonality
   d. Political, e.g., trade policies, subsidies
2. Present your findings for class discussions, looking at factors across commodities and implications for producers, consumers and markets.

Activity 8.5 Factors of Supply That Influence Agricultural Production

1. In pairs, watch a video on the effects of shifts in the demand and supply curves (click here https://youtu.be/V0tIOqU7m-c?si=QYBPrpy83WtVpWbA).
2. Write your findings from the video on the factors that cause shifts in demand and supply curves.
3. Present your findings to the class for discussion and feedback.

DEMAND AND SUPPLY SCHEDULES AND DETERMINANTS OF PRICES FOR AN AGRICULTURAL COMMODITY

Demand Schedules and Determinants of Prices for an Agricultural Commodity

A demand schedule is a table that shows the quantity of a commodity that consumers are willing to purchase at various prices over a specific period. It is a crucial tool in understanding the relationship between price and quantity demanded. Below is an example of a demand schedule for a hypothetical agricultural commodity, E.g., Wheat:

Table 8.1: Demand Schedule for Wheat

Price per bag	Quantity Demanded (Wheat)
GHS 50.00	100
GHS 45.00	120
GHS 40.00	150
GHS 35.00	180
GHS 30.00	220

In this schedule, as the price of wheat decreases, the quantity demanded increases, illustrating the law of demand.

Determinants of Prices for an Agricultural Commodity from Demand Perspective

The price of an agricultural commodity is influenced by a variety of factors, often categorised into supply-side and demand-side determinants. The key determinants include:

Demand-Side Determinants

- Higher consumer incomes, which can boost demand and prices, especially for premium products.
- Changes in consumer preferences, driven by trends, health information, and cultural factors, affect demand and prices. For instance, rising demand for organic produce drives up prices.
- Population growth typically leads to higher demand, potentially increasing prices.
- The availability and prices of substitute goods impact demand. When substitute prices rise, demand for alternative goods increases, driving up prices.
- The demand for complementary goods also influences prices. For example, higher livestock feed prices reduce demand for corn used in feed, affecting corn prices.
- Seasonal variations impact demand, such as increased demand for certain fruits during specific seasons, affecting their prices.
- Consumer expectations about future prices influence current demand. Anticipated price hikes prompt consumers to buy more now, driving up current prices.

Supply-Side Determinants

- **Weather and Climate**: Adverse weather reduces supply, increasing prices, while favourable weather boosts supply and lowers prices.
- **Technological Advancements**: Improved agricultural technology increases supply, potentially lowering prices.
- **Cost of Inputs**: Changes in input costs (seeds, fertilisers, labour) impact production costs and supply.
- **Government Policies**: Subsidies, taxes, tariffs, and regulations significantly impact prices.
- **Global Trade Conditions**: International trade agreements, tariffs, and trade barriers affect global supply and prices.
- **Pest and Disease Outbreaks**: Outbreaks reduce or decimate crop yields, decreasing supply and increasing prices.
- **Natural Disasters**: Disasters disrupt supply chains, reduce supply, and drive-up prices.

- **Economic Conditions**: Inflation, interest rates, and economic health influence production costs and consumer purchasing power.
- **Storage and Transportation:** Efficient infrastructure reduces losses and increases supply, potentially lowering prices.

Interplay Between Supply and Demand

The equilibrium price of an agricultural commodity is determined by the intersection of supply and demand. Changes in any determinant shift the supply and demand curves, leading to new equilibrium prices. Examples of shifts in supply and demand curves are:

- Increased consumer income shifts the demand curve right, raising prices.
- Technological breakthroughs lowering production costs shift the supply curve right, lowering prices.
- Adverse weather reducing crop yields shifts the supply curve left, raising prices.

Supply Schedules and Determinants of Prices for an Agricultural Commodity

A supply schedule is a table that shows the quantity of a commodity that producers are willing and able to sell at various prices over a specific period. It helps illustrate the relationship between the price of a commodity and the quantity supplied. An example of a supply schedule for a hypothetical agricultural commodity, E.g., maize:

Table 8.2: Supply Schedule for maize

Price per Bag (GHS)	Quantity Supplied (Bags)
20	100
40	200
60	300
80	400
100	500

In this schedule, as the price of maize increases, the quantity supplied also increases, illustrating the law of supply.

Determinants of Prices for an Agricultural Commodity from Supply Perspective

The price of an agricultural commodity is influenced by a variety of factors from both the supply side and the demand side. The key determinants include:

Supply -Side Determinants

- Weather and climate significantly impact agricultural prices. Favourable conditions boost supply, lowering prices, while adverse weather reduces supply, increasing prices.
- Technological advancements in farming increase production efficiency, potentially lowering prices.
- Input costs (seeds, fertilisers, labour) directly affect production costs. Higher input costs decrease supply, raising prices.
- Government policies (subsidies, taxes, tariffs, regulations) influence supply. Subsidies increase supply, lowering prices, while taxes and tariffs decrease supply, raising prices.
- Global trade conditions (agreements, tariffs, barriers) impact global supply and prices.
- Pest and disease outbreaks devastate crops, reducing supply and increasing prices.
- Natural disasters disrupt production and supply chains, reducing supply and increasing prices.
- Labour availability and cost crucially impact agricultural production. Labour shortages reduce supply, increasing prices.
- Adequate storage and transportation infrastructure maintain supply, while poor infrastructure reduces supply, increasing prices.
- Farmers' access to credit and financing impacts investment in inputs, technology, and infrastructure, influencing supply.

Demand-Side Determinants

- Consumer income increases demand, potentially raising prices, especially for premium products.
- Changes in consumer preferences affect demand and prices.
- Population growth increases demand, potentially raising prices.
- Prices of substitutes and complements influence demand.
- Seasonal variations impact demand.
- Consumer expectations about future prices influence current demand.

Interplay Between Supply and Demand

The equilibrium price is determined by the intersection of supply and demand. Changes in these factors shift supply and demand curves, leading to new equilibrium prices. Examples include:

- Technological advancements increase supply, potentially lowering prices.
- Adverse weather decreases supply, raising prices.
- Population growth increases demand, raising prices.

Note: Lower incomes decrease demand, raising prices.

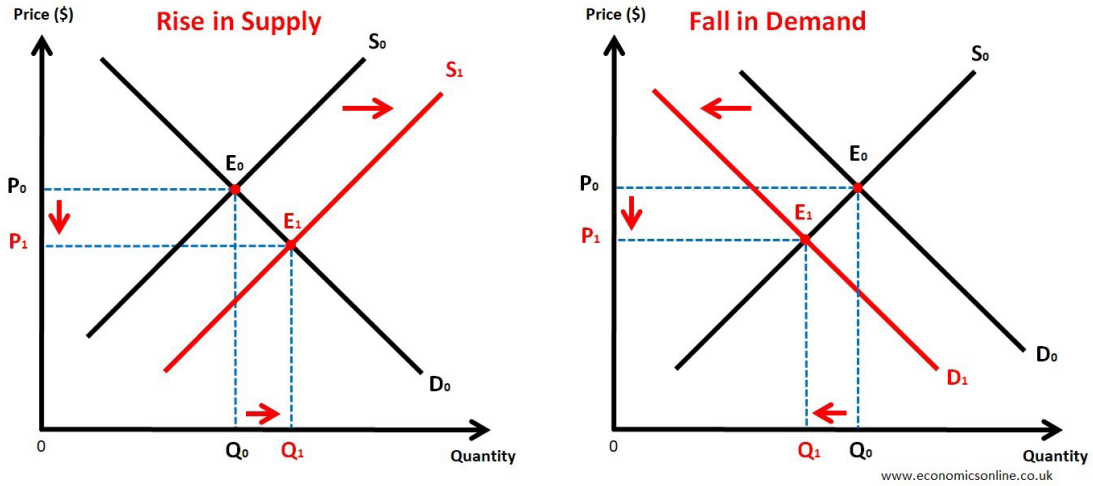


Figure 8.5: Demand and Supply equilibrium

Activity 8.6 Meaning of Demand and Supply Schedules

1. In groups, watch a video on determinants of price for an agricultural commodity (click here). Focus on the following:
   a. determinants of prices of agricultural commodity
   b. how changes in demand and supply affect price.
3. Note down the above key points from the video.
4. Create the following schedules:
   a. Demand Schedule: Price against Quantity Demanded
   b. Supply Schedule: Price against Quantity Supplied
5. From the schedules, determine the new equilibrium price and quantity.
6. Present your findings to the class for feedback.

Activity 8.7 Supply Schedules and Determinants of Prices

1. In groups of not more than five, develop a questionnaire with a maximum of 8 questions to research supply and demand schedules and determinants of price at the local market. The questionnaire should include the following:

a. General Information of respondent (Age, Gender, Occupation and Role in the Market that is retailer or wholesaler)

b. Demand-Related Questions

   i. Products they frequently sell in the local market

   ii. Factors that influence their purchasing decisions the most.

c. Supply-Related Questions

   i. What factors influence the quantity of goods they supply to the market.

   ii. Challenges they face in maintaining a steady supply

d. Determinants of Price

   i. The main factors that affect price changes in the local market

   ii. How they respond to price increases or decreases

2. Administer the questionnaire to sellers of a chosen agricultural commodity (e.g. maize, cowpea, rice) in your local market.
3. With the help of the internet and other relevant resources, create a supply schedule that is 'Price against Quantity Supplied' for the named commodity.
4. Analyse the determinants of price and how changes in determinants affect supply and price of the commodity focusing on:

   a. Production costs

   b. Weather conditions

   c. Government policies

   d. Global demand

5. Write a two-page report on the research for the named agricultural commodity and present to the class. The report should contain the following headings:

   a. Introduction

      i. Brief background on the agricultural commodity surveyed

      ii. Purpose and objectives of the research

      iii. Scope and significance of the research

   b. Methodology

      i. Description of the survey approach (e.g., questionnaires, interviews, observations)

      ii. Target respondents (retailer or wholesaler)

      iii. Survey location

   c. Findings and Analysis (Use graphs, charts or tables to support your analysis)

d. Challenges Identified

i. Issues affecting supply stability

ii. Factors leading to price volatility

e. Conclusion and Recommendations

i. Summary of key findings

ii. Suggestions for improving supply stability and price regulation

THE INTERACTIONS BETWEEN THE SECTORS OF AGRICULTURAL PRODUCTION AND ENTERPRISES, AND THE EXTENT OF HUMAN INTERACTION

Agricultural production and enterprises involve complex interactions between economic, social, and environmental factors, with human activities playing a crucial role in shaping and being shaped by these dynamics. Let us explore the overview of these interactions!

