



MINISTRY OF EDUCATION

AGRICULTURE

for Senior High Schools

TEACHER MANUAL

YEAR TWO



NATIONAL COUNCIL FOR
CURRICULUM & ASSESSMENT
OF MINISTRY OF EDUCATION

MINISTRY OF EDUCATION



REPUBLIC OF GHANA

AGRICULTURE

For Senior High Schools Teacher Manual

Year Two



**NATIONAL COUNCIL FOR
CURRICULUM & ASSESSMENT
OF MINISTRY OF EDUCATION**

AGRICULTURE TEACHER MANUAL

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Introduction

The National Council for Curriculum and Assessment (NaCCA) has developed a new Senior High School (SHS) curriculum which aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, competencies, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, further their education and enter the world of work.

This is the first time that Ghana has developed an SHS 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.

This Teacher Manual for Agriculture is a single reference document which covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively teach Year Two of the new curriculum. It contains information for all 24 weeks of Year Two including the nine key assessments required for the Student Transcript Portal (STP).

Thank you for your continued efforts in teaching our children to become responsible citizens.

It is our belief that, if implemented effectively, this new curriculum 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.

Acknowledgements

Special thanks to Professor Samuel Ofori Bekoe, Director-General of the National Council for Curriculum and Assessment (NaCCA) and all who contributed to the successful writing of the Teacher Manuals for the new Senior High School (SHS) curriculum.

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SECTION 1: AGRICULTURAL DEVELOPMENT IN AN INDUSTRIALISING SOCIETY

Strand: **Concept of Agriculture in an Industrialising Society**

Sub-strand: **Agriculture and Society**

Week 1

Learning Outcome: Use the knowledge acquired to explain the importance of Agricultural development to the national economy.

Content Standard: Demonstrate knowledge and understanding of the meaning, importance, roles and stages of Agricultural development.

Week 2

Learning Outcome: Use the knowledge acquired to identify the various land tenure systems and their effects on agricultural production.

Content Standard: Demonstrate knowledge and understanding of land tenure systems and their effect on Agriculture production

Hint



- Remind learners to create a portfolio to show performance progress in the academic year.
- Refer to appendix A for sample portfolio assessment to be submit in Week 23.
- The report on the research work will be given in Week 2 should be submitted in Week 5.

INTRODUCTION AND SECTION SUMMARY

Agricultural development in an industrialising society forms the basis for accelerated socio-economic development of countries that are agriculture inclined. It serves as the tool for industrialisation for food security and economic advancement. This is crucial especially in Ghana where agriculture is the mainstay for a large percentage of the population particularly those who depend on agriculture as a source of livelihood. This section will introduce learners to the nuances of agricultural development including the stages of development, the challenges that hinder the developmental processes and how to overcome them .

This section emphasises the role of government and non-governmental organisations (NGOs) in the development of agriculture. It also sheds light on the land tenure systems in agricultural production and the implications on the development of agriculture. This will help learners to appreciate the dynamics of agricultural development and how to contribute to the development of Agriculture in Ghana and beyond. This section is linked with other subjects such as Social Studies, Government, Economics and Business Studies.

The weeks covered by the section are:

Week 1: Meaning, Importance and Stages of Agricultural Development and the Roles of Governmental and Non-Governmental Organisations in Agricultural Development.

Week 2: Land Tenure Systems in Ghana and Their Effects on Agricultural Production.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The suggested pedagogical strategies to be used include initiating talk for learning, experiential learning, think-pair-share, project-based learning, managing talk for learning and collaborative learning. The teacher should use initiating talk for learning, think-pair-share and collaborative learning to enable learners to share their views and experiences on agricultural development, the role of government and non-governmental organisations in agricultural development and the effects of land tenure systems in agricultural production. For project-based and experiential learning, learners will be required to surf the internet, watch videos, draw a map or create a diagram and to undertake research where necessary. Critical thinking skills, communication, digital literacy and collaboration skills of learners will be enhanced as they surf the internet, share their views and experiences. Teachers should ensure that the videos/pictures used do not enforce stereotyping. Teachers should endeavour to involve introverts and learners with speech problems in the report presentations. Teachers should also ensure that learners do not sway into unapproved sites during the surfing of the internet for information. Learners should be encouraged to work in mixed-ability and mixed-gender (where appropriate) groups, in pairs or as individuals as and when necessary.

ASSESSMENT SUMMARY

The assessment for this section will examine issues on Agricultural development in an industrialising society and the role of governmental organisation and non-governmental organisation (NGOs) in agricultural development. It should also cover the effects of land tenure systems in the development of Agriculture and how land tenure systems both impart and affect agricultural production. The questions should have a balance of the various depth of knowledge (DoK), that is, Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning) assessments. Summative and formative assessments using strategies such as group discussions, presentations, homework, class exercises, class tests and project-based work should be given. The teacher should accept varying number of demonstrations, oral and written responses. He/she should develop rubrics and marking scheme to score group presentations and assignments.

WEEK 1

Learning Indicators

1. *Explain the meaning, importance and stages of agriculture development.*
2. *Discuss the roles of governmental and non-governmental organisations in agricultural development.*

Focal Area 1: **Meaning, Importance and Stages of Agricultural Development.**

1. **Meaning of Agricultural Development**

Agricultural development is the process of improving the efficiency, productivity and sustainability of agricultural practices to enhance economic growth, reduce poverty and ensure food security. It involves the adoption of new technologies, sustainable farming methods, infrastructure improvement and the empowerment of farmers through education and access to resources. Agricultural development is critical for economic growth, poverty reduction, food security, environmental sustainability, and social empowerment.

2. **Importance of Agricultural Development**

- a. **Economic Growth and Poverty Reduction:** Agricultural development is a key driver of economic growth, especially in rural areas where it is often the primary source of income. Enhanced Agricultural productivity leads to higher incomes for farmers, thereby reducing poverty.
- b. **Food Security:** Improved Agricultural practices ensure a stable and sufficient supply of food, which is essential for food security. By increasing Agricultural productivity and diversifying Agricultural production, Agricultural development helps meet the growing demand for food.
- c. **Sustainable Development:** Sustainable Agricultural practices protect natural resources and help mitigate the impacts of climate change. By promoting soil health, water conservation, and biodiversity, Agricultural development supports long-term environmental sustainability.
- d. **Social Empowerment:** Agricultural development also empowers rural communities by providing them with the knowledge, tools and resources needed to improve their livelihoods. This is particularly important for women, who play a significant role in Agriculture. Empowering women in Agriculture leads to better productivity and economic outcomes.
- e. **Infrastructure and Market Access:** Development in Agriculture often includes building infrastructure such as roads, storage facilities and markets, which are essential for reducing post-harvest losses and improving market access for farmers. This facilitates better integration into local, national and global markets, enhancing economic opportunities.
- f. **Employment Creation:** Agricultural development significantly contributes to employment, particularly in rural areas where Agriculture is the primary livelihood. In many developing countries, Agriculture is the largest employer, engaging a significant

portion of the population, therefore, as Agricultural productivity and efficiency improve, there is a corresponding increase in the demand for labor to manage more intensive farming operations, handle improved technologies and manage increased production. Agricultural development also leads to the creation of various off-farm jobs such as those in food processing, logistics, marketing and agribusiness.

3. Stages and Challenges of Agricultural Development

Agricultural development has progressed through several stages, each characterised by specific changes in technology, production methods and economic dynamics. Here are the five (5) major stages of Agricultural development:

- a. **Stage 1: Subsistence Agriculture:** This is the initial stage in Agricultural development which is characterised by small-scale farming primarily to meet the immediate needs of the farmer's family. There is minimal surplus for trade or sale. It involves the use of traditional tools and techniques, reliance on family labour and limited use of external inputs like fertilisers and pesticides. It has low productivity and minimal economic growth, but critical for survival in rural and developing regions.

Challenges

- i. **Low Productivity:** Subsistence farmers often lack access to modern tools, fertilisers, and improved seed varieties, resulting in low yields.
 - ii. **Vulnerability to Environmental Changes:** These farmers are highly dependent on natural rainfall and are vulnerable to climate variability and extreme weather events.
 - iii. **Limited Market Access:** There is often minimal surplus production, and farmers may have limited access to markets due to poor infrastructure.
 - iv. **Poverty and Food Insecurity:** Many subsistence farmers live in poverty and struggle with food insecurity due to their low productivity and limited resources.
- b. **Stage 2: Transitional Agriculture:** This stage involves a shift from purely subsistence farming to more market-oriented production. Farmers begin to produce surplus produce for sale. There is an introduction of improved farming techniques and inputs, partial mechanisation and better access to markets. It is characterised by increased productivity, higher incomes and greater integration into the local economy.

Challenges

- i. **Access to Capital:** Transitioning to more market-oriented Agriculture requires investment in inputs and infrastructure, which can be challenging due to limited access to credit and financial services.
 - ii. **Knowledge and Skills Gap:** Farmers need training and education to adopt new techniques and technologies effectively.
 - iii. **Infrastructure Deficiencies:** Poor roads, storage facilities, and market infrastructure can hinder the ability to sell surplus produce profitably.
 - iv. **Market Volatility:** Farmers may be exposed to price volatility in the markets, which can impact their income stability.
- c. **Stage 3: Commercial Agriculture:** At this stage, farming becomes a business enterprise focused on maximising profit. Production is highly market-oriented, with significant

investment in inputs and technology. There is the use of advanced machinery, high-yield crop varieties and animal breeds, extensive use of fertilisers and pesticides and sophisticated supply chains. There is also substantial increase in productivity and efficiency, large-scale production and significant contribution to the national economy.

Challenges

- i. **Environmental Degradation:** Intensive farming practices can lead to soil depletion, water overuse, and pollution from agrochemicals.
- ii. **Market Access and Competition:** While production increases, accessing broader markets and competing with established players can be difficult.
- iii. **Income Inequality:** There can be a growing disparity between small-scale farmers and large agribusinesses.
- iv. **Dependence on External Inputs:** High dependence on purchased inputs such as seeds, fertilisers, and pesticides can be costly and unsustainable in the long run.
- d. **Stage 4: Industrial Agriculture:** This stage is characterised by the large-scale, industrial production of crops and livestock. It involves highly mechanised and technologically advanced farming practices. It also involves the extensive use of technology, biotechnology, precision farming and vertical integration of Agricultural businesses. It has very high productivity, economies of scale, but also potential environmental and social concerns such as pollution, biodiversity loss and rural employment issues.

Challenges

- i. **Environmental Impact:** Industrial Agriculture is often associated with significant environmental issues, including greenhouse gas emissions, deforestation and loss of biodiversity.
- ii. **Social Issues:** The industrial model can lead to rural depopulation and the decline of small farms, concentrating land and resources in the hands of a few large corporations.
- iii. **Sustainability Concerns:** Over-reliance on chemical inputs and monoculture practices can threaten long-term agricultural sustainability.
- iv. **Health and Safety:** Concerns about food safety, pesticide residues and the ethical treatment of animals are prevalent in industrial Agriculture.
- e. **Stage 5: Sustainable Agriculture:** In response to the environmental and social challenges of industrial Agriculture, the sustainable Agriculture stage focuses on balancing productivity with environmental stewardship and social equity. Its practices include organic farming, agroecology, conservation Agriculture, integrated pest management and sustainable water use. It gives enhanced long-term productivity, reduced environmental footprint, improved soil health and better adaptation to climate change.

Challenges

- i. **Transition Costs:** Shifting from conventional to sustainable practices can involve significant initial costs and require substantial changes in farming techniques.
- ii. **Knowledge and Training:** Farmers need access to education and support to implement sustainable practices effectively.

- iii. **Market Incentives:** There is often a lack of market incentives and support for sustainable products, which can make it difficult for farmers to achieve economic viability.
- iv. **Policy and Regulation:** Inadequate policy support and regulatory frameworks can hinder the adoption of sustainable practices.
- v. **Scale and Efficiency:** Sustainable practices can sometimes be less efficient at larger scales, requiring more labor and careful management to maintain productivity,

Learning Tasks

1. State the meaning and importance of Agricultural development.
2. Explain the stages of Agricultural development.
3. Discuss the challenges of Agricultural development and suggest solutions to them.

Pedagogical Exemplars

1. **Initiating talk for learning:** Learners in mixed-ability groups brainstorm to come up with the meaning of Agricultural development. In the same groups, learners surf for information and discuss the importance of Agricultural development in Ghana, West Africa and the World. Provide learners with links to websites where they can get the necessary information. Use leading questions to guide learners with difficulties in their brainstorming to come up with the meaning and importance of Agricultural development in Ghana. Allow learners who are exceptional to give detailed information on the meaning and importance of Agricultural development. Learners should be encouraged to discuss the roles of men, women and persons with disabilities in the Agricultural development process.
2. **Structured talk for learning:** Learners in gender-based groups watch a short documentary on Agricultural development and discuss the stages and challenges of Agricultural development, and suggest possible solutions. Learners with sight and hearing challenges should be seated in a way to benefit from the documentary. Encourage learners to write down questions from the documentary so they can ask after the documentary. Provide learners with leading questions that will let them reflect on how poor rural farmers manage the transition from one stage to the other.
3. **Project-based learning:** Learners in mixed ability groups undertake research on how Ghana's Agricultural has developed through the years and present their report in a plenary session in the class. Encourage all learners to take active part in the research activity.

Key Assessments

Assessment level 1: What is meant by Agricultural development?

Assessment level 2: Discuss at least three (3) challenges of Agricultural development and suggest solutions to them.

Assessment level 3: Critically compare the stages of Agricultural development in developed and developing countries, stating the similarities and differences.

Assessment level 4: How does Agricultural development contribute to poverty reduction and food security?

Focal Area 2: Roles of Governmental and Non-Governmental Organisations in Agricultural Development

1. The Roles of Governmental Organisations in Agricultural Development

- a. **Policy Formulation and Implementation:** Government formulates and implements Agricultural policies aimed at improving productivity, ensuring food security and promoting sustainable agricultural practices. Ministry of Food and Agriculture (MoFA) in Ghana is responsible for the development and implementation of policies, plans, and programs for the growth and development of the Agricultural sector.
- b. **Financial Support and Subsidies:** Governmental organisations provide financial assistance to farmers through subsidies, grants and low-interest loans to encourage investment in Agricultural inputs and technologies. For example, Ghana Cocoa Board (COCOBOD) provides financial support and incentives to cocoa farmers, including bonuses and subsidised inputs, to enhance cocoa production.
- c. **Research and Innovation:** Government invests in Agricultural research to develop new technologies, improve crop varieties and promote sustainable farming practices. For example, The Council for Scientific and Industrial Research (CSIR) conducts research in various areas of Agriculture, including crop and animal improvement, soil fertility and pest management. Their work helps to address the challenges faced by farmers and improves Agricultural productivity.
- d. **Infrastructure Development:** Government's investment in rural infrastructure, such as roads, irrigation systems and storage facilities, is crucial for reducing post-harvest losses and improving market access therefore ensuring Agricultural development. For example, government has invested in road construction and rehabilitation to improve access to markets for Agricultural produce, enhancing the efficiency of the Agricultural supply chain.
- e. **Education and Extension Services:** Governmental organisations provide Agricultural education and extension services to disseminate knowledge and best practices to farmers. For example, MoFA's extension services play a crucial role in educating farmers about modern Agricultural techniques, pest and disease management and efficient use of resources. These services help farmers adopt improved practices that enhance productivity.
- f. **Regulation and Quality Control:** The government establishes regulations and quality control standards to ensure food safety, environmental protection and fair-trade practices. For example, The Ghana Standards Authority (GSA) sets standards for the quality and safety of Agricultural products. This helps to protect consumers and ensure

that Ghanaian Agricultural products meet international standards. COCOBOD also regulates the cocoa industry in Ghana, ensuring quality control from farm to export.

2. The Roles of Non-Governmental Organisations in Agricultural Development

- a. **Capacity Building and Training:** Non-Governmental Organisations (NGOs) provide training programmes to farmers, enhancing their skills in modern agricultural techniques, sustainable practices and resource management. This education helps improve productivity and sustainability. For example, The Hunger Project-Ghana works with local communities to build their capacity through training in Agricultural best practices and community mobilisation.
- b. **Access to Resources and Inputs:** NGOs facilitate access to essential Agricultural inputs such as seeds, fertilisers and tools. They also provide financial resources through microloans and grants to help farmers invest in their operations. For example, World Vision Ghana helps farmers access resources and inputs necessary for improving their Agricultural practices and yields.
- c. **Research and Innovation:** NGOs engage in research and development to create innovative solutions for Agricultural challenges. This includes developing new crop varieties, animal breeds, pest management strategies and sustainable farming practices. For example, NGOs like the African Agricultural Technology Foundation (AATF) work on introducing innovative Agricultural technologies to Ghanaian farmers.
- d. **Advocacy and Policy Influence:** NGOs advocate for favorable Agricultural policies and reforms. They work to influence government policies, ensuring that smallholder farmers' interests are represented and supported. For example, ActionAid Ghana is actively involved in advocacy for pro-poor Agricultural policies and works to ensure that the voices of smallholder farmers are heard in policy-making processes. Also SEND Ghana engages in policy advocacy to improve Agricultural policies that benefit smallholder farmers and promote food security.
- e. **Market Access and Value Chain Development:** NGOs help farmers access markets by linking them to buyers, establishing cooperatives and providing market information. They also work on developing value chains to add value to Agricultural products. For example, TechnoServe Ghana focuses on value chain development by helping farmers process and market their products more effectively.
- f. **Environmental Conservation and Climate Resilience:** NGOs promote sustainable Agricultural practices that conserve natural resources and enhance climate resilience. They work on projects that address soil conservation, water management, and agroforestry. For example, The Rainforest Alliance works with cocoa farmers in Ghana to implement sustainable farming practices that protect biodiversity and improve climate resilience.

Learning Tasks

1. State examples of governmental and non-governmental organisations and agencies involve in Agricultural development.
2. Explain the roles of governmental organisations in Agricultural development.
3. Discuss the roles of non-governmental organisations in Agricultural development.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm to come up with the list of governmental and non-governmental organisations and agencies involved in Agricultural development in Ghana. Use leading questions to enable learners with difficulty to contribute. Encourage learners who can give more examples of governmental and non-governmental organisations to delve deeper to give more. Ensure that learners do not stray into unapproved websites while surfing the internet for information.
2. **Collaborative learning:** Learners in mixed-gender groups surf the internet to gather information on the activities and functions of government and non-governmental organisations and agencies involved in Agriculture. Provide learners with links to websites that they can get the needed information. Also, learners with difficulty in surfing the internet should be assisted. Ensure that learners do not sway into unapproved websites
3. **Managing talk for learning:** Learners in mixed-ability groups discuss the role of governmental and non-governmental organisations and agencies in the Agricultural development in Ghana and present a report. Encourage all learners to take active part in the activities. Use leading questions to aid learners with difficulty to contribute in the discussions.

Encourage learners to discuss how women, the rural poor and persons with disabilities involved in Agriculture benefit from government policies and activities of non-governmental organisations.

Key Assessments

Assessment Level 1: State at least three (3) governmental and non-governmental organisations (NGOs) in Ghana and their contribution to Agricultural development.

Assessment level 2: Explain the role of the media in Agricultural development.

Assessment level 3: Discuss how NGOs support farmer organisations and cooperatives in advocacy and capacity building to promote Agricultural development.

Assessment level 4

1. Discuss how women, the rural poor and persons with disabilities involved in Agriculture benefit from government policies and activities of non-governmental organisations.
2. Discuss the role of governmental and non-governmental organisations and agencies in Agricultural development in Ghana.

Hint



The recommended mode of assessment for week 1 is observation. Use the level 4 question 2 as a sample question.

WEEK 2

Learning Indicators

1. Describe the land tenure systems in Ghana.
2. Explain the effects of land tenure systems on Agricultural production.

Focal Area 1: Land Tenure Systems in Ghana

1. Meaning of Land Tenure System

The land tenure system refers to the legal and institutional framework that governs the ownership, use and management of land.

2. Description of Land Tenure Systems in Ghana

- a. **Customary Land Tenure System:** This is based on traditional norms and practices where land is owned communally by clans or families. Access to land is often through inheritance or allocation by traditional leaders.

Advantages	Disadvantages
Provides stability and continuity in land access for local communities.	Lack of formal documentation can lead to disputes and insecure land rights.
It preserves cultural practices and social cohesion.	Limited opportunities for large-scale commercial Agriculture due to fragmented land ownership.

- b. **Leasehold Tenure System:** Land is leased from the government or customary landowners for a specified period. This is more prevalent in urban and peri-urban areas.

Advantages	Disadvantages
Provides a legal framework for land transactions and investment.	Lease terms can sometimes be short, which may deter long-term investment.
Allows for large-scale agricultural projects with secure tenure.	Landowners or government may revoke leases at the end of the term.

- c. **Freehold Tenure System:** Involves outright ownership of land by an individual or entity. It is less common in rural areas but more prevalent in urban settings.

Advantages	Disadvantages
Provides maximum security and control over the land.	High acquisition costs can limit access for small-scale farmers.
Encourages long-term investment and development.	In rural areas, it may conflict with customary tenure practices.

- d. **Government/State Owned Land Tenure System:** Land owned and managed by the government, often for large-scale Agricultural projects or infrastructure development.

Advantages	Disadvantages
Can facilitate planned development and infrastructure projects.	Limited availability and accessibility to small-scale farmers.
Provides a formalised process for land allocation.	Bureaucratic processes can be cumbersome.

- e. **Tenancy Land Tenure System:** This is where a legal arrangement is made, where a landowner rents out land to a tenant (farmer) for a specified period and usually for a fixed rent amount or share of the produce.

Advantages	Disadvantages
Tenants gain access to land without the initial capital outlay required for ownership, allowing them to start farming immediately.	Tenants may face the risk of eviction or rent increases at the end of the lease period, limiting long-term planning and investment.
Tenants are not directly responsible for fluctuations in land value, providing a level of financial security.	Tenants have limited control over land use decisions, as the landlord may impose restrictions on farming practices.
	Tenants may be dependent on landlords for access to land, which can restrict their ability to make independent decisions.

- f. **Sharecropping Land Tenure System:** This is where the landowner provides land, and the tenant (farmer) provides labour and often a share of the harvest as rent.

Advantages	Disadvantages
Provides access to land and necessary resources (seed, tools) to those who may not have capital for independent farming.	Farmer often remain economically dependent on the landowner due to limited bargaining power and potential indebtedness.
Landowner and farmer share risks and rewards of Agricultural production, fostering mutual interest in productivity.	Farmer may lack incentives for long-term soil conservation and improvement, as they may not reap all the benefits of their efforts.
Sharecroppers can diversify their income sources by sharing in the Agricultural output rather than relying solely on wages.	Farmer may face exploitation if terms are unfavorable or if there is unequal power dynamics between landowner and sharecropper.



Figure 1.1: *Land Tenure Systems in Agricultural Production*

Learning Tasks

1. Define land tenure system in Ghana.
2. Describe the types of land tenure systems in Ghana.
3. Discuss the advantages and disadvantages of the land tenure systems in Ghana.

Pedagogical Exemplars

1. **Structuring talk for learning:** Learners in mixed-ability groups brainstorm to come up with the meaning of land tenure systems in Agricultural production. Use leading questions to guide learners with difficulties to assist them to contribute. Encourage fast learners who can provide more detailed information on the meaning of land tenure system in Ghana to do so.
2. **Experiential learning:** Learners in mixed-gender groups mention the types of land tenure system being practiced in their communities. Learners then surf the internet to identify the types, characteristics, advantages and disadvantages of land tenure systems in Ghana. Guide learners with difficulties links to websites where they can get information. Ensure that learners do not access unapproved or illegal websites. Encourage learners to discuss the types of land tenure systems that are gender neutral and promote inclusivity.
3. **Collaborative learning:** Learners in mixed-gender groups discuss the characteristics, advantages and disadvantages of the land tenure systems identified and make a presentation to the class. Encourage all to take active part in the activity.

Key Assessments

Assessment Level 1: What is meant by the term “land tenure system” in the context of Agriculture?

Assessment Level 2: Compare and contrast any two (2) land tenure systems in Ghana indicating their advantages and disadvantages.

Assessment Level 3: Discuss how insecure land tenure systems affect investment in Agricultural production.

Assessment Level 4

1. Critically discuss the characteristics and differences between Customary and State-owned Land Tenure System
2. Discuss how the above land tenure systems impact land access, use rights and management practices among farmers.

Focal Area 2: Effects of Land Tenure Systems on Agricultural Production

1. The Effects of Land Tenure Systems on Agricultural production

Land tenure systems can have both positive and negative effects on Agricultural production, which can influence productivity, investment in land and the overall socio-economic development of farmers.

- a. **Security of Tenure:** Secure land tenure encourages farmers to invest in land improvements such as irrigation, soil conservation and long-term crops. Farmers with secure land rights are more likely to adopt modern Agricultural techniques and make investments that increase productivity. Where there are no clear and enforceable property rights, it can discourage long-term investments in land improvements and Agricultural technologies. Farmers may hesitate to make costly improvements or adopt new techniques due to the risk of losing access to the land.
- b. **Incentives for Investment:** Land tenure systems that provide farmers with long-term rights (such as freehold or secure leasehold) encourage them to invest in sustainable Agricultural practices, technology and infrastructure. However, where there are no clear property rights, it may restrict farmers’ ability to use the land as collateral for loans or investments. This limits their access to credit, which is crucial for purchasing inputs, machinery, and technology that could enhance Agricultural productivity.
- c. **Access to Credit and Markets:** Formal land tenure systems, such as registered leases or freehold titles, enable farmers to use land as collateral for credit. This access to finance allows farmers to invest in inputs, machinery, and technology that improve Agricultural productivity.
- d. **Efficient Land Use and Allocation:** Transparent and well-defined land tenure systems facilitate efficient land allocation, ensuring that land is used for its most productive purposes. This can involve better management of land resources, reduced land fragmentation, and improved crop rotation practices.
- e. **Social Equity and Welfare:** Equitable land tenure systems promote social stability and improve the welfare of rural communities by ensuring fair distribution of land rights. This

can reduce conflicts over land and empower marginalised groups, such as women and smallholder farmers.

- f. **Land Fragmentation and Subdivision:** In some traditional or customary land tenure systems, land is inherited and subdivided among family members over generations. This can lead to small and fragmented landholdings that are inefficient to manage and may not support viable Agricultural operations.
- g. **Conflict and Disputes over Land:** Ambiguous or overlapping land tenure rights can lead to conflicts and disputes among farmers, communities or between farmers and external investors. These conflicts can disrupt Agricultural activities, reduce productivity, and undermine social cohesion.
- h. **Exclusion of Marginalised Groups:** Inequitable land tenure systems may marginalise certain groups, such as women, indigenous communities, or landless farmers, by denying them access to land or restricting their rights to use and control land resources. This exclusion can perpetuate poverty and limit overall Agricultural productivity.

Learning Tasks

1. State the effects of land tenure system on Agricultural production.
2. Discuss the effects of land tenure system on Agricultural production.
3. Analyse the effects of land tenure systems in Agricultural production and suggest solutions to them.

Pedagogical Exemplars

1. **Experiential learning:** Learners in mixed-ability/gender-based groups (where applicable) develop questionnaires with a maximum of 5 questions to gather information on the effects of land tenure systems in Agricultural production in the school community. Learners then analyse their results and write a report on the effects of land tenure systems in Agricultural production. Encourage all learners to take active part in the activity. Assist learners with difficulties in analysing the data collected. Encourage learners to use different format in their data presentation such as bar charts, pie charts, tables, etc.
2. **Initiating talk for learning:** Learners surf the internet to come up with information on the effects of land tenure systems in Ghana and discuss the information. Assist learners with difficulties with links to websites where they can get information. Ensure that learners do not access unauthorised or illegal websites. Encourage learners to discuss the effects of the various land tenure systems on the operations of women and persons with disabilities involved in Agriculture.

Key Assessments

Assessment Level 1: Provide at least two (2) examples of land tenure systems in Ghana.

Assessment Level 2: Explain the economic consequences of insecure land tenure systems on Agricultural production.

Assessment Level 3: Discuss how land tenure systems influence farmers' adoption of new technologies and sustainable Agricultural practices.

Assessment Level 4

1. Discuss the effects of customary/community land tenure system on the operations of women and persons with disabilities involved in Agriculture.
2. Research and write report on the types of land tenure systems being practiced in your community and their effects on Agricultural production.

Hint



*The recommended mode of assessment for week 2 is **research**. Use the level 4 question 2 as a sample question.*

SECTION 1 REVIEW

Agricultural development is deemed as a panacea to the issue of economic advancement of many development countries, especially Ghana. The understanding by learners on the various roles played by government and its agencies like MoFA and Non-governmental organisations (NGOs) on Agriculture is crucial to promote Agricultural development and appropriate land tenure systems. Agricultural development is the process of improving the efficiency, productivity and sustainability of Agricultural practices to enhance economic growth, reduce poverty and ensure food security. Agricultural Development is important for Economic Growth and Poverty Reduction, Food Security, Sustainable Development, Social Empowerment, Infrastructure and Market Access and Employment Creation. The five major stages of Agricultural Development are Stage 1: Subsistence Agriculture, Stage 2: Transitional Agriculture, Stage 3: Commercial Agriculture, Stage 4: Industrial Agriculture and Stage 5: Sustainable Agriculture. The roles of Governmental Organisations in Agricultural Development include Policy Formulation and Implementation, Financial Support and Subsidies, Research and Innovation, Infrastructure Development, Education and Extension Services and Regulation and Quality Control. The roles of Non-Governmental Organisations in Agricultural Development include Capacity Building and Training, Access to Resources and Inputs, Research and Innovation, Advocacy and Policy Influence, Market Access and Value Chain Development and Environmental Conservation and Climate Resilience. Land tenure system refers to the legal and institutional framework that governs the ownership, use and management of land. Land Tenure Systems in Ghana include Customary Land Tenure System,

Leasehold Tenure System, Freehold Tenure System, Government/State Owned Land Tenure System, Tenancy Land Tenure System and Sharecropping Land Tenure System. The Effects of Land Tenure Systems on Agricultural production are Security of Tenure, Incentives for Investment, Access to Credit and Markets, Efficient Land Use and Allocation, Social Equity and Welfare, Land Fragmentation and Subdivision, Conflict and Disputes over Land and Exclusion of Marginalised Groups.

RUBRICS FOR ASSESSING THE CLASS OBSERVATION

Criteria	Yes	No	In Part
Does the learner stay on the topic of discussion?			
Does the learner show understanding of the topic e.g. stating some roles of governmental organisations in Agricultural development (Policy Formulation and Implementation, Financial Support and Subsidies, Research and Innovation, etc.) and roles of non-governmental organisations in Agricultural development (Access to Resources and Inputs, Advocacy and Policy Influence, etc.)			
Does the learner contribute his/her ideas and build upon the ideas of others?			
Is the learner respecting different views and opinions of other group members?			
Does the learner provide feedback to others regarding their thoughts, comments or work?			



APPENDIX A: SAMPLE PORTFOLIO ASSESSMENT

Refer to the Teacher Assessment Manual and Toolkit pages 27–30 for guidelines on portfolio assessment

1. **Task:** Collect your work from weeks 1 to 20 and compile it into a portfolio to be submitted in week 23 of the academic year for assessment. Your portfolio should include assignments, reports of projects, quizzes, tests, posters, first and second mid-term examinations marked scripts and end-of-semester one marked script. This portfolio will be assessed to evaluate your overall understanding and progress throughout the year.
2. **Example of artefacts/learners' works to be included in the Portfolio Assessment**
 - a. Assignments
 - b. Reports of Projects
 - c. Quizzes and Tests
 - d. Posters
 - e. First and second mid semester examination marked scripts
 - f. End of first Semester marked scripts

3. Example of organisation /structure of the Portfolio

As part of the structure of the portfolio assessment, make sure the following information has been provided:

- a. Cover Page which entails the learner's name, student ID, class, subject and period/date.
- b. Table of Contents which has the list of items included with page numbers.
- c. Brief description/background of items such as short notes of the significance of the report of research or poster, etc.

4. Sample mode of administration

- a. Explain the purpose and components of the portfolio to the learners and provide examples and templates for each section.
- b. Schedule periodic reviews (e.g., every 3-4 weeks) to ensure learners are keeping up with their portfolios and provide feedback and guidance during these checkpoints, etc.

5. Sample mode of submission/presentation

- a. Communicate the final deadline for portfolio submission to all students to ensure timely and complete submissions.
- b. Ensure the portfolio includes all required elements: assignments, projects, quizzes, tests, posters marked examination answer booklets, etc.

6. Rubrics for assessing Portfolio Assessment

Learner's works	Score
Cover page	1 mark
Table of contents	2 marks
Brief description/background of items	2 marks
Assignments/exercises	7 marks
Reports of projects	7 marks
Quizzes and tests	7 marks
Posters	7 marks
First and second mid-semester examination marked scripts	10 marks
End of first semester marked scripts	7 marks
Total marks	50 marks

7. Sample feedback strategy

Schedule periodic check-ins to discuss progress, set goals, and adjust strategies as needed, etc.

RUBRICS FOR ASSESSING THE REPORT ON THE RESEARCH ON LAND TENURE SYSTEM

Criteria	Excellent (4 marks)	Very good (3 marks)	Good (2 marks)	Fair (1 mark)
Introduction and Background of research	Include 4 of the following in the introduction; Background information Definition of land tenure system, Importance of the study, Objectives of the study Importance of land tenure systems in Ghana	Include 3 of the following in the introduction; Background information Definition of land tenure system, Importance of the study, Objectives of the study Importance of land tenure systems in Ghana	Include 2 of the following in the introduction; Background information Definition of land tenure system, Importance of the study, Objectives of the study Importance of land tenure systems in Ghana	Include 1 of the following in the introduction; Background information Definition of land tenure system, Importance of the study, Objectives of the study Importance of land tenure systems in Ghana

Content of research	Stating and describing 4 types of land tenure systems practiced in their community and their effect on agricultural (e.g. Customary Land Tenure System: is based on traditional norms and practices where land is owned communally by clans or families. Access to land is often through inheritance or allocation by traditional leaders. Effects: Secure land tenure encourages farmers to invest in land improvements such as irrigation, soil conservation and long-term crops).	Stating and describing 3 types of land tenure systems practiced in their community	Stating and describing 2 type of land tenure systems practiced in their community	Stating and describing 1 type of land tenure systems practiced in their community
Methodology used	Indicating 4 of the following; Describing and justifying the research design, Describing the sampling methods used Describing the data collection methods used e.g. using questionnaire to collect information. Describing how the data were analysed and presented e.g. using tables, charts etc.	Indicating 4 of the following; Describing and justifying the research design, Describing the sampling methods used Describing the data collection methods used e.g. using questionnaire to collect information. Describing how the data were analysed and presented e.g. using tables, charts etc.	Indicating 4 of the following; Describing and justifying the research design, Describing the sampling methods used Describing the data collection methods used e.g. using questionnaire to collect information. Describing how the data were analysed and presented e.g. using tables, charts etc.	Indicating 4 of the following; Describing and justifying the research design, Describing the sampling methods used Describing the data collection methods used e.g. using questionnaire to collect information. Describing how the data were analysed and presented e.g. using tables, charts etc.
Conclusions	Conclusion of the research giving 4 implications for policy and practice.	Conclusion of the research giving 3 implications for policy and practice.	Conclusion of the research giving 2 implication for policy and practice.	Conclusion of the with 1 implications for policy and practice.

SECTION 2: INDUSTRIES IN AGRICULTURAL PRODUCTION

Strand: Concept of Agriculture in an Industrialising Society

Sub-strand: Agriculture and Industry

Week 3

Learning Outcome: Use the knowledge acquired to identify the industries in crop production.

Content Standard: Demonstrate knowledge and understanding of the industries of crop production.

Week 4

Learning Outcome: Use the knowledge acquired to identify the industries in animal/fish production.

Content Standard: Demonstrate knowledge and understanding of the industries in animal/fish production.

Hint



- Assign group project to learners in Week 3 to be submitted in Week 8 of the academic year.
- Refer to Appendix B for more information on the group project.

INTRODUCTION AND SECTION SUMMARY

Industries in crop and animal/fish production are the driving force for producing crop and animal products and contribute significantly to the Agricultural value chain. The production of crops and animals are sources of food products such as flour, meat, milk, eggs etc. which are important sources of nutrients and nourishment. They also provide raw materials such as cotton, hide and skin (leather) to make clothing, belts and shoes for local and international markets. This section exposes learners to the various industries in crop and animal/fish production. It also provides the basic understanding of the relevance of raw and waste materials and their contribution to the sustenance of industries for production of Agricultural goods. For instance, how to process cassava into gari, how to process beef into corned beef and how to process fish into sardine (canned fish). Industries provide employment for the youth, food security, and a source of livelihood for the rural folk. This section has links with subjects such as Economics, Home Economics and Business Studies.

The weeks covered by the section are:

Week 3: Industries of Crop Production

Week 4: Industries of Animal/Fish Production

SUMMARY OF PEDAGOGICAL EXEMPLARS

The suggested pedagogical strategies to be used include: initiating talk for learning, experiential learning, think-pair-share, project-based learning, managing talk for learning and collaborative learning. The teacher should use initiating talk for learning, think-pair-share and collaborative learning to enable learners to share their views and experiences on industries in crops and animal/fish production. For project-based and experiential learning, learners will be required to search the internet, watch videos, draw a map or create a diagram, visit some of the Aro-based (cottage industries) industries near-by to observe how some of the Agricultural products are processed into other goods. Learners should be given ample time to undertake project where necessary to present their results at an agreed time if the time allotted for it in class is insufficient. Critical thinking skills, communication, digital literacy and collaboration skills of learners will be enhanced as they surf the internet, share their views and experiences. Teachers should ensure that the videos/pictures used do not enforce stereotyping. Teachers should endeavour to involve introverts and learners with speech problems in the report presentations. Teachers should also ensure that learners do not sway into unapproved sites during the surfing of the internet for information.

ASSESSMENT SUMMARY

The assessment for this section will examine the industries of crop and animal/fish production. It should also cover the importance of raw and waste materials from crop and animal/fish production to the industry. The teacher should ask questions in the afore-mentioned areas considering different abilities and proficiencies of learners. The questions should have a balance of the various depth of knowledge (DoK), that is, Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning) assessments. Summative and formative assessments using strategies such as group discussions, presentations, homework, class exercises, class tests and project-based work should be given. The teacher should accept varying number of demonstrations, oral and written responses. He/she should develop rubrics, marking schemes or score cards to score group presentations, projects, assignments and other works.

WEEK 3

Learning Indicators

1. *Examine the industries of crop production.*
2. *Discuss the importance of raw and waste materials from crop production to the industry.*

Focal Area 1: Industries of Crop Production

1. Food and Beverage Industry

Food and beverage industry transforms raw materials from Agriculture such as grains, fruits and vegetables into packaged foods, beverages like beer, juice, wine, soft drinks etc. for consumption and for export. For example, cocoa is processed into milo, liquors like whisky, gin, among others. Wheat is processed into flour and other grain-based products. Examples of industries that are into processing food and beverages are: Blue Skies Holdings Ltd: Processes fresh fruits into packaged fruit salads, juices, and other fruit products for local and international markets. Wienco Ghana Limited: Processes locally grown rice, improving quality for the domestic market. Cargill Ghana: Processes cocoa beans into cocoa liquor, butter and powder for both domestic and export markets. Nsawam Agro-Processing Company: Processes maize into corn flour and other maize-based products for both local and international markets.

2. Textile Industry

Processes cotton into yarn and fabrics, producing printed textiles for the local and international markets. Examples of factories into textile production are: Ghana Textiles Printing Company (GTP): Processes cotton into fabrics, producing printed textiles for the local and international markets. Akosombo Textiles Limited (ATL): Involved in processing raw cotton into finished textiles, focusing on African prints.

3. Sugar Industry

Engages in the processing of sugarcane and sugar beets into refined sugar, molasses and other sweeteners as well as ethanol for domestic and industrial use. Examples of Factories in Ghana into sugar production are: Asutware and Komeda sugar factories. They produce granulated white sugar, brown sugar and molasses (a by-product of sugar refining) which can be used in baking, cooking, or as a sweetener. They also produce sugar syrup (a concentrated solution of sugar in water used in food processing and beverage industries), industrial sugar (various grades of sugar used in food manufacturing, beverages, and other industrial applications) and bagasse (a fibrous material left after extracting juice from sugarcane and is often used as a biofuel or in paper production).

4. Pharmaceutical Industry

Processes Agricultural products such as herbs, roots and leaves of plants to produce medicines and supplements for human use and for veterinary services. Factories in Ghana that produce pharmaceutical products: Tobinco pharmacy, Ernest chemist, East Cantonment pharmacy, Kinapharma etc.

5. Oilseed Processing Industry

Processes oilseeds such as soybeans, groundnut, shea butter into edible oils, margarine, and biodiesel. Crops such as coconut and palm nuts are also process into edible oils. Example of Agro-base industries in Ghana that are into the processing of oilseeds: Benso Oil Palm Plantation (BOPP) and Twifo Oil Production Company. They produce Palm Oil (PO), Palm Kernel Oil (PKO), Palm Sludge Oil (PSO), Empty Fruit Bunches (EFB) and Kernel Shells (PKS). Palm Oil (PO): Extracted from the kernel or seed for cooking. Palm Kernel Oil (PKO): Also, extracted from the kernel or seed are used to manufacture soaps, detergents, and other personal care products, as well as in food processing. It is also used as animal feed due to its high protein content. Palm Sludge Oil (PSO): This is a by-product of the clarification process of palm oil production, palm sludge oil is used in the soap and biodiesel industries. Empty Fruit Bunches (EFB): After the extraction of oil from the fruit, the empty bunches are often used as biomass fuel or as organic fertiliser. Kernel Shells (PKS): These are the hard shells from the palm kernels, commonly used as a biomass fuel or in the production of activated carbon.

6. Cosmetic industry

Processes shea nuts into shea butter for the cosmetics industries. Example of factory into processing shea butter: Savannah Fruits Company and Akoma Cooperative Multipurpose Society: They produce organic and fair-trade shea butter for both local and international markets.



Figure 2.1: *Industries in crop production*

Learning Tasks

1. List at least two (2) industries of crop production.
2. Provide at least two factories from the food and beverage industry and explain what they produce.
3. Discuss at least three (3) industries in crop production and what they produce.

Pedagogical Exemplars

1. **Managing talk for learning:** Learners in mixed-ability groups, brainstorm to come up with types of industries in crop production. Use leading questions to help learners to come up with the types of industries in crop production. All learners should be prompted that both males and females including persons with disabilities can be active drivers of industries in crop production. This is to dispel misconceptions and gender stereotyping.
2. **Collaborative learning:** Learners in mixed-ability groups identify factories in their community or country that uses produce from crop production and make a presentation on it. Where possible, the teacher should provide learners with links to websites where they can get information on factories in Ghana. All learners should be encouraged to take part in the presentation. Confident learners should be allowed to play lead roles during preparation and presentation in class.
3. **Problem-based learning:** Learners in mixed-ability groups discuss the raw materials required by the identified industries. Learners individually create a table/chart showing the industries in crop production and the raw materials they use. All learners should be encouraged to identify agro-based factories that women and people with disabilities have established in their communities. Learners should also discuss how to overcome the difficulties in getting raw materials by the women and the people living with disabilities.

Key Assessments

Assessment Level 1: List at least three (3) industries in crop production found in Ghana.

Assessment Level 2: Discuss three at least (3) raw materials from crop production and their importance to industries.

Assessment Level 3: Discuss at least three (3) ways crop production industry can impart the socio-economic development of Ghana?

Assessment Level 4: Critically discuss the significance of the oilseed processing industry to the economy of Ghana.

Focal Area 2: Importance of Raw and Waste Materials from Crop Production to the Industry

1. **Raw Materials from Crop Production Used by Industry**
 - a. Grains: Wheat, rice, corn etc.
 - b. Fruits: Apples, oranges, bananas etc.
 - c. Vegetables: Tomatoes, potatoes, carrots etc.
 - d. Oilseeds: Soybeans, sunflower seeds, canola etc.
 - e. Sugarcane and Sugar Beets
 - f. Fiber Crops: Cotton, hemp etc.
2. **Waste Materials from Crops Used by Industry**
 - a. Crop Residues: Corn stalks, wheat straw, rice husks for animal bedding and feed, bioenergy, biomass fuel, mulching and composting.

- b. Processing By-products: Wheat bran, fruit pulp, vegetable peels for Bioenergy Organic fe fertilisers and animal feed.
- c. Spent Grains Brewers' spent grain for animal feed biogas production composting.
- d. Press Cakes Soybean meal, canola meal for animal feed and organic fertilizers.
- e. Bagasse from sugarcane processing: Bioenergy for electricity generation, paper and packaging materials and building materials (fibreboard).
- f. Fruit and Vegetable Scraps: Peels, cores, seeds for animal feed, composting and bioenergy (biogas).

3. Importance of Raw Materials from Crops to Industry

- a. **Food and Beverage Industry:** Primary crops like wheat, corn, rice and sugarcane are essential raw material to produce a wide range of food products, for human and animal consumption. Cocoa bean, coffee, Grapes, barley, hops and other crops are crucial for beverages, wine, beer, and other drinks.



Figure 2.2: *Some raw materials for the food and beverage industry*

- b. **Pharmaceutical and Cosmetic Industries:** Medicinal plants such as aloe vera, chamomile, and various herbs and plants (e.g., shea nut, neem tree) are used in pharmaceuticals and cosmetics products for their therapeutic properties. Essential oils plants like lavender, eucalyptus, and peppermint provide essential oils used in skincare, aromatherapy, and health products.



Figure 2.3: *Some pharmaceutical and cosmetic plants*

- c. Textile Industry:** Natural fibres such as cotton, flax, hemp, and jute are key raw materials for producing textiles and fabrics, providing the basis for clothing and other textile products for the local and international use.



Figure 2.4: *Some textile manufacturing plants*

- d. Biofuel Industry:** Corn and sugarcane are major sources of ethanol, a renewable energy source used in biofuel production. Biodiesel: Soybeans and jatropha are also used to produce biodiesel, an alternative to fossil fuels.



Figure 2.5: *Some biofuel industry plants*

- e. **Construction Industry:** Bio-composites materials like straws and bamboo are used in making eco-friendly building materials. Also, cork from cork oak trees and other plant-based materials are used for insulation and flooring solutions. Thatch plants are used for roofing.



Bamboo plant



Thatch

Figure 2.6: Some building and construction industry plant

4. Importance of Waste Materials from Crops to Industry

- a. **Animal Feed:** Crop Residues like straw, husks, and stalks are utilized as feed for livestock, turning waste into valuable animal nutrition.
- b. **Bioenergy and Biogas Production:** Crop wastes like manure and corn stover can be used to produce biogas, which is then converted to electricity and heat. Agricultural waste can be compacted into pellets and briquettes for use as a renewable and efficient energy source.
- c. **Composting and Soil Amendment:** Composting crop residues enriches the soil, enhancing its fertility and promoting sustainable agriculture. Adding organic matter from crop waste helps improve soil structure, aiding in better water retention and soil health.
- d. **Industrial Products:** Paper and Packaging: Agricultural residues like bagasse (sugarcane residue) are used to produce paper and biodegradable packaging, reducing reliance on wood and synthetic materials. Crop waste is being developed into bioplastics, providing an eco-friendly alternative to conventional plastics.
- e. **Environmental Management:** Crop residues are used in erosion control measures, such as mulching to protect soil from erosion. Certain crops and their residues can be used to clean contaminated soils and water, helping in environmental restoration efforts.
- f. **Chemical Industry:** Extraction of Valuable Compounds crop waste can be a source of valuable chemicals, such as pectin from citrus peels and lignin from corn stalks, which are used in various industrial applications.

Learning Tasks

1. List the raw and waste materials available from crop production.
2. Explain the uses of raw materials from crop production to the industry.
3. Discuss the importance of waste material from crop production to the industry.

Pedagogical Exemplars

1. **Experiential Learning:** Learners in mixed-ability groups visit a nearby Agro-based industry/watch videos/pictures on the use of raw materials and Agricultural wastes in their processing activities. They then discuss the importance of raw materials and waste from crop production to the industries. Teachers should ensure that the videos/pictures used do not enforce stereotyping and if they do, the teacher should discuss them with the learners. Learners with difficulties should be assisted with clues and leading questions to come up with some of the importance of raw and waste materials. Ensure that all learners fully participate in the activity.
2. **Collaborative learning:** Learners in the mixed-ability groups prepare and present a report on their discussion. Encourage all learners to be involved in the discussions.
3. **Project-based learning (homework):** Learners in mixed-ability groups embark on a case study on the industrial uses and importance of cash crops grown in their locality and present a portfolio on their case study. Teachers should endeavour to involve introverts and learners with speech problems in the report presentations.

Key Assessments

Assessment Level 1

1. Answer the following question by circling the correct answer
Which of the following is a common use for crop waste in sustainable agriculture?
 - a. Burning it in open fields
 - b. Converting it into biofuels
 - c. Disposing of it in landfills
 - d. Using it as landfill cover
2. List at least three (3) raw and waste materials from crop production to industry.

Assessment Level 2: Discuss at least two (2) raw materials from crop production and their importance to industry.

Assessment Level 3: Examine the economic importance of waste materials from crop production to industry.

Assessment Level 4: Critically examine the role of waste materials from crop production in soil amendment and environmental management.

Hint



The recommended mode of assessment for week 3 is **multiple choice questions**. Use the level 1 question 1 as a sample question.

WEEK 4

Learning Indicators

1. *Explore the industries of animal/fish production.*
2. *Discuss the importance of raw and waste materials from animal production to the industry.*

Focal Area 1: Industries of Animal/Fish Production

1. Factories in Ghana That Process Animal and Fish Products

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

- a. **WAMCO (West African Mills Co. Ltd.) Takoradi, Ghana:** This company processes fish into canned fish products such as tuna and mackerel.
- b. **Myroc Food Processing Company Limited, Tema:** Processed fish including tuna and sardines.
- c. **Ghana Agro Food Company (GAFCO) Tema, Ghana:** They process fish into fishmeal and fish oil.
- d. **Savana Pride Tamale, Ghana:** Processed meat products into meat cut, minced meat, meatballs, kebabs etc for both local and international market.
- e. **Pioneer Food Cannery Ltd. Tema, Ghana:** Process tuna into canned tuna and other fish products.
- f. **Meat Processing and Distribution Company Limited (MEPDCOL) Tema, Ghana:** They processed meats, including beef, goat, and pork for both local and international market.
- g. **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.
- h. **Fan Milk Limited. Accra, Ghana:** They produce wide range of dairy products including yogurt, ice cream, and frozen dairy desserts.
- i. **Accra Dairy Company Limited (Producers of Cowbell) Accra, Ghana:** Process milk into powdered milk, flavoured milk drinks, and yogurt.
- j. **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.

2. Industries in Animal and Fish production

- a. **Livestock Industry:** This industry focuses on the production of meat (beef, mutton, chevon and pork), milk and dairy products such as cheese, butter and yogurt and pork products such as bacon and ham to supply humans with their protein needs. Other products such as wool and leather can be obtained from animals. Wool can be used for the manufacturing of clothing, while leather can be used for the manufacturing of shoes, belts, leather bags etc.

- b. Poultry Industry:** The poultry industry focuses on the production of meat and eggs from various breeds of birds such as chickens (domestic fowls), turkeys, ducks, ostrich, guinea fowl, quail etc. for both local and international markets.
- c. Aquaculture Industry:** This involves the breeding, rearing and harvesting of fish, shellfish and aquatic plants. Freshwater Aquaculture is the raising of fish species such as tilapia, catfish and trout in freshwater bodies such rivers, streams etc. Marine Aquaculture also involves raising fish species such as salmon, sea bass and shrimp in saltwater environments such as the sea and ocean.
- d. Beekeeping (Apiculture) Industry:** The keeping of bee colonies in hives for honey, beeswax and pollination services. Honey serves as an important food product as well as a pharmaceutical product as a sweetener. Beeswax is also for industrial use.
- e. 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 and stylish accessories such as hats, gloves and scarves. It can also be used to line or trim coats and jackets, providing warmth and a unique aesthetic. The fur can be used in the creation of decorative items such as throw pillows, rugs, or wall hangings.
- f. Rabbit Industry:** Rabbits are farmed worldwide for their meat, fur and as pets. Rabbits are also bred as laboratory animals for research. Rabbit meat is known for being lean and nutritious. It is marketed fresh, frozen or processed into products like sausages and pâté. Rabbit fur is used in the fashion industry for clothing and accessories. Rabbits are popular pets, and there is a market for pet rabbits, as well as supplies and accessories.
- g. Snail Industry:** The snail industry, particularly the farming of edible snails (heliciculture), is prominent in regions where snail is a culinary delicacy. Snails are bred in captivity and require specific environmental conditions to thrive. Snail meat, considered a gourmet item in many cuisines, is sold fresh, frozen, or canned. Snail slime is used in the cosmetic industry for its purported skin benefits.
- h. Processing and Packaging Industry:** Meat Processing: Slaughtering, butchering, and packaging meat products. Dairy Processing: Processing milk into various dairy products such as cheese, yogurt and butter. Fish and Seafood Processing: Filleting, canning, smoking and freezing fish and seafood.

Learning Tasks

1. List the industries in animal/fish production.
2. State the factories in Ghana that process animal/fish produce, and what they produce.
3. Discuss the animal/fish industries in Ghana.

Pedagogical Exemplars

1. **Managing talk for learning:** Learners in mixed-ability groups brainstorm to come up with types of industries in animal/fish production and discuss it in their groups. Guide learners with additional support needs with leading questions to help them to come up with the types of industries in animal and fish production. Encourage learners to respect, tolerate and accept each other's view during the discussion. Also, Confident learners should be allowed to play lead roles during discussions.
2. **Think-pair-share:** Learners in pairs identify factories in their community and country that use produce from animal/fish production. Where possible, the teacher should provide learners with links to websites where they can get information on factories in Ghana that produce animal/fish products.
3. **Problem-based learning:** Learners in mixed-ability groups discuss the raw materials required by the identified industries. Learners individually create a table/chart showing the industries in animal/fish production and the raw materials they use and present their work to the class. Learners should be encouraged to identify Agro-based factories that are owned by women and people with disabilities among others, in their communities. Learners should also discuss the extent of difficulty in getting raw materials by the women and the people living with disabilities. The teacher should endeavour to involve introverts and learners at all levels of abilities in the class discussion and report presentation.

Key Assessments

Assessment Level 1: Specify at least three (3) industries in animal/fish production.

Assessment Level 2: Discuss the roles of at least two (2) factories in Ghana that process animal/fish products.

Assessment Level 3: Analyse the benefits of fish products to Ghanaians.

Assessment Level 4: Critically discuss the significance of the processing and packaging industry to the economy of Ghana.

Focal Area 2: Importance of Raw and Waste Materials from Animal Production to the Industry

1. **Importance of Raw and Waste Materials in Animal and Fish Industries**
 - a. **Livestock (Cattle, Sheep, Goats and Pigs)**
 - i. Meat and Offal: For human consumption as fresh meat or processed into various products such as sausages, burgers and canned meats.
 - ii. Hide and Skin: Tanned and processed into leather used for shoes, bags, belts, and upholstery.
 - iii. Bones: Ground into bone meal for livestock feed or processed into gelatine used in food products, pharmaceuticals, and cosmetics.
 - iv. Pharmaceuticals: Some organs are used in medical research and the production of pharmaceuticals.
 - v. Manure: Used as organic fertilizer to improve soil fertility and crop yields.

b. Poultry (Chicken, Ducks, Turkeys, Guinea fowl etc)

- i. **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.
- ii. **Feathers:** Down feathers are used in bedding and clothing insulation. Other feathers may be used in crafts and decorative items.
- iii. **Manure:** Poultry manure is utilised as organic fertiliser for crops due to its high nutrient content and very good for soil remediation.

c. Fish (Tilapia, Catfish and Mudfish)

- i. **Meat:** Fish is a major source of protein. It is consumed fresh, frozen, smoked, dried or canned.
- ii. **Fish Oil:** Rich in omega-3 fatty acids, fish oil is used in supplements and pharmaceuticals for heart health, joint health and other benefits.
- iii. **Fish Meal:** Ground fish used as a protein-rich ingredient in livestock, poultry and aquaculture feeds.
- iv. **Fish Skin and Scales:** Collagen-rich fish skin and scales are used in cosmetics for skin care products and in biomedical applications.
- v. **Fish Bones:** Fish bones are processed into gelatine used in food products, pharmaceuticals and cosmetics.

d. Grasscutter and rabbit

- i. **Fur:** Grasscutter and rabbit fur can be used to produce clothing items such as hats, gloves, scarves and decorative accessories. Rabbit fur and wool from some breeds are used in making sweaters, and can also be used for creation of toys, decorative items and artisanal crafts.
- ii. **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.
- iii. **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.
- iv. **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.
- v. **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.

e. Snails

- i. **Snail Mucin:** A secretion produced by snails, also known as snail slime. It is used in skincare products for its moisturizing, anti-aging, and healing properties. It is used in wound healing and scar treatment products due to its regenerative properties.

- ii. **Snail Meat:** The edible flesh of snails is a delicacy in many cultures, especially in French cuisine (escargot).
- iii. **Snail Shells:** The hard, protective outer layer of snails. It is grounded into powder and used as a calcium supplement in animal feed.

d. **Honey Bees**

- i. **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.
- ii. **Beeswax** is used in lip balms, lotions and creams for its emollient properties. It is utilised in furniture polish, shoe polish, and as a lubricant for various applications. It is also essential in making natural and high-quality candles. In cosmetic industry it is incorporated into skincare products for its moisturising and antibacterial properties. It is also used in traditional medicine and as a natural remedy for sore throats and coughs.
- iii. **Propolis:** A resinous mixture that honey bees produce by mixing saliva and beeswax with exudate gathered from tree buds. It is known for its antimicrobial, anti-inflammatory and healing properties, and it is used in various health supplements. It is incorporated into skincare products for its healing and protective benefits.
- iv. **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.

Pedagogical Exemplars

1. **Experiential Learning:** Learners in mixed-ability groups visit a nearby Agro-based industry/watch videos/pictures on the use of raw materials and Agricultural wastes in their processing activities. They then discuss the importance of raw materials and waste from animal/fish production to the industries. Teachers should ensure that the videos/pictures used do not enforce stereotyping and if they do, the teacher should discuss them with the learners. Learners with difficulties should be assisted with clues and leading questions to come up with some of the importance of raw and waste materials from animal production. Ensure that all learners fully participate in the activity.
2. **Collaborative learning:** Learners in the mixed-ability groups prepare and present a report on their discussion. Encourage all learners to be involved in the discussions.
3. **Project-based learning (homework):** Learners in mixed-ability groups embark on a case study on the industrial uses and importance of livestock in their locality and present a portfolio on their case study. Teachers should endeavour to involve introverts and learners with speech problems in the report presentations.

Key Assessments

Assessment Level 1: List at least three (3) raw and waste materials from animal/fish production to industry.

Assessment Level 2: Discuss at least two (2) raw materials from fish production and their importance to industry.

Assessment Level 3: Examine the economic importance of waste materials from animal production to industry.

Assessment Level 4: Critically examine the role of waste materials from livestock production for soil fertility and crop improvement.

Hint



The recommended mode of assessment for week 4 is display and exhibitions. Use the level 1 question 1 as a sample question.

SECTION 2 REVIEW

Industries in crop and animal/fish production are essential for value addition to Agricultural products. The identification of industries in crop and animal production and raw and waste materials by learners form the basis for industrial revolution. Learners' understanding of the processes that Agricultural produce go through for value addition will help them to appreciate the business of Agricultural productivity and the employment opportunities that are available in the crop and animal/fish industry. Again, learners will appreciate that waste and raw materials from crops and animal production are important ingredients for industrial drive. The Industries of Crop Production are Food and Beverage, Textile, Sugar Pharmaceutical, Oilseed Processing and Cosmetic industries. Raw and Waste Materials from Crop Production are also important to the Food and Beverage Industry, Pharmaceutical and Cosmetic Industries, Textile Industry, Biofuel Industry, Construction Industry, Animal Feed Production Industry, Bioenergy and Biogas Production, and Chemical Industry. Notable factories in Ghana that process crop products include Nestle Ghana Limited, Blue Skys, Ghana Textiles Product, and Unilever, Ghana. The Industries of Animal and Fish production are Livestock, Poultry, Aquaculture, Beekeeping (Apiculture), Grasscutter, Rabbit, Snail and Processing and Packaging Industries. Importance of Raw and Waste Materials in Animal and Fish Industries include Meat, Offal and Eggs for human Consumption, Hide and Skin for shoes, bags and belts, Bones for bone meal, some organs for medical research and the production of pharmaceuticals and Manure as fertiliser to improve soil fertility and crop yields, Fur for hats, gloves and scarves, Honey for natural sweeteners. Notable factories that process animal and fish products in Ghana include WAMCO (West African Mills Co. Limited) Takoradi, and Myroc Food Processing Company Limited, Tema.



APPENDIX B: ASSESSMENT OF GROUP PROJECT

Task: Identify agricultural waste material from an agro-processing company in your community and devise ways that the waste can be useful.

1. Structure

The following items should be included in the presentation of the project

- The useful product from the agricultural waste.
- Report on how it was prepared and its uses.
- Signed list of members in the group.
- Pictures taken and other visuals about the project

2. How to administer

- Provide clear guidelines for developing the project and how it will be assessed.
- Schedule periodic reviews (e.g., every 3-4 weeks) to ensure learners are keeping up with their project and provide feedback and guidance during these checkpoints, etc.

3. Sample rubrics for assessing the group projects

CRITERIA	Excellent (4 marks)	Very Good (3 marks)	Good (2 mark)	Fair (1 mark)
Relevance of Project	Describing 4 products/ solutions to the agro-based waste e.g. Palm kernel cake for animal feed and organic fertilisers, crop residue for composting, etc.	Describing 3 products/solutions to the agro-based industry e.g. using palm kernels for cooking, straws used as building materials, etc.	Describing 2 products/solutions to the agro-based industry e.g corn cobs used as fashion accessories such as necklaces, etc.	Describing 1 products/ solutions to the agro-based industry e.g corn cobs used as fashion accessories such as necklaces, etc

Eco-friendliness of the product / solution	Product shows any 4 of the following Materials used are not Toxic Product does not have negative impact on the environment Minimised carbon emission from product Project minimise waste generation. Product conserve the eco-system and biodiversity.	Product shows any 3 of the following Materials used are not Toxic Product does not have negative impact on the environment Minimised carbon emission from product Project minimise waste generation. Product conserve the eco-system and biodiversity.	Product shows any 2 of the following Materials used are not Toxic Product does not have negative impact on the environment Minimised carbon emission from product Project minimise waste generation. Product conserve the eco-system and biodiversity.	Product shows any 1 of the following Materials used are not Toxic Product does not have negative impact on the environment Minimised carbon emission from product Project minimise waste generation. Product conserve the eco-system and biodiversity.
Teamwork and Active Participation	Exhibit 4 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility	Exhibit 3 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility	Exhibit 2 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility	Exhibit 1 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility

Procedural Record Keeping	Provides 4 evidence of procedural records e.g. Step-by-step report on how the product /solution was devised Accurate data and procedure documentation Organised and easy to navigate Records are clear and easy to read with visuals and photographs.	Provides 3 evidence of procedural records e.g. Step-by-step report on how the product /solution was devised Accurate data and procedure documentation Organised and easy to navigate Records are clear and easy to read with visuals and photographs.	Provides 2 evidence of procedural records e.g. Step-by-step report on how the product /solution was devised Accurate data and procedure documentation Organised and easy to navigate Records are clear and easy to read with visuals and photographs.	Provides 1 evidence of procedural records e.g. Step-by-step report on how the product / solution was devised Accurate data and procedure documentation Organised and easy to navigate Records are clear and easy to read with visuals and photographs.
Innovativeness	Product shows 4 of the following; Originality Addresses an unmet need Potential for scalability Technically viable Innovative method or processes used	Product shows 3 of the following; Originality Addresses an unmet need Potential for scalability Technically viable Innovative method or processes used	Product shows 2 of the following; Originality Addresses an unmet need Potential for scalability Technically viable Innovative method or processes used	Product shows 1 of the following; Originality <i>Addresses an unmet need</i> <i>Potential for scalability</i> <i>Technically viable</i> <i>Innovative method or processes used</i>

4. Sample Feedback

Provide feedback on the project and ask the groups to do corrections and resubmit their finale project, etc.

SECTION 3: CONCEPT OF SURVEYING AND MAPPING IN AGRICULTURE

Strand: Modern Technical and Mechanised Agriculture

Sub-strand: Modern Technical Agriculture

Week 5

Learning Outcome: Use the knowledge and skills acquired to explain the meaning and importance of surveying and mapping in Agriculture.

Content Standard: Demonstrate the knowledge, understanding and skills of the meaning and purpose of surveying and mapping in Agriculture.

Week 6

Learning Outcome: Use the knowledge and skills acquired to prepare the map of a farmstead.

Content Standard: Demonstrate the understanding and skills of the procedure for conducting surveys and mapping of farmstead.

Hint



- Remind learners to submit their research work in Week 5.
- Remind learners of Mid-Semester examination in Week 6.
- Refer to the Appendix C for more sample task and the Table of Specification

INTRODUCTION AND SECTION SUMMARY

The use of machinery and equipment, ranging from simple and basic hand tools to more sophisticated, motorised equipment and machinery, to perform Agricultural operations is important for increasing food production. They ease farm operations and enable large area of land to be cultivated. Besides machines, equipment and tools, certain activities are carried out to make judicious use of land. They include surveying and mapping that provide information that is essential in land-use planning. This includes identifying zoning regulations, environmental constraints, and other factors that can affect land development. This section will help learners to know the meaning, importance and uses of survey instruments, as well as equip learners with the ability to conduct surveying and mapping of a farmstead. This section has links with subjects such as Applied Technology and Engineering, due to the use of tools.

The weeks covered by the section are:

Week 5: Meaning, importance and uses of surveying and mapping instruments.

Week 6: Procedure for conducting surveying and mapping of farmstead.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical exemplars to be used for learners to successfully achieve an understanding of the meaning, importance and uses of surveying and mapping instruments as well as the procedures for conducting survey and mapping of farmstead include talk-pair-share, collaborative learning, experiential learning, collaborative learning, project-based learning and initiating talk for learning. The use of the afore-mentioned pedagogies will enhance the critical thinking, communication, digital literacy, creativity and collaboration skills of learners. The teacher should set ground rules to discourage the teasing of learners as they express themselves and encourage shy and introverted learners to actively participate in the lesson. Learners should be encouraged to work in mixed-ability and mixed-gender (where appropriate) groups, in pairs or as individuals as and when necessary. Gifted and talented learners should be assigned extra tasks and made to support their peers in feasible and applicable activities. Learners should also be guided by the teacher and technician during the hands-on practice.

ASSESSMENT SUMMARY

The teacher should assign tasks and assessed learners on the meaning, importance and uses of survey and mapping instruments as well as the procedures for conducting survey and mapping of farmstead. The teacher should ask questions on the above considering different abilities and proficiencies of learners. The questions should have a balance of the various depth of knowledge, that is, Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning) assessments. Summative and formative assessments using strategies such as group discussions, presentations, homework, class exercises, class tests and project-based work should be given. Varying number of demonstrations, oral and written responses should be accepted. Rubrics and marking schemes should be developed to score groups and assignments.

WEEK 5

Learning Indicators

1. *Explain the meaning and importance of surveying and mapping in Agriculture.*
2. *Describe surveying and mapping instruments and their uses in Agriculture production.*

Focal Area 1: Meaning and Importance of Surveying and Mapping in Agriculture

1. Meaning of Surveying and Mapping in Agriculture

- a. **Survey and Mapping** in Agriculture refer to the processes used to collect, analyse, and visualise spatial data to enhance Agricultural practices. These activities assist agriculturists to make informed decisions, improve land management, and increase productivity.
- b. **Surveying in Agriculture** involves systematically collecting data about agricultural land and its characteristics. This includes:
 - i. **Land Assessment:** Measuring and recording the size, shape, and boundaries of agricultural plots.
 - ii. **Soil Analysis:** Determining soil types, composition, and fertility to inform crop selection and soil management practices.
 - iii. **Water Resources:** Assessing availability and quality of water sources, as well as irrigation needs.
 - iv. **Topography:** Studying the terrain and its impact on farming practices, including slope, elevation, and drainage patterns.
 - v. **Climate Data:** Collecting information on temperature, rainfall, and other climatic conditions that affect agriculture.
- c. **Mapping in Agriculture involves creating visual representations (maps) of the surveyed data. This includes:**
 - i. **Topographic Maps:** Showing the physical features of the land, including hills, valleys, and water bodies.
 - ii. **Soil Maps:** Indicating different soil types and their distribution across the agricultural land.
 - iii. **Land Use Maps:** Displaying current and planned uses of the land, such as crop areas, pastures, and forested regions.
 - iv. **Irrigation Maps:** Detailing the layout and extent of irrigation systems and water distribution networks.
 - v. **Pest and Disease Maps:** Highlighting areas affected by pests or diseases to aid in targeted interventions.

2. Importance of Surveying and Mapping in Agriculture

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

a. Precision and Sustainable Agriculture Practices

- i. **Optimised Input Application:** Surveying and mapping allow for precise application of , fertilisers, pesticides, and water, ensuring that each part of the field receives the right amount. This leads to more efficient use of resources and reduces waste.
- ii. **Environmental Protection:** Surveying and mapping help in identifying environmentally sensitive areas and promoting practices that protect soil and water quality, such as contour farming and buffer zones.
- iii. **Conservation Efforts:** Detailed maps support conservation planning, ensuring that natural resources are used sustainably, and biodiversity is preserved.

b. Improved Land Management and Enhanced Resource Management

- i. **Land Use Planning:** Detailed maps assist in planning the use of agricultural land, including crop rotation, irrigation, and infrastructure development. This enhances land productivity and sustainability.
- ii. **Soil Management:** Soil maps provide information on soil types, composition, and fertility, aiding in selecting suitable crops and improving soil health through targeted interventions.
- iii. **Water Resource Management:** Surveys help in assessing the availability and quality of water resources. Irrigation maps ensure efficient water distribution and management, reducing water wastage.

c. Risk Management

- i. **Pest and Disease Control:** Mapping areas affected by pests and diseases enables targeted interventions, reducing crop losses and preventing the spread of infestations.
- ii. **Climate Adaptation:** Climate data maps assist in understanding local climate patterns and preparing for extreme weather events, helping farmers to adapt and mitigate risks associated with climate change.

d. Increased Productivity and Profitability

- i. **Yield Monitoring and Mapping:** By analysing yield maps, farmers can identify areas with high and low productivity and take corrective measures to improve overall yield.
- ii. **Cost Efficiency:** Precise application of inputs and efficient resource management lead to cost savings and higher profitability for farmers.

e. Informed Decision Making

- i. **Data-Driven Decisions:** Access to accurate and detailed spatial data allows farmers and agricultural professionals to make informed decisions regarding crop selection, planting schedules, and resource allocation.

- ii. **Strategic Planning:** Long-term planning and development of farming strategies are facilitated by comprehensive maps and surveys, leading to more resilient and adaptive agricultural systems.
- f. **Technological Integration**
- i. **Adoption of Advanced Technologies:** Surveys and maps are integral to the adoption of technologies such as GPS, GIS, remote sensing, and drones, which revolutionize farming practices.
 - ii. **Innovation in Farming:** The integration of survey and mapping data with emerging technologies like artificial intelligence and machine learning drives innovation in precision agriculture and smart farming solutions.
- g. **Regulatory Compliance**
- i. **Land Registration and Ownership:** Surveys ensure accurate land registration and help in resolving disputes related to land ownership and boundaries.
 - ii. **Compliance with Agricultural Policies:** Mapping helps farmers comply with agricultural policies and regulations by providing documentation of land use and management practices.

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 5.1: Importance of Surveying and Mapping in Agriculture

Learning Tasks

1. State the meaning of surveying and mapping in Agriculture.
2. Explain the importance of surveying and mapping in Agriculture.
3. Explain the meaning and importance of surveying and mapping in Agriculture.

Pedagogical Exemplars

1. **Talk-pair-share:** In pairs, learners brainstorm to come up with the meaning of survey and mapping in Agriculture. Slow learners should be assisted with probing questions that will help them to state the meaning of surveying and mapping in Agriculture. Challenge others to explain the meaning of surveying and mapping in Agriculture.

2. **Collaborative learning:** Learners in mixed-ability groups surf the internet for information on the importance of surveying and mapping in Agriculture. Learner presents their report in a plenary session in class for assessment. Teacher should encourage all learners to participate in searching the internet for information on the importance of surveying and mapping in Agriculture. Learners who are proficient in using the internet should be allowed to support others. The teacher should also monitor the content of what learners browse. All learners should be tolerant and respect each other's views.

Key Assessments

Assessment Level 1: State the meaning of surveying and mapping in Agriculture.

Assessment Level 2: Explain surveying and mapping in Agriculture.

Assessment Level 3: Why is land surveying and mapping essential for increase productivity and profitability.

Assessment Level 4: How can land surveying and mapping be used to promote sustainable agricultural practices?

Focal Area 2: Surveying and Mapping Instruments and Their Uses in Agricultural Production

1. Surveying and Mapping Instruments Used in Agricultural Production

Agricultural surveying and mapping instruments are essential for collecting data and managing various aspects of farming operations. These instruments are essential for improving efficiency, sustainability, and productivity in agriculture. Key agriculture surveying and mapping instruments and their uses are:

a. Global Positioning System (GPS) Devices

- i. **Field Mapping:** GPS devices accurately map field boundaries, irrigation systems, and other important features.
- ii. **Precision Navigation:** GPS enables precise navigation and guidance for farm machinery, facilitating activities like planting, spraying, and harvesting.
- iii. **Variable Rate Technology (VRT):** utilises GPS data to apply inputs such as seeds, fertilizers, and pesticides at variable rates based on field conditions.

b. Geographic Information Systems (GIS)

- i. **Data Management:** Storing, analysing, and visualising spatial data related to soil, crops, and environmental conditions.
- ii. **Land Use Planning:** Developing detailed maps to optimise the allocation of agricultural activities.
- iii. **Mapping and Analysis:** Creates detailed maps and visualisations that aid in decision-making for crop management, resource allocation, and land use planning.
- iv. **Environmental Monitoring:** GIS tools help monitor environmental factors such as water quality, habitat conservation, and land degradation.

c. Remote Sensing Technology

- i. **Satellite Imagery:** Provides high-resolution images of agricultural fields to monitor crop health, soil moisture, vegetation cover, and changes over time.
- ii. **Drones:** Capturing high-resolution aerial images for detailed analysis of crop conditions, pest infestations, and soil erosion.
- iii. **LiDAR (Light Detection and Ranging):** Uses laser technology to create detailed 3D maps of terrain, vegetation structure, and canopy height for precision agriculture.

d. Soil Testing Kits

- i. **Soil Composition Analysis:** Determining soil texture, structure, and organic matter content.
- ii. **Nutrient Testing:** Measuring levels of essential nutrients like nitrogen, phosphorus, and potassium.
- iii. **pH Measurement:** Assessing soil acidity or alkalinity to guide crop selection and soil management practices.
- iv. **Crop Sensors:** Assess crop health indicators such as chlorophyll content, biomass, and nutrient deficiencies, aiding in timely interventions.

e. Laser Land Levellers

- i. **Field Preparation:** Creating level fields to improve irrigation efficiency and prevent waterlogging.
- ii. **Surface Smoothing:** Ensuring even distribution of water across the field.

f. Weather Stations

- i. **Climate Data Collection:** Recording temperature, humidity, rainfall, wind speed, and other weather conditions.
- ii. **Microclimate Monitoring:** Providing data to adjust farming practices according to local climate variations.

g. Yield Monitors and Harvest Mapping

- i. **Yield Monitors:** Measure and record crop yield and moisture content during harvesting operations to create yield maps for future analysis and decision-making.
- ii. **Harvest Mapping:** Creates spatially explicit maps that show variations in crop yield across fields, helping identify areas for improvement and resource allocation.

h. Pest and Disease Detection Tools

- i. **Field Scouting Tools:** Identifying and monitoring pest infestations and disease outbreaks.
- ii. **Remote Sensors:** Detecting early signs of plant stress due to pests or diseases.

i. Surveying Equipment

- i. **Total Stations:** Measuring land elevations and distances for topographic mapping and infrastructure planning.

- ii. **Theodolites:** Measuring horizontal and vertical angles to determine land slopes and elevations.
- iii. **Tape measure:** Used for measuring distance or size.
- iv. **Ranging pole:** For marking out boundaries and measuring small offsets on site.



Figure 5.1 Some Survey and Mapping Instruments

Learning Tasks

1. List the surveying and mapping instruments used in Agriculture.
2. Explain the surveying instruments used in Agriculture.
3. Discuss the surveying and mapping instruments used in Agriculture.

Pedagogical Exemplars

1. **Experiential learning:** In gender-based groups, learners visit a survey site/watch videos/pictures on a surveying process of a land and identify some of the survey instruments used and document them. Teachers should ensure that videos/pictures used do not enforce stereotyping and if they do, teachers should discuss them with learners. All learners should be encouraged to visit a survey site/watch videos/pictures on the process of surveying and mapping.
2. **Collaborative learning:** Learners in gender-based groups surf the internet to come up with information on the uses of the survey and mapping instruments identified. Learners familiar with the use of the internet should be allowed to help others. The teacher should also encourage all learners to be involved in searching the internet to improve their digital literacy skills.

The teacher should also support all learners and monitor the contents browsed by learners.

3. **Project-based learning:** Learners in gender-based groups create a portfolio on the survey instruments and their uses with pictures. All learners should be encouraged to take part in

the portfolio building. Weak students should be supported by the teacher while others should be encouraged to lead roles.

Key Assessments

Assessment Level 1: List the surveying and mapping instruments used in Agricultural production.

Assessment Level 2: Explain the uses of pest and disease detection tools as surveying and mapping instruments in Agricultural production.

Assessment Level 3: Why is geographic information systems important as surveying and mapping equipment?

Assessment Level 4

1. How can remote sensing technology be used to improve Agricultural production?
2. Design and present a poster of four (4) survey instruments and their uses.

Hint



The recommended mode of assessment for week 5 is poster. Use the level 4 question 2 as a sample question.

WEEK 6

Learning Indicators

1. *Demonstrate the procedure for conducting surveys and mapping of farmstead.*
2. *Prepare map of a farmstead.*

Focal Area 1: Procedure for Conducting Survey and Mapping of Farmstead

1. The Procedure for Conducting Survey and Mapping of a Farmstead

a. Planning and Preparation

- i. **Define Objectives:** Clearly outline the goals and objectives of the survey. Determine what specific information needs to be collected (e.g., field boundaries, infrastructure, soil types, water resources).
- ii. **Gather Existing Data:** Collect any existing maps, aerial imagery, or historical data of the farmstead that may aid in planning the survey.
- iii. **Equipment and Tools:** Ensure that necessary survey equipment and tools are available and in working condition. This may include GPS devices, total stations, drones, soil sampling kits and GIS software.
- iv. **Field Personnel:** Assign trained personnel who are familiar with survey equipment and methodologies to conduct the fieldwork.

b. Field Survey

- i. **Field Boundary Survey:** Use GPS devices or total stations to accurately measure and mark the boundaries of the farmstead. Record boundary coordinates and verify against legal property boundaries if required.
- ii. **Infrastructure Mapping:** Identify and map existing infrastructures such as buildings, roads, fences, irrigation systems and drainage channels. Measure distances, record locations and note any necessary details (e.g., condition of infrastructure).
- iii. **Topographic Survey:** Conduct topographic mapping to determine land elevation, slopes, and terrain features. Use total stations or drones equipped with LiDAR or photogrammetry to create 3D models and detailed contour maps.
- iv. **Soil Sampling and Mapping:** Collect soil samples from various points across the farmstead to analyse soil properties (texture, pH, nutrient content). Use soil sensors or sampling kits to document soil characteristics at different depths and locations.
- v. **Water Resources Assessment:** Identify and map water sources (wells, ponds, streams) and irrigation infrastructure. Measure water flow rates, assess water quality parameters and document distribution systems.
- vi. **Crop and Vegetation Mapping:** Use remote sensing techniques (e.g., satellite imagery, drones) to map crop types, vegetation cover, and health status. Record

observations on crop growth stages, pest infestations, and overall vegetation condition.

c. Data Processing and Analysis

- i. Data Integration:** Combine survey data, field measurements, and remote sensing imagery into a unified GIS database. Georeference all collected data to ensure spatial accuracy and consistency.
- ii. Map Creation:** Generate maps using GIS software that depict various layers of information (e.g., boundaries, infrastructure, topography, soil types, water resources). Create thematic maps that highlight specific aspects of the farmstead, such as soil fertility zones or irrigation coverage.
- iii. Analysis and Interpretation:** Analyse spatial patterns and relationships between different data layers (e.g., soil properties and crop yield). Interpret findings to identify strengths, weaknesses, opportunities and threats (SWOT analysis) related to farm management.

d. Reporting and Implementation

- i. Documentation:** Prepare a detailed report summarising the survey methodology, data collected, analysis results, and recommendations. Include maps, graphs, and tables that visually communicate the findings to stakeholders.
- ii. Recommendations:** Provide actionable recommendations for optimizing farm management practices, improving resource efficiency and addressing challenges identified during the survey.
- iii. Implementation:** Work with farm management and stakeholders to implement recommended strategies and improvements based on survey findings. Monitor and evaluate changes over time to assess the effectiveness of implemented measures.

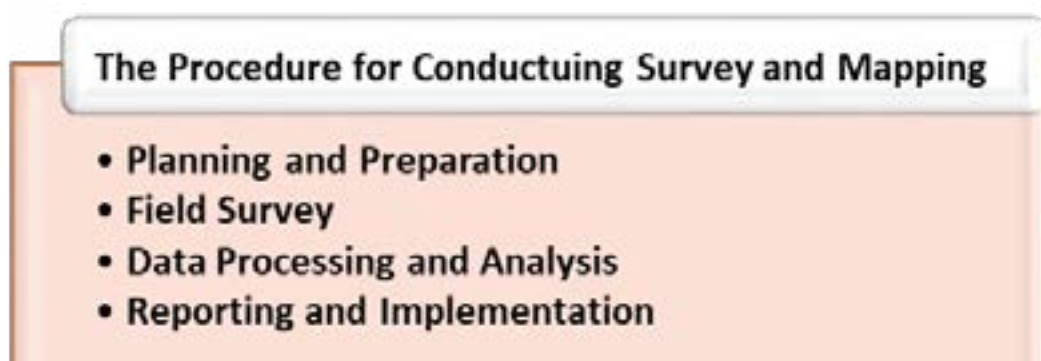


Figure 6.1: *The Procedure for Conducting Survey and Mapping of a Farmstead*

Learning Tasks

- 1.** Outline the procedures for conducting survey and mapping of a farmstead.
- 2.** Explain the procedures for conducting survey of a farmstead.
- 3.** Discuss the procedures for conducting survey and mapping of a farmstead.

Pedagogical Exemplars

1. **Initiating talk for learning:** Learners in mixed-ability groups discuss the procedures for conducting survey and mapping of farmstead under the guidance of a resource person. All learners should be encouraged to take part in the discussion. Confident and eloquent learners should be allowed to play lead roles in the discussion under the guidance of the teacher. All learners should tolerant and respect each other views.
2. **Experiential learning:** Learners in gender-based groups demonstrate the procedures for conducting survey and mapping of farmstead on the field (just outside the classroom) under the guidance of a technician/resource person observing all the safety protocols. The teacher should pre-arranged with the survey department for a theodolite. Under the guidance of a technician/resource person learners use the theodolite to measure the angles of the field outside the classroom. Teacher should encourage all learners to actively participate in conducting the surveying and mapping of the farmstead. Learners should be appreciated for good submissions.

Key Assessments

Assessment Level 1: List the procedures for conducting surveying and mapping of a farmstead.

Assessment Level 2: Explain data processing and analysis as a procedure for conducting surveying and mapping of a farmstead.

Assessment Level 3: Systematically discuss the procedures for conducting surveying and mapping of a farmstead.

Assessment Level 4: How can reporting and implementation improve and promote surveying and mapping of a farmstead?

Focal Area 2: Preparation of a Map of a Farmstead

1. **Procedure for Preparation of a Map of a Farmstead**
 - a. **Define Objectives and Scope**
 - i. **Identify Purpose:** Determine the specific goals and objectives for creating the map. Examples include land use planning, infrastructure management, crop management, and resource allocation.
 - ii. **Scope of Mapping:** Define the boundaries and extent of the farmstead that will be mapped. Consider including all fields, buildings, roads, water bodies, and other relevant features.
 - b. **Gather Existing Information**
 - i. **Collect Existing Maps and Data:** Gather any existing maps, aerial imagery, survey reports, or historical data related to the farmstead. This information can provide a starting point and reference for the mapping process.
 - ii. **Verify Boundaries:** Ensure that legal property boundaries are accurately represented and verified against official records if necessary.

c. Conduct Field Survey and Data Collection

- i. **Equipment Preparation:** Ensure that survey equipment such as GPS devices, total stations, measuring tapes, and drones are calibrated and ready for use. Prepare notebooks, data sheets, and field mapping software for recording observations and measurements.
- ii. **Field Survey**
 - **Boundary Mapping:** Use GPS devices or total stations to accurately measure and mark the boundaries of the farmstead. Record boundary coordinates and any relevant features along the perimeter.
 - **Infrastructure Mapping:** Identify and map buildings, roads, fences, gates, wells, irrigation systems, drainage channels, and any other infrastructure. Measure distances between key points and record their locations.
 - **Topographic Mapping:** Conduct topographic surveys to determine land elevations, slopes, and terrain features. Use total stations or drones equipped with LiDAR or photogrammetry to capture detailed elevation data.
 - **Soil Sampling:** Collect soil samples from representative locations across the farmstead to analyse soil properties such as texture, pH, nutrient content, and organic matter. Record sample locations and depths.
 - **Vegetation and Crop Mapping:** Utilise remote sensing techniques such as satellite imagery or drones to map crop types, vegetation cover, and health status. Record observations on crop growth stages and any pest or disease infestations.
- iii. **Water Resources Assessment:** Map water sources such as wells, ponds, streams, and irrigation systems. Measure water flow rates, assess water quality parameters, and document distribution networks.

d. Data Processing and Map Creation

- i. **Data Integration:** Compile and integrate all collected field data, measurements, and observations into a unified GIS database or mapping software. Georeference all data to ensure spatial accuracy and alignment with geographic coordinates.
- ii. **Map Design and Creation:** Use GIS software to create maps that represent various layers of information, including boundaries, infrastructure, topography, soil types, water resources, and vegetation cover. Design thematic maps that highlight specific aspects of the farmstead, such as soil fertility zones, irrigation coverage, or crop distribution.

e. Analysis and Interpretation

- i. **Spatial Analysis:** Analyse spatial relationships between different layers of data (e.g., soil types and crop yield) to identify patterns and correlations. Conduct overlay analysis to visualize the intersection of various map layers and derive insights.
- ii. **Interpretation and Reporting:** Interpret the findings from the map analysis to identify strengths, weaknesses, opportunities, and threats (SWOT analysis) related to farm management and planning. Prepare a comprehensive report that summarizes

the mapping methodology, data collected, analysis results, and recommendations for farmstead management.

f. **Implementation and Monitoring**

- i. **Implementation of Recommendations:** Work with farm management and stakeholders to implement recommended strategies and improvements based on the map findings. Monitor the implementation process and assess the effectiveness of measures taken.
- ii. **Periodic Updates:** Regularly update the farmstead map with new data and changes in farm infrastructure, land use, and crop management practices. Use updated maps for ongoing decision-making and continuous improvement in farm operations.