Supply Chain and Markets Dynamics

Agricultural production and enterprises are interconnected through a complex supply chain, where:

- **Production to Market**: Agriculture provides the foundation of the supply chain, supplying raw materials to various industries such as food processing, textiles, and biofuels.
- **Market Demand**: Enterprises drive agricultural production through market demand, with consumer preferences, purchasing power, and trends influencing the types of crops or livestock farmers produce.
- **Price Setting**: The dynamic interaction between agricultural producers and enterprises determines market prices, influenced by factors like supply and demand, economic conditions, and external market forces.

Technological Advancements

- **Innovation**: Enterprises spearhead technological breakthroughs that transform agricultural production, introducing advancements like precision farming, biotechnology, and eco-friendly practices.
- **Research and Development (R&D)**: Collaborative R&D efforts between agricultural sectors and enterprises yield innovative solutions, boosting productivity and sustainability.

- **Government Policies:** Agricultural policies, subsidies, and regulations shape farming practices and enterprise operations, with significant impact from trade policies, environmental regulations, and food safety standards.
- **Corporate Practices:** Enterprises implement practices influencing agricultural production, including sourcing policies, sustainability commitments, and social responsibility initiatives.

Environmental Impacts

- **Sustainable Practices**: The agricultural and enterprise sectors profoundly impact the environment, but enterprises can foster sustainability by demanding eco-friendly products and supporting environmentally responsible farming initiatives.
- **Resource Management**: Effective management of natural resources, including water, soil, and biodiversity, is crucial; enterprises can make a positive impact by investing in sustainable resource management practices.

Economic and Social factors

- **Employment**: Agricultural production and enterprises generate employment opportunities, bolstering rural and urban economies.
- **Rural Development**: Enterprises investing in rural areas stimulate economic growth, enhance infrastructure, and improve agricultural communities' quality of life.

Global Trade

- **Exports and Imports**: Agricultural products are globally traded, with enterprises playing a pivotal role in exports and imports, influenced by trade agreements and global market conditions.
- **Supply Chain Resilience**: Ensuring the reliability of agricultural supply chains requires strategic cooperation between producers, enterprises, and industry stakeholders to address climate change and pandemic-related risks.

Human Interactions

- **Farmers and Workers**: Farmers, labourers, and workers drive agricultural production and related enterprises through their skills, knowledge, and labour.
- **Consumers**: Consumer preferences, such as organic farming, local sourcing, and fair-trade practices, shape agricultural production and enterprise operations.
- **Stakeholder Engagement**: Effective communication and collaboration among stakeholders (farmers, enterprises, governments, NGOs, and consumers) address challenges and leverage opportunities in both sectors. Collaboration between agricultural producers and enterprises ensures supply chain resilience, particularly in the face of climate change and pandemics.

Figure 8.6: Stakeholder Engagement

Activity 8.8 Interactions Between the Sectors of Agricultural Production and Enterprises

In groups of not more than five, discuss how any one sector of agriculture (e.g., crop production, livestock, agribusiness) interacts, focusing on the interactions between sectors and human interaction within sectors. You can use the internet and other resources during your research.

Write your findings in your notebook and share with a peer for feedback.

Activity 8.9 Interactions Between the Sectors of Agricultural Production and Enterprises

1. In pairs, come up with information on how any one sector of agriculture (e.g., crop production, livestock) interacts with enterprises. In your research, be guided by the following:
   a. How agricultural enterprises interact with the production sector
   b. Role of agribusiness in supporting the agricultural sector.
   c. How advertising and media enterprises interact with the agricultural sector.
   d. Benefits of collaboration between agricultural production and enterprise.
2. Present your findings to other pairs for feedback.

VARIOUS MODES OF COMMUNICATION IN AGRICULTURE

The Modes of Communication in Agriculture

Communication is the process of exchanging information, ideas, thoughts, and messages between individuals, groups, or organisations through various channels, mediums, or languages. Communication plays a crucial role in disseminating information, sharing knowledge and ensuring effective coordination among stakeholders. The primary modes of communication used in agriculture are:

Traditional Methods

- **Face-to-face meetings**: It is allowing farmers, extension workers, and stakeholders to interact directly and discuss specific needs.
- Field **days and demonstrations:** Provide hands-on exposure to innovative techniques and technologies.
- **Farmer cooperatives and associations**: Facilitate group meetings, information sharing, and discussions on new methods and resources.

Print Media

- **Newspapers and Magazines:** Informative articles and advertisements keep farmers updated on best practices, industry news, and market trends.
- **Brochures and Flyers:** Concise printed materials, distributed at events or through agricultural offices, provide accessible information on agricultural practices and services.

Electronic Media

- **Radio**: Targeted programs and announcements provide essential updates on weather, market prices, and best farming practices.
- **Television**: Specialised agricultural shows and news segments showcase innovative techniques, weather forecasts, and market analysis.

Digital Online Communication

- **Mobile Phones and SMS**: Timely alerts and updates on weather, market prices, and pest outbreaks.
- **Social media**: Platforms such as Facebook, WhatsApp, and YouTube facilitate information sharing, training videos, and farmer group promotion.
- **Websites and Blogs**: Comprehensive online resources offer in-depth articles, guides, and updates on current and emerging agricultural topics.

- **Email Newsletters:** Regularly distributed updates inform subscribers about cutting-edge research, upcoming events, and market trends

Educational and Extension Services Division

- **Workshops and Training Programs:** Organisations such as agricultural extension services, NGOs, and educational institutions host workshops and training programs.
- **Extension Agents**: Specialised professionals provide personalised guidance, training, and support through on-farm visits.
- **Farmer Field Schools:** Interactive, field-based learning sessions foster collaborative knowledge sharing.

Interactive platforms

- **Webinars and Online Courses**: Interactive virtual training sessions ensuring quality and assurance.
- **Mobile Apps**: Specialised applications offer guidance on crop management, pest control, and market prices .e.g. MoFA e-Extension, UENR Akuafo adamfo, Farmerline, and Esoko.
- **Online Forums and Discussion Groups**: Collaborative platforms for farmers and experts to share knowledge and experiences.

Innovative Technologies

- **Drones and Remote Sensing**: Advanced monitoring of crop health and real-time data analysis.
- **GIS and Precision Agriculture Tools:** Efficient resource management and data-driven decision-making.
- **Artificial Intelligence and Machine Learning:** Predictive analytics, issue diagnosis, and process optimisation.

The following strategies of communication will promote the involvement of women, youth and people with disabilities in agriculture.

- Schedule meetings and training sessions at convenient times that fit women's household responsibilities.
- Use women-friendly communication channels, such as women's groups and cooperatives.
- Ensure equal access to land, inputs, credit, and extension services.
- Promote female extension officers and role models.
- Encourage women's participation in decision-making and leadership roles.
- Integrate modern technologies such as mobile apps, social media, and digital tools to attract youth.

- Provide accessible information (large print, audio messages, sign language, and simple visuals).
- Ensure physical access to training centres and farms (ramps, clear paths).

Figure 8.7: Various methods used for communication in agriculture

Barriers to Communication In Agriculture

Barriers to communication in agriculture are challenges that prevent farmers and other stakeholders from receiving and understanding important information. The following are some barriers to communication

1. Language : as extension messages are sometimes delivered in official or technical languages that farmers may not understand.
2. Literacy levels: affect communication, since many farmers may have difficulty reading written materials such as manuals, leaflets, or labels on agrochemicals.
3. Cultural beliefs and traditions: can influence how farmers accept new ideas or technologies; some practices may be resisted if they conflict with local customs.
4. Limited access to technology, such as mobile phones, internet services, radio, or electricity—especially in rural areas—can further restrict information flow.
5. Poor extension services: lack of trust between farmers and extension officers, and inadequate feedback mechanisms.
6. Time constraints – Farmers may be too busy during farming seasons to attend meetings or training sessions.
7. Gender barriers – Women farmers may have less access to information due to cultural norms or household responsibilities.
8. Age barriers – Older farmers may find it difficult to adopt new communication methods or technologies.

9. Poor feedback channels – Farmers may not have opportunities to ask questions or share their experiences.
10. Technical complexity – Information may be too scientific or complex for farmers to understand easily.
11. Lack of trust – Farmers may distrust information sources due to past negative experiences.