Example Layout of a Farmstead Map

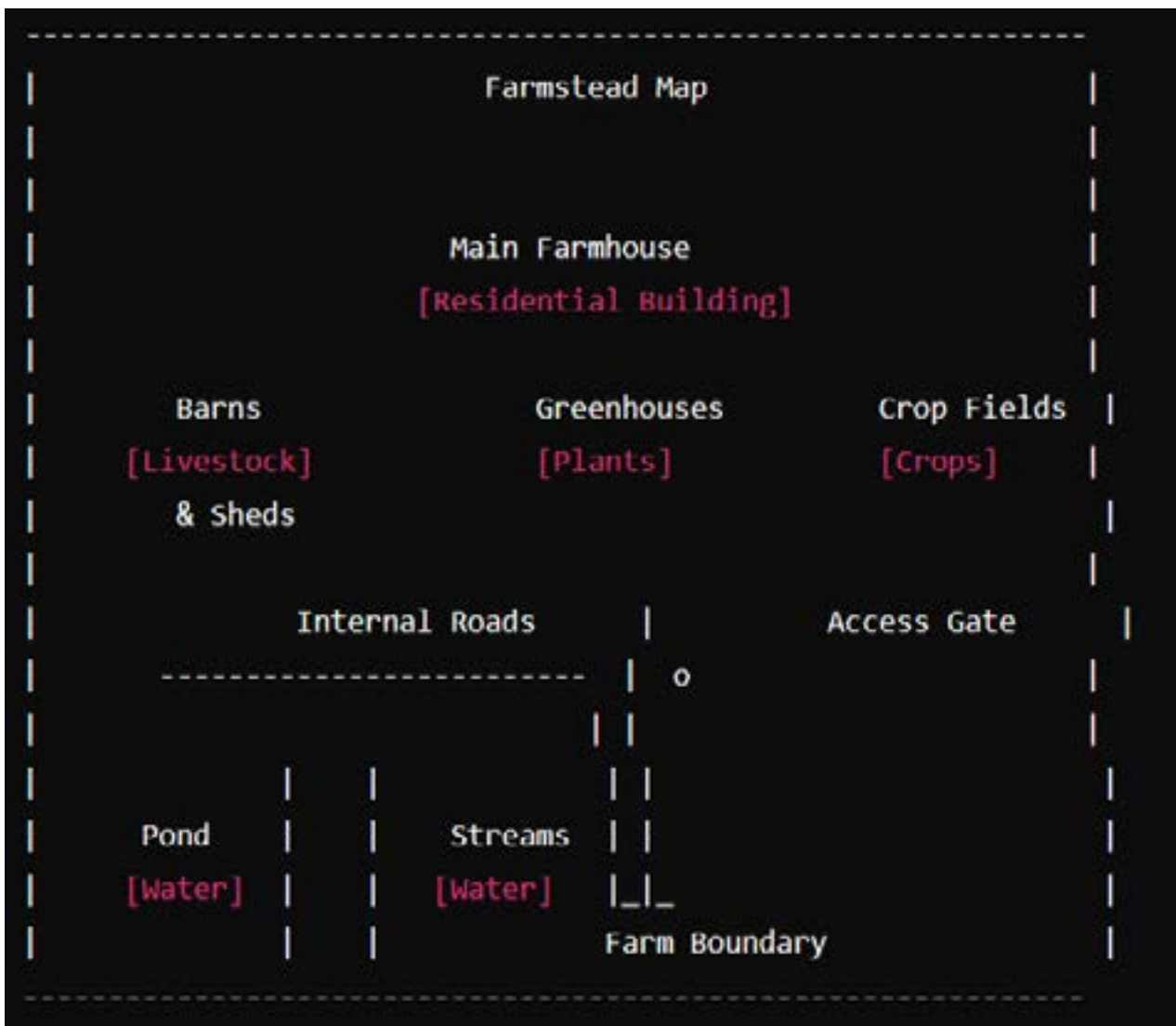


Figure 6.2a: A typical farm stead for crops and animals

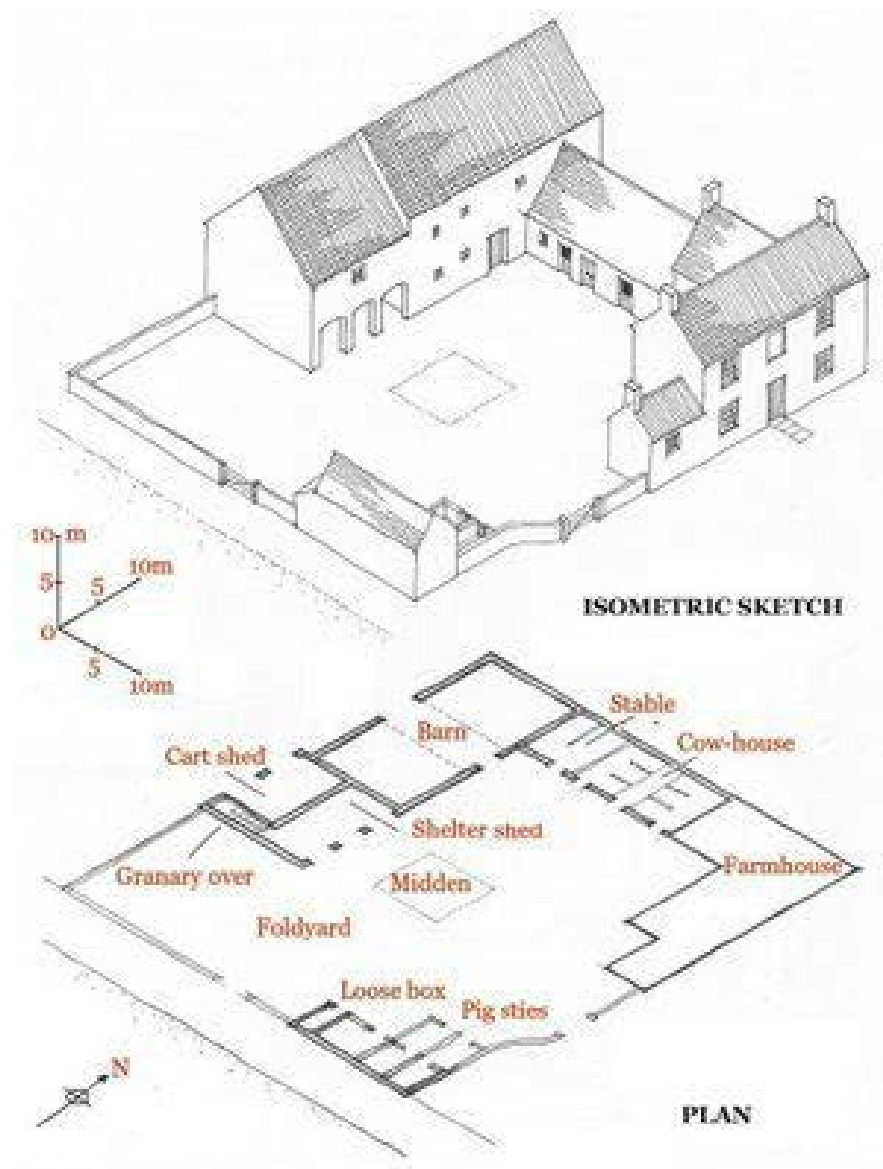


Figure 6.2b: A typical layout and farm stead for farm animals



Figure 6.2c: A typical farm stead

Learning Tasks

1. List the procedures for preparing a map of a farmstead
2. Explain the procedures for preparing a map of a farmstead
3. Prepare a map of a farmstead

Pedagogical Exemplars

1. **Experiential learning:** In gender-based groups, learners visit a farmstead or watch short documentary on mapping of a farmstead to gather data/information for mapping. All learners should be encouraged to be actively involved.
2. **Project-based learning:** Learners in the gender-based learning prepare a map of the farmstead using the data gathered. Learners present and explain their map in a plenary session in the class.

Teacher should ensure that all learners participate in preparing a map of a farmstead. Learners who are introverts and those with additional support needs should be encouraged to be involved in the plenary presentation of the map of the farmstead in class.

Key Assessments

Assessment Level 1: List the procedures for preparing a map of a farmstead.

Assessment Level 2: Discuss the procedures for preparing a map of a farmstead.

Assessment Level 3: Analyse the significance of the various components of a farmstead.

Assessment Level 4: Create a farmstead that can be used for both crop and animal production.

Hint



- *The recommended mode of assessment for week 6 is Mid semester examination*
- Refer to the Appendix C for more sample task and the Table of Specification

SECTION 3 REVIEW

Survey and Mapping in Agriculture refer to the processes used to collect, analyse, and visualise spatial data to enhance agricultural practices. These activities assist Agriculturists to make informed decisions, improve land management and increase productivity. Survey and Mapping in Agriculture are important for Precision and Sustainable Agricultural Practices, Improved Land Management and Enhanced Resource Management, Risk Management, Increased Productivity and Profitability, Informed Decision Making, Technological Integration and Regulatory Compliance. Survey and Mapping Instruments Used in Agricultural Production are Global Positioning System (GPS) Devices, Geographic Information Systems (GIS), Remote Sensing Technology, Soil Testing Kits, Laser Land Levelers, Weather Stations, Yield Monitors and Harvest Mapping, Pest and Disease Detection Tools and Surveying Equipment. The procedures for conducting survey and mapping of a farmstead are Planning and Preparation,

Field Survey, Data Processing and Analysis, as well as, Reporting and Implementation, while the procedures for preparation of a map of a farmstead include stating the Definition of the Objectives and Scope, Gathering Existing Information, Conducting Field Survey and Data Collection, Data Processing and Map Creation, Analysis and Interpretation and Implementation and Monitoring.

RUBRICS FOR THE POSTER ASSESSMENT

Criteria	Excellent (4 marks)	Very Good (3 marks)	Good (2 marks)	Fair (1 mark)
Identifying survey Instruments	Presents pictures of 4 different survey instruments with their uses.	Presents pictures of 3 different survey instruments with their uses.	Presents pictures of 2 different survey instruments with their uses.	Presents pictures of 1 different survey instruments with their uses.
Visual Design and creativity	The poster shows 4 of the following; Layout that draws attention to key points. Visuals are eye-catching and relevant, Text and images are balanced and easy to follow Poster is clear and easy to understand.	The poster shows 4 of the following; Layout that draws attention to key points. Visuals are eye-catching and relevant, Text and images are balanced and easy to follow Poster is clear and easy to understand.	The poster shows 4 of the following; Layout that draws attention to key points. Visuals are eye-catching and relevant, Text and images are balanced and easy to follow Poster is clear and easy to understand.	The poster shows 4 of the following; Layout that draws attention to key points. Visuals are eye-catching and relevant, Text and images are balanced and easy to follow Poster is clear and easy to understand.
Presentation	Showing 4 of the skills e.g. Audible voice, Keeping eye contact Pay attention to audience Engaging the audience with interaction Use of gesture	Showing 3 of the skills e.g. Audible voice, Keeping eye contact Pay attention to audience Engaging the audience with interaction Use of gesture	Showing 2 of the skills e.g. Audible voice, Keeping eye contact Pay attention to audience Engaging the audience with interaction Use of gesture	Showing 1 of the skills e.g. Audible voice, Keeping eye contact Pay attention to audience Engaging the audience with interaction Use of gesture



APPENDIX C: MID SEMSTER EAMINATION

1. Nature

- Cover content from weeks 1 – 5, taking into consideration DoK levels 1-3.
- The test should have 20 multiple choice questions for 20 marks
- Time: 30 minutes.
- Total Score: 20 marks – 1 mark each

2. Resources

- Answer Booklets
- Learner Material
- Teachers Manual
- Teacher Assessment Manual and Toolkit

3. Sample questions

Answer the following questions by circling the correct answers;

- Which stage of agricultural development is marked by the shift from hand tools to mechanised farming equipment?
 - Green Revolution
 - Industrial Agriculture
 - Information Agriculture
 - Neolithic Revolution

4. Sample table of specification

Weeks	Learning indicator(s)	Type of Questions	DoK Levels				Total
			1	2	3	4	
1	Meaning, Importance and Stages of Agricultural Development	Multiple Choice	2	2	1	-	5
2	Land Tenure Systems in Ghana	Multiple Choice Essay	1	1	1	1	4
3	Importance of Waste Materials from Crops to Industry	Multiple Choice Essay	1	2	-	-	3
4	Importance of Raw and Waste Materials from Animal Production to the Industry	Multiple Choice	1	1	1	-	3
5	Meaning and Importance of Survey and Mapping in Agriculture	Multiple Choice	1	2	1	1	5
	Total	6	8	4	2	20	

SECTION 4: IRRIGATION, DRAINAGE AND POST-HARVEST IMPLEMENTS IN AGRICULTURAL PRODUCTION

Strand: Modern Technical and Mechanised Agriculture

Sub-Strand: Modern Mechanised Agriculture

Weeks 7 & 8

Learning Outcome: Use the knowledge acquired to explain the meaning and benefits of irrigation and drainage systems in Agricultural production.

Content Standard: Demonstrate the knowledge and understanding of the meaning and benefits of irrigation and drainage systems in Agricultural production.

Weeks 9 & 10

Learning Outcome: Use the knowledge and skills acquired to operate a simple harvest and post-harvest implements and machinery.

Content Standard: Demonstrate knowledge and understanding of harvest and post-harvest implements and machinery.

Hint



- Remind learners to submit their Week 8 homework in Week 9.
- Remind learners to submit their Group project in Week 8.

INTRODUCTION AND SECTION SUMMARY

Irrigation and drainage systems maximise crop yields and ensure sustainable Agricultural practices. Careful operation of irrigation and drainage systems can optimise water usage, improve crop health, and enhance overall agricultural productivity. Application of Agricultural tools, implements and machinery can significantly enhance the efficiency and effectiveness of both harvesting and post-harvest processes, ultimately leading to increased productivity, reduced labour costs, and minimised crop losses. An understanding of the classification and uses of tools will help in choosing the right equipment for their specific needs, leading to more efficient and effective harvesting operations. It will also lead to reduced losses, improved product quality, and better marketability. By following operational guidelines, farmers can efficiently and safely use simple harvest implements and machinery, enhancing productivity and ensuring the quality of the harvested crops. This section will help learners to know

the meaning and benefits of irrigation and drainage systems in Agricultural production as well as demonstrate the ability operate simple harvest and post-harvest tools, implements and machinery. This section has links with subjects such as Applied Technology, Engineering, Manufacturing, Robotics, and Aviation and Aerospace due to the use of tools, implements and machinery.

The weeks covered by the section are:

Week 7: Meaning, types and benefits of Agricultural irrigation and drainage systems as well as methods and uses of irrigation and drainage systems in Agricultural production.

Week 8: Parts and functions of the irrigation and drainage system in Agricultural production and demonstrate the skills of operating them.

Week 9: Classification and uses of harvest and post-harvest tools, implements and machinery.

Week 10: Demonstration of skills in the operation of simple harvest and post-harvest implements and machinery use in Agricultural production.

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section is to be taught using various pedagogical exemplars. The suggested pedagogical exemplars to be used are think-pair-share, structuring talk for learning, collaborative learning, experiential learning, initiating talk for learning, inquiry-based learning, project-based learning and initiating talk for learning. The use of these pedagogies in different ways to teach irrigation and drainage systems as well as harvest and post-harvest tools will inculcate creativity, critical thinking, problem solving skills, team work, communication, digital skills and national values in learners. Also, gender, equality and social inclusion will be promoted as learners work in various groups and learn to tolerate, accept and respect each other's view. Where field trips cannot be embarked on, the teacher should make arrangements for learners to watch documentaries, videos, charts or pictures that will support and facilitate their understanding. Also, ample time should be given to projects and low learners to catch up. Gifted and talented learners should be assigned extra tasks and made to support their peers in feasible and applicable activities. Learners should also be guided by the teacher and technician during the operation of harvest and post-harvest tools. The teacher should encourage all learners to actively take part in all activities.

ASSESSMENT SUMMARY

Assessments to be given should cover i) meaning, types and benefits of Agricultural irrigation and drainage systems, ii) methods and uses of irrigation and drainage systems in Agricultural production, iii) parts and functions of irrigation and drainage system in Agricultural production iv) classification and uses of harvest and post-harvest tools, implements and machinery and v) operation of simple harvest and post-harvest implements and machinery use in Agricultural production. Assessments should take in cognisance the different ability and proficiencies of learners and a balance of the various depth of knowledge, that is, Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning) assessments. The assessments should be summative and formative using strategies such as group discussions, presentations, homework, class exercises, class tests and project-based work. The teacher should accept varying number of demonstrations, oral and written responses. The teacher should develop rubrics, score cards and marking schemes to score group works, projects and other assignments.

WEEK 7

Learning Indicators

1. Explain the meaning and benefits of Agricultural irrigation and drainage systems.
2. Describe the methods and uses of irrigation and drainage systems in Agricultural production.

Focal Area 1: Meaning and Benefits of Agricultural Irrigation and Drainage Systems

1. Meaning of Agricultural Irrigation and Drainage Systems

- a. **Meaning of Agricultural Irrigation Systems:** Agricultural irrigation systems are engineered methods used to supply water to crops in a controlled manner to ensure their optimal growth and yield. These systems are particularly important in regions where rainfall is insufficient or irregular.
- b. **Meaning of Agricultural Drainage Systems:** Agricultural drainage systems are designed to remove excess water from the soil surface and subsurface to prevent waterlogging, improve soil conditions, and promote healthy crop growth.
- c. **Meaning of Integration of Irrigation and Drainage:** This is the combination of irrigation and drainage systems to manage water effectively. This integration ensures that crops receive adequate water for growth while preventing water-related issues such as waterlogging or salinity buildup. The factors to consider under this system are:
 - i. **Climate and Weather Patterns:** Systems should be designed based on local climate conditions and variability.
 - ii. **Soil Characteristics:** Understanding soil type and structure is crucial for effective system design.
 - iii. **Crop Requirements:** Different crops have varying water needs, influencing the choice of irrigation and drainage methods.
 - iv. **Environmental Impact:** Sustainable practices should be adopted to minimize environmental impacts, such as water conservation and prevention of runoff pollution.

2. Benefits of Agricultural Irrigation and Drainage Systems

- a. **Benefits of Agricultural Irrigation Systems**
 - i. **Increased Crop Yield and Quality:** *Consistent Water Supply:* Provides crops with a reliable water source, leading to more consistent and higher yields. *Improved Crop Quality:* Optimal water supply helps produce healthier and higher-quality crops.
 - ii. **Efficient Water Use:** *Water Conservation:* Advanced systems like drip and sprinkler irrigation minimise water wastage compared to traditional methods. *Precise Application:* Delivers water directly to the root zone, reducing evaporation and runoff.

- iii. **Expanded Cultivation Areas: *Arid and Semi-Arid Regions*:** Enables farming in regions with insufficient rainfall. ***Season Extension*:** Allows for crop growth beyond the natural rainy season, leading to multiple harvests in a year.
 - iv. **Enhanced Soil Fertility: *Nutrient Delivery*:** Fertigation (the combination of fertilisation and irrigation) ensures nutrients are delivered directly to the roots. ***Soil Moisture Management*:** Maintains optimal soil moisture levels, preventing soil erosion and nutrient leaching.
 - v. **Improved Crop Diversity: *Variety of Crops*:** Allows for the cultivation of a wider range of crops, including those that require specific water conditions.
 - vi. **Labor Savings: *Automation*:** Modern irrigation systems can be automated, reducing the need for manual labour and monitoring.
- b. **Benefits of Agricultural Drainage Systems**
- i. **Prevention of Waterlogging: *Root Health*:** Removes excess water from the soil, preventing root suffocation and promoting healthy root development. ***Crop Survival*:** Enhances the survival and growth of crops in areas prone to heavy rainfall.
 - ii. **Improved Soil Structure and Aeration: *Soil Aeration*:** Facilitates air movement in the soil, improving root respiration and soil microorganism activity. ***Better Soil Conditions*:** Enhances the physical properties of the soil, making it more suitable for plant growth.
 - iii. **Salinity Control: *Salt Removal*:** Helps in removing excess salts from the soil, which can otherwise accumulate and hinder plant growth. ***Soil Reclamation*:** Reclaims saline soils, making them arable and productive.
 - iv. **Enhanced Field Accessibility: *Reduced Standing Water*:** Drains fields quickly after heavy rains, making them accessible for machinery and labour sooner. ***Timely Agricultural Operations*:** Ensures timely planting, cultivation, and harvesting operations.
 - v. **Disease and Pest Management: *Reduced Waterborne Diseases*:** Minimises the incidence of diseases caused by waterlogged conditions. ***Pest Control*:** Limits the habitat for water-loving pests, reducing their impact on crops.
- c. **Combined Benefits of Integrated Irrigation and Drainage Systems**
- i. **Optimal Water Management: *Balanced Water Levels*:** Ensures fields are neither too dry nor too wet, maintaining optimal moisture conditions for crops. ***Resource Efficiency*:** Enhances the efficient use of water resources by combining irrigation and drainage practices.
 - ii. **Sustainable Farming Practices: *Environmental Protection*:** Reduces runoff and prevents soil erosion, protecting the environment. ***Climate Resilience*:** Enhances the ability to cope with varying weather patterns and climate change impacts.
 - iii. **Economic Benefits: *Increased Farm Income*:** Higher yields and better crop quality lead to increased farm profitability. ***Cost Savings*:** Reduces costs related to crop losses, soil reclamation, and pest and disease management.
 - iv. **Food Security: *Reliable Food Production*:** Contributes to a stable food supply by ensuring reliable crop production. ***Nutritional Benefits*:** Supports the cultivation of diverse and nutritious crops, improving food quality and availability.

Learning Tasks

1. State the meaning of Agricultural Irrigation and Drainage Systems.
2. Explain the importance of Agricultural Irrigation and Drainage Systems.
3. Explain the meaning and importance of Agricultural Irrigation and Drainage Systems.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm to come up with the meaning and types of Agricultural irrigation and drainage systems. Some learners should be assisted with probing questions that will help them to state the meaning and types of Agricultural irrigation and drainage systems. Challenge others to explain the meaning of Agricultural irrigation and drainage systems.
2. **Structuring talk for learning:** Learners in mixed-gender groups surf the internet to gather information on the benefits of irrigation and drainage systems in Agriculture. Learners present their reports in a plenary session in the class. Teacher should encourage all learners to participate in searching the internet for information on the benefits of irrigation and drainage systems in Agriculture. Learners who are fast in using the internet should be allowed to support others. The teacher should also monitor the content of what learners browse. All learners should tolerant and respect each other views.
3. **Collaborative learning:** Learners in mixed-ability groups discuss the problems associated with irrigation and drainage in Agriculture. Learners should discuss the challenges that women and people with disabilities involved in Agriculture face with the provision of irrigation facilities in the communities. Learners should respect and tolerate each other's view during discussions.

Key Assessments

Assessment Level 1: Differentiate between Agricultural irrigation and drainage systems.

Assessment Level 2: Discuss at least three (3) importance of Agricultural irrigation and drainage systems.

Assessment Level 3: Justify why you will go for integration of Agricultural irrigation and drainage systems.

Assessment Level 4: How can Agricultural irrigation help enhanced soil fertility and increased crop yield and quality.

Focal Area 2: Methods and Uses of Irrigation and Drainage Systems in Agricultural Production

1. Methods of Irrigation Systems in Agricultural Production

a. Surface Irrigation

Description: Water is distributed over the soil surface by gravity. It includes flood and furrow irrigation.

i. Flood Irrigation: Water is released across the entire field.

- **Advantages:** Low initial cost, easy to implement.
- **Disadvantages:** High water usage, potential for waterlogging and erosion.

ii. Furrow Irrigation: Water is directed into furrows (small channels) between crop rows.

- **Advantages:** More efficient than flood irrigation, reduces water contact with plant leaves.
- **Disadvantages:** Labour-intensive, uneven distribution of water.

b. Sprinkler Irrigation

Description: Water is sprayed into the air and allowed to fall on crops like natural rainfall using a system of pipes and sprinklers. Center pivot and lateral move types exist.

i. Center Pivot: A rotating sprinkler system that moves in a circular pattern.

- **Advantages:** Covers large areas, efficient water use.
- **Disadvantages:** High initial cost, requires energy for operation.

ii. Lateral Move: Sprinklers mounted on a straight system that moves laterally across the field.

- **Advantages:** Even water distribution, suitable for rectangular fields.
- **Disadvantages:** High initial cost, potential for water drift in windy conditions.

c. Drip Irrigation

Description: Water is delivered directly to the root zone of plants through a network of valves, pipes, tubing, and emitters.

- **Advantages:** Highly efficient, minimises water wastage, reduces weed growth.
- **Disadvantages:** High initial setup cost, requires regular maintenance.

d. Subsurface Irrigation

Description: Water is applied below the soil surface, directly to the root zone through underground pipes or drip lines.

- **Advantages:** Reduces evaporation losses, precise water application.
- **Disadvantages:** High installation cost, complex maintenance.

e. Manual Irrigation

Description: Water is manually carried to plants using buckets, watering cans, or hoses.

- **Advantages:** Low cost, minimal equipment needed.
- **Disadvantages:** Labour-intensive, not suitable for large-scale farming.



Figure 7.1: *Methods of Irrigation System*

2. Methods of Drainage Systems in Agricultural Production

a. Surface Drainage

Description: Removal of excess water from the soil surface through ditches, channels, or shaping of the land. Open ditches and land grading are types of surface drainage.

i. **Open Ditches:** Channels dug to direct water away from fields.

- **Advantages:** Effective for large volumes of water, relatively simple to construct.
- **Disadvantages:** Can take up valuable land, requires regular maintenance.

ii. **Land Grading:** Smoothing and shaping the land to facilitate runoff.

- **Advantages:** Improves water flow, reduces waterlogging.
- **Disadvantages:** Can be costly, may disrupt soil structure.

b. Subsurface Drainage

Description: Removal of excess water from below the soil surface using a network of underground pipes or tiles. Tile drainage and mole drainage are the types of subsurface drainage.

i. **Tile Drainage:** Use of perforated pipes laid below the soil surface to collect and transport water away from the field.

- **Advantages:** Effective water removal, enhances soil structure.
- **Disadvantages:** High installation cost, potential for pipe clogging.

ii. **Mole Drainage:** Creation of unlined channels (mole drains) using a mole plow, suitable for clay soils.

- **Advantages:** Low-cost alternative to tile drainage, improves soil aeration.
- **Disadvantages:** Less durable than tile drains, may need frequent maintenance.

c. Vertical Drainage

Description: Use of deep wells to lower the water table in areas with high groundwater levels.

- **Advantages:** Effective for deep water removal, suitable for large areas.
- **Disadvantages:** High cost, energy-intensive.

d. Controlled Drainage

Description: Management of water levels in drainage systems using control structures like weirs and gates.

- **Advantages:** Allows for water table management, can enhance water conservation.
- **Disadvantages:** Requires careful monitoring and management, initial setup cost.

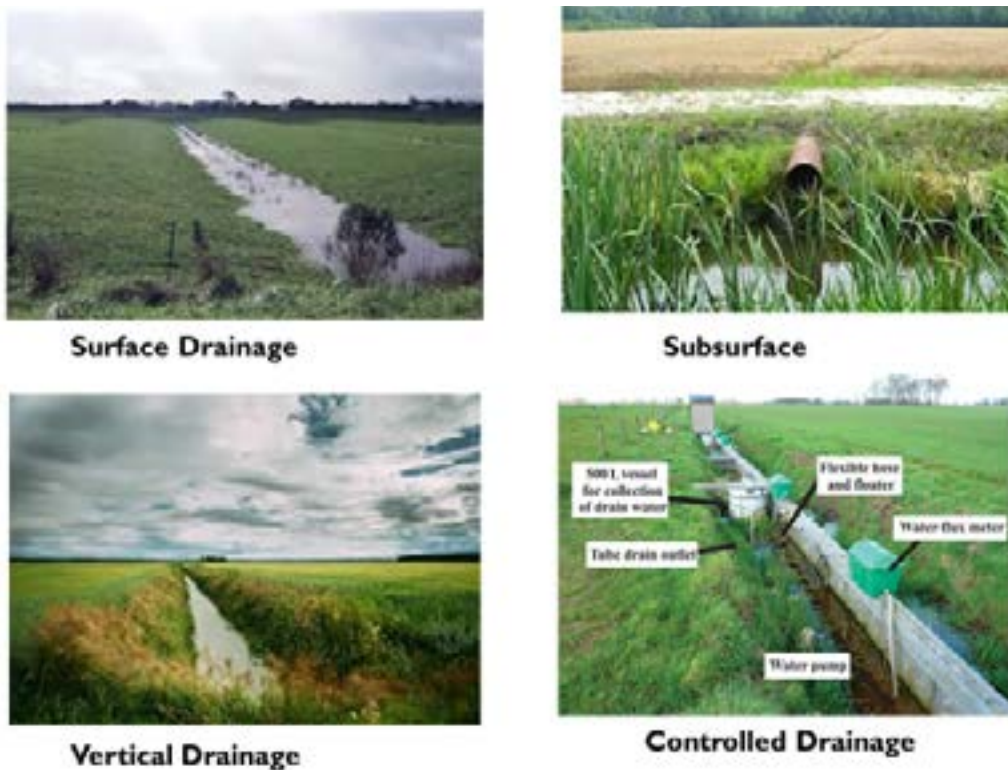


Figure 7.2: Methods of Drainage System

3. Uses of Irrigation Systems in Agricultural Production

a. Supplementing Natural Rainfall

- Purpose:** To provide additional water to crops when rainfall is insufficient.
- Benefit:** Ensures consistent crop growth and productivity regardless of rainfall variability.

b. Enhancing Crop Yields

- Purpose:** To deliver the right amount of water at the right time to crops.
- Benefit:** Maximises yield potential by meeting crop water needs during critical growth stages.

c. **Improving Crop Quality**

- i. **Purpose:** To provide a steady and controlled water supply.
- ii. **Benefit:** Results in better-quality produce with uniform size and taste, reducing crop stress.

d. **Expanding Arable Land**

- i. **Purpose:** To enable farming in arid and semi-arid regions.
- ii. **Benefit:** Increases the amount of cultivable land, boosting food production and economic returns.

e. **Facilitating Multiple Cropping**

- i. **Purpose:** To allow for multiple crop cycles within a year by providing reliable water throughout the growing season.
- ii. **Benefit:** Enhances farm income and food availability by increasing the number of harvests.

f. **Enabling Precision Agriculture**

- i. **Purpose:** To integrate with modern technologies like sensors and automated systems.
- ii. **Benefit:** Enhances efficiency and effectiveness of water use, improving overall farm management.

Uses of Drainage Systems in Agricultural Production

a. **Preventing Waterlogging**

- i. **Purpose:** To remove excess water from the soil surface and root zone.
- ii. **Benefit:** Protects crops from root suffocation and diseases caused by excess moisture.

b. **Improving Soil Aeration**

- i. **Purpose:** To maintain appropriate air and water balance in the soil.
- ii. **Benefit:** Promotes healthy root development and microbial activity, improving plant health.

c. **Managing Salinity Levels**

- i. **Purpose:** To control and reduce soil salinity by flushing out salts.
- ii. **Benefit:** Prevents salt buildup that can inhibit plant growth and reduce soil fertility.

d. **Reclaiming Marginal Lands**

- i. **Purpose:** To convert waterlogged or saline lands into productive Agricultural areas.
- ii. **Benefit:** Increases the available land for cultivation, enhancing food production and farm profitability.

e. Enhancing Field Accessibility

- i. **Purpose:** To ensure fields are dry enough for machinery and labour after heavy rains.
- ii. **Benefit:** Allows timely planting, cultivation, and harvesting operations, reducing delays and losses.

f. Facilitating Sustainable Farming

- i. **Purpose:** To integrate with irrigation systems for balanced water management.
- ii. **Benefit:** Promotes sustainable use of water resources, ensuring long-term Agricultural productivity.

Learning Tasks

1. List the methods of irrigation and drainage systems in Agricultural production.
2. Explain the methods of irrigation and drainage systems in Agricultural production.
3. Discuss the uses of irrigation and drainage systems in Agricultural production.

Pedagogical Exemplars

1. **Experiential learning:** Learners in mixed-ability groups visit a nearby farm with irrigation system/watch videos/pictures on irrigation system in Agriculture and discuss the methods of irrigation and drainage systems in Agriculture. Teachers should ensure that videos/pictures used do not enforce stereotyping and if they do, teachers should discuss them with learners. All learners should be encouraged to visit an irrigation and drainage system site/watch videos/pictures on irrigation and drainage systems.
2. **Initiating talk for learning:** Learners in mixed-ability groups discuss the various types of irrigation and drainage equipment used in Agricultural production. Encourage learners with the ability to play lead roles to do so. All learners should be encouraged to accept and tolerant the view of others. Learners should be appreciated for their submissions.
3. **Collaborative learning:** Learners in mixed-ability groups discuss the uses of the various irrigation and drainage systems in Agricultural production. Learners should discuss the benefits of irrigation facilities to the agricultural activities of women and persons living with disabilities. Confident learners should be allowed to play lead roles in the discussion under the guidance of the teacher. All learners should tolerant and respect each other views. Learners should be recognised for good submissions.

Key Assessments

Assessment Level 1

1. List at least two (2) methods of irrigation and drainage systems in Agricultural production.
2. Match the following terminologies in methods of irrigation with their respective descriptions.

Terminologies	Surface Irrigation, Sprinkler Irrigation, Drip Irrigation, Subsurface Irrigation, Manual Irrigation
Descriptions	Water is sprayed into the air and allowed to fall on crops like natural rainfall using a system of pipes and sprinklers. Water is applied below the soil surface, directly to the root zone through underground pipes or drip lines. Water is carried to plants using buckets, watering cans, or hoses. Water is distributed over the soil surface by gravity. It includes flood and furrow irrigation.

Assessment Level 2: Explain at least two (2) uses of irrigation and drainage systems in Agricultural production.

Assessment Level 3: Explain how irrigation can be used to expand arable land for crop cultivation.

Assessment Level 4: Discuss how drainage systems in Agriculture can facilitate sustainable farming.

Hint



The recommended mode of assessment for week 7 is matching. Use the level 1 question 2 as a sample question.

WEEK 8

Learning Indicator: Describe the parts and functions of the irrigation and drainage system in Agricultural production and demonstrate the skills of operating them.

Focal Area 1: Parts and Functions of Irrigation and Drainage System in Agricultural Production and their Operation

1. Parts of Irrigation System

- a. **Water Source:** Rivers, lakes, reservoirs, wells, or groundwater: Primary sources of water for irrigation.
- b. **Pump:** Centrifugal pumps, submersible pumps, turbine pumps: Used to lift or transport water from the source to the fields.
- c. **Pipes and Channels:** Main lines, sub-main lines, laterals, and field ditches: Transport water from the source to the fields.
- d. **Valves and Gates:** Gate valves, butterfly valves, check valves: Control the flow and pressure of water within the system.
- e. **Sprinklers and Drip Emitters:** Sprinkler heads, micro-sprinklers, drip emitters: Distribute water directly to the crops. Sprinklers spray water over the crops, while drip emitters release water slowly at the base of plants.
- f. **Filters and Screens:** Sand filters, screen filters, disc filters: Remove debris and particles from the water to prevent clogging of pipes and emitters.
- g. **Controllers and Timers:** Automatic controllers, manual timers: Regulate the timing and duration of irrigation cycles.
- h. **Sensors:** Soil moisture sensors, rain sensors, flow meters: Monitor soil moisture levels, rainfall, and water flow to optimize irrigation efficiency.

2. Functions of Irrigation System

- a. **Water Supply:** Ensures a consistent and reliable supply of water to crops, especially in areas with inadequate rainfall.
- b. **Soil Moisture Management:** Maintains optimal soil moisture levels to support plant growth and development.
- c. **Nutrient Distribution:** Facilitates the application of fertilizers and nutrients through fertigation, ensuring even distribution.
- d. **Weed Control:** Helps manage weed growth by creating a controlled environment that limits water availability to unwanted plants.
- e. **Microclimate Control:** Modifies the local microclimate to improve crop conditions, such as reducing temperature extremes

3. Parts of Drainage System

- a. **Surface Drains:** Field ditches, contour drains: Channels that collect and divert excess surface water away from fields.

- b. Subsurface Drains:** Tile drains, mole drains, perforated pipes: Buried conduits that remove excess water from the root zone of crops.
- c. Drainage Outlets:** Drainage ditches, drainage wells: Discharge points where collected water is released away from agricultural fields.
- d. Pumps:** Sump pumps, drainage pumps: Used in areas where gravity drainage is not possible to lift water to the drainage outlets.
- e. Control Structures:** Weirs, sluice gates: Regulate water levels and flow within the drainage system.

4. Functions of Drainage System

- a. Water Table Management:** Lowers the water table to prevent waterlogging and ensure optimal root zone aeration.
- b. Soil Salinity Control:** Reduces soil salinity by flushing out excess salts through drainage.
- c. Erosion Prevention:** Minimises soil erosion by controlling the speed and volume of surface water runoff.
- d. Crop Health Improvement:** Enhances crop health by preventing conditions such as root rot and fungal diseases associated with excess moisture.
- e. Field Accessibility:** Improves field conditions, making them more accessible for farming operations such as planting, cultivation, and harvesting.

5. Operation of Irrigation System

a. Planning and Design

- i. Assessment of Water Needs:** Determine the water requirements of crops based on factors like crop type, growth stage, soil type, and climate conditions.
- ii. System Design:** Plan the layout of the irrigation system, including the placement of pumps, pipes, valves, and emitters, to ensure even water distribution.

b. Water Source Management

- i. Monitoring Water Levels:** Regularly check the water levels in reservoirs, wells, or other sources to ensure a sufficient supply.
- ii. Water Quality Testing:** Test water for salinity, pH, and contaminants to prevent damage to crops and irrigation equipment.

c. Pump Operation

- i. Starting and Stopping Pumps:** Operate pumps to draw water from the source and pressurize the system.
- ii. Pressure Regulation:** Adjust the pump settings to maintain the required water pressure throughout the system.

d. Water Distribution

- i. Opening and Closing Valves:** Use valves to control the flow of water to different sections of the field.

- ii. **Adjusting Emitters:** Set the flow rate of sprinklers or drip emitters to match the water needs of crops.

e. Scheduling Irrigation

- i. **Irrigation Timers:** Program timers to control the duration and frequency of irrigation cycles.
- ii. **Soil Moisture Sensors:** Use sensors to monitor soil moisture levels and adjust irrigation schedules accordingly.

f. Maintenance and Monitoring

- i. **Inspecting Equipment:** Regularly check for leaks, clogs, and wear in pipes, emitters, and pumps.
- ii. **Cleaning Filters:** Clean or replace filters to prevent debris from clogging the system.
- iii. **Performance Monitoring:** Track system performance and water usage to identify and address inefficiencies.

g. Seasonal Adjustments

- i. **Adjusting for Weather:** Modify irrigation schedules based on weather conditions, such as rainfall or temperature changes.
- ii. **Seasonal Maintenance:** Perform maintenance tasks like winterizing equipment to prevent damage during off-seasons.

6. Operation of Drainage System

a. Planning and Design

- i. **Site Assessment:** Evaluate the topography, soil type, and water table levels to design an effective drainage system.
- ii. **System Layout:** Plan the arrangement of surface and subsurface drains, including the placement of ditches, tiles, and outlets.

b. Installation

- i. **Digging Ditches and Trenches:** Construct ditches and trenches for surface and subsurface drainage.
- ii. **Installing Drains:** Lay tile drains or perforated pipes in trenches and cover them with permeable material like gravel.

c. Water Collection

- i. **Surface Drains:** Collect excess surface water from fields through ditches and contour drains.
- ii. **Subsurface Drains:** Remove excess water from the root zone using buried drains.

d. Water Discharge

- i. **Gravity Flow:** Utilise gravity to direct water from drains to discharge points like drainage ditches or wells.

- ii. **Pumping:** Use pumps to lift water to drainage outlets in areas where gravity flow is insufficient.
- e. **Control Structures Operation**
 - i. **Adjusting Weirs and Gates:** Operate control structures to regulate water levels and flow within the drainage system.
 - ii. **Monitoring Discharge:** Ensure that discharge points are functioning properly and are not obstructed.
- f. **Maintenance and Monitoring**
 - i. **Inspecting Drains:** Regularly check for blockages, sediment buildup, and damage in both surface and subsurface drains.
 - ii. **Cleaning and Repairs:** Clean ditches, replace damaged tiles, and remove debris to maintain system efficiency.
 - iii. **Monitoring Water Table:** Track water table levels to ensure effective drainage and prevent waterlogging.
- g. **Seasonal Adjustments**
 - i. **Wet Season Management:** Increase drainage capacity during wet seasons to handle excess water.
 - ii. **Dry Season Maintenance:** Conduct maintenance and repairs during dry periods when the system is less active.

Learning Tasks

1. State parts of an irrigation and drainage system in Agricultural production.
2. Explain the functions of the parts of an Agricultural irrigation and drainage system in.
3. Discuss the operation of an irrigation and drainage system in Agricultural production.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in gender-based groups surf the internet to come up with information on the parts and functions of an irrigation and drainage system in Agricultural production. Learners familiar with the use of the internet should be allowed to help others. The teacher should also encourage all learners to be involved in surfing the internet to improve their digital literacy skills. The teacher should monitor the contents browsed by learners. All learners should be encouraged to accept and tolerant the view of others.
2. **Project-based learning:** Learners in gender-based groups watch a short documentary on the application of irrigation system for cultivation of a selected crop and create a portfolio on the application of the irrigation system. All learners should be encouraged and monitored to watch the short documentary and actively take part in the portfolio building. Confident

and eloquent learners should be allowed to play lead roles under the guidance of the teacher. All learners should tolerant and respect each other views.

Key Assessment Levels

Assessment Level 1: List at least three (3) parts of irrigation and drainage systems in Agricultural production.

Assessment Level 2

1. Explain the functions of at least three (3) parts of irrigation and drainage systems in Agricultural production.
2. Name 5 parts of an irrigation system used in Agricultural production and their function.

Assessment Level 3: Explain why drainage system can be helpful in improving crop health and water table management.

Assessment Level 4: Systematically discuss the operation of an irrigation system and drainage systems.

Hint



The recommended mode of assessment for week 8 is homework. Use the level 2 question 2 as a sample question.

WEEK 9

Learning Indicators

1. Classify harvest and post-harvest implements and machinery.
2. Describe the uses of harvest and post-harvest tools, implements and machinery in Agricultural production.

Focal Area 1: Classification of Harvest and Post-harvest Implements and Machinery

1. Classification of Harvest Implements and Machinery

Harvest tools can be classified based on their operational mechanism, scale of use, and the type of crops they are used to harvest. They include:

- a. Manual Harvest (Hand) Tools:** Examples are sickles, scythes, shears/pruning shears and knives.



Figure 9.1: Some Manual Harvest (Hand) Tools

- b. Mechanised Harvest Tools:** Examples are combined harvesters, forage harvesters, potato harvesters, cotton pickers, vegetable harvesters and fruit harvesters.



Figure 9.2: *Some Mechanised Harvest Tools*

- c. Combined and Integrated Harvest Tools:** Examples are multi-crop harvesters, mowers, and windrowers.