Barriers to communication in agriculture can be overcome through

1. Use local languages and simple words when sharing information, and avoid technical terms.
2. Use visual and practical methods such as demonstrations, field days, pictures, videos, and charts instead of written materials only.
3. Strengthen agricultural extension services by training and increasing the number of extension officers.
4. Improve access to technology through community radios, shared mobile phones, SMS alerts, and farmer WhatsApp groups.
5. Promote adult literacy and farmer education programmes to improve understanding of written information.
6. Respect cultural beliefs and practices and involve community leaders to encourage acceptance of new ideas.
7. Ensure gender inclusion by designing communication activities that involve women and youth.
8. Provide regular feedback channels, allowing farmers to ask questions and share experiences.
9. Build trust by giving reliable, consistent, and practical advice and following up on recommendations.
10. Improve infrastructure such as rural roads and meeting centres to support extension activities.

Activity 8.10 Common Communication Modes in Agricultural Production

1. In pairs, use the internet and other resources to research and come up with information on any three communication modes in agriculture (e.g., social media, radio, extension services).
2. Make a presentation (digital or paper-based) on your findings, focusing on:
   - Definition of each mode of communication identified
   - Advantages of each mode of communication identified
   - Disadvantages of each mode of communication identified

- Pictures and other visuals in the communication mode.
- The most effective communication modes among your selection
- How the communication modes impact agricultural productivity.

Activity 8.11 Digital and Online Communication to Promote Agricultural Production

1. In groups of not more than five, watch a documentary on assigned digital and online modes of communication in agriculture (e.g., social media, messaging apps, online forums) (click here https://youtu.be/jVZWM1I--uI?si=6SdrdSJTjHwg_4tf)
   i. Focusing on the following:
   ii. Advantages
   iii. Disadvantages
   iv. Pictures and other visuals on the communication mode.
   v. The most effective communication modes
   vi. How the communication modes impact agricultural productivity.
2. Write your observations from the documentary in your notebook and present them to the class for discussion.

PROCEDURE FOR THE ESTABLISHMENT OF AGRICULTURAL ENTERPRISES

The Procedure for Establishment of Agricultural Enterprise

Launching a successful agricultural business requires a comprehensive approach, encompassing planning, regulatory adherence, funding, and operational implementation. The detailed process for establishing an agricultural enterprise is:

Conduct Market Research

- **Identify Market Needs:** Determine the demand for specific agricultural products or services in your target market.
- **Analyse Competition**: Assess the competitive landscape to uncover opportunities and potential threats.

- **Evaluate Market Trends:** Research current and future trends in the agricultural sector, including shifting consumer preferences, emerging technologies, and regulatory developments.

Develop a Business Plan

To create a comprehensive business plan for your agricultural enterprise, consider the following key components:

- **Define Business Goals:** Establish clear short-term and long-term objectives.
- **Detail Products/Services:** Specify the agricultural products or services offered.
- **Market Strategy:** Develop targeted marketing, sales, and distribution approaches.
- **Financial Projections**: Prepare detailed financial statements, including profit/loss projections, cash flow analysis, and funding needs.
- **Operational Plan**: Outline operational processes, production methods, equipment requirements, and staffing needs.

Legal and Regulatory Compliance

To establish your agricultural business, complete the following legal and regulatory steps:

- **Choose a Business Structure**: Select a suitable legal entity, such as a sole proprietorship, partnership, corporation, or cooperative.
- **Register the Business**: Register with the relevant government authorities to obtain necessary licenses and tax identification.
- **Obtain Permits and Licenses**: Secure specialised permits and licenses for agricultural operations, including environmental and health and safety clearances.
- **Comply with Zoning Laws**: Ensure agricultural activities align with local zoning regulations.

Secure Financing

To secure financing for your agricultural business:

- **Identify Funding Sources**: Research and explore diverse funding options, including personal savings, loans, grants, venture capital, and group loans.
- **Prepare Funding Proposals**: Develop persuasive proposals and comprehensive business plans to showcase to potential investors or lenders.
- **Apply for Grants and Subsidies**: Investigate and apply for agricultural grants and subsidies provided by government agencies and non-governmental organisations.

Acquire Land and Resources

- **Select Suitable Land:** Choose land based on soil quality, climate, water availability, and market accessibility.
- **Purchase or Lease Land:** Decide on land ownership or rental options aligned with budget and long-term objectives.
- **Procure Equipment and Inputs:** Acquire essential farming equipment, seeds, fertilisers, pesticides, and other necessary inputs.

Infrastructure Development

- **Develop essential infrastructure** thus including irrigation systems, storage facilities, greenhouses, and processing units.
- **Ensure reliable utilities**, such as water supply, electricity, and waste management systems.

Hiring and Training

- Recruit skilled and unskilled labour tailored to operational needs.
- Implement training programs focusing on modern agricultural practices and safety standards.

Implement Production Plan

- Initiate agricultural production following best practices and sustainability principles.
- Monitor and manage production, implementing pest control, soil health, and crop/livestock management practices.

Marketing and Sales

- Create promotional materials, including brochures, websites, and social media profiles.
- Establish efficient distribution channels, such as direct sales, farmers' markets, wholesalers, and retailers.
- Foster strong customer relationships through excellent service and feedback.

Financial Management

- Implement robust accounting systems for financial tracking and monitoring.
- Regularly update financial forecasts and budgets for sustained growth.
- Ensure timely tax payments and compliance with financial regulations.

Continuous Improvement

- Evaluate performance against set goals and objectives, making adjustments as needed.
- Adopt innovative agricultural technologies and practices for enhanced productivity and sustainability.
- Gather stakeholder feedback to identify areas for improvement.

Activity 8.12 Procedures for Establishing an Agricultural Enterprise

1. In pairs, discuss the procedures for the establishment of an agricultural enterprise. In your discussion, be guided by the following questions:
   a. What steps would you take to start an agricultural enterprise?
   b. What factors should be considered when establishing an agricultural enterprise?
   c. How should the resources be planned and managed?
   d. What market research should be conducted?
   e. How should the business plan be developed?
   f. What financing options should be explored?
   g. How should risk be managed?

   You can use the internet and other resources during your research.
2. Share your findings with other pairs for feedback.

Activity 8.13 Procedures for Establishing an Agricultural Enterprise

1. In groups of not more than five, research into how a local agricultural enterprise (e.g., crop production farm, an animal production farm or agribusiness) is established or watch a video on establishing an agricultural enterprise (click here) focusing on the procedures involved.
2. Present your findings to the class.

Activity 8.14 Market Research Before Establishing an Agricultural Enterprise

1. In groups of not more than five, conduct market research on an agricultural product or service (e.g. vegetable oil, fruit juice, canned meat). You can either visit an agricultural enterprise in your community or watch a video

on the procedures involved in establishing an agricultural enterprise. In your research, be guided by the following:

a. How was it established?
b. Who are the consumers of the product?
c. Are there other companies producing similar products?
d. What are the sales and demand of the product like?

2. Write a 2-page report on the research conducted for presentation. The report should contain the following:
   a. Title
      i. Name
      ii. Class
      iii. Date of submission
   b. Introduction
      i. Background information on the topic
      ii. Purpose and scope of the report
   c. Content of the report/body in detail.
      i. Create visual aids (e.g., charts, graphs, tables) where appropriate
      ii. Observations
   d. Conclusions/recommendations
3. Present the findings to stakeholders.

Activity 8.15: Developing a business plan

1. In groups, develop a mini business plan for a small-scale poultry farm for your school

   In developing the plans consider the following headings;

   i. Name of the business

   ii. What the business does (explain what the business is about)

   iii. Business goals (state what you want the business to achieve).

   iv. Products to sell (what the products or services you will offer).

   v. Customers (who will buy your products)

   vi. How products will be sold (explain how and where you will sell your products.)

   vii. How the business will operate (describe how daily activities will be carried out.)

viii. Items needed to start the business (list the tools, materials, and inputs required).

ix. Money needed and expected profit (state the cost of starting and the expected profit).

x. Possible problems and solutions (Mention challenges and how you will solve them).

2. Present your business plan to the class for feedback.

SOURCES OF FINANCE FOR AGRICULTURAL ENTERPRISES

Financial sources for Agricultural Enterprises

Agricultural enterprises often require various sources of finance to support their operations, expansion and sustainability. Some common sources of finance for agricultural enterprises are:

Traditional Bank Loans

- Commercial banks offer tailored agricultural loans and credit facilities.
- Development banks provide specialised financial services for agricultural growth.

Government Support

- Subsidies reduce input costs and encourage specific practices.
- Grants fund specific projects and research.
- Low-interest loans support agricultural activities.

Cooperative Financing

- Credit unions offer competitive credit rates to members.
- Farmer cooperatives pool resources for financing and risk-sharing.

Microfinance Institutions

Microloans provide flexible financing for individual farmers or small businesses.

Private Investment

- Agribusiness investment funds target growth and expansion.
- Impact investors fund projects with social, environmental, and financial returns.

Non-Governmental Support

Grants and donations from NGOs and foundations fund agricultural initiatives.

Input Suppliers and Contract Farming

- Supplier credit facilitates input purchases.
- Contract farming agreements provide upfront finance or inputs.

Equipment Financing

- Equipment leasing offers flexible machinery access.
- Hire purchase agreements enable instalment payments.

Risk Management

- Crop insurance protects against weather and pest-related losses.
- Livestock insurance covers health and productivity risks.

Community-Based Financing

Village Savings and Loan Associations (VSLAs) provide member-managed savings and credit services.

Activity 8.16 Sources of Finance for Agricultural Enterprises

1. In groups of not more than five, discuss the sources of finance for agricultural enterprises. In your discussion, be guided by the following questions:
   a. What sources of finance can agricultural enterprises access?
   b. What are the benefits and risks of each source?
   c. How can entrepreneurs choose the best finance option?
   d. What government programs support agricultural finance?
   e. How do private investors support agricultural enterprises?
   f. What role do microfinance institutions play?
   g. What are the benefits of crowdfunding in agricultural production?