Figure 9.3: *Some Mechanised Harvest Tools*

2. Classification of Post-harvest Implements and Machinery

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. They include:

a. Cleaning and Sorting Tools

- i. **Cleaning Equipment:** Examples are air blowers, grain cleaners and seed cleaners.
- ii. **Sorting Equipment:** Examples are color sorters, size graders and weight graders.



Grain cleaner



Seed cleaner



Weight grader



Size grader

Figure 9.4: Some Cleaning and Sorting Tools

b. Drying Equipment

- i. Natural Drying Tools:** Examples are drying mats and drying racks.
- ii. Mechanical Dryers:** Examples are grain dryers, dehydrators and solar dryers.



Drying mats



Solar dryer



Drying racks



Grain dryer

Figure 9.5: Some Drying Equipment

c. Storage Equipment

- i. **Temporary Storage:** Examples are harvest bags and silage bags.
- ii. **Long-Term Storage:** Examples are grain bins/silos, cold storage units and storage crates and bins.



Harvest bag



Silage bag



Cold storage unit



Size grader

Figure 9.6: Some Storage Equipment

d. Processing Equipment

- i. **Primary Processing:** Examples are threshers and shellers
- ii. **Secondary Processing:** Examples are milling machines, juicers and presses, and pulverisers.



Thresher



Sheller



Milling machine



Pulveriser

Figure 9.7: Some Processing Equipment

e. **Packaging and labelling Equipment**

- i. **Packaging:** Examples are bagging machines, boxing machines and sealing machines.
- ii. **Labeling:** Examples are label printers and label applicators.



Figure 9.8: *Some Packaging and labelling Equipment*

f. **Handling and Transportation Equipment**

- i. **Handling:** Examples are conveyors and elevators.
- ii. **Transportation:** Examples are forklifts and transport vehicles.



Figure 9.9: *Some Handling and Transportation Equipment*

Learning Tasks

1. Outline the tools, implements and machinery used in Agricultural production.
2. Group the harvest tools, equipment and machinery use in crop production.
3. Classify the post-harvest tools, equipment and machinery use in crop production.

Pedagogical Exemplars

1. **Initiating talk for learning:** Learners in mixed-ability groups brainstorm to come up with examples of harvest and post-harvest tools, implements and machinery. Learners should be assisted with leading questions that will help them to come up with examples of harvest and post-harvest tools, implements and machinery. Where necessary allow learners to surf the internet for examples of harvest and post-harvest tools, implements and machinery. In that case, the teacher should monitor learners during browsing.
2. **Collaborative learning:** Learners in mixed-ability groups classify the tools, implements and machinery identified, and make a presentation on it in class. Learners should be supported to classify the tools into harvest and post-harvest tools, implements and machinery where necessary. Confident and eloquent learners should be allowed to play lead roles in the discussion and presentation under the guidance of the teacher. All learners should be encouraged to accept and tolerant the view of others.
3. **Project-based learning:** Learners visit a nearby processing factory/watch video on the harvesting and post harvesting tools, equipment and machinery, and create a picture album on the harvest, post-harvest and storage tools, equipment and machinery in a plenary session in class. All learners should be encouraged to visit nearby processing factory site/watch videos/pictures on harvesting and post harvesting tools, equipment and machinery. Teachers should ensure that the videos/pictures used do not enforce stereotyping and if they do, the teachers should discuss them with the learners. Teachers should encourage learners with speech problems to actively take part in the plenary sessions in class.

Key Assessments

Assessment Level 1: List at least three (3) harvest tools.

Assessment Level 2: Explain the broad classification of cleaning and sorting, drying and storage equipment with examples.

Assessment Level 3: Create a photo album of Agricultural harvest tools available in your community.

Assessment Level 4: Build a portfolio of post-harvest tools and present a report on it.

Focal Area 2: Uses of Harvest and Post-Harvest Tools, Implements and Machinery in Agricultural Production

1. **Uses of Harvest Tools, Implements and Machinery in Agricultural Production**
 - a. **Manual Harvest (Hand) Tools**
 - i. **Sickles:** Used for cutting grain crops like wheat, barley, and rice.

- ii. **Scythes:** Larger than sickles, used for mowing grass and harvesting cereal crops.
- iii. **Shears/Pruning Shears:** Used for harvesting fruits, vegetables, and for pruning plants and vines.
- iv. **Knives:** Various types, including curved knives for harvesting specific crops like sugarcane.

b. Mechanised Harvest Tools

- i. **Combine Harvesters:** Perform reaping, threshing, and winnowing of crops like wheat, rice, barley, and corn.
- ii. **Forage Harvesters:** Used to chop forage crops like alfalfa and grass for silage.
- iii. **Potato Harvesters:** Designed to dig and separate potatoes from the soil.
- iv. **Cotton Pickers:** Harvest cotton bolls from plants.
- v. **Vegetable Harvesters:** Used for various vegetables, such as carrots and onions.
- vi. **Fruit Harvesters:** Include mechanical arms or shaking mechanisms to pick fruits like apples and oranges.

c. Combined and Integrated Harvest Tools

- i. **Multi-Crop Harvesters:** Machines that can be adapted to harvest different types of crops by changing attachments or settings.
- ii. **Mowers and Windrowers:** Used in the initial stages of harvesting hay and forage crops, cutting and laying them in rows for drying.

2. 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:

a. Cleaning and Sorting Tools

i. Cleaning Equipment

- **Air Blowers:** Used to remove light debris and chaff from grains and seeds.
- **Grain Cleaners:** Remove impurities such as dirt, stones, and other unwanted materials from grains.
- **Seed Cleaners:** Specifically designed to clean seeds, removing dust, chaff, and other impurities.

ii. Sorting Equipment

- **Color Sorters:** Use optical sensors to sort grains, seeds, or fruits based on color, helping to remove damaged or discolored items.
- **Size Graders:** Sort agricultural produce based on size, commonly used for fruits and vegetables.
- **Weight Graders:** Sort produce by weight to ensure uniformity in packaging and sale.

b. Drying Equipment**i. Natural Drying Tools**

- **Drying Mats:** Used for sun drying grains, seeds, and other produce.
- **Drying Racks:** Elevated racks used for drying fruits, vegetables, and herbs in the sun.

ii. Mechanical Dryers

- **Grain Dryers:** Used for reducing the moisture content of grains to safe levels for storage.
- **Dehydrators:** Used for drying fruits, vegetables, and herbs by circulating hot air.
- **Solar Dryers:** Use solar energy to dry produce, often featuring enclosed designs to protect from pests and weather.

c. Storage Equipment**i. Temporary Storage**

- **Harvest Bags:** Used for collecting and temporarily storing harvested produce in the field.
- **Silage Bags:** Used for storing silage, a type of fermented fodder for livestock.

ii. Long-Term Storage

- **Grain Bins/Silos:** Large containers used for storing bulk grains, maintaining grain quality by controlling temperature and humidity.
- **Cold Storage Units:** Refrigerated units essential for preserving perishable items like fruits, vegetables, and dairy products.
- **Storage Crates and Bins:** Used for storing fruits and vegetables, allowing for proper ventilation and easy handling.

d. Processing Equipment**i. Primary Processing**

- **Threshers:** Machines that separate grains from the harvested crop by beating them.
- **Shellers:** Remove the outer shell or husk from crops like corn and nuts.

ii. Secondary Processing

- **Milling Machines:** Used for grinding grains into flour or other products.
- **Juicers and Presses:** Extract juice from fruits and vegetables.
- **Pulverisers:** Grind spices, grains, and other produce into fine powders.

e. Packaging and Labelling Equipment**i. Packaging**

- **Bagging Machines:** Used for packaging grains, seeds, and other products into bags for transportation and sale.

- **Boxing Machines:** Package fruits, vegetables, and other produce into boxes.
- **Sealing Machines:** Ensure that packaged goods are properly sealed to prevent contamination and spoilage.

ii. Labelling

- **Label Printers:** Print labels for packaged goods, providing information such as product name, weight, and expiration date.
- **Label Applicators:** Automatically apply labels to packages.

f. Handling and Transportation Equipment

i. Handling

- **Conveyors:** Used to move harvested crops within processing facilities, reducing manual handling and improving efficiency.
- **Elevators:** Lift grains and other bulk materials to different heights within storage or processing facilities.

ii. Transportation

- **Forklifts:** Used for moving pallets and heavy containers of produce within storage and processing areas.
- **Transport Vehicles:** Trucks, trailers, and other vehicles essential for moving harvested crops from the field to storage or processing facilities

Learning Tasks

1. Identify the harvest tools, implements and machinery in Agricultural production.
2. Explain the uses of the harvest tools, implements and machinery in Agricultural Production.
3. Discuss the uses of post-harvest equipment, implements and machinery in Agricultural production.

Pedagogical Exemplars

1. **Experiential learning:** Learners in mixed-ability groups embark on a visit to a nearby Agro processing factory/watch a video on the uses of harvest, post-harvest and storage tools, implements and machinery to observe the uses of the available harvest, post-harvest and storage tools, implements and machinery in Agricultural production. All learners should be encouraged to visit nearby Agro-processing factory/watch videos/pictures to observe the uses of harvest, post-harvest and storage tools, implements and machinery in Agricultural production. Teachers should make sure the videos/pictures used do not enforce stereotyping and if they do, the teacher should discuss it with the learners.
2. **Structuring talk for learning:** Learners in mixed-ability groups discuss the uses of the harvest, post-harvest and storage tools, implements and machinery. Encourage learners to take part in the discussion and those with the ability to play lead roles should be allowed to

do so. All learners should be encouraged to accept and tolerant the view of others during discussions.

3. **Project based learning:** Learners individually create a table showing the harvest, post-harvest and storage tools, implements and machinery and their uses. Leaners should discuss the difficulties faced by women and people with disabilities in the use of the harvest and post-harvest tools, implements and machinery. All learners should be encouraged to take part in the creation of table showing the harvest, post-harvest and storage tools, implements and machinery.

Key Assessments

Assessment Level 1: State the uses of sickles and scythes as a harvest tool.

Assessment Level 2: Explain the meaning of combined and integrated harvest tools.

Assessment Level 3: Justify your preference for manual, mechanised or combined and integrated harvest tools.

Assessment Level 4

1. How can processing and storage equipment be used to reduce post-harvest losses.
2. Write a report on the field trip to an agro-processing industry where harvest, post-harvest and storage tools, implements and machinery are used to observe their uses in Agricultural production.

Hint



The recommended mode of assessment for week 9 is essay. Use the level 4 question 2 as a sample question.

WEEK 10

Learning Indicator: Demonstrate the skills in the operation of simple harvest and postharvest implements and machinery use in Agricultural production.

Focal Area 1: Operation of Simple Harvest and Post-Harvest Implements and Machinery Use in Agricultural Production.

1. Operation of Simple Harvest Implements and Machinery Use in Agricultural Production.

a. Operation of manual harvest tools

i. Sickles

- **Preparation:** Ensure the sickle blade is sharp and free of rust.
- **Operation:** Hold the sickle in one hand and the crop stalks in the other. Use a swift, sweeping motion to cut the stalks at their base.
- **Safety:** Wear gloves to protect hands from cuts. Keep the blade pointed away from the body.

ii. Scythes

- **Preparation:** Sharpen the blade and check the handle for cracks or splinters.
- **Operation:** Stand with feet shoulder-width apart. Swing the scythe in a smooth, arc-like motion, keeping the blade close to the ground to cut the stalks.
- **Safety:** Ensure a clear area around you to avoid hitting others. Wear protective clothing and gloves.

iii. Shears/Pruning Shears

- **Preparation:** Sharpen the blades and lubricate the pivot point.
- **Operation:** Use shears to cut stems and small branches close to the main plant without damaging it. For pruning, make clean cuts at an angle.
- **Safety:** Wear gloves to protect hands from sharp edges. Keep fingers away from the blades.

b. Operation of Mechanised Harvest Tools

i. Combine Harvesters

- **Preparation:** Conduct a pre-operation check, including fuel levels, oil levels, tire pressure, and checking for any mechanical issues. Ensure all guards and shields are in place.
- **Operation**
 - **Starting:** Start the engine and allow it to warm up.
 - **Adjust Settings:** Set the header height and reel speed according to the crop being harvested.

- **Harvesting:** Drive the harvester through the field, ensuring an even feed of crops into the machine. The combine will cut, thresh, and separate the grains from the chaff.
- **Unloading:** Once the grain tank is full, unload it into a trailer or grain cart.
- **Safety:** Ensure the area is clear of people before starting. Always follow manufacturer's guidelines for operation. Wear hearing and eye protection.

ii. Forage Harvesters

- **Preparation:** Check the machine for fuel, oil, and any mechanical issues. Ensure the blades are sharp.
- **Operation**
 - **Starting:** Start the engine and engage the cutting mechanism.
 - **Adjust Settings:** Adjust the cutter head and feed rollers based on the type of forage being harvested.
 - **Harvesting:** Drive the harvester through the forage crop, allowing it to cut and chop the material, which is then blown into a trailing wagon or truck.
- **Safety:** Keep bystanders at a safe distance. Wear appropriate protective gear and follow the manufacturer's operating instructions.

iii. Potato Harvesters

- **Preparation:** Ensure the harvester is clean, and check for any mechanical issues. Set the digging depth and conveyor speed.
- **Operation**
 - **Starting:** Start the machine and allow it to reach operating speed.
 - **Adjust Settings:** Adjust the depth control and shaking mechanisms to match soil conditions.
 - **Harvesting:** Drive the harvester through the field, allowing the digging blades to lift potatoes from the soil, which are then separated from the soil and collected.
- **Safety:** Make sure the area is clear of people and pets. Wear appropriate protective gear.

c. General Safety Tips

- **Training:** Ensure operators are properly trained and familiar with the equipment they are using.
- **Personal Protective Equipment (PPE):** Always wear appropriate PPE, such as gloves, safety glasses, hearing protection, and sturdy footwear.
- **Maintenance:** Regularly maintain and inspect tools and machinery to ensure they are in good working condition.
- **Emergency Procedures:** Know the emergency shut-off procedures for all machinery and have a first-aid kit readily available.

- **Environment:** Be aware of the surroundings, including terrain, weather conditions, and presence of other people or animals.

2. Operation of Post-Harvest Implements and Machinery Use in Agricultural Production

a. Operation of Cleaning and Sorting Tools

i. Air Blowers

- **Preparation:** Ensure the blower is clean and free of blockages. Check for any mechanical issues.
- **Operation**
 - Position the blower to direct airflow over the grains or seeds to remove light debris and chaff.
 - Adjust the airflow speed as needed.
- **Safety:** Wear protective goggles to protect eyes from dust and debris.

ii. Grain Cleaners

- **Preparation:** Inspect the cleaner for any damage or blockages. Ensure the screens are appropriate for the type of grain.
- **Operation**
 - Load the grains into the cleaner.
 - Start the machine and adjust the settings to ensure optimal cleaning.
 - Collect the cleaned grains from the output chute.
- **Safety:** Wear a dust mask and goggles. Ensure proper ventilation in the working area.

iii. Seed Cleaners

- **Preparation:** Check the seed cleaner for any mechanical issues. Select the appropriate screens and settings for the seeds being cleaned.
- **Operation**
 - Load the seeds into the cleaner.
 - Start the machine and monitor the cleaning process, adjusting settings as necessary.
 - Collect the cleaned seeds from the output.
- **Safety:** Wear protective equipment to prevent inhalation of dust and seed particles.

iv. Colour Sorters

- **Preparation:** Calibrate the optical sensors according to the specific crop being sorted.
- **Operation**

- Load the product into the sorter.
- Start the machine and monitor the sorting process.
- Adjust the sensitivity settings to ensure accurate sorting.
- **Safety:** Follow manufacturer guidelines and ensure all safety guards are in place.

b. Operation of Drying Equipment

i. Grain Dryers

- **Preparation:** Inspect the dryer for any mechanical issues. Ensure fuel or power supply is adequate.
- **Operation**
 - Load the grains into the dryer.
 - Set the desired drying temperature and duration.
 - Start the machine and monitor the drying process.
- **Safety:** Regularly check for overheating. Wear protective gloves when handling hot equipment.

ii. Dehydrators

- **Preparation:** Clean the dehydrator trays and ensure the machine is in good working condition.
- **Operation**
 - Arrange the produce on the trays in a single layer.
 - Set the temperature and timer according to the type of produce.
 - Start the machine and check periodically.
- **Safety:** Use oven mitts or gloves when handling hot trays.

iii. Solar Dryers

- **Preparation:** Ensure the dryer is clean and positioned to receive maximum sunlight.
- **Operation**
 - Spread the produce evenly on the drying racks.
 - Cover the dryer and adjust vents to control airflow.
 - Monitor the drying process regularly.
- **Safety:** Ensure the structure is stable and secure.

c. Operation of Storage Equipment

i. Harvest Bags

- **Preparation:** Ensure the bags are clean and free of any damage.

- **Operation**

- Fill the bags with harvested produce in the field.
- Transport the bags to storage or processing areas.

- **Safety:** Avoid overloading the bags to prevent injury.

ii. Grain Bins/Silos

- **Preparation:** Inspect the bins or silos for any structural damage. Ensure the ventilation system is working.

- **Operation**

- Load the grains into the bin or silo.
- Monitor temperature and humidity levels regularly.

- **Safety:** Use harnesses when climbing. Ensure proper ventilation to prevent respiratory issues.

iii. Cold Storage Units

- **Preparation:** Ensure the unit is clean and the temperature controls are functioning properly.

- **Operation**

- Set the desired temperature and humidity levels.
- Load the produce into the storage unit.
- Monitor the conditions regularly.

- **Safety:** Wear warm clothing when entering cold storage. Ensure the doors can be opened from the inside.

d. Operation of Processing Equipment

i. Threshers

- **Preparation:** Inspect the thresher for any mechanical issues and ensure the blades are sharp.

- **Operation**

- Load the crop into the thresher.
- Start the machine and adjust settings for optimal threshing.
- Collect the separated grains and chaff.

- **Safety:** Wear protective gloves and goggles. Ensure bystanders are at a safe distance.

ii. Shellers

- **Preparation:** Check the sheller for any damage and ensure it is properly lubricated.

- **Operation**

- Load the crop into the sheller.
- Start the machine and adjust settings for the type of crop.
- Collect the shelled product and discard the husks.
- **Safety:** Wear protective equipment and follow manufacturer's guidelines.

iii. Milling Machines

- **Preparation:** Ensure the machine is clean and the grinding plates or blades are in good condition.
- **Operation**
 - Load the grains into the hopper.
 - Set the desired grinding fineness.
 - Start the machine and monitor the milling process.
- **Safety:** Wear dust masks and keep fingers away from moving parts.

e. Operation of Packaging Equipment

i. Bagging Machines

- **Preparation:** Check the machine for any mechanical issues and ensure the bags are of the correct size.
- **Operation**
 - Load the product into the machine.
 - Set the desired weight and fill settings.
 - Start the machine and monitor the packaging process.
- **Safety:** Ensure the area is free of obstructions. Wear gloves to handle filled bags.

ii. Sealing Machines

- **Preparation:** Ensure the machine is clean and the sealing elements are in good condition.
- **Operation**
 - Position the filled bags or packages in the machine.
 - Set the sealing temperature and duration.
 - Start the machine and ensure a proper seal is achieved.
- **Safety:** Use caution when handling hot surfaces. Wear gloves if necessary.

iii. Label Printers and Applicators

- **Preparation:** Load the printer with labels and check for any issues.
- **Operation**
 - Set the printer for the correct label size and information.

- Start the printer and ensure labels are applied correctly.
 - **Safety:** Ensure hands and clothing are clear of moving parts.
- f. **Operation of Handling and Transportation Equipment**
- i. **Conveyors**
- **Preparation:** Check the conveyor belt for any damage and ensure it is properly aligned.
 - **Operation**
 - Load the produce onto the conveyor belt.
 - Start the conveyor and monitor the movement of produce.
 - **Safety:** Ensure no loose clothing or body parts come in contact with the moving belt.
- ii. **Forklifts**
- **Preparation:** Inspect the forklift for any mechanical issues and check fuel or battery levels.
 - **Operation**
 - Start the forklift and ensure it is stable.
 - Use the controls to lift and move pallets or containers of produce.
 - **Safety:** Follow all safety protocols, including wearing seat belts and ensuring the load is secure.
- iii. **Transport Vehicles**
- **Preparation:** Check the vehicle for any mechanical issues and ensure it is clean.
 - **Operation**
 - Load the produce carefully to avoid damage.
 - Drive at appropriate speeds and follow transportation regulations.
 - **Safety:** Secure all loads properly and use tarps or covers if necessary.

Learning Tasks

1. List the simple harvest implements and machinery use in Agricultural production
2. Explain the operation of post-harvest implements and machinery use in Agricultural production
3. Discuss the operation of simple harvest implements and post-harvest implements and machinery use in Agricultural production

Pedagogical Exemplars

1. **Collaborative learning:** Learners in gender-based groups search the internet for information on the operations of a simple harvest, post-harvest and storage tools, implements and machinery in Agricultural production and discuss their findings. Teacher should encourage all learners to participate in surfing the internet for information on the operations of a simple harvest, post-harvest and storage tools, implements and machinery in Agricultural production. Learners who are fast in using the internet should be allowed to support others. The teacher should also monitor the content of what learners browse. All learners should be encouraged to tolerant and respect each other views.
2. **Project based learning:** Learners in mixed-gender groups demonstrate how simple available tools and equipment are used in performing harvesting, post-harvesting and storage activity in Agricultural production. Teacher should encourage female learners and learners with disabilities to operate the available simple tools and equipment to the best of their ability. All safety rules must be followed in the operation of the simple tools.

Key Assessments

Assessment Level 1: List the operation of at least two (2) storage equipment.

Assessment Level 2: Explain the operation of at least two (2) processing equipment.

Assessment Level 3: Systematically describe the operation of a combine harvester.

Assessment Level 4

1. Demonstrate how to use air blowers and seed cleaners to sort and clean seeds.
2. Demonstrate the operation of a simple harvest, post-harvest and storage tools, implements and machinery to perform harvest and post-harvest activities in Agricultural production.

Hint



The recommended mode of assessment for week 10 is demonstration. Use the level 4 question 2 as a sample question.

SECTION 4 REVIEW

Agricultural irrigation systems are engineered methods used to supply water to crops in a controlled manner to ensure their optimal growth and yield. These systems are particularly important in regions where rainfall is insufficient or irregular. Agricultural drainage systems are designed to remove excess water from the soil surface and subsurface to prevent waterlogging, improve soil conditions, and promote healthy crop growth. Integration of Irrigation and Drainage is the combination of irrigation and drainage systems to manage water effectively. This integration ensures that crops receive adequate water for growth while preventing water-related issues such as waterlogging or salinity build-up. The Benefits of Agricultural Irrigation Systems are Increased Crop Yield and Quality, Efficient Water Use, Expanded Cultivation Areas, Enhanced Soil Fertility, Improved Crop Diversity and Labour Savings. Prevention of Waterlogging, Improved Soil Structure and Aeration, Salinity Control, Enhanced Field Accessibility, and Disease and Pest Management are the Benefits of

Agricultural Drainage Systems. Integrated Irrigation and Drainage Systems are important for Optimal Water Management, Sustainable Farming Practices, Economic Benefits and Food Security. The Methods of Irrigation Systems in Agricultural Production are Surface Irrigation, Sprinkler Irrigation, Drip Irrigation, Subsurface Irrigation and Manual Irrigation. Also, Surface Drainage, Subsurface Drainage, Vertical Drainage and Controlled Drainage are the Methods of Drainage Systems in Agricultural Production. Irrigation Systems are used in Agricultural Production for Supplementing Natural Rainfall, Improving Crop Quality, Expanding Arable Land, Facilitating Multiple Cropping and Enabling Precision Agriculture. Drainage Systems are used in Agricultural Production for Preventing Waterlogging, Improving Soil Aeration, Managing Salinity Levels, Reclaiming Marginal Lands, Enhancing Field Accessibility and Facilitating Sustainable Farming. The Parts of Irrigation System includes Water Source, Pump, Pipes and Channels, Valves and Gates, Sprinklers and Drip Emitters, Filters and Screens, Controllers and Timers and Sensors while the Functions include Water Supply, Soil Moisture Management, Nutrient Distribution, Weed Control and Microclimate Control. Parts of Drainage System include Surface Drains, Subsurface Drains, Drainage Outlets, Pumps and Control Structures; while the Functions of Drainage System include Water Table Management, Soil Salinity Control, Erosion Prevention, Crop Health Improvement and Field Accessibility. The Operation of Irrigation System involves Planning and Design, Water Source Management, Pump Operation, Water Distribution, Scheduling Irrigation, Maintenance and Monitoring, and Seasonal Adjustments. The Operation of Drainage System also involves Planning and Design, Site Assessment, Installation, Water Collection, Water Discharge, Control Structures Operation, Maintenance and Monitoring, and Seasonal Adjustments. Harvest Implements and Machinery can be classified into Manual Harvest (Hand) Tools, Mechanised Harvest Tools, and Combined and Integrated Harvest Tools. Post-harvest Implements and Machinery can be classified into Cleaning and Sorting Tools, Drying Equipment, Storage Equipment, Processing Equipment, Packaging and labelling Equipment, and Handling and Transportation Equipment. General safety measures such as Proper Training of Operators, Wearing of Appropriate Personal Protective Equipment (PPE), Regular Maintenance of Tools and Machinery, Knowing Emergency Shut-offs and Environment Consideration are important in the Operation of Tools, Implements and Machinery.

MARKING SCHEME FOR THE MATCHING ASSESSMENT TASK

Correct matching of terminologies with description (1 mark each)

Terminologies	Description
Surface Irrigation	Water is distributed over the soil surface by gravity. It includes flood and furrow irrigation.
Sprinkler Irrigation	Water is sprayed into the air and allowed to fall on crops like natural rainfall using a system of pipes and sprinklers.
Drip Irrigation	Water is applied below the soil surface, directly to the root zone through underground pipes or drip lines.
Manual Irrigation	Water is carried to plants using buckets, watering cans, or hoses.

MARKING SCHEME FOR THE HOMEWORK ASSESSMENT TASK

Names of 5 parts of an irrigation system = 1 mark each

Stating the functions of the parts named = 1 mark each

For instance;

Parts of an irrigation system and their function.

- i. **Water Source:** Primary sources of water for irrigation.
- ii. **Pump:** Used to lift or transport water from the source to the fields.
- iii. **Pipes and Channels:** Transport water from the source to the fields.
- iv. **Valves and Gate:** Control the flow and pressure of water within the system.
- v. **Sprinklers:** Distribute water directly to the crops by spraying water over the crops,

Total = 10 marks

RUBRICS FOR THE ESSAY ASSESSMENT TASK

Criteria	Excellent (4 marks)	Very Good (3marks)	Good (2marks)	Fair (1 mark)
Introduction	Introduction; stating 4 of the following; The date and place of the field trip, The purpose of the trip what they expected to learn from the trip and preparatory activities that was done before the field trip.	introduction; stating any 3 of the following; The date and place of the field trip, The purpose of the trip What they expected to learn from the trip and Preparatory activities that was done before the field trip.	introduction; stating any 2 of the following; The date and place of the field trip, The purpose of the trip What they expected to learn from the trip and Preparatory activities that was done before the field trip.	introduction; stating any 1 of the following; The date and place of the field trip, The purpose of the trip what they expected to learn from the trip and preparatory activities that was done before the field trip.
Description of Observations	Descriptions of 4 harvest, post-harvest, and storage tools, implements, and machinery and their uses. Stating the name of the machine and its physical characteristics, and how it operates (manual, mechanical or automated).	Descriptions of 3 harvest, post-harvest, and storage tools, implements, and machinery and their uses. Stating the name of the machine and its physical characteristics, and how it operates (manual, mechanical or automated).	Descriptions of 2 harvest, post-harvest, and storage tools, implements, and machinery and their uses. Stating the name of the machine and its physical characteristics, and how it operates (manual, mechanical or automated).	Descriptions of 1 harvest, post-harvest, and storage tools, implements, and machinery and their uses. Stating the name of the machine and its physical characteristics, and how it operates (manual, mechanical or automated).

Conclusion	Conclusion containing 4 of the following Summary of key findings What was learnt at the field trip Recommendation for future field trip Closing remarks .	Conclusion containing any 3 of the following Summary of key findings What was learnt at the field trip Recommendation for future field trip Closing remarks	Conclusion containing any 2 of the following Summary of key findings What was learnt at the field trip Recommendation for future field trip Closing remarks	Conclusion containing any 1 of the following Summary of key findings What was learnt at the field trip Recommendation for future field trip Closing remarks
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RUBRICS FOR THE DEMONSTRATION ASSESSMENT TASK

Criteria	Excellent (4 marks)	Very Good (3marks)	Good (2marks)	fair (1 mark)
Knowledge about the simple harvest, post-harvest and storage tools, implements and machine	Shows knowledge about the simple harvest, post-harvest and storage tools, implements and machinery by indicating 4 of the following; Name of the machine Uses How its operated Type of machine (harvest, post-harvest or storage tools, implement and machine)	Shows knowledge about the simple harvest, post-harvest and storage tools, implements and machinery by indicating 3 of the following; Name of the machine Uses How its operated Type of machine (harvest, post-harvest or storage tools, implement and machine)	Shows knowledge about the simple harvest, post-harvest and storage tools, implements and machinery by indicating 2 of the following; Name of the machine Uses How its operated Type of machine (harvest, post-harvest or storage tools, implement and machine)	Shows knowledge about the simple harvest, post-harvest and storage tools, implements and machinery by indicating 1 of the following; Name of the machine Uses How its operated (manual automated, mechanical) Type of machine (harvest, post-harvest or storage tools, implement and machine)

Demonstration Skills in operating the machine	Perform all the steps involves in the operation of the simple harvest, post-harvest and storage tools, implements and machine; Pre-preparation (wearing the appropriate PPEs) Preparation (conducting a pre-operation check, including fuel levels, oil levels, tyre pressure, and checking for any mechanical issues) Operation (Starting the engine and allow it to warm up, adjusting settings of the machine to suit the operation, driving the machine to perform the required activity and unloading harvested products into a trailer or grain cart) Safety measures (always following the manufacturer's guidelines for operation)	Perform any 3 of the steps involves in the operation of the simple harvest, post-harvest and storage tools, implements and machine; Pre-preparation (wearing the appropriate PPEs) Preparation (conducting a pre-operation check, including fuel levels, oil levels, tyre pressure, and checking for any mechanical issues) Operation (Starting the engine and allow it to warm up, adjusting settings of the machine to suit the operation, driving the machine to perform the required activity and unloading harvested products into a trailer or grain cart) Safety measures (always following the manufacturer's guidelines for operation)	Perform any 2 of the steps involves in the operation of the simple harvest, post-harvest and storage tools, implements and machine; Pre-preparation (wearing the appropriate PPEs) Preparation (conducting a pre-operation check, including fuel levels, oil levels, tyre pressure, and checking for any mechanical issues) Operation (Starting the engine and allow it to warm up, adjusting settings of the machine to suit the operation, driving the machine to perform the required activity and unloading harvested products into a trailer or grain cart) Safety measures (always following the manufacturer's guidelines for operation)	Perform any 2 of the steps involves in the operation of the simple harvest, post-harvest and storage tools, implements and machine; Pre-preparation (wearing the appropriate PPEs) Preparation (conducting a pre-operation check, including fuel levels, oil levels, tyre pressure, and checking for any mechanical issues) Operation (Starting the engine and allow it to warm up, adjusting settings of the machine to suit the operation, driving the machine to perform the required activity and unloading harvested products into a trailer or grain cart) Safety measures (always following the manufacturer's guidelines for operation)
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SECTION 5: CONCEPTS OF CROPS AND ANIMAL PRODUCTION

Strand: Food Production and Natural Resource Conservation

Sub-Strand: Principles of Agriculture in Food Production

Week 11

Learning Outcome: Use the knowledge and skills acquired in the management and production of the selected crops.

Content Standard: Demonstrate knowledge, understanding and skills of the cultivation of selected crops.

Week 12

Learning Outcome: Use the knowledge and skills acquired on the economic importance and management practices of farm animals to rear selected animals/fish.

Content Standard: Demonstrate knowledge, understanding and skills of husbandry of selected animals/fish.

Hint



- Remind learners of the end of semester examination in week 12.
- Refer to Appendix D at the end of this section for Table of specification.

INTRODUCTION AND SECTION SUMMARY

Crops and animal/fish production is critical and crucial to sustainable food production and the economic advancement of Ghana as an agrarian country. Vegetable crops, arable crops, cash crops and ornamental crops, together with the production of animals and fish are the main sources of food for humans, provide employment and livelihood for Ghanaians. They are sources of raw material to drive industries and environmental sustainability especially to champion and mitigate the hazards of climate change which is a threat to the world. This section will introduce learners to understanding the economic importance of some selected crops and animals/fish. It will also help learners to appreciate the technologies and techniques involved in the production of the crops and the animals/fish. Some vegetable crops and poultry production have also been discussed. In addition, attention should be given to the cultivation of other vegetable crops, at least one arable crop, cash crop and ornamental crop. The management of at least one livestock and fish other than poultry should also be of interest to the teachers. The cultivation of crops and rearing of animals/fish should be given to learners as project

work to be carried out outside the classroom starting from weeks 11 of year two to the end of year 3 where applicable. Learners should be put in groups and assigned with different crops or animals/fishes to cultivate/rear. They should be given the opportunity to observe and participate in what other groups are producing as well share their experiences. This section also has links with other subjects including Applied Technology, Business Studies, Economics, Engineering and Home Economics.

The weeks covered by the section are:

Week 11: Meaning and Economic Importance of Selected Crops

Week 12: Application of Technologies and Techniques to Cultivate Selected Crops

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical strategies to be employed in this section include: managing talk for learning, think-pair-share, initiating talk for learning, project-based learning and experiential learning. Teachers should use think-pair-share, initiating talk for learning and managing talk for learning to help learners to express their views, elicit ideas about the various topics for discussion from them, build their confidence and promote good public speaking skills. In terms of projects-based and experiential learning, learners will be expected to surf the internet under the guidance and supervision of teachers, watch videos and documentaries, create diagrams, keep records and visit nearby farms for hands on experiences. Learners should be given ample time to embark on projects where necessary and present their results at agreed time in case the time allocation in the class will not be enough. Critical thinking skills, communication skills, digital literacy skills and collaborative skills of learners should be enhanced as they surf the internet, share their experiences and views. Teachers should ensure that learners do not access unapproved or illegal sites in the course of searching the internet for information. As much as practicable teachers should ensure all learners are given the opportunity to explore and express themselves. Teachers should ensure the videos/pictures used do not enforce stereotyping. Learners should be encouraged to participate in all activities, respect, tolerate and accept the views of others.

ASSESSMENT SUMMARY

The assessment for this section should encompass the economic importance of crops and animal/fish production. It also includes the technologies and techniques for the production of the selected crops, including vegetables (tomatoes, pepper, okro, onion and garden eggs) and the rearing of the selected animal/fish (poultry production). Assessment questions should be tailored to cover the above-mentioned areas considering different learning abilities and proficiency of learners. The questions should be well balanced with depth of knowledge (DoK) in mind thus Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and level 4 (extended critical thinking and reasoning). The teacher should exhibit a high level of professionalism when accepting answers whether right or wrong. He/she should set up rubrics, marking schemes or scores cards to assess group presentations, projects, assignment and other works.

WEEK 11

Learning Indicators

1. Explain the economic importance of selected crops.
2. Apply the technologies and techniques to cultivate selected crops.

Focal Area 1: Meaning and Economic Importance of Selected Crops

1. Meaning of Some Selected Crops

- Vegetable crops:** Vegetable crops refer to plants that are primarily grown for their edible parts such as leaves, roots, stems and flowers, which are consumed by humans. These crops are an essential component of a balanced diet, providing essential vitamins, minerals and fibres. Vegetable crops can also be defined as plants grown specifically for their edible herbaceous parts, including herbs and certain legumes. They are characterised by high water content and quick growth cycles. Example of vegetable crops: Tomatoes, carrots, lettuce, garden eggs, hot pepper, sweet pepper, okro, radish, squash, lettuce, etc.



Tomatoes



Carrots



Onions



Garden eggs



Okro



Peppers

Figure 11.1: Some vegetable crops

- Arable crops:** Arable crops are plants that are grown on ploughed and tilled lands, typically for human consumption, animal feed or industrial purposes. These crops are often annuals that require regular soil disturbance for planting and growth. Examples of arable crops are:
 - Cereals and Grains:** Maize, rice, wheat, millet and sorghum.
 - Legumes:** Soybeans, cowpea, lima beans, Bambara beans and French beans.
 - Root Crops:** Cassava, yam, cocoyam, sweet potatoes and carrots.

- iv. **Oilseeds:** Groundnut, cowpea, coconut, sunflower and peanuts.
- v. **Fibre and forage crops:** Cotton, hemp, alfalfa and jute.
- c. **Cash Crops:** Cash crops are grown primarily for sale (generate revenue and profit), rather than for personal consumption or subsistence. These crops are produced for their commercial value and are often exported to generate income. Cash crops can also be defined as Agricultural products grown for sale to return a profit, including non-food crops like flowers, rubber, and medicinal plants. These crops shape economies and global trade. Examples of cash crops: Cocoa, coffee, cashew, cotton, tobacco, citrus, sugarcane etc.
- d. **Ornamental crops:** Ornamental crops are grown for aesthetic value and improving environmental quality and human well-being, used for decoration in urban green spaces, for phytoremediation (cost-effective method that uses plants to remove, degrade or stabilise contaminants from soil, water, and air), and in therapeutic gardens. Ornamental crops include plants grown for decorative purposes in landscapes, gardens and indoor environments. These crops are valued for their aesthetic qualities such as flowers, foliage, forms and fragrance. Examples of ornamental crops: roses, tulips, orchids and araucaria trees. It may also include spider plant, royal palm, weeping willow, hibiscus, frangipani, bougainvillea, whistling pine and flamboyant.

2. Economic importance of some selected crops

a. Vegetables

- i. Vegetables are essential for balanced diet. They are sources of vitamins, minerals and fibre, which are crucial for human health.
- ii. Vegetables are sources of income for farmers. They have relatively shorter growth cycles and have high market demands.
- iii. The vegetable sector creates jobs in farming, processing, distribution and retail. The above-mentioned areas are major sources of employment and livelihood for many people in Ghana.

b. Arable crops

- i. Arable crops such as wheat, rice, and maize are staple foods that sustain large populations in Ghana and around the world.
- ii. Crops such as maize and barley are used in the production of biofuels, animal feed and various industrial products. These crops are the major sources of raw materials for keeping our industries running.
- iii. Arable crops are exported to other countries for foreign exchange.

c. Cash Crops

- i. Cash crops such as coffee, cocoa and cotton contribute substantially to the GDP of Ghana and the economies of most developing countries. This goes a long way to promote Ghana's economic advancement.
- ii. Export of cash crops such as cocoa, coffee and cashew nuts are major sources of foreign exchange, which is crucial for importing goods and services.

- iii. Cash crop farmers get a lot of income from the sale of the crops like cocoa and coffee thereby reducing poverty levels.

d. **Ornamental crops**

- i. Ornamental crops enhance the beauty and the aesthetic value of the environments, contributing to the well-being and quality of life.
- ii. The cultivation and sale of ornamental plants drive the horticulture industry by creating jobs and business opportunities for many people.
- iii. Ornamental plants and flowers are sold for income generation.
- iv. Ornamental plants trap dust particles and release oxygen during photosynthesis for human use. This helps to purify the air for human use to improve upon health.
- v. Ornamental plants serve as windbreaks for the protection of buildings.
- vi. Ornamental plants provide shade for man during hot sunny days.

Learning Tasks

1. Identify some examples of crops
2. Explain the meaning of vegetables crops, arable crops, cash crops and ornamental crops
3. Discuss the economic importance of some selected crops

Pedagogical Exemplars

1. **Initiating talk for learning:** In pairs, learners brainstorm the meaning of vegetable crops, arable crops, cash crops and ornamentals. Teacher should use pictures and videos to help learners with difficulty. Learners can also be asked to surf the internet to come up with the meaning of the selected crops. The teacher should ensure that all the learners participate in all activities. Also, learners who have difficulties in using the internet should be provided with links and support that will help them search for the needed information. Remind learners not to go into unapproved or illegal sites as they surf the internet.
2. **Think-pair-share:** In pairs, learners surf the internet to come up with examples of the selected crops, and discuss in mixed-ability groups the economic importance of vegetable crops, arable crops, cash crops and ornamentals. Teachers should ensure that all learners fully participate in the exercise. Learners with difficulty in surfing the internet should be helped with the sites for the needed information. Where necessary, let the learners who are fast in searching the internet help those who have difficulty under the teacher's supervision to prevent them from venturing into unapproved or illegal sites.
3. **Project-based learning:** In mixed-ability groups (where applicable), learners will prepare a chart showing the economic importance of vegetable crops, arable crops, cash crops and ornamentals. Teachers should encourage all learners to actively participate in the preparation of the charts on the economic importance of the crops. Confident learners can take lead roles in preparing the charts for the learners with difficulties to draw inspiration from them.

Key Assessments

Assessment Level 1: State the meaning of vegetable, arable and cash crops.

Assessment Level 2: Explain at least two (2) economic importance of arable crops.

Assessment Level 3: Discuss the extent to which cash crops can contribute to Ghana's economy.

Assessment Level 4: Conduct simple research on the impact of ornamental plants in environmental sustainability.