   You can use the internet and other resources in your research.
2. Make a presentation on the salient points from your discussion to the class for feedback.

Activity 8.17 Support of Microfinance Institutions in Agricultural Enterprises

1. In pairs, surf the internet and other relevant resource materials to come up with information on how microfinance institutions finance agricultural production. In your research, focus on the following;
   a. Types of microfinance services (e.g., loans, savings)
   b. Benefits of microfinance to agricultural enterprises
   c. Challenges faced by women/persons with disabilities in accessing microfinance services
2. Present your findings to your class for feedback.

Activity 8.18 Sources of Finance for Agricultural Enterprises

1. In groups of not more than five, discuss three sources of finance for agricultural enterprises. In your discussion, focus on the following:
   a. Types of financing sources for agricultural enterprises
   b. Criteria for choosing a financing source
   c. Impact of the financing source on agricultural enterprises
   d. Challenges in accessing a financial source
   e. Government and policy support on financing agricultural enterprises.

   You can use the internet and other resources on agricultural financing in your research.
2. Present the salient points from your discussion to the class for feedback.

MEANING, TYPES AND IMPORTANCE OF RECORDS KEEPING IN AGRICULTURAL ENTERPRISES

Farm Records

Farm records refer to the systematic collection and documentation of information related to farm operations, management, and production. These records provide valuable data to support informed decision-making, improve efficiency, and ensure sustainability.

Types of Farm Records

1. **Production Records**: Details on crop yields, livestock productivity, planting/harvesting schedules, breeding history, and feed consumption.
2. **Financial Records**: Comprehensive accounts of income/expenses, including sales, purchases, wages, loans, and other transactions.
3. **Inventory Records**: Quantitative and monetary records of farm assets, such as equipment, machinery, livestock, seeds, and fertilisers.
4. **Labour Records**: Documentation of labour hours, wages, tasks, and employee information.
5. **Input Records**: Detailed accounts of inputs utilised, including seeds, fertilisers, pesticides, feed, and water.
6. **Maintenance Records:** Records of equipment/machinery maintenance, repairs, and infrastructure upkeep.
7. **Sales and Marketing Records:** Information on product sales, market prices, customer data, and marketing initiatives.
8. **Compliance Records:** Documentation about regulatory adherence, certifications, permits, and inspections.

Importance of Farm Records

- Tracking income and expenses, budgeting, and preparing financial statements through sound financial management.
- Making informed decisions about crop selection, livestock management, resource allocation, and investments with data-driven insights.
- Monitoring productivity and efficiency, identifying areas for improvement to optimise performance.
- Managing risks by analysing production trends, weather impacts, and pest outbreaks.
- Ensuring compliance with legal and regulatory requirements, including environmental and safety standards.
- Enhancing access to credit and loans by demonstrating financial stability and performance to lenders.
- Simplifying tax preparation and filing by maintaining accurate records of income and expenses.

Methods of keeping farm Records

1. **Manual Record Keeping**: Recording farm activities and transactions using traditional methods such as notebooks, ledgers, and paper forms.
2. **Electronic Record Keeping**: Managing data through digital tools like spreadsheets, databases, and specialised farm management software.

3. **Mobile Apps**: Utilising mobile applications specifically designed for farm record keeping, enabling effortless data entry and access in real-time, even in the field.

Activity 8.19 Meaning of Farm Records

1. In pairs, come up with the definition of farm records.
2. Write your definition in your notebook and share with other pairs to fine-tune your definition.

Activity 8.20 Types and Importance of Farm Records

1. In pairs, come up with types of farm records and write them in your notebooks.
2. With the help of the internet and other resources, explain the four types of farm records, stated in Activity 8.18 and give examples of each of them. Present your findings in a table. A template has been provided below. Use the internet and other resources in your research.

Table 8.3

Types of farm records	Examples
e.g. financial records	Income statements, expense logs

3. In the same pair, discuss the importance of keeping accurate farm records in agricultural production.
4. Share the salient points from your discussion with the class.

Activity 8.21 Designing a Typical Farm Record for an Agricultural Business Operation

Study the case study below:

Dako Farms is a mid-sized agricultural enterprise located in Somanya in the Eastern region of Ghana. The farm focuses on both crop production (corn and soybeans) and livestock (cattle and poultry). Recently, Dako Farms decided to improve its record-keeping practices to enhance efficiency, improve decision-making, and ensure compliance with regulatory requirements.

1. Design a farm record-keeping system for Dako Farms. The system should cover all the aspects of farm operations, including financial records, crop and livestock production records and inventory management.
2. You can use the example below as a guide:

Table 8.4: Records on Crop production at Dako farm.

Field ID	Crop Type	Planting Date	Harvest Date	Seed Variety	Fertilizer	Pesticide	Yield (kg)	Quality
Field 1	Corn	04/15/2024	09/20/2024	Abrotia	50 kg/ha	Lambda	10,000	Good
Field 2	Soy bean	05/10/2024	10/15/2024	Jenguma	30 kg/ha	Nativo	8,000	Excellent

3. Present your farm record system to the class for feedback.

MANAGERIAL CHARACTERISTICS REQUIRED FOR THE MANAGEMENT OF AGRIBUSINESS

Managerial Characteristics Required for the Management of Agribusiness

Technical knowledge, thus understanding agricultural practices, soil science, crop management, livestock production and farm machinery operation. Some key managerial characteristics essential for the successful management of an agribusiness are:

Technical Knowledge

- Understand crop and livestock production, soil management, pest control, and sustainable farming practices.
- Possess business acumen, including marketing, finance, accounting, and strategic planning.

Leadership Skills

- Set a clear vision and develop strategies for long-term goals.
- Inspire and motivate employees to achieve their best performance.

Decision-Making Abilities

- Analyse data, assess risks, and make informed decisions.
- Identify problems, generate solutions, and implement effective actions.

Financial Management

- Prepare budgets, financial forecasts, and manage cash flow.
- Control costs and improve efficiency.

Marketing and Sales

- Analyse market trends, customer needs, and competitive landscape.
- Develop and execute sales and marketing strategies.

Operational Management

- Efficiently manage resources (labour, equipment, materials).
- Coordinate the supply chain for timely input delivery and product distribution.

Communication Skills

- Build strong relationships with employees, customers, suppliers, and stakeholders.
- Negotiate favourable terms with suppliers and buyers.

Human Resource Management

- Recruit, train, and develop skilled workers.
- Manage employee relations, resolve conflicts, and foster a positive work environment.

Adaptability and Innovation

- Adapt to changing market conditions, technology, and regulations.
- Encourage innovation and adopt new technologies and practices.

Risk Management

- Identify potential risks and implement mitigation strategies.
- Handle crises and unexpected events effectively.

Technological Proficiency

- Utilise farm management software, mobile apps, and digital tools.
- Implement precision agriculture technologies for optimised resource use and yields.

Activity 8.22 Managerial Characteristics for Agribusiness Management

1. In groups of not more than five, come up with managerial characteristics required for managing agribusiness. You can use the internet and other resources such as an agribusiness management website (e.g., USDA, FAO) and online articles/journals (e.g., Journal of Agribusiness) in your research.
2. Present your findings to the class for feedback.
3. Visit a local agribusiness owners in your locality and conduct interview on the management strategies that she/he uses.
4. Present the outcome of the interview to the class to for feedback, emphasising on the management strategies been used by local agribusiness farmers.

Activity 8.23 Effective Communication Skills

1. In pairs, discuss how effective communication skills can promote the establishment of an agricultural enterprise. In your discussion, focus on the following:
   a. Essential communication skills for agribusiness management
   b. Role of active listening in effective communication
   c. The strategies that agribusiness managers can use to resolve conflicts.
2. Present the salient points from your discussion to other pairs for feedback.

Activity 8.24 Roleplay of Managerial Characteristics for The Management of An Agribusiness

In groups of no more than five, role-play any of the scenarios presented below in class.

These scenarios will help you demonstrate key managerial characteristics for managing agribusiness, such as visionary leadership, effective communication, strategic planning and problem-solving skills.

Scenario 1: You are the CEO of an agribusiness seeking funding to expand production. Interested investors are sceptical about your business plan. How will you convince them to invest in your business?

Scenario 2: Two employees of your poultry processing firm conflict with their work responsibilities. As a manager of the company, how will you resolve the conflicts between the two employees?

EXTENDED READING

- Godos, K. (2023). Supply and demand: the ultimate supply and demand trading guide for beginners and advanced traders, for profit making in the financial market. ASIN: B0CHPMZTSB.
- Freddie, L. B., Foltz, J., Yeager, E.A. and Brewer, B. (2021). Agribusiness management. ISBN 9780367341947.
- Agricultural Marketing and Price Analysis" by James N. Trapp. (Click here)
- Zhuo, J. (2019). The making of a manager: what to do when everyone looks to you. Publisher: Portfolio. ISBN-10: 0735219567.

REVIEW QUESTIONS

1. What is the primary goal of agricultural economics?
   - **A.** Ensuring food security
   - **B.** Maximising profit gains
   - **C.** Minimising production cost
   - **D.** Optimising resource allocation
2. Which economic principle states that resources are scarce?
   - **A.** Law of Supply
   - **B.** Law of Demand
   - **C.** Opportunity Cost
   - **D.** Scarcity Principle
3. What is the difference between microeconomics and macroeconomics?
   - **A.** Microeconomics focuses on individual markets; macroeconomics focuses on the overall economy.
   - **B.** Microeconomics focuses on the overall economy; macroeconomics focuses on individual markets.
   - **C.** Microeconomics focuses on production; macroeconomics focuses on consumption.
   - **D.** Microeconomics focuses on consumption; macroeconomics focuses on production.
4. Opportunity cost is the
   - **A.** cost of producing a good or service
   - **B.** benefit of choosing one option over another
   - **C.** value of resources used in production
   - **D.** profit earned from selling a product
5. Which economic system is characterised by private ownership and free markets?
   - **A.** Capitalism
   - **B.** Socialism
   - **C.** Communism
   - **D.** Economism
6. The primary purpose of communication in agribusiness is to
   - **A.** persuade customers

REVIEW QUESTIONS

B. inform stakeholders

C. build relationships

D. negotiate prices

7. Which communication channel is most effective for reaching a large audience?

A. Verbal communication

B. Non-verbal communication

C. Written communication

D. Mass media

8. The importance of record-keeping in agribusiness is to

A. track finances

B. monitor production

C. evaluate performance

D. All of the above

9. Which agribusiness management function involves planning and organising?

A. Production management

B. Financial management

C. Marketing management

D. Operational management

10. What is the importance of market research in agribusiness?

A. Identify target markets

B. Develop marketing strategies

C. Evaluate competitor performance

D. All of the above

11. Explain the concept of scarcity and its implications for agricultural enterprises.

12. An agribusiness entrepreneur wants to launch a new product line of organic vegetables. The entrepreneur has identified a target market of health-conscious consumers. Develop a marketing strategy to promote the new product line.

13. Discuss the components of a business plan for an agricultural enterprise.

14. Evaluate the impact of digital communication on agricultural marketing in Ghana.

ANSWERS TO REVIEW QUESTIONS

SECTION 1

1. C. Increased food security
2. B. Increasing the export of agricultural products
3. C. Ministry of Food and Agriculture (MoFA)
4. C. Providing training and resources to farmers
5. C. Leasehold tenure
6. Agricultural development increases the efficiency and productivity of farming practices, leading to higher crop yields and more income for farmers. This boosts the local and national economy by creating jobs, increasing exports, and reducing poverty.
7. Governmental organisations, like the Ministry of Food and Agriculture (MoFA), develop and implement policies, provide subsidies, and offer extension services to educate farmers. Non-governmental organisations (NGOs) often focus on providing training, resources, and advocacy for sustainable farming practices and farmer empowerment.
8. In a freehold land tenure system, the landowner has permanent and absolute ownership of the land, including the right to sell, lease, or use it as they wish. In a leasehold land tenure system, the landowner grants the right to use the land to another party for a specified period, after which the land returns to the owner.
9. Secure land tenure provides farmers with confidence that they will retain the benefits of their investments in the land. This encourages them to invest in long-term improvements such as soil conservation, irrigation systems, and perennial crops, which can enhance productivity and sustainability. Conversely, insecure tenure can lead to short-term thinking and underinvestment, as farmers fear losing their land and the fruits of their labour.
10. Communal land tenure systems can promote cooperation and shared resources, which may enhance agricultural productivity through collective efforts. However, they can also lead to challenges such as a lack of individual incentives for innovation and investment, as the benefits are shared among all members. The absence of clear individual ownership may reduce accountability and hinder the adoption of new technologies or practices.
11. Refer to page 13 for content under: advantages and disadvantages of the land tenure system in Ghana.
12. Transitioning from customary to freehold land tenure systems in Ghana can lead to significant social and economic changes. Economically, it can enhance landowners' ability to use land as collateral for loans, leading

to increased investment and productivity. Socially, it may lead to greater individual ownership and responsibility for land management. However, this transition can also disrupt traditional social structures and communal land management practices, potentially leading to conflicts and marginalisation of certain groups. It may also increase land concentration and inequality if wealthier individuals or entities acquire large portions of land.

13. Potential Benefits of introducing industrial agriculture in a rural area previously dependent on subsistence farming

- Economic Growth: Increased productivity and income, creation of jobs and improved market access.
- Infrastructure Development: Better roads, storage facilities and access to technology.
- Improved Food Security: Higher yields and more consistent food supply.

Potential Drawbacks of introducing industrial agriculture in a rural area previously dependent on subsistence farming

- Displacement of Small Farmers: Industrial agriculture might push small-scale farmers off their land.
- Environmental Degradation: Overuse of chemicals and monoculture practices can harm soil health and biodiversity.
- Social Inequity: Increased disparity between large agribusinesses and smallholders.

Policy Recommendations

- Support for Small-scale Farmers: Provide subsidies, training, and access to markets for small-scale farmers.
- Environmental Regulations: Implement policies to regulate chemical use and encourage sustainable practices.
- Equitable Land Policies: Ensure fair land distribution and protect the rights of small farmers.
- Inclusive Development: Promote inclusive policies that consider the needs of all community members and ensure their participation in the development process.

14.

-

- Sustainable agricultural practices that can address the challenges of environmental degradation and resource depletion include;

- Agroforestry: Integrating trees and shrubs into crop and livestock systems can improve soil health, increase biodiversity, and provide additional income sources.
- Conservation agriculture: Practices such as minimal soil disturbance, crop rotation, and cover cropping can enhance soil fertility, reduce erosion, and improve water retention.
- Organic farming: Avoiding synthetic fertilisers and pesticides helps maintain soil health, protect water quality, and support biodiversity.
- Integrated Pest Management (IPM): Combining biological, physical, and chemical methods to control pests can reduce reliance on harmful pesticides and promote ecological balance.

- Benefits of sustainable agricultural practices include:
  - Environmental health: Sustainable practices help preserve natural resources and reduce environmental impact.
  - Long-Term Productivity: Maintaining soil fertility and ecosystem health ensures sustained agricultural productivity.
  - Climate Resilience: Diverse and resilient farming systems can better withstand climate variability and extreme weather events.

15.

- Early-Stage Agricultural Development

  Challenges: Limited technology, low productivity, subsistence focus, reliance on manual labour, and minimal market integration.

  Nature of challenges: Basic survival and meeting immediate family needs were the primary concerns.

- Modern Industrial Agriculture

  Challenges: Environmental sustainability, resource management, technological integration, market volatility, and socio-economic inequalities.

  Complexity: Things have become more complicated because of globalisation, new technology, environmental issues, and social and economic factors.

- Evolution

  From survival to efficiency: The change from subsistence farming to market-oriented and industrial agriculture shows a shift from just trying to survive to focusing on producing as much as possible efficiently.

Environmental awareness: Growing awareness of environmental impacts has introduced new challenges related to sustainability and resource conservation.

Globalisation: Joining global markets has made things more complicated because of rules about trade, competition from other countries, and how easily farmers can sell their products.

SECTION 2

1. B. Biofuel processing
2. A. Corn can be processed into ethanol, a renewable fuel.
3. D. Poultry
4. B. fur
5. B. It serves as a natural fertiliser, adding nutrients to the soil.
6. Refer to the text on pages 35 to 36.
7. Animal waste, such as animal dung and decomposed animal parts, adds nutrients to the soil, thereby improving its fertility and making plant nutrients available for plant use. It also improves the soil structure and water infiltration rate, hence enhancing crop growth and development.
8.
   - Cocoa is a raw material obtained from crop production and is used by industries to manufacture Milo, chocolate, toffee and other products. The industries that depend on cocoa to be in business would collapse if they cannot come by it, and many people would be out of a job.
   - Sugarcane is equally obtained from crop production and is used by industries to manufacture sugar. Similarly, without sugarcane, industries that use it as a raw material cannot function, and workers in this industry will be jobless.
9. Integrating aquaponics in fish farming is environmentally beneficial as it creates a symbiotic system where fish waste serves as a nutrient source for plants, reducing the need for chemical fertilisers in crop production. Economically, it allows fish farmers to diversify their products by growing marketable vegetables alongside fish, enhancing revenue streams. This method conserves water compared to traditional agriculture and aquaculture, as water is recycled within the system. This integration supports both industries by reducing waste, conserving resources, and creating additional income.

10. The country should prioritise cotton, soybeans and corn. Cotton is essential for the textile industry and provides high economic returns in fabric production. Soybeans are versatile, supporting food production (edible oils) and biodiesel, which is renewable and environmentally friendly. Corn is valuable for both food products (corn syrup, oils) and biofuel, making it a key player in renewable energy. Together, these crops would enhance industrial diversity, contribute to sustainability, and strengthen economic stability.

SECTION 3

1. B. To determine property boundaries
2. A. Levelling
3. C. Spatial relationships and distortion
4. A. Geographic Information System
5. A. To assign spatial coordinates
6. C. By establishing a network of reference points
7. B. Purpose and content
8. C. By enabling large-scale data collection
9. Refer to the content on pages 45 to 46 for answers.
10. Refer to the content on pages 46 to 47 answers.

SECTION 4

1. A
2. B
3. B
4. D
5. Refrigeration in post-harvest storage is a key practice that extends shelf life, maintains quality, reduces waste, enables wider market access, and enhances food safety, making it an essential tool for the effective handling and distribution of fruits and vegetables.
6. Refer to the content on pages 70 to 72.
7. Refer to the content on pages 78.
8. Tools like grain dryers or dehydrators remove excess water from crops, which slows down the growth of mould, bacteria, and other organisms that cause spoilage. By keeping crops dry, these tools help extend the shelf life of produce and maintain its quality during storage and transportation.

9. Proper storage is essential in post-harvest management as it preserves the quality, freshness, and nutritional value of crops, extending their shelf life and reducing waste. By controlling temperature, humidity, and exposure to pests, storage systems like silos and cold storage slow spoilage, ensuring crops remain safe and marketable for longer. This stabilisation helps maintain a steady supply and can increase profits for farmers and distributors.