Focal Area 2: Application of Technologies and Techniques to Cultivate Selected Crops

1. Technologies and Techniques to Cultivate Selected Crops

i. Tomatoes (*Lycopersicon esculentum*)

Soil and environmental requirement	Method of propagation	Land preparation/ Cultural Practices	Maturity/ harvesting	Storage	Uses
Temperature: It is not tolerant to high temperatures and humidity Climate: Tomatoes require a well-drained soil with high organic matter content and free from diseases and pests such as nematodes.. Soil: A pH of 6.0-7.0 is ideal for tomato cultivation.	Sowing: Sow seed on see beds or in seed boxes and trans-plant. Trans-planting: Plant on raised beds during the rainy season, and on sunken beds in the dry season	Land preparation: Plough and harrow after land clearing and construct ridges. Transplanting: Seedlings are transplanted 3-4weeks after nursery. Spacing is 50cm between plants and 100cm between rows. Weeding: Regular weeding is done to prevent competition. Irrigation: Adequate and timely irrigation is crucial, especially during dry periods. Drip or furrow irrigation methods are commonly used. Mulching/Staking: Is done to suppress weed growth and staking should be done to prevent soil born pest attack. Fertilisation: Use organic manure and balanced fertilisers (NPK) for good growth and yield. Pest and Disease Management: Common pests include aphids, whiteflies, and fruit worms. Diseases such as bacterial wilt, late blight, and tomato yellow leaf curl virus are prevalent. Control: use resistant varieties, proper spacing, and timely application of recommended pesticides.	Tomatoes are harvested 2-3 months after transplanting, depending on the variety. Harvest fully ripened for processing/ matured or green for storage or to be transported for market.	Can be stored in cool place for few days/ in deep freezers for more than 6mths. It can also be canned into paste or puree.	Cooked in soup, stew or eaten raw in salads.

ii. Garden eggs (*Solanum melongena*)

Soil and environmental requirement	Method of propagation	Land preparation/ Cultural Practices	Maturity/ harvesting	Storage	Uses
Temperature: Adapts to both wet and dry season cultivation. Temperature range of 25-30°C. Climate: Well-drained, loamy soils rich in organic matter are ideal. Soil: The soil pH should be between 5.5 and 6.8.	Sowing: Seeds should be planted in seed boxes and pricked out. Transplanting: Transplant seedlings when they are about 4-6 weeks old and have at least 3-4 true leaves. Spacing should be 60 cm between rows and 45-60 cm between plants within a row.	Land preparation: Clear land of weeds and debris. Plough and harrow the soil to a fine tilth. Incorporate organic matter like compost or manure to improve soil fertility. Irrigation: Regular watering is essential, especially during dry spells. Drip irrigation is recommended for efficient water use. Ensure consistent moisture levels to avoid stress on the plants. Fertilisation: Apply a balanced NPK fertiliser such as 15-15-15 at planting. Top-dress with nitrogen-rich fertiliser (e.g., urea) as the plants grow. Foliar feeds with micronutrients can also be beneficial. Pest and Diseases Management: Common pests and diseases include: Aphids, whiteflies, and fruit borers. Fungal infections like anthracnose and bacterial wilt. Control: Use of insecticides and fungicides as necessary. Practice crop rotation and proper field hygiene. Use resistant varieties and certified disease-free seeds.	Garden eggs are usually ready for harvest 70-90 days after transplanting. Harvest when fruits are firm and have reached the desired size. Overripe fruits can become bitter. Harvesting is done manually, and care should be taken to avoid damaging the plants.	Handle fruits gently to prevent bruising. Store in a cool, dry place to extend shelf life. Market promptly to ensure freshness.	Cooked in soup or in stew.

iii. Okro (*Hibiscus esculentus*)

Soil and environmental requirement	Method of propagation	Land preparation/ Cultural Practices	Maturity /Harvesting	Storage	Uses
Temperature: Okro requires temperatures between 20°C and 30°C. Climate: It prefers well-distributed rainfall although it can tolerate some drought conditions. Soil: Well-drained, fertile loamy soils with a pH range of 6 to 6.8 are ideal for okro cultivation.	Sowing: Seeds are typically sown directly into the field. Transplanting: They should be planted at a depth of 2-3 cm, with spacing of about 30 cm between plants and 60 cm between rows. Seed Rate: Approximately 5-6 kg of seeds are needed per hectare.	Land Preparation: The land should be ploughed and harrowed to a fine tilth. Use raised beds or ridges in areas prone to waterlogging. Fertilisation: Organic manure or compost is preferred. Chemical fertilisers like NPK can be applied at a rate of about 250 kg per hectare. Weeding/mulching: Regular weeding is essential to prevent competition for nutrients. Mulching can help suppress weeds and retain soil moisture. Irrigation: Although okro can tolerate dry conditions, supplementary irrigation during dry spells can significantly improve yields. Pests and Diseases Management: Aphids: Can be controlled using insecticidal soaps or neem oil. Fruit Borers: Use of insecticides or biological control methods can be effective. Root-Knot Nematodes: Crop rotation and soil solarization can help manage nematode populations. Common diseases include: Powdery Mildew: Controlled by fungicidal sprays. Yellow Vein Mosaic Virus: Planting resistant varieties and controlling vector populations (whiteflies) are essential.	Okro pods are typically harvested 50-60 days after planting, when they are tender and immature. Regular harvesting (every 2-3 days) encourages continued production.	Store okro fruits in a cool, dry place for a short period or refrigerated to extend shelf life.	Used in soups and stew

iv. Pepper (*Capsicum frutescens/annuum*)

Soil and environmental requirement	Method of propagation	Land preparation/ Cultural Practices	Maturity/ harvesting	Storage	Uses
Temperature: Both hot and sweet peppers thrive in temperatures between 21°C and 29°C. They require at least 6-8 hours of sunlight per day. Climate: They need well-distributed rainfall or irrigation, especially during flowering and fruiting stages. Soil: Peppers prefer well-drained, fertile loamy soils with a pH range of 5.5 to 7.0.	Nursery: Seedlings are raised in seed-beds or trays for about 4-6 weeks before transplanting. Transplanting: Seedlings are transplanted when they have 4-6 true leaves, spaced 45-60 cm apart within rows and 60-75 cm between rows.	Fertilisation: Organic manure or compost is recommended. Inorganic fertilisers such as NPK (15-15-15) can be applied at a rate of 300-400 kg per hectare. Weeding/ Mulching: Regular weeding is essential to reduce competition for nutrients. Mulching can help suppress weeds and retain soil moisture. Irrigation: Regular watering is crucial, especially during dry spells and flowering/fruiting periods. Drip irrigation is ideal for efficient water use. Pests and Diseases Management Common pests include: Aphids and Whiteflies: They can be controlled using insecticidal soaps or neem oil. Fruit Borers: Use of insecticides or biological control methods can be effective. Mites: Controlled by miticides or cultural practices like avoiding water stress. Common diseases include: Bacterial Leaf Spot: Managed by using disease-free seeds and crop rotation. Powdery Mildew: Controlled by fungicidal sprays and proper spacing for air circulation. Blossom End Rot: Prevented by maintaining consistent soil moisture and adequate calcium levels.	Typically harvested when they reach full colour, usually red/green	Peppers should be handled carefully to avoid bruising. They can be stored at 7-10°C with high humidity to prolong shelf life.	Used in stews and soups

v. **Onion**(*Allium cepa*)

Soil and environmental requirement	Method of propagation	Land preparation/ Cultural Practices	Maturity/ harvesting	Storage	Uses
Temperature: The ideal temperature range for onion growth is between 13°C and 24°C. Climate: Onions need well-distributed rainfall of about 400-600 mm during the growing season. However, excessive rainfall can lead to bulb rot and other diseases Soil Type: Onions thrive in well-drained, sandy-loam soils with a pH range of 6.0 to 6.8.	Seed Selection: Use improved seed varieties that are resistant to diseases and have a higher yield potential. Sowing: Onions can be grown from seeds or sets (small bulbs). Seeds are usually sown in nursery beds and transplanted after about 6 weeks. Spacing: 10-15 cm apart within rows and 30-40 cm between rows.	Soil Preparation: The soil should be well-tilled and free from weeds. Adding organic matter like compost can improve soil fertility. Irrigation: Regular irrigation is essential, especially during the dry season. Drip irrigation is preferred for efficient water use. Water Stress: Onions are sensitive to water stress, which can affect bulb development. Consistent moisture levels are necessary throughout the growing season. Fertilisation: Nitrogen is important during the early growth stages, while phosphorus and potassium are crucial for bulb development. Farmers often apply a combination of organic and inorganic fertilizers. Soil testing can help determine the specific nutrient needs. Pest and Disease Management: Common Pests: Thrips, onion flies, and nematodes are common pests affecting onions. Integrated Pest Management (IPM) strategies are recommended. Diseases: Downy mildew, purple blotch, and bulb rot are prevalent diseases. Crop rotation and proper field hygiene can help manage these issues.	Harvest 3-4 months after planting. Signs of maturity include: yellowing and falling over of the tops. Curing: After harvesting, onions need to be cured (dried) to reduce moisture content and extend shelf life. This involves drying the bulbs in a well-ventilated area for about 2-3 weeks	Onions should be stored in a cool, dry place with good ventilation.	For stew and soups

Learning Tasks

1. Identify the technologies and the techniques used for the cultivation of some crops.
2. Discuss the cultivations of some selected vegetable crops in Ghana.
3. Assess the impact of appropriate cultural practices on the growth and yield of vegetable crops.

Pedagogical Exemplars

1. **Problem-based learning:** In gender-based groups, learners visit a nearby farm/watch video on the techniques of growing selected vegetable crops, arable crops, cash crops and ornamentals. In the same groups, learners tabulate the techniques vis-à-vis the selected crops. The teacher should provide sites for the learners to search the internet for the information. Ensure that all learners fully participate in the exercise. Challenge learners who are good at using the internet to take lead roles to assist learners with difficulties.

- 2. Experiential learning:** Learners in mixed-ability groups discuss the cultivation of some selected vegetable crops. Teachers should endeavour to take learners to visit nearby farms which are owned by women and persons with disabilities to dispel stereotyping in crop production or the visit school farm(s). Videos/pictures used in the class should not enforce stereotyping in crop production, if they do, teachers should discuss them with learners. Teachers should encourage all learners to actively take part in all activities.
- 3. Project-based learning:** Put learners in mixed-ability groups to discuss the various cultural practices and their impact on the growth and yield of the selected crops. In the same group learners will discuss how to keep records and prepare record books on all the techniques used in the cultivation of each crop. Confident learners should be allowed to play lead roles during lesson discussion under the guidance of the teacher. Teachers should ensure that all the learners fully participate in the activity.

Key Assessments

Assessment Level 1: State the meaning of vegetables and give three (3) of examples of vegetables grown in Ghana.

Assessment Level 2: Write short notes on the cultivation of tomatoes under the following: a) Soil and environmental requirement b) Pest and diseases management and c) Harvesting

Assessment Level 3:

- Examine the impact of cultural practices on the successful cultivation of vegetables.
- Fill in the puzzle below using clues under the headings Across and Down.

<https://crosswordlabs.com/view/techniques-and-technologies-in-cultivating-crops>



Assessment Level 4: Assess and make a presentation on the benefits of cultivating vegetable crops on the livelihood of farmers.

Hint



The recommended mode of assessment for week 11 is gamification. Use the level 3 question 2 as a sample question.

WEEK 12

Learning Indicators

1. *Explain the economic importance of the selected animal/fish.*
2. *Demonstrate the ability to perform the various management practices involved in the rearing of the selected animal/fish.*

Focal Area 1: Economic Importance of Selected Animals/Fish

1. The Meaning and Objectives of Managing Farm Animals/Fish

Managing farm animals and fish, also known as livestock and aquaculture management, refers to the practices and strategies employed to raise, care for and optimise the production of these animals in a sustainable and efficient manner. This management involves many aspects, including nutrition, health care, breeding, housing, environmental control and business operations. The primary objective is to ensure the well-being of the animals, maximise productivity and maintain sustainability.

2. Objectives of Management Practices for Keeping Farm Animals/Fish

a. Optimise Health and Welfare

- i. **Objective:** To ensure the well-being of the farm animals/fish through proper nutrition, housing, and health care.
- ii. **Benefit:** Healthy farm animals/fish are more productive and have lower mortality rates.

c. Maximise Productivity

- i. **Objective:** To achieve high levels of egg production, meat yield, and growth rates.
- ii. **Benefit:** Increases profitability and efficiency of the farm animals/fish operation.

b. Enhance Biosecurity

- i. **Objective:** To prevent the introduction and spread of diseases.
- ii. **Benefit:** Reduces the risk of disease outbreaks, which can devastate flocks/herd and lead to significant economic losses.

e. Improve Efficiency

- i. **Objective:** To optimise the use of resources such as feed, water and labor.
- ii. **Benefit:** Reduces costs and maximises the return on investment.

h. Ensure Quality Control

- i. **Objective:** To produce high-quality eggs and meat that meet consumer standards.
- ii. **Benefit:** Enhances marketability and consumer satisfaction.

k. Sustainable Practices

- i. Objective:** To implement environmentally sustainable practices.
- ii. Benefit:** Reduces environmental impact and promotes long-term viability of the farming operation.

n. Regulatory Compliance

- i. Objective:** To adhere to local, state, and federal regulations regarding animals/fish farming.
- ii. Benefit:** Ensures legal operation and avoids penalties or shutdowns.

q. Economic Viability

- i. Objective:** To maintain a profitable business through effective management and cost control.
- ii. Benefit:** Ensures the financial sustainability of the animals/fish farm.

3. Economic Importance of the Selected Animals**a. Income Generation**

- i. Sale of Products:** Livestock products such as meat, milk, eggs, wool and hides can be sold for profit.
- ii. Value-Added Products:** Processing raw products into items like cheese, yogurt, leather goods and meat products can increase profitability.

b. Employment and Livelihood

- i. Job Creation:** Livestock farming provides employment opportunities in various sectors including farming, processing, transportation, marketing and retail.
- ii. Supporting Rural Economies:** Livestock farming is often a major source of income in rural areas, supporting the livelihoods of farmers and their families.

c. Food Security

- i. Protein Source:** Farm animals provide essential proteins and other nutrients, contributing to food security.
- ii. Year-Round Availability:** Livestock products can be produced and consumed throughout the year, ensuring a steady food supply.

d. Market and Trade

- i. Domestic Markets:** Livestock and their products cater to local markets, providing fresh produce and supporting local businesses.
- ii. Export Opportunities:** Livestock and livestock products are often exported, contributing to national economies and trade balances.

e. Supporting Industries

- i. Feed Industry:** The demand for animal feed supports the feed manufacturing industry.

- ii. **Veterinary Services:** Livestock farming supports veterinary services, pharmaceuticals and animal health industries.

f. **Equipment and Infrastructure**

- i. **The need for farming equipment, housing and processing facilities stimulates related industries.**

g. **By-products and Waste Utilisation**

- i. **Manure:** Animal manure is a valuable fertiliser that improves soil fertility and crop yields.
- ii. **Energy Production:** Animal waste can be used in biogas production, providing a renewable energy source.

h. **Cultural and Social Contributions**

- i. **Traditional Practices:** Livestock play roles in cultural traditions, festivals and social ceremonies, often representing wealth and status.
- ii. **Community Building:** Livestock farming can strengthen community ties through cooperative farming and shared resources.

i. **Research and Development**

- i. **Innovation:** Livestock farming drives research in genetics, nutrition, disease control, and breeding, leading to innovations and improved practices.
- ii. **Education:** Provides practical learning opportunities in agricultural and veterinary education.

j. **Environmental Benefits**

- i. **Grazing Management:** Properly managed grazing can enhance land use, prevent overgrowth, and reduce fire hazards.
- ii. **Biodiversity:** Livestock farming can promote biodiversity through the maintenance of various breeds and integrated farming practices.

4. **Economic Importance of Fish**

a. **Income Generation**

- i. **Sales of Fish:** Fish and seafood are sold fresh, frozen, canned or processed into various products, generating substantial income for fish farmers and fishers.
- ii. **Foreign Exchange:** Ghana exports fish and fish products, earning valuable foreign exchange and contributing to the national GDP.

b. **Employment and Livelihood**

- i. **Job Creation:** The fishing industry provides employment opportunities in fishing, aquaculture, processing, transportation, and retail. The afore-mentioned are major sources of employment for majority of Ghanaians for livelihood.
- ii. **Supporting Communities:** In many coastal and rural areas, fish farming and fishing are primary sources of livelihood, supporting the entire communities.

c. Food Security

- i. **Nutrient-Rich Food:** Fish are excellent sources of protein, omega-3 fatty acids, vitamins and minerals, contributing significantly to global food security.
- ii. **Affordable Protein:** Fish provides an affordable source of protein, especially in developing countries where other protein sources may be scarce or expensive. This promotes healthy growth among children to reduce the incidence of malnourishment (kwashiorkor) due to a poor diet.

d. Market and Trade

- i. **Local Markets:** Fish and seafood are staple foods in many local diets, supporting local markets and economies. In Ghana, many homes especially the coastal areas rely heavily on the fish industry which provides jobs for women in the local markets.
- ii. **International Trade:** Fish and fish products are significant commodities in international trade, with a vast global market.

e. Supporting Industries

- i. **Feed Industry:** The demand for fish feed supports the aquaculture feed manufacturing industry.
- ii. **Processing and Packaging:** The fish industry supports businesses involved in processing, packaging and preserving fish products.

f. Equipment and Technology

- i. The need for fishing gear, aquaculture equipment and technology stimulate related industries.

g. By-products and Waste Utilisation

- i. **Fish Meal and Oil:** Fish by-products are used to produce fish meal and fish oil, essential ingredients in animal feed and dietary supplements.
- ii. **Organic Fertilisers:** Fish waste can be processed into organic fertilisers, benefiting Agriculture for soil remediation and soil fertility improvement and eventually promote crop growth and yield.

h. Research and Development

- i. **Innovation:** The aquaculture and fisheries sectors drive research in areas like sustainable farming practices, disease management and breeding techniques.
- ii. **Education and Training:** Fisheries and aquaculture provide educational opportunities and training programmes in marine biology, aquaculture management and environmental science.

i. Environmental and Ecological Benefits

- i. **Sustainable Practices:** Sustainable aquaculture and fishing practices help conserve aquatic ecosystems and biodiversity.
- ii. **Restoration Projects:** Aquaculture can support restoration projects, such as replenishing depleted fish stocks and rehabilitating habitats.

j. **Cultural and Social Contributions**

- i. **Traditional Practices:** Fishing is deeply embedded in the cultural traditions and practices of many communities.
- ii. **Recreational Fishing:** Sport and recreational fishing contribute to tourism and local economies.

k. **Health and Nutritional Benefits**

- i. **Public Health:** Consuming fish supports public health by providing essential nutrients that help prevent chronic diseases.
- ii. **Dietary Preferences:** Growing awareness of the health benefits of fish is increasing its demand, thereby supporting the industry.

Learning Tasks

1. State the meaning and objective of management of farm animals/fish.
2. Explain the economic importance of managing farm animals.
3. Discuss the economic importance of managing fish.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm to come up with the meaning and objectives of management of farm animals/fish. In the same pairs, learners discuss their findings. The teacher can use leading questions to help learners to come up with the meaning and objectives of management of farm animals/fish. All learners should tolerate and respect each other's views. Teachers should praise learners for their contributions.
2. **Inquiry-based learning:** In mixed-ability group, learners will surf the internet using links provided by the teacher to come up with the economic importance of animals/fish production and discuss their ideas. Learners who are proficient on the use of the internet should be encouraged to support those with difficulties in searching for information. The teacher should also monitor the content of what learners browse to make sure no inappropriate or illegal sites are accessed. Confident learners should be allowed to play lead roles in the discussion under the guidance of the teacher. Teacher should ensure that all learners fully participate in the exercise.
3. **Problem-based learning:** In gender-based groups, learners build a portfolio on the economic importance of the various parts of the selected animals/fish. Teacher should involve all learners in the portfolio building. Where some have difficulties, teacher should provide the necessary information or samples learners need to build their own portfolio.

Key Assessments

Assessment Level 1: State the meaning and objectives of management of farm animals/fish.

Assessment Level 2: Explain the economic importance of farm animals.

Assessment Level 3: Critically assess the impact of the management of farm animals on profit maximisation.

Assessment Level 4: Conduct a simple survey on how business management can promote fish production.

Focal Area 2: Management Practices Involved in the Rearing of Selected Animal (Poultry)

1. Housing

a. Extensive Systems

- i. **Free-running System:** In this system fowls are allowed to move freely about in search of food over a large area of grassland or bush around and beyond the farmer's house. The house is simple and built with cheap materials for them to roost at night. In some cases, the fowls have no shelter and roost on trees, in the corners and walls of the farmer's house.
- ii. **Free-range System:** In this system birds are housed but are allowed to move freely on a large, fenced grassland during the day. Balanced ration is placed in troughs at vantage points on the range. The main differences between the free-range and free-running systems are: The birds on free range are properly housed. They are confined to a fenced area (range). They are not allowed to mix with stray birds.

Advantages

- No overcrowding of birds due to large amount of land
- Birds have plenty exercises
- Birds obtain enough green forage feed and grits.

Disadvantages

- Birds may be lost to predator attack
- There is high rate of diseases and pest attacks
- Eggs are often lost
- It gives low income to farmers
- Birds are often found to be nuisance in the environment
- No proper records kept

b. Semi-Intensive System

- i. **Run System:** this involves the rearing of fowls in a permanent house (pen) with fenced and a grass run attached for the fowls to move about. The pen is usually built at the centre of the grass run so that two runs are created for the birds to use. The run is fenced with wire-netting or other suitable materials to a height of about 2m.

- ii. **Moveable Fold Unit System:** It consists of a portable house with a fixed run attached so that the fowls can have enough sunlight and air during the day and roost in the house at night. The fold unit is moved to cleaner ground every day and it must be built to be strong to withstand the daily movement. Some units can be built on wheels to facilitate easy movement from place to place. The floor of the units should be covered with wire of fine mesh to prevent snakes and other vermin from entering the pen. Egg laying boxes are in the pen but feed and water are fixed at the side of the unit in such a way that it eliminates wild animals from getting to the feed.

Advantages

- It makes good use of pasture land
- It allows other livestock to graze at the same time
- Manure is spread evenly over a larger area, enhancing soil fertility and reducing the need for artificial fertilisers
- By avoiding the concentration of waste in one area, the fold unit system minimises the risk of water contamination and other environmental problems
- Birds raised in a more natural and healthier environment often produce higher-quality meat and eggs, which can command higher market prices.

Disadvantages

- The unit does not work well on undulating and hilly lands
- Egg eating and cannibalisms can occur if not properly supervised
- There is the risk of disease buildup in one area and moving the units can spread pathogens to new areas if not managed carefully
- The enclosures need to be moved regularly, which can be labour-intensive and time-consuming
- Additional daily tasks such as feeding, watering and cleaning can be more demanding compared to stationary systems.



Figure 12.1: A typical fold unit system

c. Intensive Systems

i. Deep Litter House System

The deep litter housing system is suitable for rearing layers, breeding, broilers and for brooding chicks. The floor of the deep litter house is usually covered with litter. Good litter materials should be absorbent, capable of breaking down easily by micro-organisms and must not be too small to block the respiratory tract of birds. The best litter materials should be soft wood shavings. A mixture of straw and wood shavings is also suitable. This bedding material is regularly turned and added to, allowing it to compost over time. The system effectively manages poultry waste, controls odours and provides a comfortable, insulated environment for the birds.

Advantages

- It requires less labour
- It is efficient and reliable for keeping large flock
- It provides hygienic conditions for reducing pest and diseases attacks
- It provides less cracked eggs.

Disadvantages

- It restricts movement of fowls(birds) and hence less exercise for the fowls
- There is no natural green forage for the fowls
- Eggs can be dirty when litter is wet and collection not done on time
- It costs more to supplement feed with vitamins and minerals which could be obtained freely from the natural vegetation
- Cannibalism may occur if fowls (birds) are overcrowded.



Figure 12.2: *Deep litter house system*

ii. Battery Cage System

The battery cage system is a method of housing poultry, particularly egg-laying hens, in which birds are confined in rows of small, identical wire cages. These cages are often stacked in tiers within large, climate-controlled barns. This system

is designed to maximise efficiency and egg production, allowing for a high density of birds in a limited space.

- Advantages
- The controlled environment and consistent access to food and water help maximise egg production
- The vertical stacking of cages allows for more birds to be housed in a smaller area
- Automation in feeding, watering, egg collection and waste removal reduces the need for manual labour
- The design minimises feed wastage, as hens have limited movement and cannot scatter feed
- Individual confinement helps limit the spread of diseases for better diseases management. It makes it easier to identify and isolate sick birds.
- Farmers can more easily monitor the health, behaviour and productivity of the hens
- Many battery cage systems are equipped with automated systems for egg collection, feeding and waste removal, which streamlines operations.
- Disadvantages
- Hens have very limited space, which prevents them from performing natural behaviours such as nesting, perching and dust bathing
- The lack of exercise can lead to health problems such as osteoporosis, feather loss and foot lesions
- The confined space and inability to express natural behaviours can cause stress and aggression
- Fowls do not have access to natural vegetation
- Not suitable for breeding
- There could be more incidence of egg cracking.



Figure 12.3: A Battery cage system

2. Incubation

Incubation in poultry production is the process of maintaining fertile eggs under controlled environmental conditions to ensure the satisfactory development of the embryo inside the egg into normal and healthy chicks. This process can occur naturally, with the mother hen providing the necessary warmth and care, or artificially, using incubators designed to replicate these conditions.

a. Natural Incubation

Natural incubation is a traditional method that relies on the natural instincts of the hen to successfully hatch chicks. It requires minimal human intervention but can vary in effectiveness depending on the hen's health, experience and environmental conditions.

Advantages

- It is suitable for hatching few eggs
- It does not require much capital
- More eggs are likely to be hatched
- It does not require any external source of power.

Disadvantages

- Hen may not be available to sit on the eggs at the time that incubation is required
- Hatching eggs are exposed to the danger of pest attack and bad weather conditions
- It cannot be used for commercial production of chicks
- Availability of suitable nesting space and conditions may limit the number of eggs a hen can successfully incubate, especially in crowded or competitive environments
- Hens that are stressed, malnourished or diseased may not effectively incubate eggs.
- Artificial Incubation
- Artificial incubation refers to the process of hatching eggs using mechanical devices called incubators, rather than relying on natural methods such as a brooding hen.

Advantages

- Artificial incubation allows for continuous egg hatching throughout the year, once eggs are available.
- It can be used for commercial day-old chick production
- Eggs are safe from predator attack and bad weather conditions
- Facilitates selective breeding programmes by enabling farmers to control the genetic diversity and quality of chicks produced
- Incubators often come equipped with sensors and alarms systems that alert operators to any deviations in temperature, humidity or other critical factors, allowing for prompt intervention to optimise hatchability.
- Automated features such as automatic turning and monitoring systems reduce the need for constant manual intervention, saving labour costs and effort

- Farmers can predict and plan for hatching times more accurately, which is crucial for scheduling and logistics in poultry production.

Disadvantages

- Mechanical failures or malfunctions in incubators can jeopardise entire batches of eggs if not detected and rectified promptly
- Incubators require electricity to operate, which can lead to increased energy costs, especially in regions with unreliable power supply or high electricity tariffs
- It is capital intensive particularly the cost of maintaining the equipment can increase the cost of production
- It is uneconomical for hatching a few eggs.

3. Brooding

Brooding refers to the process of providing newly hatched chicks with a warm and controlled environment immediately after they emerge from their eggs. Brooding of chicks is done at the brooder house.

a. Caring for Chicks at the Brooder House

- i. **Heat Management:** Chicks require a consistent and appropriate temperature to stay warm. This is typically achieved using heat lamps, brooders (heated enclosures) or radiant heaters to maintain temperatures around 35-37.8°C during the first week, gradually decreasing to 30°C as chicks grow older and become more capable of regulating their own temperature.
- ii. **Space and Ventilation:** The brooding area must be spacious enough to accommodate the number of chicks without overcrowding. It should be well-ventilated to ensure good air quality while avoiding drafts that could chill the chicks.
- iii. **Feed and Water:** Chicks need access to clean water and specialised starter feed formulated to meet their nutritional requirements. These should be readily available and easily accessible to encourage proper growth and development.
- iv. **Lighting:** While chicks require periods of darkness for rest, providing appropriate lighting during the day helps stimulate activity, feeding and overall growth. Low-intensity lighting is typically used in brooding areas to reduce stress.
- v. **Monitoring and Care:** Regular monitoring of chicks is essential to ensure they are healthy, active and adjusting well to their environment. Caretakers should be attentive to signs of distress, illness or behaviour indicating problems with temperature or other conditions.
- vi. **Sanitation:** Strict sanitation should be followed by ensuring that:
 - The floor litter is kept dry around the waterers where the chicks are likely to cause spillage.
 - Chicks are debeaked as early as possible before the third week after hatching in order to reduce pecking.
 - Chicks of different ages together are not put together in the same house.

- Footbaths are provided with disinfectants and make sure that all visitors into the brooder house dip their feet before entering.
- Sick chicks are isolated as quickly as possible and contact the vet for advice.
- Feed which has grown mouldy is discarded and clean the feeder and waterers every day.
- Contact between adult fowls and the chicks is reduced by attending differently to each group.

4. Feeding of Poultry to Maturity

a. Key Nutrients for Poultry Birds

- Protein:** Essential for growth and development, particularly muscle formation. Sources: Soybean meal, fish meal, meat meal, and other high-protein ingredients.
- Carbohydrates:** Provide energy for daily activities and bodily functions. Sources: Corn, wheat, barley, and other grains.
- Fats:** Necessary for energy, absorption of fat-soluble vitamins, and development. Sources: Animal fats, vegetable oils.
- Vitamins:** Vital for metabolic processes, growth, and health. Key vitamins: A, D, E, K, and B complex vitamins.
- Minerals:** Important for bone development, metabolic functions, and overall health. Key minerals: Calcium, phosphorus, sodium, potassium, magnesium, and trace minerals like zinc, copper, and selenium.
- Water:** Essential for all bodily functions. Always provide fresh and clean water.

b. Feeding Stages

i. Starter Phase (0-6 weeks):

- **Diet:** High in protein (18-20%) and energy to support rapid growth.
- **Feed:** Starter feed, often in crumble or mash form to facilitate easy eating.
- **Frequency:** Provide feed ad libitum (always available) to ensure chicks can eat whenever they are hungry.

ii. Grower Phase (6-14 weeks):

- **Diet:** Slightly lower in protein (16-18%) than starter feed, moderate energy levels.
- **Feed:** Grower feed, usually in mash or pellet form.
- **Frequency:** Continue providing feed ad libitum.

iii. Finisher/Broiler Phase (14 weeks to market age):

- **Diet:** Balanced for growth and meat production, protein (16-18%), high energy.
- **Feed:** Finisher feed, often in pellet form for broilers; specific layer or broiler feed depending on the type of poultry.
- **Frequency:** Feed ad libitum to promote healthy weight gain.

iv. Layer Phase (from about 18-20 weeks):

- **Diet:** Balanced for egg production, with higher calcium (for eggshell formation), protein (16-18%), and specific vitamins and minerals.
- **Feed:** Layer feed, often in pellet or crumble form.
- **Frequency:** Feed ad libitum; provide additional calcium sources like oyster shells if necessary.

c. Special Considerations**i. Supplementation:**

- **Grit:** Necessary for digestion, particularly in layers and older birds.
- **Calcium:** Especially important for laying hens to produce strong eggshells.
- **Vitamins and Minerals:** Premixes can be added to feed to ensure all nutritional requirements are met.

ii. Feeding Management:

- Ensure feeders are clean and free from mould or contaminants.
- Provide enough feeder space to reduce competition and ensure all birds can eat simultaneously.
- Monitor feed consumption and adjust quantities as needed to minimise waste.

iii. Water Management:

- Provide fresh, clean water at all times.
- Ensure drinkers are clean and accessible.

d. Practical Tips to Support Feeding**i. Feed Storage**

- Store feed in a cool, dry place to prevent spoilage and contamination.
- Use feed within its shelf life to ensure nutritional quality.

ii. Health Monitoring

- Regularly check the birds for signs of illness or malnutrition.
- Adjust feed formulations, if necessary, based on veterinary advice.

iii. Environmental Management

- Maintain proper temperature, ventilation, and lighting in the poultry house.
- Ensure good litter management to reduce disease risks.

5. Diseases and Pest Control**i. Newcastle Disease (Viral Disease)**

Symptoms: Respiratory distress (coughing, gasping for air); Nervous signs (tremors, paralysis circular movement); Drop in egg production; Discharge from the nostrils etc.

Prevention: Vaccination, strict biosecurity measures.

ii. Marek's Disease (Viral Disease)

Symptoms: Tumours develop on the skin, eyes, kidney, spleen, liver, muscles etc; Paralysis of the legs and wings; Loss of weight; Loss of appetite.

Prevention: Vaccination at day-old.

iii. Infectious Bursal Disease (Gumboro)

Symptoms: The fowls develop ruffled feathers; The birds exhibit diarrhoea conditions; Immunosuppression (increases in susceptibility to diseases).

Prevention: Vaccination; Practice good farm hygiene.

iv. Avian Influenza

Symptoms: Respiratory signs (coughing); Swelling of the head; Drop in egg production.

Prevention: Apply strict biosecurity measures; Vaccinate the fowls.

v. Infectious Bronchitis

Symptoms: Respiratory distress; Reduction in egg production; Poor egg quality.

Prevention: Vaccinate the birds; Provide good ventilation.

vi. Fowl Pox

Symptoms: Wart-like lesions on the skin; Diphtheritic lesions in the mouth.

Prevention: Vaccination.

vii. Coccidiosis

Symptoms: Diarrhoea conditions with blood stains; Loss of weight; The fowls may become anaemic; Wattle and comb become pale; Poor growth.

Prevention: Add coccidiostats to feed; Good litter management; Vaccinate the fowls.

viii. Salmonellosis

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.

ix. Mycoplasmosis (*Mycoplasma gallisepticum*)

Symptoms: Respiratory signs (coughing, sneezing nasal discharge); Reduced egg production; Swollen joints.

Prevention: Apply biosecurity measures; Vaccination.

x. Fowl Cholera (Pasteurellosis)

Symptoms: The wattle becomes swollen; The fowls suffer diarrhoea conditions; The animals die suddenly.

Prevention: Vaccination; Practice good sanitation.

xi. Vaccination regime from day-old to 16 weeks

- **Day-Old Chicks**

- Marek's Disease Vaccine: Administered at the hatchery.
- Newcastle Disease Vaccine: Initial dose given either through eye drop or spray.

- **1-2 Weeks**

- Infectious Bronchitis (IB): Given as a spray or eye drop.
- Gumboro Disease (Infectious Bursal Disease, IBD): First dose via drinking water or eye drop.

- **2-3 Weeks**

- Newcastle Disease (Booster): Second dose, usually given through drinking water.
- Infectious Bursal Disease (IBD) (Booster): Second dose via drinking water or eye drop if needed.

- **4-5 Weeks**

- Avian Encephalomyelitis (AE): Administered through drinking water.
- Fowl Pox: Given as a wing web stab.

- **6-8 Weeks**

- Newcastle Disease (Booster): Third dose through drinking water or spray.
- Infectious Bronchitis (Booster): Administered as spray or drinking water.

- **8-10 Weeks**

- Infectious Laryngotracheitis (ILT): Given via eye drop.

- **12 Weeks**

- Newcastle Disease (Booster): Fourth dose through drinking water or spray.
- Fowl Cholera: Administered via injection if the disease is a problem in the area.

- **14 Weeks**

- Coryza: Given as an injection if the disease is prevalent in the region.

- **16 Weeks**

- Newcastle Disease (Booster): Fifth dose through drinking water or spray.
- Infectious Bronchitis (Booster): Administered as spray or drinking water.

6. How to process poultry meat for the market**a. Receiving and Handling**

- Birds are transported to the processing facility and held in a holding area.
- They are kept in a calm and comfortable environment, and put only on water to purge the system of the birds to reduce the faeces in the system

b. Stunning and Slaughter

- i. Birds are rendered unconscious using electrical stunning or gas stunning.
- ii. They are then humanely slaughtered by severing the major blood vessels in the neck.

c. Scalding and Plucking

- i. The birds are scalded in hot water to loosen feathers.
- ii. Feathers are removed using the hand or through mechanical pluckers.

d. Evisceration

- i. A small incision is made around the vent (the cloaca) of the bird. This opening allows access to the internal organs.
- ii. Through the vent opening, the processor carefully reaches inside the body cavity to pull out the internal organs. This includes the digestive tract, liver, heart, lungs and other viscera mass.

e. Chilling

- i. The carcasses are rapidly cooled using chilled water or air to prevent bacterial growth.
- ii. They are usually chilled to a temperature below 4°C (40°F).

f. Cutting and Deboning

- i. The chilled carcasses are cut into parts (e.g., breasts, thighs, wings) or left whole.
- ii. Deboning involves removing bones from the meat portions.

g. Packaging

- i. The poultry parts or whole birds are packaged in trays, bags or vacuum-sealed packs.
- ii. Labels with product information, weight and expiration dates are applied.

h. Inspection and Quality Control

- i. Quality control checks are performed to ensure the meat meets safety and quality standards.
- ii. Government inspectors may also conduct inspections for compliance with regulations.

i. Storage and Distribution

- i. Packaged poultry is stored in refrigerated facilities until it is ready for distribution.
- ii. It is then transported to retailers, restaurants, or directly to consumers under refrigerated conditions.

Learning Tasks

1. State the management practices in poultry production.
2. Explain the management practices in poultry production.
3. Discuss the management practices in poultry production.

Pedagogical Exemplars

1. **Problem-based learning:** In mixed-ability groups, learners surf the internet using website links provided by the teacher for the management practices involved in keeping selected animals (poultry) and discuss their findings in class. Some learners should be assisted with probing questions that will help them state the management practices in keeping poultry. Challenge others to explain or discuss the management practices in keeping poultry. Encourage learners who are good at using the internet to help those with difficulty. Ensure that learners do not access unapproved or illegal websites.
2. **Experiential learning:** Learners in mixed-ability groups visit any poultry farm within the neighbourhood or the school poultry farm or watch a documentary on techniques used in managing domestic fowls. Learners then build a flow chart on the management practices from the visit or watched documentary. Teacher should ensure that all learners fully participate in the activities.
3. **Experiential learning (Homework):** Learners visit the school farm and have hands-on farm practices on some of the management practices such as cleaning water and feed troughs, preparing rations, applying medications, pest and disease identifications and control etc. Learners share their experiences to the class in a plenary presentation. Teachers should endeavour to take learners to visit farms that will help dispel stereotyping in animal production. Videos/pictures used in the class should be gender neutral. Teachers should encourage female learners and learners with disabilities to take part in the hands-on farm practical activities in the management practices in animal production and presentation of reports.

Key Assessments

Assessment Level 1: List the management practices involved in poultry production

Assessment Level 2: Explain brooding in poultry production

Assessment Level 3: Examine the effects of diseases and pest management on poultry production.

Assessment Level 4: Evaluate the step-by-step procedures for hygienic processing of poultry meats for local consumption and export.

Hint



- The recommended mode of assessment for week 12 is end of semester examination.
- Refer to Appendix D at the end of this section for Table of specification.

SECTION 5 REVIEW

The production of crops and the rearing of farm animals/fish is considered pivotal to Agricultural sustainability and economic revolution in Ghana and Africa at large. Understanding the economic importance and appreciation of the technologies and techniques for production of crops and the rearing of some selected animals/fish is fundamental in improving Agriculture for food security, livelihood empowerment, job creation, provision of raw materials for industrial growth and to apply biosecurity measures for promote sustainable Agriculture.

Vegetable crops refer to plants primarily grown for their edible parts such as leaves, roots, stems and flowers, which are consumed by humans. They are characterised by high water content and quick growth cycles. Arable crops are plants grown on ploughed and tilled land, typically for human consumption, as animal feed or for industrial purposes.

Cash crops are grown primarily for sale (generating revenue and profit), rather than for personal consumption or subsistence. Ornamental crops are grown for aesthetic value and improving environmental quality and human well-being, used in urban green spaces, for phytoremediation (cost-effective method that uses plants to remove, degrade or stabilize contaminants from soil, water, and air), and in therapeutic gardens.

Managing farm animals/fish refers to the practices and strategies employed to raise, care for and optimise the production of these animals in a sustainable and efficient manner. This management involves various aspects, including nutrition, health care, breeding, housing, environmental control and business operations. The economic importance of the selected animals/fish includes Income Generation, Employment and Livelihood, Food Security, Market and Trade, Supporting Industries, By-products and Waste Utilisation, Cultural and Social Contributions, Research and Development, and Environmental Benefits.

The management practices involved in poultry production includes Housing, Incubation, Brooding, Feeding and Nutrition, and Diseases and Pest Control. The stages involved in poultry processing for the market are: Receiving and Handling, Stunning and Slaughter, Scalding and Plucking, Evisceration, Chilling, Cutting and Deboning, Packaging, Inspection and Quality Control, and Storage and Distribution.

MARKING SCHEME FOR THE GAMIFICATION ASSESSMENT TASK

1 mark for each correctly identified word and filled in the puzzle (10 marks)

Fastness of completion

5 marks for completing the puzzle correctly within 5 minutes

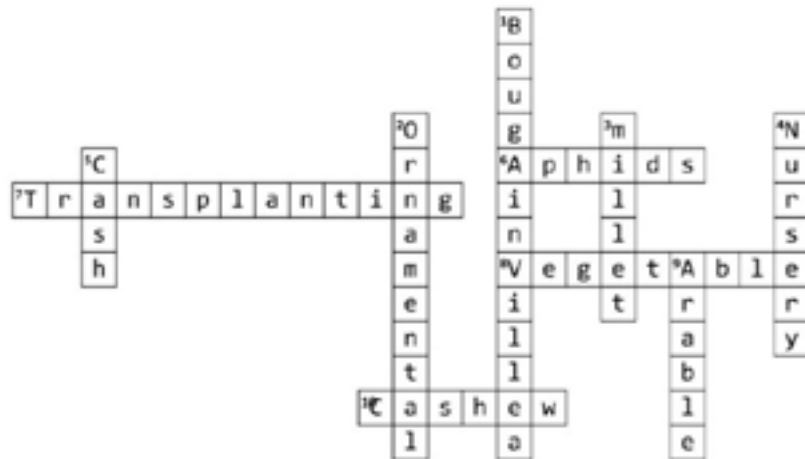
3 marks for completing the puzzle correctly within 6 to 8 minutes

2 marks for completing the puzzle correctly between 9 to 10 minutes.

1 mark for completing after 10 minutes.

Answers to the puzzle questions

Across	Down
1. Aphids	1. Bougainvillea
2. Transplanting	2. Ornamentals
3. Vegetables	3. Millet
4. Insured	4. Nursery
5. Cashew	5. Cash
	6. Arable





APPENDIX D: END OF SEMESTER EXAMINATIONS

1. Nature

- a. Cover content from weeks 1-12, taking into consideration DoK levels 1-4.
- b. The test should include
 - i. Section A- Multiple Choice Questions (40 questions, 1 mark each for 40 marks)
 - ii. Section B- 5 Essay type questions, (5 questions for 3 to be answered, Maximum of 20 marks each)
 - iii. Test of Practicals Section – (5 questions, Answer all questions, maximum of 100 marks)
 - iv. Time: 1 hour 30 minutes for Section A and B, and 1 hour for Test of Practical examination.
 - v. Total Score: 200 marks to be scaled down to 60 marks for submission.

2. Resources

- a. Answer Booklets
- b. Learners' Manual
- c. Specimen and Materials for Practical Examination
- d. Teachers' Assessment Manual and Toolkit
- e. Teachers' Manual

3. Sample question

Section A

Answer the following question by circling the correct answer

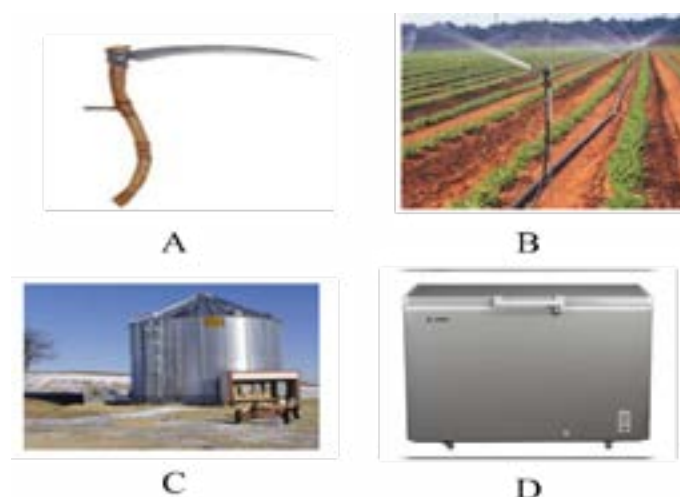
1. Which crop is typically grown for ornamental purposes?
 - a. Cotton
 - b. Marigold
 - c. Potato
 - d. Rice

Section B: Essay type questions

1. Explain how irrigation can be used to expand arable land for crop cultivation.

Section C: Test of Practicals

- Study the pictures A- D carefully and use it to answer the questions below;



- i. Write the names of the items in pictures A-D
- ii. State one use of each item
- iii. State the disadvantage of using item B
- iv. State one safety precaution that should be observed in using item A

4. **Sample table of specification for end of semester examination**

Weeks	Learning indicator(s)	Type of Questions	DoK Levels				Total
			1	2	3	4	
1 and 2	Meaning, importance and Stages of Agricultural development and Land Tenure Systems in Ghana and their effects on Agricultural production.	Multiple Choice	3	3	1	-	7
		Essay	-	-	-	1	1
		Test of Practicals	-	1	-	-	1
3 and 4	Industries of Crop and animal/ fish Production	Multiple Choice	2	3	-	-	5
		Essay	-	-	-	2	2
		Test of Practicals	-	-	1	-	1
5 and 6	Meaning, importance and uses of survey and mapping instruments, and procedure for conducting survey and mapping of farmstead.	Multiple Choice	2	3	1	-	6
		Essay	-	-	1	1	2
		Test of Practicals	-	1	-	1	2

7 and 8	Methods, Uses, Parts and Functions of Irrigation and Drainage Systems in Agricultural Production and their Operation	Multiple Choice	3	2	1	-	6
		Essay	-	-	1	-	1
		Test of Practical	-	1	-	1	2
9 and 10	Classification of Harvest and Post-harvest Implements and Machinery and their operations in Agricultural Production.	Multiple Choice	2	3	-	-	5
		Essay	-	-	-	-	-
		Test of Practical	-	-	1	-	1
11	Economic Importance of Some Selected Crops	Multiple Choice	3	2	-	-	5
		Essay	-	-	1	-	1
		Test of Practical	-	1	-	1	1
	Total		15	20	8	7	50

SECTION 6: NATURAL RESOURCE CONSERVATION IN AGRICULTURE

Strand: Food Production and Natural Resource Conservation

Sub-Strand: Principles of Natural Resource Conservation in Agriculture

Week 13

Learning Outcome: Use the knowledge acquired to manage and conserve game/wildlife.