SECTION 5

1. D
2. B
3. A
4. B
5. C
6. Income Generation: Cash crops, such as cotton, coffee, and tobacco, provide farmers with a source of income that can be significantly higher than that from subsistence crops. This income allows families to invest in education, healthcare, and other essential services.

   Market Access: The cultivation of cash crops often opens up access to larger markets, both domestic and international. Farmers can sell their produce at higher prices, boosting their economic stability.

   Job Creation: The cultivation, processing, and distribution of cash crops create numerous job opportunities. This includes not only farming but also roles in transportation, marketing, and retail. Seasonal labour is often required, providing jobs for many in rural areas.

   Support Industries: The cash crop sector stimulates the growth of related industries, such as agrochemicals, machinery, and packaging. These industries further expand employment opportunities in rural communities.

   Infrastructure Improvement: Increased income from cash crops can lead to improvements in local infrastructure, such as roads, schools, and healthcare facilities. This development can enhance the overall quality of life and attract further investment.

   Cooperative Models: Many farmers form cooperatives to pool resources for the production and marketing of cash crops. This collective approach not only provides financial benefits but also fosters community solidarity and shared knowledge.
7. Refer to the content on pages 116 to 117 for solutions.
8. Possible answers are

- Growth and Yield: Increased temperatures can accelerate the growth of some vegetables, potentially leading to higher yields in the short term. However, extreme heat can stress plants, reduce yield, and affect quality.
- Heat Tolerance: Some vegetable varieties may struggle to adapt to rising temperatures, necessitating the development of heat-resistant cultivars.
- Increased Pest Pressure: Warmer temperatures can expand the range and lifecycle of pests, leading to increased infestations and potential crop damage.
- Disease Incidence: Higher humidity and temperature can create favourable conditions for plant diseases, necessitating more stringent disease management practices.
- Extended Growing Seasons: In some regions, climate change may lead to longer growing seasons, allowing farmers to produce multiple crops per year.
- Crop Timing: However, the unpredictability of weather patterns can complicate planting and harvesting schedules, affecting overall production.

9. Possible answers:

- These crops are relatively inexpensive to produce and widely cultivated, making them accessible to low-income populations.
- They are integral to food aid programs, ensuring nutrition in regions affected by poverty, conflict, or disasters.
- These crops are critical for the livelihoods of millions of farmers, particularly in developing countries. They generate income and employment opportunities in agriculture, processing, and distribution.
- They are heavily traded commodities, and their prices significantly impact global food markets.

10. possible answers are:

- High Nutritional Value: Poultry products, particularly eggs and chicken meat, are rich sources of protein, essential vitamins, and minerals. They contribute to improved dietary diversity and nutritional intake, especially in communities where other protein sources may be scarce or expensive.
- Affordable Protein Source: Poultry farming can provide a relatively low-cost source of animal protein, making it accessible for low-income families. This is particularly important in regions where malnutrition rates are high.
- Potential for Fortification: Eggs can be fortified with essential nutrients, making them a valuable food source for addressing specific deficiencies in vitamins A, D, and B12.

- Job Creation: Poultry farming generates employment opportunities not only for farmers but also for workers in feed production, processing, and distribution. This can significantly reduce unemployment rates in rural areas.
- Entrepreneurial Opportunities: Small-scale poultry farming allows individuals to start their own businesses, requiring relatively low initial investment compared to other agricultural enterprises. This fosters entrepreneurship and self-sufficiency.
- Women's Empowerment: Poultry farming often provides women with income-generating opportunities, helping to improve their social status and economic independence. This can lead to better education and health outcomes for their families.

SECTION 6

1. B. Nitrogen
2. D. Wild animals are hunted for sport or food
3. B. Gills
4. C. kill harmful microorganisms
5. D. Potassium sulphate
6. Human activities like deforestation, pollution and urbanisation lead to habitat loss and fragmentation, which negatively impact wildlife populations. Conservation measures include establishing protected areas and promoting sustainable land-use practices to mitigate these impacts.
7.
   - Substrate Quality: The substrates must provide the essential nutrients for mushroom growth. The pH of the substrate must be appropriate as it affects nutrient uptake and mycelium development. The substrate should also contain the proper moisture levels, which are important for mycelium colonisation and fruiting.
   - Solutions: Ensure the substrate has the right balance of carbon, nitrogen, and other nutrients. Supplement with organic materials like straw, sawdust, or manure as needed. Use lime to increase pH or gypsum to decrease it, maintaining an optimal range (typically 6.0-7.5) for the specific mushroom species. Regularly monitor and adjust moisture levels. Use hygrometers and moisture meters to keep the substrate adequately hydrated without becoming waterlogged.

ANSWERS TO REVIEW QUESTIONS

- Sterilisation and Pasteurisation: the presence of contaminants like microorganisms can outcompete the mushroom mycelium. Ineffective sterilisation or pasteurisation can lead to contamination.
- Solutions: Use proper sterilisation techniques like autoclaving for smaller batches or steam pasteurisation for larger ones. Ensure the substrate reaches the required temperature for sufficient time (e.g., 60-90 minutes at 121°C for autoclaving). Maintain cleanliness in the growing environment. Regularly disinfect tools, containers, and surfaces.
- Environmental Conditions: Different stages of growth require specific temperature ranges. High humidity is necessary during the fruiting stage. Some light exposure is needed for fruiting, depending on the species. Proper ventilation is crucial to remove excess CO2 and provide fresh air.
- Solutions: Use heating or cooling systems to maintain optimal temperatures for each growth stage (e.g., 20-24°C for spawn run, 15-18°C for fruiting). Use humidifiers and misters to maintain high humidity levels (80-95%) during fruiting. Monitor with hygrometers. Provide indirect light for species requiring it during fruiting. Use grow lights if natural light is insufficient. Install fans and air exchange systems to ensure adequate airflow. CO2 levels should be kept low, especially during fruiting.
- Strain Selection: Different strains have varying yields, disease resistance and growth characteristics. Some strains are better suited to specific substrates.
- Solutions: Choose strains known for high yields and disease resistance. Use reliable suppliers and possibly experiment with different strains to find the best fit. Select strains that perform well with the chosen substrate
- Cultivation Techniques: The method and timing of inoculation affect mycelium spread. For some mushrooms, a casing layer is crucial for fruiting. Proper harvesting techniques prevent damage to the mushrooms.
- Solutions: Use sterile techniques and ensure even distribution of the spawn. Inoculate at the right temperature to encourage quick colonisation. Apply a properly prepared casing layer (e.g., peat moss and lime) and maintain its moisture. Harvest mushrooms at the right time, using clean tools to avoid damage and contamination. Harvest mushrooms at their peak for the best quality.

ANSWERS TO REVIEW QUESTIONS

8. Comparison between organic and synthetic fertilisers

Aspect	Organic Fertilisers	Synthetic Fertilisers
a. Soil Health	• Improves soil structure • Promotes microbial activity • Long-term nutrient release	• Can degrade soil structure over time • May reduce microbial activity
b. Nutrient Content and Availability	• Slow and steady nutrient release • Provides a broad spectrum of nutrients	• Immediate and precise nutrient availability • High nutrient concentration
c. Cost and Application	• Bulkier, more labour-intensive • Often variable cost	• Easier application • Generally, more cost-effective on a per-nutrient basis
d. Pollution Risk	Lower risk of runoff and leaching	Higher risk of runoff and leaching
e. Application erequency	May require more frequent application due to slower nutrient release	Less frequent application due to immediate nutrient availability

9.

A. Refer to the content on pages 173 to 177 for answers

B. Through soil analysis. It is always advisable to conduct soil analysis to confirm the nutrient lacking before applying fertilisers.

C.

- Yellowing of older leaves = ammonium nitrate, urea or blood meal
- Dark green or purple leaves = superphosphate or bone meal.
- Weak root system = NPK 15:15:15, seaweed
- Yellowing between leaf veins = magnesium sulphate or dolomitic lime.
- Yellowing of younger leaves, delayed maturity = NPK 15-5-15, blood meal or potash
- Stunted growth = compost or chicken manure
- Poor fruit development = potash or seaweed extracts

ANSWERS TO REVIEW QUESTIONS

10.

- Economic Effects of Continuous Fertiliser Use in Crop Production

  Increased Input Costs: The over-reliance on fertilisers can result in increased input costs for farmers, as fertilisers are a major operating cost in agriculture, and the increasing prices of synthetic fertilisers can strain farmers' finances.

  Decreased Soil Fertility: Continuous use of chemical fertilisers, without replenishing organic matter through crop rotation or organic amendments, can lead to decreased soil fertility. This results in the soil becoming less productive over time, necessitating the application of more fertiliser to achieve the same yields.

  Market and Export Challenges: Fertiliser overuse can sometimes lead to unsustainable agricultural practices that may not align with international sustainability standards. This can lead to market access issues, especially in countries that value environmentally friendly practices or in export markets that demand organic products.

- Ways of minimising the economic effect

  Through Soil Testing: Regular soil testing allows farmers to apply fertilisers only where and when they are needed, reducing unnecessary expenditures.

  Practising Precision Agriculture: By using precision farming tools (like GPS and soil sensors), fertilisers can be applied more efficiently, ensuring crops get the right amount at the right time.

  Integrated Nutrient Management (INM): Combining organic and inorganic fertilisers to optimise nutrient supply and minimise dependency on synthetic fertilisers.

  Organic Practices: Introducing organic matter like compost, green manures, and cover crops can improve soil structure, boost microbial life, and reduce the need for constant fertiliser application.

  Certification Programs: Adopting sustainability standards and obtaining certifications (such as organic or eco-labels) can help in improving market access while reducing fertiliser dependency.