Content Standards: Demonstrate knowledge and understanding of game and wildlife conservation and their contribution to socio-economic development.

Week 14

Learning Outcome: Use the knowledge and skills acquired in the management practices of mushroom production.

Content Standard: Demonstrate knowledge, understanding and skills of mushroom production.

Weeks 15 and 16

Learning Outcome: Use the knowledge acquired to explain the role of soil nutrients in soil fertility and productivity in crop production.

Content Standard: Demonstrate knowledge, understanding and skills of soil nutrients, fertility and productivity.

Hint



- Assign learners individual project in Week 14 be submitted for scoring in Week 22.
- Refer to appendix E for the format of the project work

INTRODUCTION AND SECTION SUMMARY

Game and wildlife are essential for the health of our planet, the stability of ecosystems and the well-being of human societies. Their conservation is crucial for maintaining the balance of nature and ensuring the well-being of future generations. Mushroom production plays a vital role in economic development by generating income, creating jobs, supporting rural economies and contributing to food

nutrition and security. Maintaining soil fertility practices not only enhance productivity but also contribute to the long-term sustainability of agricultural systems and environmental health. Sustainable fertiliser applications mitigate the harmful effects of fertilisers to the environment and promote long-term agricultural sustainability. This section will introduce learners to various aspects of game and wildlife conservation, mushroom production, effective soil fertility practices and fertiliser application with the overarching aim of promoting food security and sustaining the environment for future generations. This section has links with subjects including Biology, Chemistry, General Science, Home Economics, Government and Geography.

The weeks covered by the section are:

Week 13: Meaning and importance of game and wildlife

Week 14: Economic importance and management practices in mushroom production

Week 15: Meaning of soil nutrients, fertility and productivity

Week 16: Meaning, types and effects of fertilisers on crop production

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogies to be used include experiential learning, collaborative learning, inquiry-based learning, think-pair-share, problem-based learning, project-based learning, structuring talk for learning, managing talk for learning and initiating talk for learning as proposed in this teacher manual. The teacher is encouraged to adapt, add or modify as appropriate to suite his/her school community and/or environment. Experiential learning, project-based learning and problem-based learning are required to equip learners with problem solving skills, creative skills and hands on experience. Think-pair-share and collaborative learning will promote teamwork among learners, while inquiry-based learning, think-pair-share, structuring talk for learning, managing talk for learning and initiating talk for learning will enhance the critical thinking skills, analytical skills, communication skills and digital literacy as learners use the internet for information, share the views, engage in discussions, presentations and portfolio building. Projects that cannot be done in the classroom should be given as homework and learners should be given ample time to complete them. Pictures, videos and documentaries as well as all activities should be gender neutral. The teacher should ensure that all learners take part in all activities and exhibit respect to each other. Learners should be monitored whenever they are using the internet to ensure that they do not visit unapproved or illegal websites.

ASSESSMENT SUMMARY

The assessment for this section will cover the meaning and importance of game and wildlife, economic importance and management practices in mushroom production, meaning of soil nutrients, fertility and productivity, and meaning, types and effects of fertilisers on crop production. It will also cover important game and wildlife reserves in Ghana, wildlife conservation strategies, meaning of mushroom, methods of fertiliser application and best practices for fertiliser use. Assessments should note the various proficiencies of learners (approaching proficiency, proficiency and highly proficient) and depth of knowledge (Level 1 - recall/reproduce/remember, Level 2 - skills of conceptual understanding, Level 3 - strategic reasoning and Level 4 - extended critical thinking and reasoning). These assessments should be a balance of both summative and formative activities, making use of class exercises, class tests, demonstrations, group discussions, homework, project-based, presentations, among others. The teacher should accept varying responses and show professionalism towards answers given by learners whether right or wrong. Marking schemes, score cards, and rubrics among others can be used to score assignments, presentations, projects and other assessments.

WEEK 13

Learning Indicators

1. Explain the meaning and importance of game and wildlife.
2. Discuss the need for conserving game and wildlife.

Focal Area 1: Meaning and Importance of Game and Wildlife

1. Meaning of Game and Wildlife

- a. **Game:** Game refers to wild animals that are hunted for meat, recreation, sport, fur or other by-products. These animals are sometimes subject to hunting regulations and laws designed to manage their populations, ensure sustainable hunting practices and protect certain species from overexploitation. Game animals can be found in various habitats, including forests, grasslands, wetlands, and mountains. The types of game include:
 - i. **Big Game:** Large mammals often targeted by hunters. Examples: Deer, elk, moose, bear, bison and antelope.
 - ii. **Small Game:** Smaller mammals and birds. Examples: Rabbits, squirrels, pheasants, quail, guinea fowl and ducks.

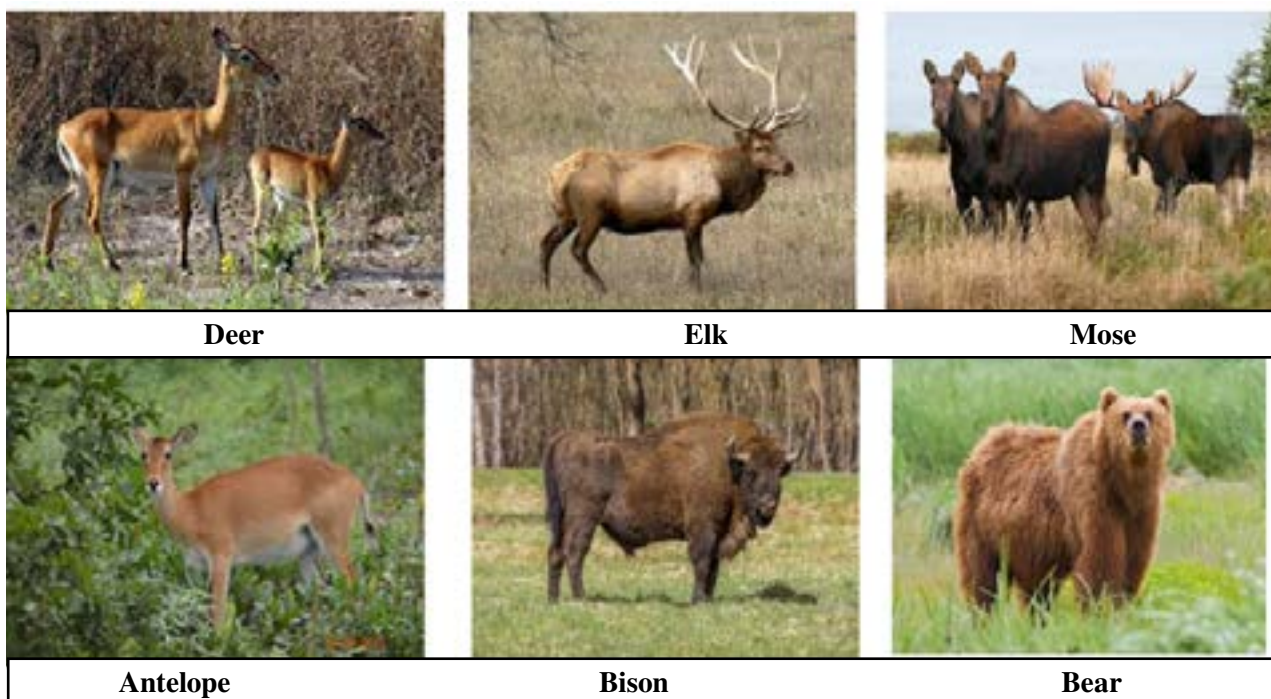


Figure 13.1a: Some examples of big game animals

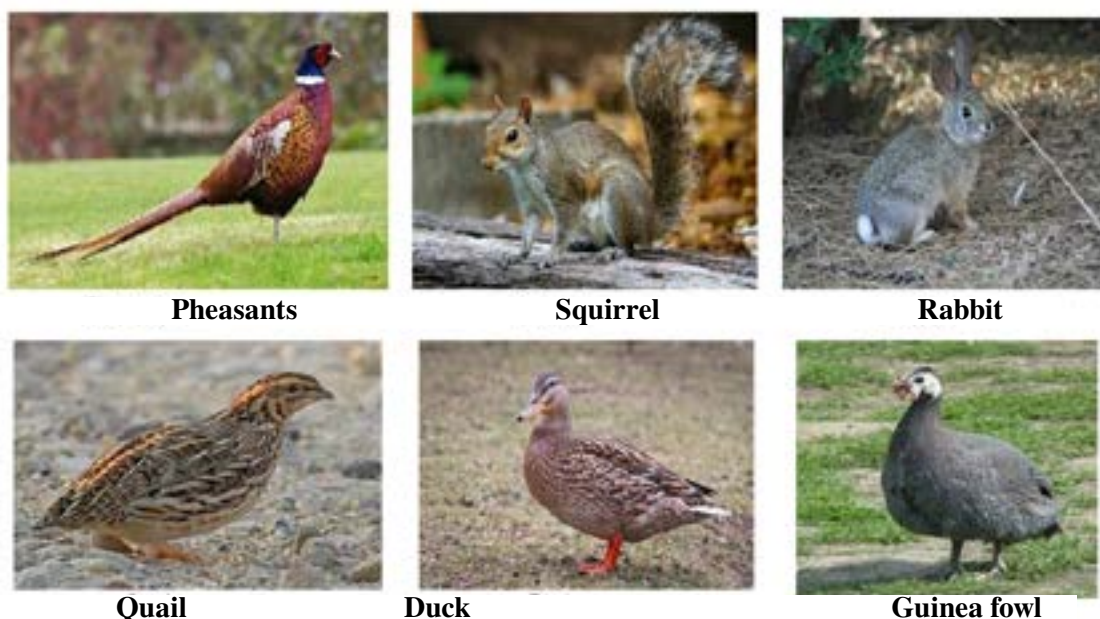


Figure 13.1b: *Some examples of small game animals and birds*

- b. Wildlife:** Wildlife refers to all non-domesticated animals, plants, fungi and other organisms that live in natural environments. It encompasses a wide range of species, from mammals, birds, reptiles, amphibians and fish to insects, plants and microorganisms. Wildlife exists in various ecosystems, including forests, deserts, grasslands, wetlands, mountains, and oceans, and plays a crucial role in maintaining ecological balance and biodiversity. The threats to wildlife are:
- i. Habitat Loss and Fragmentation:** Urbanisation, agriculture, deforestation and infrastructure development leading to the destruction and fragmentation of natural habitats.
 - ii. Pollution:** Pollution from industrial, agricultural and urban sources can harm wildlife through contamination of air, water and soil.
 - iii. Climate Change:** Climate change affects wildlife by altering habitats, disrupting migration patterns and increasing the frequency of extreme weather events.
 - iv. Overexploitation:** Overhunting, overfishing and illegal wildlife trade can deplete populations and drive species to extinction.
 - v. Invasive Species:** Non-native species introduced to new environments can outcompete, prey on or bring diseases to native wildlife.
- c. Wildlife and Game Conservation Strategies**
- i.** The strategies that can be put in place to conserve game and wildlife include:
 - ii. Protected Areas:** Establishing national parks, wildlife reserves and marine protected areas to conserve habitats and species.
 - iii. Legislation and Policies:** Implementing laws and regulations to protect endangered species and their habitats.
 - iv. Sustainable Practices:** Promoting sustainable agriculture, forestry and fishing practices to minimise the impacts on wildlife.

- v. **Restoration Projects:** Restoring degraded habitats and reintroducing species to areas where they have been eradicated.
- vi. **Community Involvement:** Engaging and educating local communities in conservation efforts to ensure that they benefit from and support wildlife protection.

d. Some Important Game and Wildlife Reserves in Ghana

- i. **Mole National Park:** It is located in the Savannah Region. Animals that can be found here include elephants, antelopes, buffaloes, warthogs, hyenas and various bird species. Lions and leopards are also present but less frequently seen. It is the largest national park in Ghana, known for its diverse ecosystems, including savannah, forest, and wetlands. It offers guided safari tours, walking safaris and bird watching.
- ii. **Kakum National Park:** It is located in the Central Region. Notable wildlife includes forest elephants, bongo antelopes, Diana monkeys and over 200 bird species. It is famous for its canopy walkway, which is about 350 meters long and 40 meters above the forest floor, providing a unique perspective of the rainforest.
- iii. **Shai Hills Resource Reserve:** It is located in the Greater Accra Region. Notable wildlife includes olive baboons, kobs, antelopes and various bird species. It is known for its rocky hills and savannah vegetation. It has historical sites with caves that were once inhabited by the Shai people.
- iv. **Digya National Park:** It is located in Brong-Ahafo and Ashanti Regions along the shores of Lake Volta. Notable wildlife includes: elephants, antelopes, leopards and various bird species. It is one of Ghana's oldest protected areas, established in 1900. It offers diverse habitats including savannah, forests and wetlands.
- v. **Bia National Park and Biosphere Reserve:** It is located in the Western Region. Notable wildlife includes forest elephants, chimpanzees, various primates and numerous bird species. A UNESCO biosphere reserve known for its rich biodiversity and conservation importance.
- vi. **Ankasa Conservation Area:** It is located in the Western Region. It comprises the Ankasa and Nini-Suhien Forest Reserves. It is one of the most biologically diverse areas in Ghana, with barren tropical rainforest. Notable wildlife includes forest elephants, bongo antelopes, leopards, and various primates and birds.
- vii. **Kyabobo National Park:** It is located in the Oti region near the Ghana-Togo border. It features mountainous terrain and diverse flora and fauna. Notable wildlife includes Buffaloes, kobs, bushbucks and various bird species.
- viii. **Boabeng-Fiema Monkey Sanctuary:** It is located in the Bono region. It is known for its harmonious relationship between the local community and the monkeys, which are considered sacred. Notable wildlife includes mona monkeys and black-and-white colobus monkeys.

2. Importance of Game and Wildlife

a. Ecological Importance

- i. **Biodiversity:** Wildlife contributes to the richness of biodiversity, ensuring the stability and resilience of ecosystems. Diverse species interactions help maintain ecological balance and promote ecosystem health.

- ii. **Ecosystem Services:** Wildlife plays critical roles in ecosystem services such as pollination, seed dispersal, pest control, and nutrient cycling. These services are essential for the functioning of ecosystems and human agriculture.
- iii. **Food Chain Balance:** Predators, herbivores, and decomposers maintain the balance of ecosystems by regulating population dynamics and nutrient flow. For instance, predators control the populations of herbivores, preventing overgrazing.

iv. b. Economic Importance

- v. **Tourism and Recreation:** Wildlife attracts tourists, supporting eco-tourism industries and generating significant revenue for local and national economies. Activities such as wildlife safaris, bird watching, and game hunting contribute to economic growth.
- vi. **Sustainable Resources:** Managed game species can provide sustainable sources of meat, leather, and other products, supporting livelihoods and food security. For example, sustainable hunting practices ensure that wildlife populations are maintained while providing resources for communities.
- vii. **Ecosystem Services:** Healthy ecosystems, supported by diverse wildlife, contribute to agriculture, fisheries, and forestry, which are essential for economic stability. Pollinators like bees and other insects are vital for the production of many crops.

b. Cultural Importance

- i. **Heritage and Traditions:** Many cultures have deep-rooted connections with wildlife, reflected in myths, traditions, and practices that shape their identities. Indigenous peoples, in particular, have strong cultural ties to local wildlife and land.
- ii. **Spiritual and Religious Significance:** Wildlife often holds spiritual and religious significance, featuring prominently in rituals and beliefs. For example, certain animals may be considered sacred or symbolic in various religions.
- iii. **Art and Literature:** Wildlife inspires art, literature, and folklore, enriching human culture and creativity. Many artists and writers draw inspiration from the natural world and its inhabitants.

c. Recreational Importance

- i. **Outdoor Activities:** Wildlife supports recreational activities such as birdwatching, hunting, fishing, and hiking, contributing to physical health and well-being. These activities provide opportunities for people to connect with nature.
- ii. **Education and Awareness:** Wildlife provides opportunities for environmental education, fostering a connection with nature and promoting conservation awareness. Nature reserves and wildlife parks often serve as educational centers.
- iii. **Mental Health Benefits:** Interactions with wildlife and natural environments have been shown to reduce stress, anxiety, and depression, enhancing mental health. Spending time in nature can have therapeutic effects.

Learning Tasks

1. State some important game and wildlife reserves in Ghana
2. Explain the meaning of game and wildlife
3. Discuss the importance of game and wildlife

Pedagogical Exemplars

1. **Think-pair-share:** In pairs, learners brainstorm to come up with the meaning of game and wildlife. Teachers should provide some internet sites to guide learners for information on the meaning of game and wildlife. Learners who are good at using the internet should support those having difficulty. The teacher should also monitor learners as they use the internet to prevent them from using unapproved or illegal sites when using the internet to search for information. All learners should tolerate and respect each other's views.
2. **Experiential learning:** Teachers should organise learners to visit a nearby game and wildlife reserve/watch a video or documentary (national geographic channels) about wildlife for them to appreciate wildlife and share their findings in a class discussion. In the same groups, learners should identify some of the notable game and wildlife reserves in Ghana. Teachers should ensure that all learners fully participate in the activities. Teachers should ensure that the videos/documentaries do not promote gender stereotyping. All learners should be encouraged to accept and tolerate the view of others.
3. **Collaborative learning:** Learners in mixed-ability groups surf the internet for information on the importance of game reserve and wildlife. Learners present their report in a plenary session in class for assessment. Learners who are good at using the internet should support those with difficulty. The teacher should also monitor learners as they use the internet to prevent learners from using unapproved or illegal sites as they search for information. Confident learners should be allowed to play lead roles during presentation of reports in the plenary session under the guidance of the teacher. All learners should be encouraged to accept and tolerate the view of others.

Key Assessments

Assessment Level 1: List at least three (3) important game and wildlife reserves in Ghana

Assessment Level 2: Explain the meaning of game and wildlife

Assessment Level 3: Discuss at least three (3) economic importance of game and wildlife

Assessment Level 4: Make a presentation on the reason for which game and wildlife are of ecological importance.

Focal Area 2: Need to Conserve Game and Wildlife

1. The Need to Conserve Game and Wildlife

There is the need to conserve game and wildlife for numerous reasons that span ecological, economic, cultural, scientific and ethical dimensions. Here are a range of the key reasons for conserving game and wildlife:

a. Ecological Importance

- i. **Biodiversity Preservation:** Conservation helps maintain biodiversity, which is crucial for ecosystem stability and resilience. Diverse ecosystems are more robust and better able to recover from disturbances such as natural disasters and climate change.
- ii. **Ecosystem Services:** Wildlife provides essential ecosystem services such as pollination, seed dispersal, pest control, and nutrient cycling. These services are critical for the health of ecosystems and human agricultural systems.
- iii. **Food Web Integrity:** Every species plays a specific role in its ecosystem. The loss of one species can lead to imbalances and have cascading effects on other species, ultimately disrupting the entire ecosystem.
- iv. **Habitat Preservation:** Protecting wildlife often involves preserving their habitats. This, in turn, benefits all species living in those environments and maintains essential ecological processes.

b. Economic Benefits

- i. **Ecotourism:** Wildlife and natural landscapes attract tourists, generating significant revenue for local and national economies. This creates jobs in ecotourism, hospitality, and related sectors, often providing a sustainable alternative to other forms of economic development.
- ii. **Sustainable Resource Use:** Many communities rely on wildlife for sustainable hunting, fishing, and harvesting. Effective conservation ensures that these resources remain available and productive for future generations.
- iii. **Natural Products:** Wildlife and their habitats are sources of natural products such as food, medicine, and raw materials. These products have significant economic value and contribute to human well-being.

c. Cultural and Social Value

- i. **Cultural Heritage:** Wildlife holds a deep cultural significance for many indigenous and local communities, featuring prominently in traditions, folklore, and spiritual beliefs. Conserving wildlife helps preserve these cultural heritages and supports the identity and practices of these communities.
- ii. **Recreational Opportunities:** Wildlife-related activities such as bird watching, hiking, hunting, and photography provide recreational opportunities that enhance human well-being and promote an appreciation for nature.

d. Scientific and Educational Contributions

- i. **Research and Innovation:** Wildlife provides opportunities for scientific research, leading to discoveries in fields such as medicine, agriculture, and environmental science. Studying wildlife can lead to innovations that benefit humanity.
- ii. **Environmental Education:** Conservation efforts foster environmental education and awareness, encouraging responsible stewardship of natural resources and inspiring future generations to protect wildlife.

e. Health and Well-being

- i. **Disease Regulation:** Healthy ecosystems help regulate diseases by controlling populations of vectors such as mosquitoes and rodents. Biodiverse systems are less likely to see outbreaks of diseases that can jump to humans.
- ii. **Mental Health Benefits:** Exposure to nature and wildlife has been shown to improve mental health, reduce stress, and enhance overall well-being.

f. Climate Change Mitigation

- i. **Carbon Sequestration:** Forests, wetlands, and other habitats that wildlife depend on are crucial for carbon sequestration, helping to mitigate climate change by absorbing and storing carbon dioxide from the atmosphere.
- ii. **Adaptation and Resilience:** Biodiverse ecosystems are more resilient to climate change impacts, providing natural buffers against extreme weather events and other environmental changes. This resilience helps protect both wildlife and human communities.

g. Ethical Responsibility

- i. **Intrinsic Value:** Many people believe that all species have an intrinsic right to exist. Conserving wildlife honours this belief and recognises the inherent value of all living beings.
- ii. **Interconnectedness of Life:** Understanding the interconnectedness of all life forms underscores the ethical responsibility to protect and conserve wildlife. The health and well-being of human populations are closely linked to the health of natural ecosystems.

Learning Tasks

1. State the need to conserve game and wildlife.
2. Explain the need for conserving game in Ghana.
3. Discuss the need for conserving wildlife globally.

Pedagogical Exemplars

1. **Inquiry-based learning:** In mixed-gender groups, learners surf the internet for information on the need to conserve game and wildlife. Provide learners with links to websites that they can get the needed information. Also, learners with difficulty in surfing the internet should be assisted. Ensure that learners do not access unapproved or illegal websites.
2. **Think-pair-share:** In pairs, learners discuss the usefulness of conserving game and wildlife. Some learners should be assisted with probing questions that will help them to state the usefulness of conserving game and wildlife. Challenge others to explain or discuss the usefulness of conserving game and wildlife. All learners should tolerate and respect each other views.

Key Assessments

Assessment Level 1: List at least two (2) reasons for the need to conserve game and wildlife

Assessment Level 2: Explain the need to conserve game animals in Ghana.

Assessment Level 3: Discuss the need to conserve game and wildlife animals in the global world.

Assessment Level 4

1. Debate on the pros and cons of keeping game and wildlife for human sustenance.
2. Write the name of one game and wildlife reserve in Ghana, its location and 2 animals that can be found at the reserve on the strips of paper (exit ticket) provided.

Hint



*The recommended mode of assessment for week 13 is **exit card**. Use the level 4 question 2 as a sample question.*

WEEK 14

Learning Indicators

1. Outline the economic importance and management practices in mushroom production.
2. Demonstrate the skills in the cultivation of mushrooms.

Focal Area 1: Economic Importance and Management Practices in Mushroom Production

1. Meaning of Mushroom Production

Mushrooms are fungi that typically have a stem cap, and gills or pores underneath the cap. They belong to the kingdom Fungi and vary widely in shape, size, colour and texture. Mushrooms can be cultivated or wild-harvested and are consumed worldwide for their culinary and medicinal properties. The following are the parts of a mushroom and their location:

- Cap (Pileus):** The upper part of the mushroom.
- Gills (Lamellae):** Located on the underside of the cap.
- Spores:** Released from the gills.
- Stem (Stipe):** The stalk supporting the cap.
- Ring (Annulus):** A ring around the stem.
- Volva:** A cup-like structure at the base of the stem.
- Mycelium:** The network of hyphae, typically below the surface.

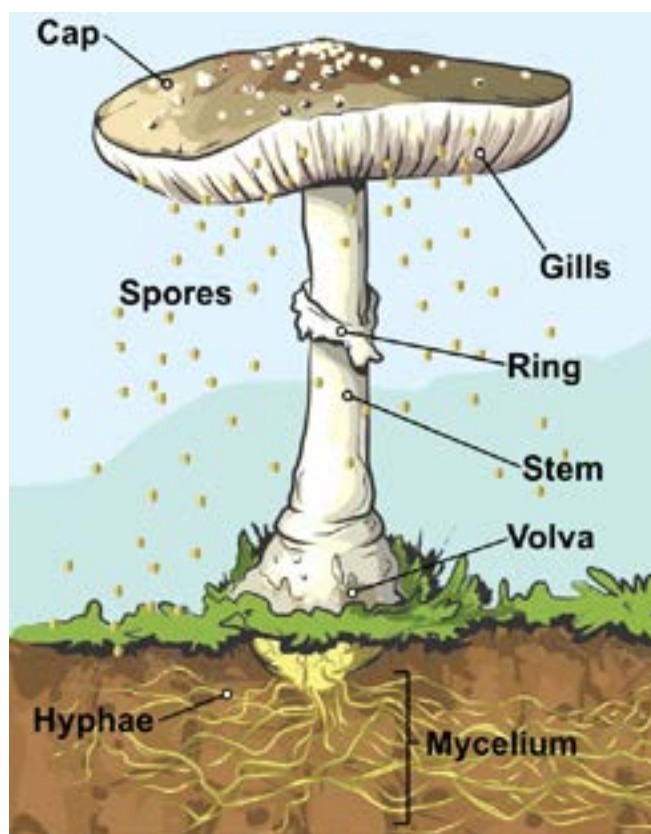


Figure 14.1: A typical fungus and its parts

2. Economic Importance of Mushroom Production

a. Direct Economic Benefits

i. Income Generation

- **Farmers and Producers:** Mushroom cultivation provides an additional source of income for those who cultivate them. It can be a supplementary activity alongside traditional farming.
- **Export Revenue:** Countries that produce mushrooms at a commercial scale can earn substantial revenue from exporting them. Countries like China, the Netherlands and the United States are major exporters.

ii. Job Creation

- **Cultivation and Harvesting:** Mushroom farming requires labour for various stages including preparation, cultivation, harvesting and packaging, creating employment opportunities.
- **Processing and Marketing:** Additional jobs are created in processing, packaging, marketing and distribution.

iii. Value-Added Products

- **Processed Foods:** Mushrooms are processed into various products such as dried mushrooms, mushroom powder, sauces and canned mushrooms, adding value and increasing market potential.
- **Nutraceuticals and Supplements:** Medicinal mushrooms are used to produce health supplements, contributing to the pharmaceutical and wellness industries.

b. Socio-Economic Benefits

i. Rural Development

- **Empowering Small-Scale Farmers:** Mushroom cultivation can be carried out with minimal land and investment, making it accessible to small-scale and resource-poor farmers.
- **Women's Participation:** In many regions, women play a significant role in mushroom farming, thus promoting gender equality and empowering women economically.

ii. Sustainable Agriculture

- **Utilisation of Agricultural Waste:** Mushrooms can be grown on agricultural by-products like straw, sawdust and coffee grounds, promoting recycling and reducing waste.
- **Low Environmental Impact:** Mushroom farming has a relatively low environmental footprint compared to traditional agriculture, requiring less water and no need for pesticides.

c. Health and Nutritional Benefits

i. Nutritional Value

- **Dietary Supplements:** Mushrooms are rich in essential nutrients such as proteins, vitamins (especially B vitamins and vitamin D), minerals (like selenium and potassium), and antioxidants.
- **Food Security:** Including mushrooms in diets can improve food security and nutrition, especially in regions with limited access to diverse food sources.

ii. Medicinal Value

- **Health Benefits:** Medicinal mushrooms like Reishi, Shiitake and Lion's Mane are known for their potential health benefits, including immune support, anti-inflammatory properties and cognitive enhancement.
- **Healthcare Cost Reduction:** Incorporating medicinal mushrooms into healthcare can contribute to overall health and potentially reduce healthcare costs through preventive measures.

3. Management Practices in Mushroom Production

a. Site Selection and Preparation

- Location:** Choose a site with good drainage, adequate ventilation and access to clean water. Ensure the site is free from contamination sources such as chemical sprays or industrial pollution.
- Infrastructure:** Construct mushroom houses or sheds with controlled environmental conditions, including temperature, humidity, and light. Use materials that maintain cleanliness and can be easily disinfected.

b. Substrate Preparation

- Selection of Substrate:** Use agricultural by-products such as straw, sawdust, coffee grounds or composted manure as substrates. Ensure the substrate is free from contaminants and appropriately processed.
- Sterilisation or Pasteurisation:** Sterilise or pasteurise the substrate to kill pathogens and unwanted microorganisms. Use steam pasteurisation, chemical treatments or hot water treatment methods.

c. Spawn Production and Inoculation

- Spawn Quality:** Source high-quality spawn from reputable suppliers to ensure good yield and disease resistance. Store spawn in cool, dark conditions to maintain viability.
- Inoculation Techniques:** Mix the spawn thoroughly with the substrate to ensure even distribution. Maintain hygiene during inoculation to prevent contamination.

d. Environmental Control

- Temperature:** Maintain optimal temperature ranges for different stages of growth (e.g., 20-25°C for mycelial growth and 15-20°C for fruiting).

- ii. **Humidity:** Keep relative humidity levels between 85-95% to promote mycelium growth and fruiting. Use humidifiers or misting systems to control humidity levels.
 - iii. **Ventilation:** Ensure adequate ventilation to provide fresh air and remove excess CO₂. Install fans or ventilation systems to maintain air quality.
 - iv. **Light:** Provide indirect light for fruiting stages, as most mushrooms require some light to initiate fruiting. Avoid direct sunlight, which can dry out substrates and harm mycelium.
- e. **Monitoring and Maintenance**
- i. **Regular Monitoring:** Monitor environmental parameters such as temperature, humidity, CO₂ levels and light regularly. Inspect for signs of contamination or disease.
 - ii. **Maintenance of Equipment:** Clean and disinfect equipment and growing areas regularly to prevent contamination. Repair any damaged infrastructure promptly.
- f. **Disease and Pest Management**
- i. **Sanitation:** Maintain high levels of cleanliness in all aspects of production. Use disinfectants and sanitisers to clean surfaces and tools.
 - ii. **Disease Identification and Control:** Identify common diseases such as green mold (*Trichoderma* spp.), cobweb mold (*Cladobotryum* spp.) and bacterial blotch. Implement appropriate control measures, such as removing contaminated materials and applying fungicides if necessary.
 - iii. **Pest Management:** Control pests such as flies, mites and rodents using physical barriers, traps and biological controls. Maintain a clean environment to reduce pest infestations.
- g. **Harvesting**
- i. **Timing:** Harvest mushrooms at the right stage of maturity for optimal quality and yield. Use sharp tools to cut mushrooms cleanly to avoid damaging the substrate.
 - ii. **Handling:** Handle mushrooms gently to prevent bruising and damage. Place harvested mushrooms in clean, dry containers.
- h. **Post-Harvest Handling**
- i. **Cleaning and Sorting:** Clean mushrooms by gently brushing off debris. Avoid washing them as they can absorb water and spoil faster. Sort mushrooms by size and quality for uniformity in marketing.
 - ii. **Packaging:** Use appropriate packaging materials to protect mushrooms during transport and storage. Consider using breathable materials to maintain freshness.
 - iii. **Storage:** Store mushrooms in cool, humid conditions to extend shelf life. Maintain cold storage at 0-2°C and 90-95% relative humidity.
- i. **Marketing and Sales**
- i. **Market Research:** Identify potential markets and understand consumer preferences. Develop relationships with buyers, retailers and distributors.

- ii. **Branding and Promotion:** Create a brand for your mushrooms to distinguish them in the market. Use attractive packaging and engage in promotional activities to increase visibility.
- iii. **Value Addition:** Explore value-added products such as dried mushrooms, mushroom powders and ready-to-cook mushroom meals. Diversify your product range to cater to different market segments.

Learning Tasks

1. State the meaning and parts of a mushroom.
2. Explain the importance of mushroom production.
3. Discuss the management practices involved in mushroom production.

Pedagogical Exemplars

1. **Inquiry-based learning:** In mixed-ability groups, learners surf the internet to come up with the meaning, importance and management practices in the cultivation of mushrooms. Learners who are good at using the internet should support others who require assistance. The teacher should also monitor learners when they are surfing the internet for information to ensure that, they do not visit unauthorised or illegal sites. All learners should tolerate and respect each other views.
2. **Think-pair-share:** In pairs, learners discuss the economic importance and management practices in the cultivation of mushrooms. The teacher should intentionally involve all learners in the lesson discussion to dispel gender stereotyping in mushroom production. Confident learners should be allowed to play lead roles during lesson discussion under the guidance of the teacher. All learners should be encouraged to respect, accept and tolerate the view of others.

Key Assessments

Assessment Level 1: List the parts of a mushroom.

Assessment Level 2: What is mushroom?

Assessment Level 3: Examine the importance of mushroom in relation to its nutritional and health benefits to humans.

Assessment Level 4: Demonstrate the skills of management practices involved in mushroom production.

Focal Area 2: Skills in Mushrooms Cultivation

1. **Skills in the Cultivation of Mushrooms**
 - a. **Substrate Preparation and Management**

Select an appropriate substrate for the mushroom species. Common substrates include straw, sawdust, wood chips, coffee grounds or a combination of these can be used.

Pasteurise or sterilise the substrate to eliminate competing organisms such as bacteria and other fungi that have the potential to destroy the mycelium.

b. Inoculation

Once the substrate is cool after pasteurisation, inoculate it with the mushroom culture. This can be done using: 1) Grain Spawn: Mycelium grown on sterilized grains like millet, 2) Liquid Culture: A liquid medium containing mycelium and 3) Plug Spawn: Wooden dowels infused with mycelium, often used for outdoor cultivation on logs.

c. Incubation

Place the inoculated substrate in a suitable container such as plastic bags, jars, trays and incubate it in a dark, warm and humid environment. Maintain the temperature appropriate for the chosen mushroom species, usually between 20-25°C. Maintaining optimal temperature ranges for mycelial growth, pinning and fruiting stages (varies by mushroom species). Ensure good air exchange to prevent the buildup of carbon dioxide.

d. Environmental Control: Providing high humidity levels (80-95%) during critical stages to support mushroom growth and prevent drying out.

e. Monitoring and Maintenance: Regularly check the substrate for signs of contamination (e.g., mould, off-smells) and remove any contaminated sections immediately. Maintain optimal humidity levels, often between 85-95%, to support mycelium growth.

f. Colonisation: Allow the mycelium to fully colonise the substrate. This can take several weeks, depending on the species and environmental conditions. Once the substrate is fully colonised, it should appear white and dense.

g. Fruiting: Induce fruiting by exposing the colonised substrate to the appropriate conditions for mushroom formation. These conditions include: Lowering the temperature slightly, increasing light exposure to simulate natural day-night cycles, maintaining high humidity, often around 90-95% and introducing fresh air to reduce carbon dioxide levels.

h. Pest and Disease Management

Common pests such as mites, flies and diseases such as molds, bacterial infection affect mushroom production and must be effectively controlled using Integrated Pest Management (IPM). Strategies such as sanitation and biological control, such as using beneficial microbes, can be used to manage pests and disease and if necessary and seldomly, using recommended fungicides or insecticides.

i. Harvesting: Harvest the mushrooms when they reach the desired size and before the caps fully open for best quality. Use a sharp knife to cut the mushrooms at the base.

j. Post-Harvest: Clean the growing area to prepare for the next cycle. Save some of the best- performing cultures for future use.

k. Packaging and Storage: Correctly packing mushrooms to preserve freshness and shelf life, and storing them under suitable conditions (cool, humid environment).

l. Record Keeping and Documentation: Keeping detailed records of cultivation activities, including substrate formulations, inoculation dates, environmental conditions, pest/disease occurrences, harvest yields and any interventions or adjustments made. Use the records to analyse trends, identify areas for improvement and optimise future cultivation cycles.

Learning Tasks

1. List the steps involved in mushroom cultivation.
2. Explain the steps involved in mushroom cultivation.
3. Demonstrate how to cultivate mushrooms..

Pedagogical Exemplars

1. **Experiential learning:** Learners in mixed-ability groups undertake field trips to nearby mushroom farms or watch a documentary on various techniques involved in the production of mushrooms. All learners should be encouraged to actively take part in the field trip or watch the documentary on mushroom cultivation. Learners should respect, accept and tolerate each other as they interact among themselves.
2. **Problem-based learning:** In gender-based groups, learners use internet/watch video on the techniques of mushroom production, discuss and make a presentation on efficient ways of mushroom production. The teacher should also monitor learners when they are searching the internet for information to ensure that they do not visit unauthorised or illegal sites. All learners should tolerate and respect each other views. Confident learners should be allowed to play lead roles during lesson discussion under the guidance of the teacher.
3. **Project based learning (Homework):** In gender-based groups, learners cultivate mushrooms and write a report on the activities performed during cultivation. The teacher should encourage all learners to be involved in the cultivation of mushroom to reduce gender stereotyping in mushroom production.

Key Assessments

Assessment Level 1: List at least two (2) steps involve in mushroom cultivation.

Assessment Level 2: Explain how inoculation is carried out in mushroom cultivation.

Assessment Level 3: Describe how can pest and diseases in mushroom production be managed effectively to increase yield?

Assessment Level 4

1. Demonstrate the skills of cultivating mushroom.
2. Cultivate mushrooms and package them for sale in the school community and write a report on the activities performed during cultivation.

Hint



The recommended mode of assessment for week 14 is **individual project**. Use the level 4 question 2 as a sample question.

WEEK 15

Learning Indicators

1. *Explain the meaning of soil nutrients, fertility and productivity.*
2. *Discuss the soil nutrients and their importance in crop production.*

Focal Area 1: Meaning of Soil Nutrients, Fertility and Productivity

1. **Meaning of soil Nutrients:** Soil nutrients are the essential elements required for plant growth and development. They can be categorised into macronutrients and micronutrients.
 - a. **Macronutrients:** Are needed by crops in larger quantities for growth and yield. The macronutrients can also be classified into Primary Macronutrients which include Nitrogen (N), Phosphorus (P), Potassium (K), and Secondary Macronutrients which include Calcium (Ca), Magnesium (Mg), Sulphur (S).
 - b. **Micronutrients:** They are needed by plants in smaller quantities but are still essential for growth and development. Examples: Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Boron (B), Molybdenum (Mo), Chlorine (Cl).
2. **Meaning of Soil Fertility:** Soil fertility refers to the soil's ability to provide essential nutrients to crops in adequate amounts and proper proportions for growth and yield. Factors influencing soil fertility include:
 - a. **Nutrient Content:** Availability of essential nutrients.
 - b. **Soil pH:** Is how acid or alkaline a soil is and influences nutrient availability and microbial activity.
 - c. **Organic Matter:** Enhances nutrient supply, soil structure, and water retention.
 - d. **Soil Structure:** Affects root growth and water/nutrient movement.
 - e. **Microbial Activity:** Soil organisms help decompose organic matter and recycle nutrients.
3. **Meaning of Soil Productivity:** Soil productivity is the ability of soil to support crop growth and produce crop yield in high outputs. It is influenced by soil fertility but also encompasses other factors such as:
 - a. **Climate:** Temperature, rainfall and sunlight availability.
 - b. **Water Availability:** Adequate and timely irrigation or natural precipitation.
 - c. **Crop Management Practices:** Planting techniques, pest and disease control, crop rotation and soil conservation methods.
 - d. **Genetic Potential of the Crop:** Inherent capacity of the crop variety to produce yields.

While soil fertility focuses on the nutrient-supplying capacity of the soil, soil productivity is a broader concept that includes all factors affecting crop yield and overall agricultural output.

Learning Tasks

1. State the meaning of soil nutrients
2. Explain the meaning of soil fertility and soil productivity
3. Discuss the meaning of soil nutrient, soil fertility and soil productivity and any relationship that exist among them

Pedagogical Exemplars

1. **Structuring talk for learning:** Learners in mixed-ability groups brainstorm to come up with the meaning of soil nutrients, fertility and productive soils using relevant sources from the environment. Use leading questions to help learners to come up with the meaning of soil nutrients, fertility and productive soils. Learners should be recognised for their efforts.
2. **Experiential learning:** Learners in mixed-ability groups examine soil samples and discuss the characteristics of the soils in terms of colour, texture, structure and composition. Where possible, the teacher should provide learners with links to websites where they can get information on the characteristics of the soils. All learners should be encouraged to take part in the discussion. Confident learners should be allowed to play lead roles during discussion in class.
3. **Inquiry-based learning:** Learners in mixed-ability groups search the internet for information on soil fertility and productivity, and discuss the conditions under which fertile soils may not be productive. Teachers should involve all learners in the class discussions, supporting individuals where necessary. Learners should respect, accept and tolerate each other's views.

Key Assessments

Assessment Level 1: State the two (2) categorisation of soil nutrients.

Assessment Level 2: Explain the meaning of soil nutrients and the factors that affect it.

Assessment Level 3: Discuss the link between soil fertility and productivity.

Assessment Level 4: Evaluate the importance of micronutrients in the improvement of crop yield to promote food security.

Focal Area 2: Soil Nutrients and their Importance in Crop Production

1. Importance of Soil Nutrients in Crop Production

a. Plant Growth and Development:

- i. **Cell Formation:** Nutrients are vital for cell division and elongation, which are fundamental processes for plant growth.
- ii. **Protein Synthesis:** Nitrogen is a key component of amino acids, the building blocks of proteins, which are essential for growth and repair.

b. Photosynthesis

- i. Chlorophyll Production:** Magnesium is a central element in chlorophyll, which is necessary for photosynthesis, the process by which plants convert sunlight into energy.
- ii. Energy Transfer:** Phosphorus is involved in the formation of ATP, the energy currency of cells, which drives various physiological processes.

c. Root Development

- i. Root Growth:** Nutrients like phosphorus are important for the development of strong and extensive root systems, which enhance water and nutrient uptake and provide stability in the ground.
- ii. Nutrient Absorption:** A healthy root system improves the plant's ability to absorb nutrients efficiently from the soil.

d. Flowering and Fruiting

- i. Reproductive Development:** Potassium and other nutrients are crucial for flower and fruit development, influencing the quality and quantity of the harvest.
- ii. Disease Resistance:** Adequate nutrient supply helps in building strong plant tissues that can resist pests and diseases.

e. Stress Tolerance

- i. Abiotic Stress:** Nutrients like potassium help plants tolerate stresses such as drought, salinity, and extreme temperatures.
- ii. Biotic Stress:** Nutrients contribute to the plant's defence mechanisms against pathogens and pests.

f. Soil Health

- i. Microbial Activity:** Nutrients support the growth and activities of beneficial soil microorganisms, which play a role in nutrient cycling and organic matter decomposition.
- ii. Soil Structure:** Nutrients like calcium help in maintaining good soil structure, promoting better root penetration and water infiltration.

g. Yield and Quality

- i. Crop Yield:** Adequate nutrient supply ensures optimal growth conditions, leading to higher crop yields.
- ii. Product Quality:** Nutrients influence the nutritional content, taste and appearance of the produce, which are important for marketability and consumer preference.