- Ecological Effects of Continuous Use of fertiliser in crop production

  Water Pollution: Continuous fertiliser application can lead to runoff, where nitrogen and phosphorus from fertilisers wash into nearby rivers, lakes and coastal areas, which can cause the population of algae to increase and deplete the oxygen content in the water, creating "dead zones" where aquatic life cannot survive.

Soil Acidification: The continuous use of ammonium-based fertilisers (like ammonium nitrate or urea) can cause soil acidification. Acidic soils reduce the availability of essential nutrients like calcium, magnesium and phosphorus, and may harm soil microbial populations, reducing soil health and productivity.

Biodiversity Loss: Over-fertilisation can reduce biodiversity by disrupting ecosystems. Excess nitrogen, for example, can favour the growth of certain plant species (like grasses) over others, leading to monocultures and a loss of species diversity. Fertilisers can also harm soil organisms such as earthworms, which play a crucial role in maintaining soil health.

Greenhouse Gas Emissions: Fertiliser application, particularly nitrogen fertilisers, can contribute to greenhouse gas emissions, specifically nitrous oxide (N_2O), a potent greenhouse gas. The over-application of nitrogen can lead to the loss of nitrogen through volatilisation (as ammonia gas) or denitrification, both of which contribute to climate change.

- Ways of minimising the ecological effect

  Cover Cropping: Growing cover crops helps restore organic matter, promotes soil biodiversity, and reduces the need for excessive fertiliser.

  Using Nitrogen Stabilisers: Adding nitrification inhibitors to fertilisers can reduce the microbial processes that lead to nitrous oxide emissions.

  Creating buffer Zones: Planting grass or vegetation along waterways can act as a natural filter, reducing fertiliser runoff.

  Reducing Fertiliser Use in Sensitive Areas: Farmers can avoid over-fertilising in areas near water bodies or in regions prone to leaching.

  Use of Less Acidifying Fertilisers: Switching to fertilisers that are less likely to acidify the soil, such as potassium nitrate or urea, can reduce this impact.

SECTION 7

1. Rust
2. Whiteflies and bacterial wilt; application of neem oil and crop rotation
3. Laboured breathing and gasping at the water surface
4. Bacteria
5. Erratic swimming behaviour
6. Galls or swellings on roots
7. Refer to the text on pages 228, 230 to 231.

ANSWERS TO REVIEW QUESTIONS

8. Factors that predispose animals/fish to diseases include:
   - Nutritional factors can lead to diseases as a result of poor diet, overfeeding, underfeeding or eating contaminated food or water.
   - Environmental factors such as poor hygiene, overcrowding, poor ventilation and extreme temperature can bring about disease infections.
   - Chemical exposure is another factor that can lead to diseases as a result of consuming toxins or incorrect medication.
9. Lack of nutrients or inadequate nutrients can bring about low productivity and poor growth, hence affecting the performance of the animal/fish. For example, calcium deficiency can lead to milk fever in dairy cattle or soft egg shells in poultry.
10.
    A. Possible Diseases
       - Dairy cows: Bovine respiratory disease complex (BRDC), possibly caused by viruses (e.g., Bovine herpesvirus), bacteria (e.g., Pasteurella multocida), or both.
       - Laying hens: Feather loss and lethargy could be due to external parasites like mites (scaly leg mites) or nutritional deficiencies.

    B. Causes
       - **Dairy cows:** Poor ventilation, stress from new animals, lack of vaccination.
       - **Laying hens:** Overcrowding, delayed cleaning, inconsistent vaccination and parasite control.

    C. Biosecurity Measures
       - Restrict farm access to essential personnel only.
       - Implement strict quarantine protocols for new animals.
       - Regularly clean and disinfect equipment and housing.

    D. Importance of Vaccination:
       - Prevents common diseases and reduces the overall pathogen load.
       - Regular health check-ups help in the early detection and management of diseases.

    E. Environmental Factors
       - Poor ventilation can increase humidity and the spread of respiratory pathogens.

- Poor hygiene and overcrowding can lead to the spread of parasites and pathogens.

F. Action Plan

- Train staff on disease recognition and management.
- Schedule regular veterinary visits for health check-ups and vaccinations.
- Implement a comprehensive record-keeping system for monitoring animal health.

SECTION 8

1. Optimising resource allocation
2. Scarcity Principle
3. Microeconomics focuses on individual markets; macroeconomics focuses on the overall economy.
4. The benefit of choosing one option over another
5. Capitalism
6. Build relationships
7. Mass media
8. All of the above
9. Operational management
10. All of the above
11. The concept of scarcity and its implications for agricultural enterprises.

    Scarcity refers to the fundamental economic problem of limited resources. In agriculture, scarcity affects inputs (land, labour, water), outputs (crops, livestock), and resources (finance, technology). Agricultural enterprises must allocate resources efficiently to maximise production and profitability. Scarcity implications include:

    - Opportunity costs: Choosing between alternatives.
    - Resource allocation: Prioritising uses.
    - Price determination: Influencing market prices.

    Understanding scarcity enables agricultural entrepreneurs to make informed decisions, optimise resource use, and adapt to changing market conditions.
12. Marketing strategy to promote a new product
    - Conduct market research to understand consumer preferences.

- Create a social media campaign highlighting product benefits.
- Partner with local health food stores for distribution.
- Iv. Develop eye-catching packaging and labelling.
- Offer discounts for bulk purchases.

13. Components of a business plan for an agricultural enterprise

- Executive summary.
- Market analysis.
- Production plan.
- Marketing strategy.
- Financial projections.

14. Digital communication has significantly improved agricultural marketing in Ghana by making information and markets more accessible to farmers. Through mobile phones, social media platforms, and online marketplaces, farmers can advertise their produce, communicate directly with buyers, and access real-time price information. This reduces dependence on middlemen, improves bargaining power, and helps farmers obtain better prices for their products.

However, the impact is not uniform across the country. Many smallholder farmers, especially in rural areas, face challenges such as limited internet access, high data costs, low digital literacy, and unreliable electricity. Despite these challenges, digital communication has increased efficiency, expanded market reach, and created new opportunities for agribusinesses, making it an important tool for improving agricultural marketing in Ghana

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GLOSSARY

- **Advocacy:** when people speak up and take action to support a cause or help others. It involves raising awareness, influencing decisions, and pushing for changes to improve situations or protect rights.
- **Agribusiness:** Integrated businesses involving agricultural production, processing, and marketing.
- **Agricultural Enterprise:** Business venture involving agricultural production and/or processing.
- **Agricultural Marketing:** Processes involved in moving agricultural products from producers to consumers.
- **Altitude:** The vertical distance of a point or object above sea level.
- **Aquariums:** Places or containers where fish and other aquatic animals are kept for display, study, or education.
- **Arable Crops:** Crops that are grown primarily for food, feed, or fibre on land that can be ploughed and tilled.
- **Azimuth:** A horizontal angle measured clockwise from north to a point or object.
- **Bagasse:** The dry, fibrous material that remains after juice is squeezed from sugarcane, commonly used as fuel or to make paper and boards.
- **Banding:** is a fertiliser application method where fertilisers are placed in bands close to the seed or plant roots.
- **Baseline:** A reference line used for surveying and mapping.
- **Bio-composite Materials:** Materials made by combining natural fibres (like plant fibres) with other materials to make strong, useful products.
- **Biodegradable materials :** Materials that are able to break down naturally in the environment by microorganisms without causing harm.
- **Biodiversity Protection:** Actions taken to protect different types of plants, animals, and ecosystems from harm or extinction.
- **Bioenergy:** Energy produced from plant or animal materials, such as wood, crop waste, or animal manure.
- **Biofuel:** This is a fuel that is made from living things or their waste.
- **Biomedical Research:** Scientific studies that help us understand the human body and develop new medicines and medical treatments.
- **Biosecurity:** A set of measures implemented to prevent the introduction and spread of harmful organisms, such as diseases and pests, in agricultural settings.
- **Broadcasting:** is a fertiliser application method where fertilisers are spread evenly over the soil surface.
- **Brood:** A group of young birds, particularly those that are hatched at the same time and are cared for together. The term can also refer to the act of incubating eggs and raising young birds until they are independent.
- **Cadastre:** A public record of property boundaries and ownership.
- **Climate change:** when the Earth's usual weather patterns change over a long period of time. This can mean more extreme weather, like hotter days, heavier rain or longer droughts. These changes are mostly caused by human activities, like burning fossil fuels (coal, oil, and gas), which release gases that trap heat in the atmosphere.

- **Coccidiostats:** Substances added to animal feed or water to prevent or control coccidiosis, a parasitic disease caused by protozoa
- **Collagen:** A natural protein found in the skin, bones, and connective tissues that helps give strength and structure to the body.
- **Communication Channel:** Medium through which information is transmitted (e.g., social media, print, radio).
- **Contour:** An imaginary line connecting points of equal elevation.
- **Conveyor:** A conveyor is a mechanical device used to transport materials or objects from one location to another.
- **Coordinate:** A set of numbers defining a point's location (x, y, z).
- **Cosmetic:** This is a preparation applied to the body to improve its appearance.
- **Crop Residues:** The parts of crops left on the farm after harvesting, such as stalks, leaves, and husks.
- **Culling:** The process of removing animals from a flock or herd based on specific criteria, such as age, health, or productivity.
- **Cylindrical Channels:** Tube-shaped spaces or holes in soil or pipes that allow water or air to move through.
- **Data Processing:** Collecting, organising, and analysing information to make it useful and understandable.
- **Dehuskers:** Machines used to remove the outer covering (husk) from grains such as rice or maize.
- **Demand:** Quantity of a commodity consumers are willing and able to purchase at a given price.
- **Disease:** It is any abnormal condition caused by pathogenic organisms or environmental factors.
- **Disinfectant Footbaths:** Containers filled with disinfectant solution placed at farm entrances to clean footwear and prevent the spread of diseases.
- **Drainage:** Drainage is the process of removing excess water from the soil, such as waste water from irrigation or surface runoff.
- **Ecological Balance:** The natural balance between plants, animals, and the environment that allows ecosystems to function properly.
- **Economic Growth:** Economic growth is when a country produces more goods and services over time, leading to better jobs, higher incomes and improved living standards for its people.
- **Ecosystem Services:** Benefits that humans get from nature, such as clean air, clean water, food, and soil fertility.
- **Ectoparasite:** It is a parasite that live on the exterior surface of their host.
- **Endoparasite:** It is a parasite that live inside the body of their host.
- **Equilibrium Price:** Price at which demand equals supply.
- **Fertigation:** is a fertiliser application method where fertilisers are delivered through irrigation systems.
- **Fertilisers:** are substances that provide essential nutrients to plants to help them grow better and produce more crops.

- **Financial Management:** Planning, organising, and controlling financial resources.
- **Foliar Application:** is a fertiliser application method where liquid fertilisers are sprayed directly onto plant leaves.
- **Food Security:** A situation where all people have enough safe and nutritious food to eat at all times for a healthy life.
- **Game:** are wild animals that are hunted for meat, fun, sport, fur or other products
- **GDP (Gross Domestic Product):** GDP is the total monetary value of all goods and services produced within a country's borders over a specific time period, usually annually or quarterly.
- **Gelatine:** A protein product made from animal bones or skin, used in foods, medicines, and cosmetics.
- **Georeferencing:** Assigning spatial coordinates to map data.
- **Ghana's GDP (Gross Domestic Product):** The total value of all goods and services produced in Ghana within one year, used to measure the country's economic performance.
- **Governmental organisations:** are organisations that are created and run by the government to provide services, enforce laws, and manage public resources. For example, ministry of food and Agriculture, Environmental protection Agency, Council for Scientific and Industrial Research, Ghana Cocoa Board.
- **Harvesters:** are machines used to gather and collect crops from the field after they have been grown and are ready for harvest.
- **Implements:** Farm implements refer to the various tools and equipment used in agricultural activities.
- **Incubation:** refers to the period during which eggs are kept warm to allow the embryos to grow and eventually hatch into chicks.
- **Industry:** It is an economic activity concerned with the processing of raw materials and manufacture of goods in factories or a group of similar nature of firms which produce same goods or services.
- **Installation:** The process of setting up equipment or systems so they are ready to use.
- **Irrigation:** Irrigation refers to the artificial application of water to the soil to provide moisture needed for plant growth, where rainfall is insufficient.
- **Landscape:** The visible features of an area of land, including hills, rivers, plants, and buildings.
- **Land Tenure:** The system that explains who owns land, who can use it, and how the land can be transferred or shared.
- **Leached:** When nutrients or salts are washed down through the soil by water.
- **Levelling:** Measuring vertical distances and heights.
- **Macronutrients:** are nutrients required by plants in large amounts to support growth and yield. E.g. Nitrogen(N), Phosphorus(P), Potassium (K), Calcium (Ca), Magnesium (Mg) and Sulphur (S)
- **Managerial Characteristics:** Traits necessary for effective agribusiness management (e.g., leadership, decision-making).
- **Manual:** Manual refers to tasks or processes that are carried out by hand, without the aid of machines or automation.
- **Map Projection:** A method of representing Earth's surface on a flat map.

- **Market Analysis:** Study of market trends, competition, and consumer behaviour.
- **Market Fluctuations:** Changes in market prices and demand.
- **Mechanisation:** The use of machines and tools, such as tractors and harvesters, to make farm work easier, faster, and more efficient.
- **Micronutrients:** are nutrients required by plants in smaller amounts but are still crucial for plant health and development. Examples are; Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Boron (B), Molybdenum (Mo) and Chlorine (Cl).
- **Molasses:** A thick, dark syrup left after sugar is made from sugarcane or sugar beet, often used in food, animal feed, and industry.
- **Mushrooms:** are type of fungus with a stem, cap and gills or pores underneath the cap. They belong to the Fungi kingdom and come in many different shapes, sizes, colours and textures
- **Non-governmental organisations (NGO):** are organisations that are not run by the government. They work independently to help people, protect the environment, support communities, or promote certain causes. Example Care International, Oxfam Ghana, Send Ghana, ProFams Gateway.
- **Nutrient deficiency symptoms:** are visible signs in plants indicating a lack of essential nutrients needed for growth and development. These symptoms include yellowing leaves, stunted growth, poor flowering, or discoloration, depending on which nutrient is missing.
- **Ornamental Crops:** Plants cultivated primarily for decorative purposes rather than for food or other practical uses.
- **Orthophoto:** An aerial photograph corrected for distortion.
- **Parasite:** Refers to any organism that live on or inside other organisms deriving their nutrition at the host expense.
- **Percolation:** The slow movement of water downward through soil.
- **Pest:** Is any organism that adversely affect the health, growth or productivity of crop or animal.
- **Pest and Disease Management:** The use of methods to prevent, control, or reduce pests and diseases that affect crops and animals.
- **Pharmaceutical:** is the manufacture and sale of medicine /drugs
- **Pharmaceutical Industry:** The sector that develops, produces, and distributes medicines used to prevent, treat, and cure diseases.
- **Policy:** A set of rules or plans made by governments or organisations to guide decisions and actions.
- **Post-harvest:** The post-harvest system encompasses all the activities and processes involved in delivering a crop from the time and place of harvest to the time and place of consumption.
- **Productivity:** Is the efficiency of production of goods or services expressed by some measure.
- **Pulverisers:** Machines or tools used to crush materials into very small pieces or powder.
- Raw materials are input goods or inventory that a company needs to manufacture its products or the basic material from which a product is made.
- **Record Keeping:** Systematic documentation of agricultural enterprise transactions and activities.

- **Regulatory Compliance:** Following rules, laws, and guidelines set by authorities or governments.
- **Remote Sensing:** Acquiring data without physical contact.
- **Renewable Energy:** Energy that comes from natural sources that do not run out, such as sunlight, wind, water, and plants.
- **Resilient:** Able to recover quickly from difficulties such as disasters, climate change, or economic problems.
- **Resource Management:** The careful planning and use of natural, human, and financial resources so they are not wasted and can last longer.
- **Risk Management:** The process of identifying possible problems and taking steps to reduce their negative effects.
- **Roost:** a perch on which domestic fowl rest or sleep.
- **Safaris and Birdwatching:** Tourism activities where people visit natural areas to observe wildlife and birds in their natural habitats.
- **Salinisation:** The build-up of salt in the soil, which can reduce soil fertility and harm plant growth.
- **Scale:** The ratio of map distance to actual distance.
- **SDGs (Sustainable Development Goals):** Seventeen global goals set by the United Nations to end poverty, protect the environment, and improve life for everyone by 2030.
- **Shellers:** Shellers are machines used to remove the kernels or seeds from the cobs or pods of crops, such as corn or peanuts.
- **Side-Dressing:** is a fertiliser application method where fertilisers are applied along the sides of growing plants.
- **Soil fertility:** refers to the soil's ability to provide the necessary nutrients for crops to grow well and produce good yields
- **Soil nutrients:** are essential elements that plants need to grow and develop properly
- **Soil productivity:** is the ability of soil to support crop growth and produce high yields.
- **Spatial Analysis:** Studying information based on location to understand patterns, relationships, and trends on maps.
- **Subsistence Agriculture:** is when farmers grow just enough food to feed themselves and their families. They don't usually sell much of what they produce because they need it for their own survival.
- **Subsistence Farming:** A type of farming where farmers grow food mainly to feed themselves and their families, with little or no food left to sell.
- **Suffocating Roots:** A condition where plant roots do not get enough air because the soil is too wet.
- **Supply:** Quantity of a commodity producers are willing and able to produce and sell at a given price.
- **Sustainable Agriculture:** farming in a way that protects the environment, supports farmers and provides healthy food. It involves using methods that don't harm the soil, water, or other natural resources, so that farming can continue for future generations.
- **Symptom:** It is a physical or mental feature which is regarded as indicating a condition of a disease.

- **Technological Integration:** Using technology, such as computers and mobile phones, together with traditional methods to improve work and learning.
- **Threshers:** Threshers are agricultural machines used to separate the grain or seeds from the stalks and husks of crops, such as wheat, rice, or soybeans.
- **Topography:** The study of Earth's surface features and landforms.
- **Triangulation:** A surveying method using triangles to establish points.
- **Vaccination:** The process of administering a vaccine to an individual (human or animal) to stimulate the immune system and provide protection against specific infectious diseases
- **Vaccine:** A substance given to animals or humans to help protect them from diseases by building immunity.
- **Value Chain:** Series of processes from production to distribution.
- **Vegetables:** Edible plant parts, including leaves, stems, roots, bulbs, and fruits, that are consumed as food.
- Waste materials are substances discarded after the primary use, defective and is of no use.
- **Water Conservation:** The careful and wise use of water to reduce waste and protect water resources.
- **Waterlogged:** Waterlogging refers to a condition where the soil becomes saturated with water, usually due to poor drainage or excessive irrigation
- **Water Table:** The level underground where soil and rocks are fully soaked with water.
- Wildlife: are animals, plants, fungi and other living things that are not tamed and live in nature

Acknowledgements

Ghana Education Service (GES)

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