2. Classification of Soil Nutrients**a. Macronutrients**

These are nutrients required by plants in larger quantities. Examples of some macronutrients and their functions are as follows:

i. Nitrogen (N)

- **Functions:** Vital for the synthesis of amino acids, which are the building blocks of proteins. Crucial for the production of chlorophyll, which is necessary for photosynthesis. Promotes vegetative growth and the overall plant vigour.
- **Deficiency Symptoms:** Yellowing of leaves (chlorosis), particularly older leaves. Stunted growth and poor crop yields.

ii. Phosphorus (P)

- **Functions:** Key component of ATP (adenosine triphosphate), which provides energy for cellular processes. It is important for root development and the establishment of seedlings. It is involved in the synthesis of nucleic acids and phospholipids.
- **Deficiency Symptoms:** Stunted growth. Dark green or purplish colouration of leaves. Poor root development and delayed maturity.

iii. Potassium (K)

- **Functions:** Activates enzymes involved in photosynthesis, protein synthesis, and carbohydrate metabolism. Regulates water uptake and loss by opening and closing stomata. Enhances disease resistance and improves the quality of fruits and seeds.
- **Deficiency Symptoms:** Yellowing or browning of leaf edges (marginal chlorosis). Weak stems. Poor resistance to diseases.

iv. Calcium (Ca)

- **Functions:** It is an integral component of cell walls, providing structural stability. It is involved in cell division and elongation. Helps in the functioning of certain enzymes and in signalling processes within the plant.
- **Deficiency Symptoms:** Blossom end rot in fruits like tomatoes. Weak, distorted new growth and root tips.

v. Magnesium (Mg)

- **Functions:** Central atom in the chlorophyll molecule, essential for photosynthesis. Activates many plant enzymes needed for growth and development.
- **Deficiency Symptoms:** Interveinal chlorosis (yellowing between veins) in older leaves. Reduced photosynthetic efficiency and stunted growth.

vi. Sulphur (S)

- **Functions:** Component of certain amino acids and vitamins, essential for protein synthesis. Involved in chlorophyll formation and overall plant metabolism.
- **Deficiency Symptoms:** Yellowing of younger leaves (similar to nitrogen deficiency but affects younger leaves first). Stunted growth. Delayed maturity.

b. Micronutrients

These are nutrients required by plants in smaller quantities but are still essential for proper growth and development. Examples of some micronutrients and their functions are as follows:

i. **Iron (Fe)**

- **Functions:** Essential for the synthesis of chlorophyll. Involved in electron transport during photosynthesis and respiration.
- **Deficiency Symptoms:** Interveinal chlorosis in new leaves. Poor growth and reduced chlorophyll production.

ii. **Manganese (Mn)**

- **Functions:** Involved in photosynthesis, respiration and nitrogen metabolism. Functions as a cofactor for various enzymes.
- **Deficiency Symptoms:** Interveinal chlorosis and necrotic spots on younger leaves. Reduced growth and vigour.

iii. **Zinc (Zn)**

- **Functions:** Important for enzyme function, protein synthesis, and growth regulation. Influences hormone production and internode elongation.
- **Deficiency Symptoms:** Shortened internodes and small leaves (rosette formation). Chlorosis in young leaves.

iv. **Copper (Cu)**

- **Functions:** Necessary for photosynthesis and enzyme function. Involved in lignin synthesis and respiration.
- **Deficiency Symptoms:** Stunted growth and dieback of shoot tips. Pale leaves with necrotic spots.

v. **Boron (B)**

- **Functions:** Critical for cell wall formation and stability. Involved in carbohydrate transport and reproductive development.
- **Deficiency Symptoms:** Brittle, discoloured leaves and poor fruit/seed set. Cracked stems and hollow stems in severe cases.

vi. **Molybdenum (Mo)**

- **Functions:** Essential for nitrogen fixation and nitrate reduction. Part of enzymes involved in nitrogen metabolism.
- **Deficiency Symptoms:** Chlorosis in older leaves and poor growth. Nitrogen deficiency symptoms due to poor nitrogen utilisation.

vii. **Chlorine (Cl)**

- **Functions:** Important for osmotic and ionic balance. Participates in photosynthesis and disease resistance.
- **Deficiency Symptoms:** Wilting and chlorosis of leaves. Reduced growth and leaf bronzing.

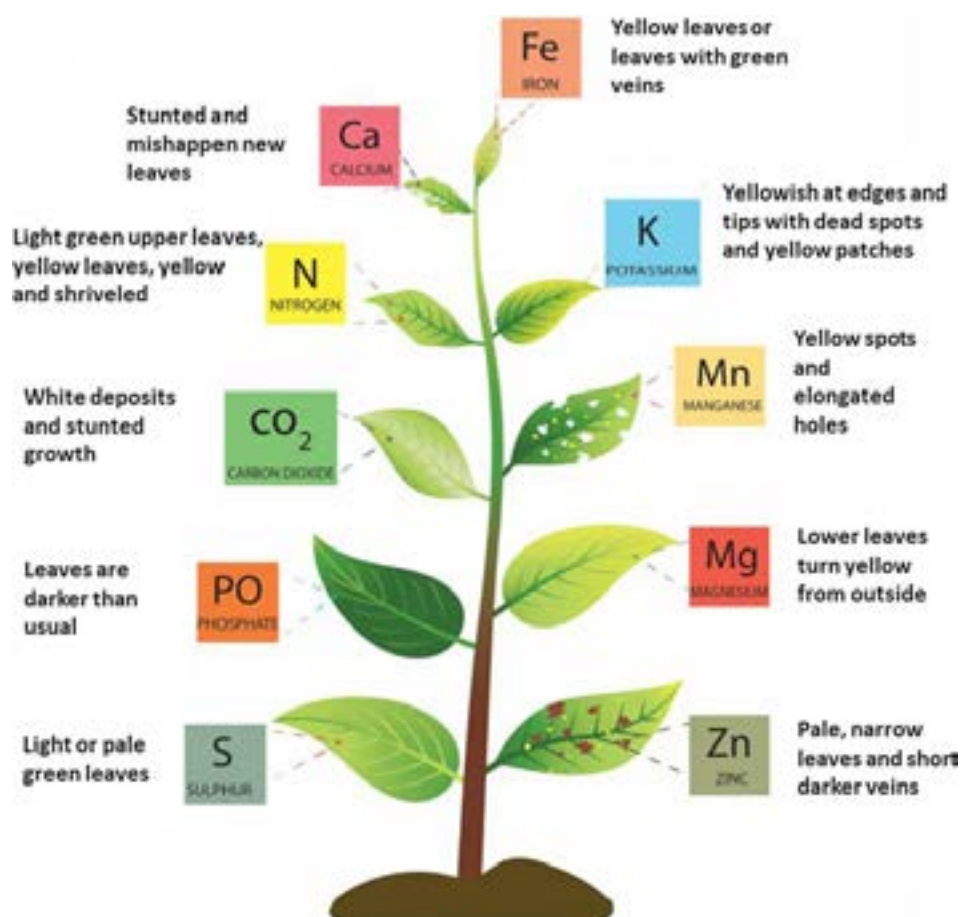


Figure 15.1: Type of deficiencies in ornamental plant/house plant

Learning Tasks

1. List the importance of soil nutrients
2. Classify soil nutrients
3. Explain the importance of soil nutrient

Pedagogical Exemplars

1. **Managing talk for learning:** Brainstorm learners in mixed-ability groups to come up with examples, sources and importance of soil nutrients. Guide learners with difficulty with leading questions to help them to come up with examples, sources and importance of soil nutrients. Encourage learners to respect, tolerate and accept each other's view. Confident learners should be allowed to play lead roles.
2. **Collaborative learning:** Learners in mixed-gender groups surf the internet for information on the classification and roles of soil nutrients. Learners in their groups discuss and make a presentation on their findings in class. Learners who are good at using the internet should support others who require assistance. The teacher should also monitor learners when they are searching the internet for information to ensure that, they do not visit unauthorised or illegal sites. All learners should tolerate and respect each other views.
3. **Experiential learning:** Learners in gender-based groups visit a farm/watch videos/pictures to observe plants showing nutrient deficiency symptoms and discuss their observations.

Learners prepare a table showing the nutrients and their deficiency symptoms. Teachers should ensure that the videos/pictures used do not enforce stereotyping and if they do, the teacher should discuss them with the learners. Learners with difficulties should be assisted with clues and leading questions to come up with some nutrient deficiency symptoms in plants. Ensure that all learners fully participate in the activities, class discussions and presentations.

Key Assessments

Assessment Level 1: List at least two (2) example each of macronutrients and micronutrients

Assessment Level 2: Explain at least two (2) importance of nutrients

Assessment Level 3: Why is zinc important to crops.

Assessment Level 4:

1. Analyse how soil nutrients promote flowering and fruiting of crops.
2. Indicate the plant nutrients lacking in plants showing the following deficiency symptoms;
 - a. Wilting and chlorosis of leaves
 - b. Interveinal chlorosis of older leaves
 - c. Blossom end rot in fruits like tomatoes
 - d. Purplish coloration of leaves
 - e. Stunted growth and dieback of shoot tips.

Hint



*The recommended mode of assessment for week 15 is **short quiz**. Use the level 4 question 2 as a sample question.*

WEEK 16

Learning Indicator: Describe the types of fertilisers and their effects on crop production.

Focal Area 1: Meaning, Types and Effects of Fertilisers on Crop Production

1. **Meaning of Fertilisers:** Fertilisers are substances either natural (organic) or manufactured (inorganic) that are added to soil or plants to supply essential nutrients required for plant growth and development. They are used to improve soil fertility, enhance crop yields and ensure healthy plant growth. Fertilisers can be classified based on their origin and composition.
2. **Types of Fertilisers**
 - a. **Based on Origin**
 - i. **Organic Fertilisers:** these are obtained from natural sources such as plant or animal matter. Examples include compost, manure, bone meal and green manure.
 - ii. **Inorganic (Chemical) Fertilisers:** Manufactured through industrial processes. They contain specific ratios of essential nutrients. Examples include ammonium nitrate, superphosphate and potassium chloride.
 - b. **Based on Nutrient Composition**
 - i. **Single-Nutrient Fertilisers (Straight Fertilisers):** Supply only one primary nutrient. Examples include: Nitrogen Fertilisers: Urea, ammonium sulphate; Phosphorus Fertilisers: Single superphosphate (SSP), triple superphosphate (TSP); and Potassium Fertilisers: Potassium chloride (muriate of potash), potassium sulphate.
 - ii. **Multi-Nutrient Fertilisers (Compound or Complete Fertilisers):** Contain two or more primary nutrients. Examples include NPK fertilisers that contain nitrogen (N), phosphorus (P), and potassium (K).



Figure 16.1: Types of organic (top) and inorganic (bottom) fertilisers

3. Effects of Fertiliser on Crop Production

a. Positive Effects

i. Enhanced Nutrient Supply

- **Improved Growth:** Fertilisers provide essential nutrients that may be lacking in the soil, promoting healthy and vigorous plant growth.
- **Balanced Nutrition:** They ensure a balanced supply of macronutrients (N, P, K) and micronutrients (Fe, Mn, Zn, etc.), crucial for various physiological functions.

ii. Increased Crop Yields

- **Higher Productivity:** Adequate fertilisation significantly boosts crop yields by enhancing the availability of nutrients required for growth and development.
- **Quality Improvement:** Proper nutrient management improves the quality of produce, including size, colour, taste and nutritional content.

iii. Accelerated Plant Development

- **Faster Maturity:** Fertilisers can hasten the growth cycle, leading to quicker maturity and potentially allowing for multiple cropping cycles within a year.
- **Enhanced Root Development:** Phosphorus-rich fertilisers promote robust root systems, improving nutrient and water uptake.

iv. Stress Resistance

- **Drought Tolerance:** Potassium helps plants regulate water usage and improves drought resistance.
- **Disease Resistance:** Balanced nutrition strengthens plant immunity, reducing susceptibility to pests and diseases.

v. Economic Benefits

- **Increased Income:** Higher yields and better-quality produce can lead to increased income for farmers.
- **Cost Efficiency:** Efficient use of fertilisers can optimise input costs, providing better returns on investment.

b. Negative Effects

i. Soil Degradation

- **Nutrient Imbalance:** Over-reliance on certain fertilisers can lead to nutrient imbalances, depleting essential elements and disrupting soil health.
- **Soil Acidification:** Excessive use of chemical fertilisers, especially nitrogen, can lower soil pH, leading to acidification and reduced fertility.

ii. Water Pollution

- **Water Contamination:** Runoff from fertilised fields can carry nutrients into water bodies, causing eutrophication and harming aquatic ecosystems.

- **Groundwater Pollution:** Nitrate leaching from fertilisers can contaminate groundwater, posing health risks to humans and animals.

iii. Greenhouse Gas Emissions

- **Nitrous Oxide Release:** Fertiliser application, particularly nitrogen-based, can lead to the emission of nitrous oxide, a potent greenhouse gas contributing to climate change.

iv. Plant Health Issues

- **Nutrient Burn:** Over-application of fertilisers can cause nutrient burn, damaging plant tissues and reducing growth.
- **Toxicity:** Excessive amounts of certain nutrients (e.g., boron, manganese) can become toxic to plants, impairing their development.

v. Human Health Risks

- **Exposure to Chemicals:** Farmers and agricultural workers who handle fertilisers may be exposed to harmful chemicals, leading to health issues such as respiratory problems, skin irritation and other long-term health effects.
- **Food Contamination:** Over-application of fertilisers can lead to the accumulation of harmful substances (e.g., heavy metals like cadmium and lead) in crops, posing risks to human health when these contaminated foods are consumed.

vi. Disruption of Soil Microbial Communities

- High levels of synthetic fertilisers can disrupt the natural microbial balance in the soil, affecting beneficial microorganisms that play a crucial role in nutrient cycling, soil health and plant growth.

vii. Biodiversity Loss

- Fertiliser runoff can alter the nutrient dynamics of natural ecosystems, leading to changes in species composition and reductions in biodiversity. Sensitive plant and animal species may be outcompeted or displaced by those that thrive in nutrient-rich conditions.

c. Mitigation Measures

- Precision Agriculture:** Utilise precision agriculture techniques to apply fertilisers more efficiently, matching the nutrient supply with crop needs and minimising excess application.
- Organic Amendments:** Incorporate organic fertilisers and amendments, such as compost and manure, to improve soil health and reduce dependency on synthetic fertilisers.
- Integrated Nutrient Management:** Implement integrated nutrient management practices that combine the use of chemical fertilisers with organic inputs and other sustainable practices to maintain soil fertility and health.
- Buffer Zones:** Establish buffer zones around water bodies to reduce nutrient runoff and protect aquatic ecosystems from pollution.

- v. **Education and Training:** Educate farmers and Agricultural workers on the proper use of fertilisers, including application rates, timing and methods, to minimise negative impacts and promote sustainable practices.

4. Fertiliser Application Methods

- i. **Broadcasting:** Spreading fertilisers evenly over the soil surface.
- ii. **Banding:** Placing fertilisers in bands near the seed or plant roots.
- iii. **Foliar Application:** Spraying liquid fertilisers directly onto plant leaves.
- iv. **Side-Dressing:** Applying fertilisers along the sides of growing plants.
- v. **Fertigation:** Delivering fertilisers through irrigation systems.

5. Best Practices for Fertiliser Use

- i. **Soil Testing:** Conduct regular soil tests to determine nutrient needs and apply fertilisers accordingly.
- ii. **Balanced Fertilisation:** Use a balanced mix of macronutrients and micronutrients tailored to the specific crop and soil conditions.
- iii. **Correct Application Methods:** Employ appropriate application methods (e.g., banding, side-dressing, fertigation) to enhance nutrient uptake efficiency.
- iv. **Integrated Nutrient Management:** Combine chemical fertilisers with organic amendments (compost, manure) to maintain soil health and fertility.
- v. **Monitoring and Adjustment:** Regularly monitor crop response and adjust fertilisation practices as needed to avoid over- or under-application.

Learning Tasks

1. List the types of fertilisers and the best practices for using fertilisers.
2. Explain the meaning of fertilisers and fertiliser application methods.
3. Discuss the merits and demerits of fertilisers, and identify mitigation strategies against the negative effects of fertilisers.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm to come up with the meaning of fertiliser. Some learners should be assisted with probing questions that will help them to state the meaning of fertilisers. Challenge others to explain the meaning of fertilisers with examples.
2. **Initiating talk for learning:** Learners in mixed-ability groups watch a video or documentary on the types of fertilisers used in crop production and discuss their observations in class. Teachers should ensure that videos or documentary used do not enforce stereotyping and if they do, teachers should discuss them with learners. All learners should be encouraged to pay attention when watching the video or documentary. All learners should be encouraged to respect, accept and tolerate the views of others. Learners should be recognised for their submissions.

3. **Collaborative learning:** Learners in mixed-ability groups discuss the merits, demerits and effects of using the various types of fertilisers. Confident learners should be allowed to play lead roles in the discussion under the guidance of the teacher. All learners should tolerate and respect each other views. Learners should be recognised for good submissions.
4. **Experiential learning:** Learners in gender-based groups demonstrate the various fertiliser application methods in the school farm under the guidance of a technician. Teachers should make sure all learners take part in the demonstration.
5. **Project-based learning (Homework):** Learners in gender-based groups embark on a project to prepare compost for use on the school farm under the guidance of a farm technician or teacher. Learners present a portfolio on the project for assessment. All learners should be encouraged to take part in the preparation of the compost and portfolio building.

Key Assessments

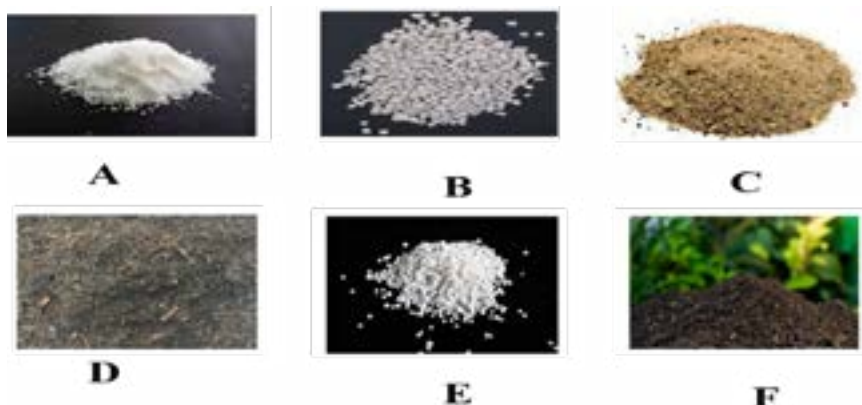
Assessment Level 1: State the types of fertilisers.

Assessment Level 2: Explain the meaning of fertiliser.

Assessment Level 3: Examine and relate the effects of fertiliser on human and plant health.

Assessment Level 4:

1. Analyse how mitigation strategies can be used to combat the negative effects of fertilisers.
2. Identify the following samples of fertilizer and the nutrients that it will supply to plants.



Hint



The recommended mode of assessment for week 16 is test of practical knowledge. Use the level 4 question 2 as a sample question.

SECTION 6 REVIEW

Game refers to wild animals that are hunted for meat, recreation, sport, meat, fur or other by-products. These animals are sometimes subject to hunting regulations and laws designed to manage their populations, ensure sustainable hunting practices and protect certain species from overexploitation. Wildlife refers to all non-domesticated animals, plants, fungi and other organisms that live in natural environments. It encompasses a wide range of species,

from mammals, birds, reptiles. Some important game and wildlife reserves in Ghana include Mole National Park, Kakum National Park, Shai Hills Resource Reserve and Digya National Park. Importance of Game and Wildlife are of Ecological, Economic, Cultural and Recreational Importance.

Mushrooms are fungi that typically have a stem cap, and gills or pores underneath the cap. They belong to the kingdom Fungi and vary widely in shape, size, colour and texture. Mushrooms have Direct Economic Benefits, Socio-Economic Benefits, Health and Nutritional Benefits and Medicinal Value. The 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 growth and reproduction. Soil productivity is the ability of soil to support crop growth and yield in high outputs. Soil Nutrients support Plant Growth and Development, Photosynthesis, Root Development, Flowering and Fruiting, Stress Tolerance, Soil Health, and Yield and Quality. Soil Nutrients can be classified into Macronutrients and Micronutrients. Examples of Macronutrients are Nitrogen, Phosphorus, Potassium, Calcium, Magnesium and Sulphur. Examples of Micronutrients are Iron, Manganese, Zinc, Copper, Boron, Molybdenum and Chlorine.

Fertilisers are substances either natural (organic) or manufactured (inorganic) that are added to soil or plants to supply essential nutrients required for plant growth and development. Fertiliser are grouped Based on Origin (Organic Fertilisers and Inorganic (Chemical) Fertilisers) and Nutrient Composition (Single-Nutrient Fertilisers or Straight Fertilisers and Multi-Nutrient Fertilisers or Compound or Complete Fertilisers). Fertilisers have Positive Effects such as Enhanced Nutrient Supply, Increased Crop Yields Accelerated Plant Development, Increase Stress Resistance of Crops and Increase Economic Benefits Due to High Yield. However, Fertilisers have Negative Effects such as Soil Degradation, Water Pollution, Greenhouse Gas Emissions, Plant Health Issues, Human Health Risks, Disruption of Soil Microbial Communities and Biodiversity Loss. These Negative Effects can be Mitigated by Adopting Precision Agriculture, Integrated Nutrient Management, Establishing Buffer Zones, and Education and Training. Fertilisers can be Applied by Broadcasting, Banding, Foliar Application, Side-Dressing and Fertigation. Best Practices for Fertiliser Use include Soil Testing, Balanced Fertilisation, Proper Application Methods, Integrated Nutrient Management, and Monitoring and Adjustment.

MARKING SCHEME FOR THE EXIT CARD ASSESSMENT TASK

One game and wildlife reserve in Ghana mentioned (e.g. Mole National Park) = **2 marks**

Correct location of the game and wildlife reserve (e.g. It is located in the Savannah Region) = **1 marks**

2 animals that can be found at the reserve (elephants, antelopes) = **2 marks, 1 mark each for an animal mentioned.**

MARKING SCHEME FOR THE SHORT QUIZ ASSESSMENT TASK

Correct statement of the plant nutrients lacking in plants showing the following deficiency symptoms for 2 marks each

- Wilting and chlorosis of leaves - Nitrogen (N)
- Interveinal chlorosis of older leaves - Magnesium (Mg)
- Blossom end rot in fruits like tomatoes- Calcium (Ca)
- Purplish coloration of leaves - Phosphorus (P)
- Stunted growth and dieback of shoot tips - Boron (B)

Total – 10 marks

1 mark for the use of only letters to represent the nutrients (letters should be written in uppercase).

MARKING SCHEME FOR THE TEST OF PRACTICAL KNOWLEDGE ASSESSMENT TASK

Correct identification of fertiliser = 2 marks each

1 nutrient that it will supply to plants = 1 mark each

for instance;

A= Potassium chloride

Nutrient that it will supply = Chlorine and Potassium

B = Superphosphate

Nutrient that it will supply =phosphate

C= bone meal

Nutrient that it will supply = calcium, magnesium

D= Manure

Nutrients that it will supply = Nitrogen, Potassium, Phosphorus, Sulphur

E= Ammonium Nitrate

Nutrients that it will supply = Nitrogen

F= Compost

Nutrient it will supply = Nitrogen and Calcium

Total marks =15



APPENDIX E: ASSESSMENT OF GROUP PROJECT

1. Structure

The following items should be included in the presentation of the project

- a. Sample of the mushroom produced and packaged.
- b. Report on how they were produced.
- c. Pictures taken and other visuals about the project

2. How to administer

- a. Provide clear guidelines for developing the project and how it will be assessed.
- b. Schedule periodic reviews (e.g., every 3-4 weeks) to ensure learners are keeping up with their project and provide feedback and guidance during these checkpoints, etc.

3. Sample rubrics for assessing the group projects

Criteria	Excellent (4 marks)	Very Good (3 mark)	Good (2 marks)	Fair (1 mark)
Understanding of Concepts	Mention any 4 of the processes of cultivating mushroom; Species selection, Substrate preparation, Inoculation and Growth conditions.	Mention any 3 of the processes of cultivating mushroom; Species selection, Substrate preparation, Inoculation and Growth conditions	Mention any 2 of the processes of cultivating mushroom; Species selection, Substrate preparation, Inoculation and Growth conditions	Mention any 1 of the processes of cultivating mushroom; Species selection, Substrate preparation, Inoculation and Growth conditions.

Planning and Execution	Project plan shows any 4 of the following; Well-organised plan Time lines for each activity Steps and activities to be followed during the process Procedure for monitoring of project set-up and Making adjustment in environmental conditions when necessary	Project plan shows any 3 of the following; Well-organised plan Time lines for each activity Steps and activities to be followed during the process Procedure for monitoring of project set-up and Making adjustment in environmental conditions when necessary	Project plan shows any 2 of the following; Well-organised plan Time lines for each activity Steps and activities to be followed during the process Procedure for monitoring of project set-up and Making adjustment in environmental	Project plan shows any 1 of the following; Well-organised plan Time lines for each activity Steps and activities to be followed during the process Procedure for monitoring of project set-up and Making adjustment in environmental conditions when necessary
Practical Skills	Demonstrates practical skills in 4 of the following; Substrate preparation, Inoculation Environmental control and Monitoring and maintenance	Demonstrates practical skills in 3 of the following; Substrate preparation, Inoculation Environmental control and Monitoring and maintenance	Demonstrates practical skills in 2 of the following; Substrate preparation, Inoculation Environmental control and Monitoring and maintenance	Demonstrates practical skills in 1 of the following; Substrate preparation, Inoculation Environmental control and Monitoring and maintenance
Creativity and Innovation	Project shows creativity in approach, such as experimenting with different substrates or species; innovative techniques are applied.	Project includes some creative elements, with attempts to innovate within standard cultivation practices.	Limited creativity; follows standard procedures without attempting any innovation or experimentation.	No creativity or innovation; project strictly follows basic guidelines with no attempt at originality.

Documentation & Reporting	Shows documentation on any 4 of the following Activities carried out during the project Data collected during the project Observations made during the project Pictures and other visuals taken during the project. Well-organized, and easy to follow	Shows documentation on any 3 of the following Activities carried out during the project Data collected during the project Observations made during the project Pictures and other visuals taken during the project. Well-organized, and easy to follow	Shows documentation on any 2 of the following; Activities carried out during the project Data collected during the project Observations made during the project Pictures and other visuals taken during the project. Well-organized, and easy to follow	Shows documentation on any 4 of the following Activities carried out during the project Data collected during the project Observations made during the project Pictures and other visuals taken during the project. Well-organized, and easy to follow
Presentation Skills	Showing 4 of the skills e.g. Audible voice, Pay attention to audience Answers questions accurately Use of gesture	Showing 3 of the skills e.g. Audible voice, Pay attention to audience Answers questions accurately Use of gesture	Showing 2 of the skills e.g. Audible voice, Pay attention to audience Answers questions accurately Use of gesture	Showing 1 of the skills e.g. Audible voice, Pay attention to audience Answers questions accurately Use of gesture

SECTION 7: CROP AND ANIMAL HEALTH

Weeks 17 and 18

Strand: Agriculture and Health

Sub-strand: Health Issues in Crop Production

Learning Outcome: Use the knowledge acquired to analyse the economic importance of pests and diseases in crop production and apply appropriate measures in the prevention and control of crop pests and diseases.

Content Standard: Demonstrate knowledge, understanding and skills of the effects of common pests and diseases of crops, their causes, symptoms, prevention and control measures.

Weeks 19 and 20

Strand: Agriculture and Health

Sub-strand: Health Issues in Animal/Fish Production

Learning Outcomes: Use the knowledge acquired to analyse the economic importance of pests and diseases in animal/fish production and apply appropriate measures in the prevention and control of animal/fish pests and diseases.

Content Standard: Demonstrate knowledge, understanding and skills of the effects of common pests and diseases of animals/fish, their causes, symptoms, prevention and control measures.

Hint



- Remind learners of Mid semester examination in Week 18
- Refer to the Appendix F for more sample task and the Table of Specification

INTRODUCTION AND SECTION SUMMARY

Crop and animal/fish health is pivotal to the successful running of a vibrant and profitable agricultural production enterprise. Pest and diseases attacks on crops and animals are identified to be one of the biggest challenges of agriculture globally. Crop pests and diseases cause significant reduction in yield either on the field or in storage. In animal production, pests, parasites and diseases reduce productivity, and the attempt to control or prevent them adds

significantly to the cost of production. This phenomenon is a threat to food security and economic advancement. Understanding the impact of pests and diseases in crop and animal production is key to utilising more effective strategies that can help deal with post-harvest losses and to adopt more environmentally friendly and sustainable ways to improving food security and engender economic transformation in Ghana. This section emphasises the identification of the various pests and diseases of crops and animals/fish and their impact on crop and animal production. It also introduces learners to the practical steps that can be employed in managing pests and diseases in crops and animal/fish production to ensure the production of good quality crops and animals produced under a hygienically clean and healthy environment for food safety, improve productivity and profit maximisation. This section has links with other subjects including Biology, Biomedical Science, Chemistry, General Science and Engineering.

The weeks covered by the section are:

Week 17: Meaning, Common Crop Pests/Parasites, Diseases and their Effects on Crop Production

Week 18: Preventive and Control Measures of Pest and Diseases in Crop Production

Week 19: Meaning, Common Diseases, Pests and Parasites of Animals/Fish and their Effects on Animal/Fish Production

Week 20: Preventive and Control Measures of Diseases in Animal/Fish Production

SUMMARY OF PEDAGOGICAL EXEMPLARS

The suggested pedagogical strategies to be used in this section should include: Structuring talk for learning, collaborative learning, managing talk for learning, inquiry-based learning, experiential learning and project-based learning. The teacher should elicit the ideas of learners on the contents for discussion by employing strategies such as structuring talk for learning, managing talk for learning and collaborative learning. This will enable learners to share their views and experiences on health issues of crops and animals/fish, how to identify pest and diseases by their signs and symptoms, their causative agents and the appropriate ways of dealing with them to ensure farm environments are devoid of pests and diseases attacks for good quality crops/animals for human consumption and industry. For project-based and experiential learning, learners will be required to search the internet, watch videos, draw a map or create diagrams and to undertake research where necessary. Teachers can adapt, modify or use other pedagogies they seem appropriate for teaching the content standard. Where there is a time constraint, teachers should explore the use of homework to complete the assigned task. Critical thinking skills, communication, digital literacy and collaboration skills of learners will be enhanced as they search the internet, share their views and experiences. Teachers should ensure that the videos/pictures used do not enforce stereotyping. Teachers should endeavour to include all learners with additional support needs in the report presentations. Teachers should also ensure that learners do not enter into unapproved or illegal sites while searching the internet for information. Learners should be encouraged to work in mixed-ability and mixed-gender (where appropriate) groups, in pairs or as individuals as much as practicable.

ASSESSMENT SUMMARY

The assessment for this section will examine issues on pests and diseases of crops and animals/fish and how to effectively manage them in the production of crops and animals. The questions should have a balance of the various depth of knowledge (DoK), that is, Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning) assessments. Summative and formative assessments using strategies such as group discussions, groups and individual presentations, homework, class exercises, class tests and group and individual project-based work should be given. The teacher should accept varying number of demonstrations, oral and written responses. He/she should develop rubrics and marking scheme to score group presentations and assignments.

WEEK 17

Learning Indicators

1. *Identify common crop pests and diseases and their effects on crops*
2. *Classify crop pests and diseases*

Focal Area 1: Meaning, Common Crop Pests and Diseases and their Effects in Crop Production

1. Meaning of Crop Pests and Diseases

- a. **Crop Pest:** A crop pest is any organism that adversely affects the health, growth or productivity of cultivated plants. These pests can cause direct damage by feeding on the plants or indirect damage by transmitting diseases or competing for resources such as nutrients, light, and water. Crop pests encompass a wide range of organisms, including:
 - i. **Insects:** Such as aphids, caterpillars, beetles and locusts, which feed on various parts of the plant.
 - ii. **Mites:** Tiny arachnids that damage plants by sucking sap from leaves and stems.
 - iii. **Weeds:** Unwanted plants that compete with crops for space, nutrients and water.
 - iv. **Fungi:** Pathogens that cause diseases like powdery mildew, rusts and blights.
 - v. **Bacteria:** Microorganisms that cause bacterial wilt, fire blight and other plant diseases.
 - vi. **Viruses:** Infectious agents that lead to diseases like tomato mosaic virus and tobacco mosaic virus.
 - vii. **Nematodes:** Damaging roots and allowing entry points for fungal or bacterial infections.
- b. **Crop disease:** A crop disease refers to any abnormal condition in plants caused by pathogenic organisms or environmental factors that disrupts the normal physiological processes, leading to reduced growth, yield and quality of the crops. Crop diseases can be caused by various pathogens, including fungi, bacteria, viruses and nematodes, and by adverse environmental conditions. A diseased crop or plant is one affected by a pathogen or environmental condition that disrupts its normal growth and development.

2. Characteristics of a Healthy Crop

- a. **Vibrant Colour:** Healthy plants typically have bright, vibrant green leaves, appropriate for their species. Chlorophyll, the green pigment in plants, is a good indicator of health.
- b. **Strong, Sturdy Stems:** The stems should be strong and able to support the plant without bending or breaking easily.
- c. **Healthy Roots:** Roots should be white or light tan, firm and spread out, without signs of rot or excessive browning.

- d. **Proper Leaf Shape and Size:** Leaves should be uniform in size and shape, without distortion, curling or irregularities.
- e. **No Spots or Blemishes:** Leaves and stems should be free of spots, blemishes, or discoloration.
- f. **Vigorous Growth:** Healthy plants grow steadily and robustly, showing new growth regularly in the form of new leaves, shoots or flowers.
- g. **Flowering and Fruiting:** Plants that are healthy should flower and produce fruit or seeds as expected for their species and variety.
- h. **Consistent Development:** All parts of the plant should develop consistently, without any part being stunted or malformed.
- i. **No Signs of Pest Damage:** There should be no visible signs of pest infestation, such as holes in leaves, chewed stems or insect eggs/larvae.
- j. **Free of Disease Symptoms:** There should be no signs of diseases such as wilting, yellowing, spots, or mould.

3. Signs of Diseased Plant

- a. **Discolored Leaves:** Yellowing (chlorosis), browning or blackening of leaves, often with distinct patterns.
- b. **Spots and Blotches:** Dark, light or necrotic spots on leaves, stems or fruit.
- c. **Wilting:** Leaves and stems lose turgor pressure and droop even when soil moisture is adequate.
- d. **Leaf Drop:** Premature shedding of leaves.
- e. **Stunted Growth:** Reduced size or lack of growth in the plant or its parts.
- f. **Deformed Leaves or Stems:** Twisting, curling or misshapen growth, often indicative of viral infections or insect damage.
- g. **Fungal Growth:** Visible mould, mildew or rust on leaves, stems or soil surface.
- h. **Root Rot:** Blackened, mushy roots with an unpleasant smell.
- i. **Cankers:** Sunken, dead areas on stems or branches.
- j. **Unusual Growths:** Galls, tumors or swellings on stems, leaves or roots.



A diseased cabbage plant



A healthy cabbage plant

Figure 17.1: A Diseased and Healthy Cabbage Plant

4. Common Crop Pests and their Effects in Crop Production

a. Insect

- i. **Aphids:** Aphids feed by piercing plant tissues with their needle-like mouthparts and sucking out the sap. The removal of sap can lead to curling and distortion of leaves. Prolonged feeding can cause chlorosis (yellowing) of leaves due to nutrient deficiencies and reduced photosynthesis, stunted growth and reduce plant productivity and yield.
- ii. **Caterpillars:** Feed on leaves, stems and fruits, leading to defoliation and reduced crop yield.
- iii. **Whiteflies:** Cause leaf yellowing and wilting, produce honeydew that fosters sooty m mould. The combination of feeding damage, honeydew production and disease transmission can lead to significant reductions in crop yields.
- iv. **Beetles:** Defoliate tuber crops such as yam and potato, reducing tuber yield.
- v. **Locusts:** Feed on a wide range of crops, including cereals, vegetables, and legumes. They can consume entire fields of crops in a short period. They cause severe defoliation by stripping leaves from plants, which can lead to reduced photosynthesis and weakened plants. Locusts may also damage stalks and seeds, affecting the plant's growth and yield.

b. Birds

- i. **Weaver birds:** Consume grains, fruits and seeds; contaminate crops with droppings.
- ii. **Crows:** Pull up seedlings, peck at fruits and consume grains.

c. Rodents and other animals

- i. **Mice:** Eat seeds, grains and young plants; gnaw on plant parts.
- ii. **Rats:** Consume and damage crops and contaminate crops with droppings.
- iii. **Greater Cane Rat (Grasscutters):** These are herbivores that feed on fruits, and crops such as maize, cassava, yams, 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.
- iv. **Bats:** Feed on insects but can occasionally damage fruit crops by feeding on the fruit.
- v. **Monkeys:** Consume fruits, vegetables and other crop parts; can cause significant damage in orchards and fields.
- vi. **Squirrels:** Feed on seeds, fruits, and nuts; can damage plants by gnawing on stems and branches.
- vii. **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 vigor.

5. Common Crop Diseases and their Effects on Crop Production

a. Fungal Diseases

- i. **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.
- ii. **Blight (*Phytophthora infestans*):** Causes dark, water-soaked lesions on leaves, stems and fruits. Leads to rapid plant death, reduced yield, and poor quality.
- iii. **Rust (*Puccinia spp.*):** Causes reddish-brown pustules on leaves and stems. Results in reduced photosynthesis and plant vigor, leading to yield loss.
- iv. **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.

b. Bacterial Diseases

- i. **Bacterial Blight (*Xanthomonas campestris*):** Causes water-soaked lesions on leaves, stems and fruits. Results in leaf drop, reduced photosynthesis and yield loss.
- ii. **Bacterial Wilt (*Ralstonia solanacearum*):** Causes wilting, yellowing, and plant death. Affects the vascular system, leading to significant yield reductions.
- iii. **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.
- iv. **Bacterial soft rot:** It commonly affects vegetables such as carrot, tomato, cucumbers, melons, cabbage etc.

c. Viral Diseases

- i. **Tomato Yellow Leaf Curl Virus:** Causes yellowing and curling of leaves. Stunted growth and reduced fruit yield. Affects tomatoes and related crops.
- ii. **Cucumber Mosaic Virus:** Causes mosaic patterns on leaves, stunting and distorted fruit. Affects cucumbers, melons and other vegetables.
- iii. **Maize Streak Virus:** Causes streaks of yellow or white on leaves, stunted growth, and reduced yields. Severely infected plants may not produce ears at all.
- iv. **Cassava Mosaic Disease:** Spread by whiteflies (*Bemisia tabaci*) and through infected planting material. Causes mosaic patterns on leaves, leaf distortion and stunted growth. Causes reduction in tuber yields.
- v. **Groundnut Rosette Disease:** Spread by aphids (*Aphis craccivora*). Causes yellowing and stunting of plants, leaf deformation. Severely infected plants produce few or no pods affecting yield and productivity.
- vi. **Rice Yellow Mottle Virus:** Spread by mechanical means (handling, water) and possibly by insect vectors such as beetles. Causes yellowing and mottling of leaves, stunted growth. Causes significant yield reductions.

d. Other Diseases

- i. **Damping-Off (Various pathogens, e.g., *Rhizoctonia solani*):** Causes seedling death and root rot. Leads to high seedling mortality and reduced plant stand.
- ii. **Downy Mildew (*Peronospora spp.*):** Causes yellowing and death of leaves with a grayish fungal growth on the underside. Leads to reduced plant vigor and yield loss.

Learning Tasks

1. State the meaning of crop pests and diseases.
2. Discuss the common crop pests and their effects on crop production.
3. Assess the impact of common crop diseases and their effects on crop production.

Pedagogical Exemplars

1. **Structuring talk for learning:** Teacher puts learners in mixed-ability groups to brainstorm to come up with the meaning of plant pests and diseases. Encourage all the learners to participate in the activity. Learners who are confident should be challenged to delve deeper to discuss plant pests and diseases. Use probing questions to help learners with additional support needs to contribute.
2. **Inquiry-based learning:** Learners in mixed-gender groups search the internet for information on crop pests and diseases and make a presentation in class on the characteristics of healthy and diseased crops. Encourage learners who are proficient in the use of the internet to help those with difficulties. Provide learners with the links to the internet and supervise the use of the internet to prevent the learners from accessing unapproved or illegal sites.
3. **Collaborative learning:** Learners in mixed-ability groups discuss the effects of plant diseases and pest on agricultural production. Ensure that all learners participate in the discussions. Provide support to learners with additional support needs to take a lead in responding.
4. **Experiential learning (Homework):** Learners in mixed-ability groups visit a nearby crop production farm to observe and take pictures of healthy and diseased plants and plant pests or watch video pictures of healthy and pests and diseases and prepare a photo album. Encourage all learners to participate in the activity.

Key Assessments

Assessment Level 1: List at least two (2) common diseases and two (2) common pests of crops.

Assessment Level 2: Explain at least two (2) characteristics each of a diseased and healthy plant/crop.

Assessment Level 3: Examine and report on the effects of crop pests on crop production and the Agro-based industry.

Assessment Level 4: Evaluate the impact of diseases on crops and its implication on food security and the economy of Ghana.

Focal Area 2: Classification of Crop Pests and Diseases

1. 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:

a. Insects

- i. **Moths and Butterflies (Lepidoptera):** Fall Armyworm (*Spodoptera frugiperda*): Major pest of maize and other cereals. African Bollworm (*Helicoverpa armigera*): Affects cotton, tomatoes and legumes.
- ii. **Beetles (Coleoptera):** Maize Weevil (*Sitophilus zeamais*): Infests stored grains. Cowpea Weevil (*Callosobruchus maculatus*): Affects stored cowpeas.
- iii. **True Bugs (Hemiptera):** Aphids (e.g., *Aphis craccivora*): Affect legumes and transmits plant viruses. Whiteflies (*Bemisia tabaci*): Affect a wide range of crops and transmits viruses.
- iv. **Grasshoppers and Locusts (Orthoptera):** Desert Locust (*Schistocerca gregaria*): Causes widespread damage to various crops during outbreaks.
- v. **Flies (Diptera):** Fruit Flies (e.g., *Bactrocera dorsalis*): Affect mangoes, citrus and other fruits.

b. Mites (*Arachnids acarina*)

- i. **Spider Mites (*Tetranychus spp.*):** Affect vegetables, fruits, and other crops.
- ii. **Rust Mites (*Aceria spp.*):** Affect various crops, causing rust-like symptoms.

c. Nematodes

- i. **Plant-Parasitic Nematodes**
- ii. **Root-Knot Nematodes (*Meloidogyne spp.*):** Affect a wide range of crops, causing galls on roots.
- iii. **Cyst Nematodes (*Heterodera spp.*):** Affect cereals and legumes.

d. Snails and Slugs (Gastropods)

- i. Feed on a variety of crops, especially in humid regions.

e. Birds (Weaver birds)

- i. Major pests of cereals like rice, sorghum and millet.

f. Rats and Mice (Rodents)

- i. House Mouse (*Mus musculus*): Affect stored grains and field crops.
- ii. Multimammate Rat (*Mastomys natalensis*): Feed on field crops and stored products.
- iii. Grasscutter (*Thryonomys swinderianus*): feeds on maize, cassava, sugarcane etc.

2. Classification of Insects

It must be noted that insects are the most devastating pests of crops; they can be classified in various ways.

a. Chewing Insects: These insects have mouthparts adapted for chewing and biting.

- i. **Caterpillars (Lepidoptera):** Larvae of butterflies and moths that feed on leaves, stems, and fruits (e.g., armyworms, corn borers).
- ii. **Beetles (Coleoptera):** Both larvae and adults can be pests (e.g., Larger Grain Borer, Weevils, Leaf Beetles, Cassava Green Mite etc.).
- iii. **Grasshoppers and Locusts (Orthoptera):** Feed on leaves and stems, causing significant defoliation.



Figure 17.2: Some Biting and Chewing Insect Pests

b. Sucking Insects: These insects have mouthparts adapted for piercing and sucking plant sap. Examples are:

- i. **Aphids (Hemiptera):** Suck sap from leaves and stems, causing stunted growth and transmit plant viruses.
- ii. **Whiteflies (Hemiptera):** Feed on the undersides of leaves, excreting honeydew which leads to sooty mold.

- iii. **Scale Insects (Hemiptera):** Attach themselves to stems, leaves and fruits, sucking sap and weakening the plant.
- iv. **Mealybugs (Hemiptera):** Similar to aphids and scales, they suck plant sap and can transmit diseases.



Figure 17.3: *Some Piercing and Sucking Insects*

- c. **Boring Insects:** These insects bore into stems, fruits or roots.
 - i. **Stem Borers (Lepidoptera):** Larvae of moths that bore into plant stems (e.g., European corn borer).
 - ii. **Fruit Borers (Lepidoptera):** Larvae that bore into fruits, causing direct damage (e.g., codling moth).
 - iii. **Root Borers (Coleoptera):** Larvae that bore into roots, disrupting nutrient uptake (e.g., root weevils).



Figure 17.4: *Some Boring Insect Pests*

3. Life Cycle of Insects

a. Complete Metamorphosis (Holometabolous)

This type of life cycle consists of four distinct stages: egg, larva, pupa, and adult.

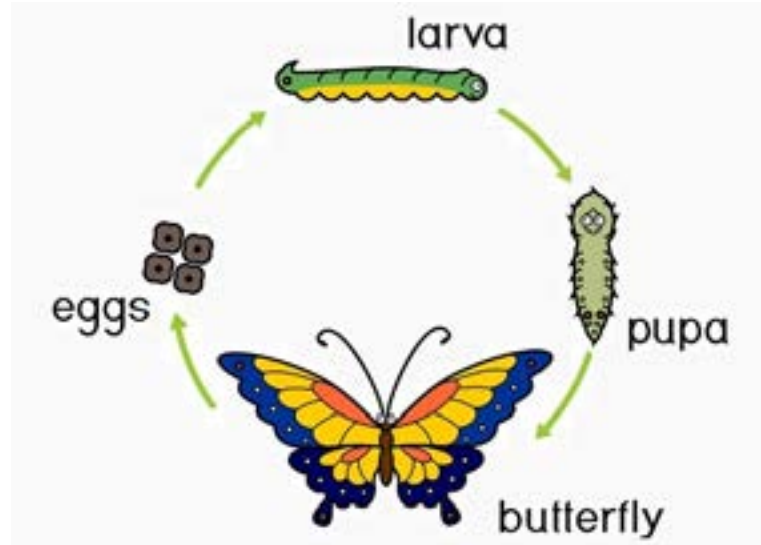


Figure 17.5: *Complete Metamorphosis*

- i. **Egg:** The life cycle begins when the female insect lays eggs. The number of eggs laid and the location varies among species.
- ii. **Larva:** After hatching from the egg, the insect enters the larval stage. Larvae look very different from adults and often have different feeding habits. They typically undergo several moults as they grow. Examples: Caterpillars (butterflies and moths), grubs (beetles) and maggots (flies).
- iii. **Pupa:** The larva then transforms into a pupa, a non-feeding, resting stage. During this stage, the insect undergoes significant transformation (metamorphosis) inside a protective casing (cocoon, chrysalis, or puparium). Examples: Butterfly chrysalis, moth cocoon and beetle pupa.
- iv. **Adult:** The final stage is the adult, which emerges from the pupa. Adults are typically the reproductive and often the dispersing stage. They may look completely different from their larval stage. Examples: Butterflies, moths, beetles and flies.

b. Incomplete Metamorphosis (Hemimetabolous)

This type of life cycle consists of three stages: egg, nymph and adult.

- i. **Egg:** Similar to complete metamorphosis, the cycle begins with eggs laid by the female insect.
- ii. **Nymph:** The egg hatches into a nymph, which resembles a smaller version of the adult but usually lacks fully developed wings and reproductive organs. Nymphs typically undergo several moults, growing larger and more similar to the adult with each moult. Examples: Grasshoppers, cockroaches and aphids.
- iii. **Adult:** The final moult produces a fully developed adult, capable of reproduction and, if applicable, flight. Examples: Grasshoppers, cockroaches and aphids.

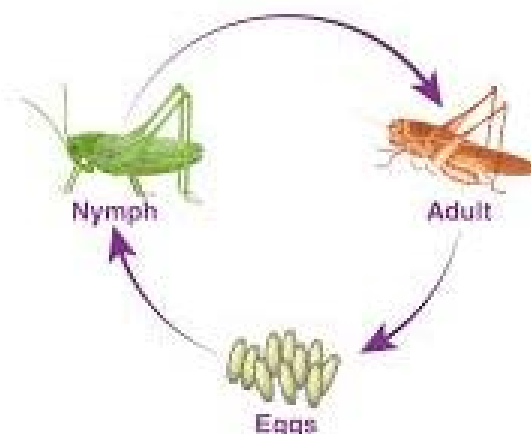


Figure 17.6: *Incomplete metamorphosis*

4. Classification of Crop Diseases

- a. **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:
 - i. **Fungi:** Fungal pathogens are one of the most common causes of plant diseases. They can cause various symptoms including wilting, leaf spots, blights and rots. Examples include: Powdery mildew: Caused by various fungi such as *Erysiphe spp.*, Rust: Caused by fungi such as *Puccinia spp.* and Late blight: Caused by *Phytophthora infestans*.
 - ii. **Bacteria:** Bacterial pathogens can infect plants, leading to symptoms such as leaf spots, blights and wilts. Examples include Bacterial wilt: Caused by *Ralstonia solanacearum*.
 - iii. **Viruses:** Viral pathogens can lead to a wide range of symptoms, including stunting, leaf discoloration and mosaic patterns. Examples include: Tobacco mosaic virus, Tomato yellow leaf curl virus and Cucumber mosaic virus.
 - iv. **Nematodes:** These are microscopic worms that can infect plant roots, causing galls, root knots, and overall plant decline. Examples include: Root-knot nematodes: *Meloidogyne spp.*, and Cyst nematodes: *Heterodera spp.*
- b. **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

 - i. **Nutrient Deficiencies:** Lack of essential nutrients can lead to symptoms such as chlorosis (yellowing of leaves), stunted growth and poor yield. Nitrogen deficiency: Yellowing of older leaves and poor growth. Iron deficiency: Interveinal chlorosis, primarily in younger leaves.
 - ii. **Environmental Stresses:** Adverse weather conditions or extreme environmental factors can cause non-pathogenic diseases. Drought stress: Wilting, leaf drop and

- reduced growth. Frost damage: Blackened or killed tissues due to freezing temperatures.
- iii. **Chemical Damage:** Improper use of herbicides, pesticides, or fertilisers can lead to plant injury. Herbicide injury: Distorted growth, leaf burn, and spotting. Salt damage: Caused by excessive fertilisation or irrigation with saline water, leading to leaf burn and stunted growth.
 - iv. **Physical Damage:** Mechanical injuries from cultivation practices, wind or hail can cause plant damage. Wind damage: Broken stems, torn leaves and lodging. Hail damage: Punctured leaves and bruised fruits.

Learning Tasks

1. State the various classifications of pests of crops.
2. Explain the life cycles of insect pests.
3. Discuss the classification of crop diseases.

Pedagogical Exemplars

1. **Managing talk for learning:** Learners in mixed-ability groups brainstorm to come up with the classification of crop pests and diseases. Teacher should ensure that all learners fully participate in the activity. Teacher should use leading questions to support learners with additional support needs to classify crop pests and diseases. Encourage talented learners to delve deeper to explain or discuss the classification of crop pests and diseases.
2. **Collaborative learning (Homework):** Learners in mixed-ability groups search the internet to identify plant diseases and pest of vegetables, arable and cash crops. Learners then discuss causative agents, symptoms and mode of transmission for the diseases and mode of feeding, stage of attacking the plant, damage caused, and the effects of damage caused by the pests. Teacher should provide learners with internet sites for the needed information and supervise them during the searching to prevent them from accessing unapproved or illegal sites. Encourage learners who are proficient in using the internet to take lead roles to inspire those with difficulty to use the internet.
3. **Experiential learning (Homework):** Learners in mixed ability groups build a picture portfolio on the pathogenic diseases and pest of vegetables, arable and cash crops indicating their causative agents, symptoms, mode of transmission, mode of feeding, stage of attacking the plant, damage caused and the effects of damage caused by the pests. Teacher should ensure that all learners take part in the portfolio building.

Key Assessments

Assessment Level 1: List at least two (2) classifications of crop pests

Assessment Level 2: Classify and explain at least two (2) non-pathogenic crop diseases.

Assessment Level 3

1. Discuss at least one (1) effect each of chewing, sucking and boring insects on crops.
2. What are the three differences between diseased and healthy crops in the field?

Assessment Level 4: With the aid of a diagram describe complete metamorphosis.

Hint



*The recommended mode of assessment for week 17 is **questioning**. Use the level 3 question 2 as a sample question.*

WEEK 18

Learning Indicator: Examine the preventive and control measures in controlling diseases in crop production under food safety measures

Focal Area: Preventive and Control Measures of Diseases in Crop Production

1. Preventive Measures of Pests and Diseases in Crop Production

a.

i. Cultural Control

- **Crop Rotation:** Changing the types of crops grown in a specific area each season can disrupt the life cycles of pests and diseases causing organisms (pathogen). Example: Rotating legumes with cereals to reduce nematode and pathogen populations.
- **Sanitation:** Removing plant debris, weeds and other potential sources of pest and pathogen infestation can help reduce pest/pathogen populations. Example: Clearing fallen fruit and pruning diseased plant parts.
- **Resistant Varieties:** Using crop varieties that are resistant/tolerant to specific pests and diseases can significantly reduce their damages. Example: Planting rust-resistant wheat varieties.
- **Planting Time and Density:** Adjusting planting times and densities can help avoid peak pest and pathogen populations and reduce their spread and impact. Example: Planting early-maturing varieties to escape late-season pests and pathogenic attacks.
- **Proper Water and Nutrient Management:** Healthy plants are more resilient to pest attacks. Also, implementing proper irrigation practices to avoid waterlogging and ensure that plants do not remain wet for extended periods, as this can encourage the development of many diseases. Example: Using drip irrigation to minimise leaf wetness and reduce the risk of foliar diseases. Avoiding over-fertilisation, which can attract certain pests.

ii. Advantages of Cultural Method of Pest and Disease Management in Crop Production

- **Environmental Sustainability:** Non-Toxic: Cultural methods do not introduce harmful chemicals into the environment, preserving ecosystems and protecting wildlife. Promotes Biodiversity: By avoiding broad-spectrum pesticides, beneficial insects, pollinators and soil microorganisms are preserved and supported.
- **Cost-Effective:** Lower Input Costs: Requires less expenditure on chemical pesticides and fertilisers. Long-Term Savings: Practices such as crop rotation and cover cropping can improve soil health and reduce the need for chemical inputs over time.

- **Prevents Pest Resistance:** Varied Techniques: Utilising multiple methods makes it more difficult for pests to establish or adapt and develop resistance, unlike with single- method chemical controls.
- **Improves Soil Health:** Increase Organic Matter: Practices like crop rotation, cover cropping and green manuring enhance soil organic matter, improving soil structure and fertility. Reduces Erosion: Techniques such as contour farming and cover cropping help prevent soil erosion, maintaining soil integrity and productivity.
- **Health and Safety:** Reduces Exposure to Chemicals: Minimises the risk of pesticide exposure for farm workers and consumers, leading to safer working conditions and healthier produce. Residue-Free Produce: Reduces the likelihood of pesticide residues in food, promoting food safety and consumer health.
- **Enhanced Crop Resilience:** Diverse Planting: Crop rotation and polyculture can break pest and disease cycles, reducing the likelihood of outbreaks. Improved Plant Health: Healthier plants are more resistant to pests and diseases, reducing the need for interventions.
- **Sustainable Agriculture:** Resource Conservation: Practices like mulching and conservation tillage conserve water and reduce soil degradation. Adaptability: Cultural methods can be adapted to local conditions and integrated with other pest management strategies, promoting a holistic approach to farming.

iii. Disadvantages of Cultural Methods in Pest and Disease Management in Crop Production

- **Labour Intensive:** Manual Effort: Many cultural methods, such as hand weeding, intercropping, and crop rotation, require significant manual labour, making them time-consuming and physically demanding.
- **Knowledge and Expertise:** Technical Understanding: Effective implementation often requires in-depth knowledge of specific pests, diseases, crops and appropriate cultural practice. This can be a barrier for farmers without access to adequate training and resources.
- **Variable Effectiveness:** Weather Dependence: The success of cultural methods can be heavily influenced by weather conditions, which may affect their reliability and consistency. Slower Results: Some practices take longer to show results compared to quick-acting chemical treatments, which can be challenging during severe pest or disease outbreaks.
- **Limited Control Scope:** Specificity: Cultural methods may not be effective against all types of pests and diseases. In cases of severe infestations, they may not provide sufficient control on their own.
- **Economic Risks:** Initial Costs: Some practices, such as establishing cover crops or implementing new irrigation systems, may require significant initial investments. Potential Yield Losses: If cultural methods fail to control pests and diseases effectively, there can be substantial crop damage and yield losses, affecting the farmer's income.

- **Scale Limitations:** Small-Scale Suitability: Some cultural methods are more suited to small-scale or subsistence farming and may be challenging to implement on a large scale without mechanization or additional labour.
- **Integration Challenges:** Combining with Other Methods: Integrating cultural methods with other pest management strategies, such as biological or chemical controls, can be complex and requires careful planning to avoid negative interactions.

b.

i. Biological Control

- **Natural Predators and Parasites:** Introducing or conserving beneficial organisms that prey on pests. This can help control populations. Example: Ladybugs to control aphids.
- **Biological Control Agents:** Using beneficial microorganisms that can suppress or outcompete pathogens. Example: *Trichoderma spp.* to control soil-borne fungal pathogens.
- **Microbial Control Agents:** Using bacteria, fungi or viruses that target specific pests. Example: *Bacillus thuringiensis* (Bt) for controlling caterpillars.
- **Biological Insecticides:** Products derived from natural sources that target specific pests. Example: Neem oil.
- **Antagonistic Plants:** Planting crops or cover crops that can suppress the growth of pathogens. Example: Planting marigolds to reduce nematode populations.

ii. Advantages of Biological Methods in Pest and Disease Management in Crop Production

- **Environmental Sustainability:** Non-Toxic: Biological control agents, such as natural predators, parasitoids and pathogens, do not introduce harmful chemicals into the environment. Ecosystem Balance: Helps to maintain and restore the natural balance of ecosystems by enhancing biodiversity and supporting the health of non-target species.
- **Safety for Humans and Animals:** Minimal Residues: Reduces the risk of chemical residues in food, making produce safer for consumers. Worker Safety: Lowers the risk of exposure to toxic chemicals for farm workers, promoting safer working conditions.
- **Sustainable Pest Management:** Long-Term Control: Once established, biological control agents can provide ongoing pest suppression, reducing the need for repeated interventions. Natural Population Regulation: Enhances the natural regulatory mechanisms within ecosystems, promoting long-term pest management.
- **Cost-Effectiveness:** Lower Long-Term Costs: Although the initial investment in biological control agents and their release can be higher, the long-term costs are often lower due to sustained pest control and reduced need for chemical pesticides. Resource Efficiency: Biological control methods often require fewer resources and inputs compared to chemical controls.

- **Compatibility with Integrated Pest Management (IPM):** Synergistic Effects: Biological methods can be effectively integrated with other pest management strategies, such as cultural, mechanical and chemical controls, to enhance overall effectiveness. Holistic Approach: Supports a more holistic and sustainable approach to pest management, reducing reliance on any single method.
- **Soil and Plant Health:** Improved Soil Health: Biological control methods do not disrupt soil microbial communities, contributing to healthier soil ecosystems. Plant Health: Reduces stress on plants caused by chemical applications, promoting healthier and more resilient crops.
- **Public Perception and Market Access:** Consumer Preference: Increasing consumer demand for organically grown and residue-free produce can be met by using biological control methods. Market Access: Can enhance market access and premium pricing opportunities for farmers adopting sustainable and eco-friendly pest management practices.

iii. Disadvantages of using Biological Methods to Manage Pests and Diseases in Crop Production

- **Slow Action:** Biological control agents (such as predators, parasites, or pathogens) often take longer to reduce pest populations compared to chemical pesticides, which can act immediately.
- **Inconsistent Results:** The effectiveness of biological control can vary due to environmental conditions, the presence of alternative prey or the specific interactions between pests and their natural enemies.
- **Potential for Non-target Effects:** Introduced biological control agents might affect non-target species, including beneficial insects, other wildlife or even the crops themselves.
- **Regulatory and Logistical Challenges:** The introduction and use of biological control agents are often subject to stringent regulatory approvals, which can be time-consuming and costly. Additionally, there may be logistical challenges in mass-rearing, storing and distributing biological agents.
- **Limited Availability:** Not all pests have effective biological control agents available. Research and development to find suitable agents can be lengthy and expensive.
- **Economic Considerations:** The initial costs of establishing a biological control program can be higher than chemical control and the economic benefits may take longer to materialise.
- **Unpredictable Outcomes:** Biological control can sometimes lead to unintended ecological consequences, such as the suppression of one pest leading to the outbreak of another pest species.

c.

i. Mechanical and Physical Control of Pests and Diseases

- **Traps and Barriers:** Using traps to capture pests or barriers to exclude them from crops. Example: Sticky traps for whiteflies and row cover for protecting seedlings.

- **Hand Picking:** Manually removing pests from plants, particularly in small-scale or home gardens. Example: Removing larger insects like caterpillars and beetles by hand.
 - **Tillage and Soil Solarisation:** Disturbing the soil to destroy pest habitats and using solar heat to reduce soil pest and pathogen populations. Example: ploughing and harrowing the soil to expose and kill soil-dwelling pests and pathogen.
 - **Pruning and Rogueing:** Removing infected plant parts or entire plants to prevent the spread of diseases. Pruning also helps remove hiding places of pests. Example: Pruning diseased branches to control fire blight in apple orchards.
 - **Advantages of using Physical/Mechanical Method in Managing Pests and Diseases in Crop Production**
- ii. **Reduced Chemical Use:** These methods minimise or eliminate the need for chemical pesticides, reducing potential environmental contamination and pesticide residues on crops.
- **Immediate Results:** Mechanical methods often provide immediate results, directly removing or killing pests without waiting for chemical or biological agents to take effect.
 - **Safety for Humans and Non-target Species:** These methods are typically safer for humans, animals and beneficial organisms compared to chemical pesticides, reducing risks to health and biodiversity.
 - **Resistance Management:** Mechanical control helps prevent the development of resistance in pest populations, a common issue with repeated chemical pesticide use.
 - **Environmentally Friendly:** Physical methods are generally more sustainable and environmentally friendly, as they do not introduce toxic substances into the ecosystem.
 - **Specific Targeting:** Many mechanical methods can be tailored to target specific pests, reducing collateral damage to non-target species.
 - **Integrated Pest Management (IPM) Compatibility:** Mechanical methods can be easily integrated into an IPM strategy, complementing biological and cultural controls for a holistic approach to pest management.
 - **Cost-Effectiveness in the Long Run:** 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.
- iii. **Disadvantages of using Mechanical/Physical Methods in Managing Pests and Diseases**
- **Labour-Intensive:** Mechanical methods often require significant manual labour, which can be time-consuming and costly, especially for large-scale operations.

- **Limited Effectiveness on Large Scales:** These methods may not be practical for large fields or extensive infestations, as they can be challenging to implement over vast areas.
 - **High Initial Costs:** Purchasing and maintaining mechanical equipment such as traps, barriers, or machinery can involve high initial costs.
 - **Continuous Maintenance:** Mechanical control methods often require ongoing maintenance and monitoring to ensure effectiveness, adding to the labour and cost.
 - **Injury Risks:** There is a potential risk of injury to workers when using mechanical equipment, especially if proper safety protocols are not followed.
 - **Non-selective Nature:** Mechanical methods can sometimes be non-selective, affecting both target pests and non-target organisms, including beneficial insects.
 - **Short-term Solutions:** Mechanical methods often provide short-term relief and may not address the root cause of pest problems, requiring repeated applications.
 - **Skill and Knowledge Requirement:** Effective use of mechanical control methods requires specific skills and knowledge, which might not be readily available to all farmers or land managers.
- d.

i. Chemical Control

- **Insecticides:** Chemicals used to kill or repel insects. It's important to use them judiciously to avoid resistance and non-target effects. Example: Pyrethroids, organophosphates.
 - **Herbicides:** Chemicals used to control weeds, which can serve as alternative hosts for pests. Example: Glyphosate for weed management.
 - **Fungicides:** Chemicals used to control fungal diseases that can weaken plants and make them more susceptible to pests. Example: Copper-based fungicides.
 - **Bactericides:** Chemicals used to control bacterial infections. Example: Applying streptomycin to control bacterial blight in beans.
- #### ii. Advantages of using Chemical Methods of Managing Pests and Diseases in Crop Production
- **Quick and Effective Action:** Chemical pesticides often provide rapid and effective control of pests and diseases, quickly reducing pest populations and minimising crop damage.
 - **Broad Spectrum Control:** Many chemical pesticides can target a wide range of pests and diseases, offering comprehensive protection for crops.
 - **Ease of Application:** Chemical pesticides are generally easy to apply using various methods such as spraying, dusting or soil treatment, allowing for efficient coverage of large areas.
 - **Cost-Effective:** 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.

- **Availability and Accessibility:** Chemical pesticides are widely available and accessible to farmers, with a variety of products to choose from depending on the specific pest or disease.
- **Convenience:** Chemical pesticides can be stored and transported easily, offering convenience for farmers who need to manage pests across different locations.
- **Integration with Conventional Farming Practices:** Chemical pest control methods are well-integrated into conventional farming systems, making them compatible with existing agricultural practices and machinery.
- **Support and Guidance:** 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.
- **Scalability:** 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.

iii. Disadvantages of using Chemical Control Methods in Managing Pests and Diseases in Crop Production.

- **Development of Resistance:** 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.
- **Environmental Pollution:** Chemical pesticides can contaminate soil, water and air, leading to pollution and harming non-target organisms, including beneficial insects, wildlife, and plants.
- **Health Risks:** 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.
- **Non-target Effects:** 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.
- **Cost:** 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.
- **Residual Effects:** 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.
- **Impact on Soil Health:** Repeated use of chemical pesticides can negatively affect soil health, reducing soil fertility and beneficial microbial activity, which can impact long-term crop productivity.
- **Ecosystem Disruption:** 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.

- **Human Error:** 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.
- e.
- i. **Integrated Pest/Diseases Management (IPM/IDM):** IPM/IDM combine multiple control strategies to manage pest/disease pathogen populations in an environmentally and economically sustainable way. Key components of IPM/IDM include:
 - **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.
 - **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 populations exceed a certain level.
 - **Combination of Controls:** Integrating cultural, biological, mechanical, and chemical controls to manage pests and diseases. Example: Using crop rotation, biological control agents, and targeted insecticide applications together.
 - **Minimising Chemical Use:** Reducing reliance on chemical controls by using them as a last resort and in combination with other methods. Example: Applying insecticides only when necessary and targeted to minimise impact on non-target organisms.
 - **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.
 - ii. **Advantages of IPM/IDM in Crop Production**
 - **Reduced Chemical Use:** Environmental Protection: Minimises pollution and reduces the risk of harming non-target organisms, including beneficial insects, birds and aquatic life. Health Benefits: Lowers the exposure of farmers, workers and consumers to potentially harmful chemicals.
 - **Economic Benefits:** Cost Savings: Reduces the cost associated with purchasing and applying pesticides. Sustainable Yield: By maintaining a healthy ecosystem, IPM/IDM can help ensure stable or increased crop yields over the long term. Resistance Management: Reduced Resistance: Helps prevent or delay the development of pest and disease resistance to chemical controls.
 - **Improved Crop Health:** Holistic Approach: Considers all factors affecting crop health, including soil quality, water management, and plant genetics, leading to overall improved crop vitality.
 - **Biodiversity:** Promotes Biodiversity: Encourages a diverse agro-ecosystem which can contribute to natural pest and disease suppression.

iii. Disadvantages of IPM/IDM in Crop Production

- **Complexity and Knowledge Requirement:** High Knowledge Requirement: Requires extensive knowledge of pest and disease biology, ecology, and management strategies. Training Needs: Farmers and workers need continuous education and training.
- **Time-Consuming:** Labour Intensive: IPM/IDM practices can be more labour-intensive compared to traditional chemical-based methods. Monitoring and Scouting: Requires regular monitoring and scouting of crops to make informed management decisions.
- **Initial Costs:** Startup Costs: There can be higher initial costs for implementing IPM/IDM strategies, including costs for training, monitoring equipment, and biological control agents.
- **Variable Effectiveness:** Unpredictable Results: The effectiveness of IPM/IDM strategies can vary depending on local conditions, pest populations, and environmental factors.
- **Market and Policy Barriers:** Market Access: Sometimes, markets may not recognise, reward or understand the benefits of IPM/IDM-grown crops.
- **Policy Support:** Requires central government supportive policies and incentives to encourage widespread adoption.

Learning Tasks

1. Explain the methods of controlling pests and diseases.
2. Discuss the merits and demerits of the various control measures.
3. Undertake a basic pest and disease control measure (application of pesticide).

Pedagogical Exemplars

1. **Experiential learning:** Learners in mixed-ability groups embark on a field trip to a nearby crop farm to observe the control and preventive measures of plant diseases and pests or watch video/pictures on control and preventive measures of plant diseases and pest. Ensure that all learners fully participate in the activity.
2. **Collaborative learning:** Teacher puts learners in mixed-ability groups to discuss the control and preventive measures for crop diseases and pests applied in crops production and make a presentation in class. Teacher should ensure that all learners actively participate in the exercise. Assign lead roles to confident learners to support learners with difficulties to allow them to fully participate.
3. **Initiating talk for learning:** Learners discuss the merits and demerits of the various methods of prevention and controlling crop diseases and pests. Confident learners should be allowed to play lead roles during lesson discussion under the guidance of the teacher. Teachers should ensure that all the learners fully participate in the activity.
4. **Experiential learning (Homework):** Learners in gender-based groups under the guidance of a technician/master craftsman undertake some of the control and preventive measures of

crop diseases and pests in crop production on the field observing the necessary safety measures. Teacher should encourage all learners to participate in the hands-on practices of controlling pests and diseases in crop production.

Key Assessments

Assessment Level 1: State any three (3) cultural methods of controlling pest.

Assessment Level 2: Explain how tillage practices and pruning can be used to control pests and diseases.

Assessment Level 3: Assess the effectiveness of integrated pest and disease management (IPM/IDM) in managing pests and diseases.

Assessment Level 4: Conduct simple research on impact of IPM/IDM on successful crop production.

Hint



- The recommended mode of assessment for week 18 is **Mid semester examination**.
- Refer to the Appendix F for more sample task and the Table of Specification

WEEK 19

Learning Indicators

1. *Identify common diseases, pests and parasites of animals/fish and their effects in animal/fish production.*
2. *Describe the classification, causes and symptoms of animal/fish diseases in animal production.*

Focal Area 1: Meaning, Common Diseases, Pests and Parasites of Animals/Fish, and their Symptoms and Effects on Animal/Fish Production

1. Meaning of Animal/Fish Disease, Pests and Parasites

a. Meaning of Animal/Fish Disease

An animal/fish disease is any condition that impairs the normal function of an animal/fish, leading to a departure from 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/fish is an animal/fish that is suffering from a condition that impairs its normal physiological functions, leading to a departure from health. This condition is characterised by specific clinical signs and symptoms, which can vary widely depending on the disease and the species of the animal/fish.

b. Meaning of Pest in Animals/Fishes

Pests in animals/fishes refer to any organism, typically insects or small animals, that cause harm, discomfort or economic loss to livestock/fishes. They can directly affect animals/fishes through physical damage or stress and indirectly by spreading diseases or contaminating feed and water.

c. Meaning of Parasite in Animals/Fishes

Parasites are organisms that live on (ectoparasites) or inside (endoparasites) animals/fishes, deriving their nutrition at the host's expense. They can cause significant health issues and decrease productivity in livestock/fishes.

i. 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:

- **Ticks:** Cause skin irritation, anaemia and can transmit diseases such as Lyme disease, babesiosis, heartwater disease, anaplasmosis, tick-borne fever, etc.
- **Fleas:** Cause itching, dermatitis, and can transmit tapeworms and bartonella.
- **Lice:** Cause skin irritation, hair loss and reduced weight gain.
- **Mites:** Cause intense itching, skin lesions and secondary infections.
- **Flies:** Cause irritation, stress and can transmit diseases.

ii. 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's tissues or bodily fluids. Examples include:

- **Roundworms (Nematodes):** Cause gastrointestinal issues such as anaemia and weight loss.
- **Tapeworms:** Cause digestive problems abdominal pain, vomiting, loss of appetite, diarrhoea and nutrient absorption issues.
- **Liver Flukes:** Cause liver damage, bile duct inflammation and reduced productivity.
- **Protozoa:** Cause diarrhoea, dehydration and in severe cases, death.
- **Lungworms:** Cause respiratory issues, coughing and reduced weight gain.

2. General Characteristics of Healthy Animals

a. Appearance

- i. **Bright Eyes:** Clear, bright and alert eyes without discharge.
- ii. **Healthy Coat/Skin:** Shiny coat, smooth skin without bald patches, sores or parasites.
- iii. **Normal Posture:** Standing, walking and sitting in a natural posture without signs of discomfort.

b. Behaviour

- i. **Alert and Active:** Engages with the environment, curious, and responsive.
- ii. **Normal Eating and Drinking:** Regular appetite and hydration, appropriate weight.
- iii. **Normal Excretion:** Regular bowel movements, normal urine colour and consistency.

c. Physical Condition

- i. **Steady Breathing:** Regular, unlaboured breathing.
- ii. **Normal Temperature:** Body temperature within species-specific normal range.
- iii. **Healthy Weight:** Well-proportioned body, no signs of obesity or emaciation.

3. General Characteristics of Sick Animals

a. Appearance

- i. **Dull Eyes:** Cloudy, sunken or excessively watery eyes.
- ii. **Poor Coat/Skin:** Dull, patchy coat, flaky skin or presence of parasites.
- iii. **Abnormal Posture:** Hunched, stiff or unusual posture indicating discomfort.

b. Behavior

- i. **Lethargic or Withdrawn:** Lack of energy, reduced interaction, hiding or unusual aggression.
- ii. **Loss of Appetite:** Refusal to eat or drink, significant weight loss.
- iii. **Irregular Excretion:** Diarrhoea, constipation or abnormal urine.

c. Physical Condition

- i. **Laboured Breathing:** Rapid, shallow or difficult breathing.
- ii. **Abnormal Temperature:** Fever or unusually low body temperature.
- iii. **Weight Changes:** Sudden weight gain or loss, bloating.

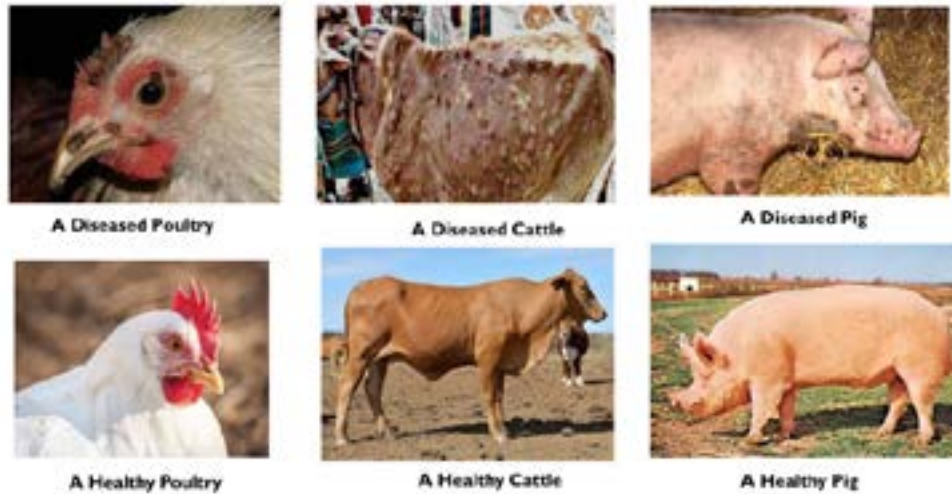


Figure 19.1: *Pictures of Diseased and Healthy Farm Animals*

4. Characteristics of Healthy Fish

a. Appearance

- i. **Clear Eyes:** Bright, clear and alert eyes without cloudiness.
- ii. **Smooth Scales:** Intact, smooth scales without missing patches.
- iii. **Vibrant Colours:** Bright and consistent colouring.
- iv. **Fins:** Erect and fully spread fins without any signs of damage or clamping.

b. Behaviour

- i. **Active Swimming:** Regular, smooth swimming with natural movements.
- ii. **Normal Respiration:** Steady breathing without gasping at the water surface.
- iii. **Healthy Appetite:** Regular feeding behaviour and eagerness to eat.
- iv. **Interaction:** Engages with other fish and shows curiosity in its environment.

c. Physical Condition

- i. **No Bloating or Emaciation:** Well-proportioned body without signs of extreme thinness or bloating.
- ii. **Clear Skin:** the skin should be devoid of lesions, sores or parasites.

5. Characteristics of Sick/Unhealthy Fish

a. Appearance

- i. **Cloudy or Bulging Eyes:** The eyes appear cloudy, bulging or sunken.
- ii. **Damaged Scales:** Missing, damaged or raised scales.

iii. Faded or Discoloured: Loss of vibrant colours or unusual spots and blotches.

iv. Damaged Fins: sick fish usually have torn, clamped, or discoloured fins.

b. Behaviour

i. Lethargic: Lack of energy, often resting at the bottom or hiding.

ii. Erratic Swimming: Unusual swimming patterns, such as darting, spiralling or floating.

iii. Rapid Breathing: Heavy or rapid breathing, sometimes gasping at the surface.

iv. Loss of Appetite: Refusal to eat or a significant decrease in feeding behaviour.

c. Physical Condition

i. Bloating or Emaciation: Swollen abdomen or extreme thinness.

ii. Visible Lesions: Presence of sores, ulcers, or white spots (indicative of diseases like Ich).

iii. Parasites: Visible parasites on the body, fins or gills.

iv. Abnormal Growths: Lumps, bumps or tumours.



Figure 19.2: *Pictures of a Diseased and Healthy Fish*

6. Some Common Diseases, their Symptoms and Effects on Farm Animals

i. 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 outbreaks, large-scale culling to control the spread.

ii. **Mastitis:** It caused by bacterial infections such as *Staphylococcus aureus*, *Streptococcus agalactiae* and *Escherichia coli*.

- **Species Affected:** It affects dairy cows, sheep and goats.
- **Symptoms:** Symptoms include Inflammation of the udder, swelling, heat, redness, hardness and abnormal milk.
- **Effects:** Reduced milk production, altered milk quality, increased veterinary costs and in severe cases, culling of affected animals.

iii. **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 spread.

iv. **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 spread.

v. **Swine Flu (H1N1)**

- **Species Affected:** Pigs.
- **Symptoms:** Fever, coughing, sneezing, difficulty breathing, decreased appetite, and lethargy.
- **Effects:** It leads to stunted growth, decreased feed efficiency, increased veterinary costs, potential zoonotic transmission to humans.

vi. **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 high 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.

vii. 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.

viii. 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, and disruption of pork supply chains.

ix. 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.

x. 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.

xi. 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.

xii. 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 health risk.

xiii. 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 deaths, and disruption of livestock production systems.

xiv. 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.

7. Common Diseases, Pests and Parasites of Fish and their Effects**a. Bacterial Diseases**

- Columnaris Disease (*Flavobacterium columnare*):** Symptoms: White or grayish 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.

b. 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: Lethargy, skin lesions, haemorrhages, abnormal swimming. Effects: High mortality rates, especially in tilapia farms.

c. Fungal Diseases

- Saprolegniasis (*Saprolegnia* spp.):** Symptoms: Cotton-like growths on the skin, gills, or eggs. Effects: Tissue necrosis, impaired respiration and increased mortality due to secondary infections.

d. 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.

e. Common Parasites

- 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.

- ii. **Trichodina spp.:** Symptoms: Excessive mucus production, gill irritation and erratic swimming. Effects: Gill damage, impaired respiration and increased susceptibility to other infections.
- iii. **Monogenean Flukes (*Dactylogyrus spp.*):** Symptoms: Gills heavily infested, respiratory distress, mucus production. Effects: Gill damage, impaired respiration, and increased mortality.
- iv. **Gyrodactylus spp.:** Symptoms: Excessive mucus, frayed fins, skin irritation. Effects: Skin damage, stress and secondary infections.
- v. **Cestodes (Tapeworms):** Symptoms: Emaciation and swollen abdomen. Effects: Nutrient depletion, stunted growth and death in severe cases.

Learning Tasks

1. Explain the meaning of animal/fish diseases, pest and parasites.
2. Discuss the general characteristics of diseased and healthy animals/fish.
3. Examine the common diseases, pests and parasites, their symptoms and effects on animals/fish.

Pedagogical Exemplars

1. **Structuring talk for learning:** Teacher to put learners in mixed-ability groups to brainstorm to come up with the meaning of animal/fish diseases, pests and parasites. Teacher should ensure that all learners fully participate in the activity. Used leading questions to guide learners with additional support needs to come up with the meanings.
2. **Experiential learning:** Learners in mixed-ability groups visit a nearby animal/fish production farm to observe and take pictures of healthy and ill health animals/fish or watch a video/picture of healthy and ill animals and prepare a photo album. Teacher should ensure that all learners take part in the activities.
3. **Collaborative learning:** Learners in mixed-ability groups discuss the effects of animal diseases on animal/fish production. Teacher should involve learners who require additional support needs in the class discussions. Confident learners should also be allowed to play lead roles in the discussion under the guidance of the teacher. All learners should respect each other's views during the discussion.

Key Assessments

Assessment Level 1: List any three (3) types of ectoparasites.

Assessment Level 2: Discuss the symptoms and effects of (a) foot-and-mouth disease (b). Newcastle disease.

Assessment Level 3: Evaluate the impact of animal diseases on the meat industry in Ghana.

Assessment Level 4: Create a photo album of at least three (3) types of disease that affect animals/fish.

Focal Area 2: Causes and Classification of Animal/Fish Diseases

1. Causes of Animal/Fish Diseases

a. Infectious Agents

- i. **Bacteria:** Brucellosis: Caused by *Brucella spp.* It causes reproductive issues. Tuberculosis: Caused by *Mycobacterium bovis*. This affects the respiratory system.
- ii. **Viruses:** Foot-and-Mouth Disease: A highly contagious disease of livestock which affects cloven-hoofed animals. Rabies: Affects the central nervous system, often fatal.
- iii. **Fungi:** Ringworm: Caused by *Trichophyton spp.* or *Microsporum spp.*, leads to skin lesions. Aspergillosis: Respiratory disease caused by *Aspergillus spp.*
- iv. **Parasites:** Endo-Parasites: Such as roundworms, tapeworms and liver flukes. Ecto-Parasites: Such as lice, mites and ticks.

b. Nutritional Deficiencies

- i. **Vitamin Deficiencies:** E.g., vitamin D deficiency causing rickets.
- ii. **Mineral Deficiencies:** E.g., calcium deficiency leading to milk fever in dairy cows.
- iii. **Protein Deficiencies:** Leading to poor growth and decreased production.
- iv. **Energy Deficiencies:** Resulting in weight loss and decreased productivity.

c. Other Factors

- i. **Toxins:** Exposure to pesticides, herbicides or toxic plants.
- ii. **Injuries:** Can lead to secondary infections or other complications.
- iii. **Poor Management Practices:** Poor management practices such as inadequate feeding, watering or healthcare routines can lead to animal diseases.
- iv. **Poor Sanitation:** Can lead to the spread of infectious diseases.
- v. **Overcrowding:** Increases stress and the risk of disease transmission.
- vi. **Extreme Weather Conditions:** Such as heat stress or frostbite.
- vii. **Inherited Conditions:** Such as hip dysplasia in dogs or certain congenital defects in livestock.
- viii. **Breed-Specific Disorders:** E.g., porcine stress syndrome in certain pig breeds.

2. Classification of Animal/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:

a. Based on Causative Agents

- i. **Bacterial Diseases:** Examples: Anthrax, Brucellosis, Tuberculosis. Symptoms: Fever, lesions, respiratory distress, diarrhoea.
- ii. **Viral Diseases:** Examples: Foot-and-Mouth Disease, Rabies, Avian Influenza. Symptoms: Fever, neurological signs, respiratory issues, haemorrhages
- iii. **Fungal Diseases:** Examples: Ringworm, Aspergillosis, Candidiasis. Symptoms: Skin lesions, respiratory issues, weight loss
- iv. **Parasitic Diseases:** Examples: Trypanosomiasis, Tapeworm infections. Symptoms: Anaemia, weight loss, digestive issues.

b. Based on Mode of Transmission

- i. **Direct Contact Diseases:** Spread through physical contact between animals. Examples: Rabies, Ringworm
- ii. **Vector-Borne Diseases:** Transmitted by vectors like ticks, mosquitoes or flies. Examples: Lyme Disease, Bluetongue.
- iii. **Waterborne Diseases:** Spread through contaminated water. Examples: Leptospirosis, Giardiasis.
- iv. **Foodborne Diseases:** Transmitted through contaminated food. Examples: Salmonellosis, Listeriosis.
- v. **Airborne Diseases:** Spread through the air via droplets or dust. Examples: Avian Influenza, Foot-and-Mouth Disease.

c. Based on Duration and Severity

- i. **Acute Diseases:** Sudden onset, severe symptoms, short duration. Examples: Anthrax, Foot-and-Mouth Disease.
- ii. **Chronic Diseases:** Long-term, persistent symptoms, slow progression. Examples: Tuberculosis, Johne's Disease.
- iii. **Subacute Diseases:** Intermediate severity and duration. Examples: Subacute Bacterial Endocarditis

d. Based on Geographic Distribution

- i. **Endemic Diseases:** Diseases that are constantly present in a particular region or population. Examples: African Swine Fever in some African countries
- ii. **Epidemic Diseases:** Occur at higher-than-normal levels in a specific area. Examples: Foot-and-Mouth Disease outbreaks
- iii. **Pandemic Diseases:** Widespread across multiple countries or continents. Examples: Avian Influenza in poultry

e. Based on Zoonotic Potential

- i. **Zoonotic Diseases:** A disease that can be transmitted between animals and humans.
Examples: Rabies, Salmonellosis
- ii. **Non-Zoonotic Diseases:** Affect only animals and cannot be transmitted to humans.
Examples: Canine Distemper, Feline Leukaemia Virus

3. Factors Predisposing Animals to Diseases

a. Environmental Factors

- i. **Poor Hygiene:** Unsanitary living conditions, contaminated water or food.
- ii. **Overcrowding:** High population density leading to stress and easier transmission of pathogens.
- iii. **Extreme Temperatures:** Exposure to very high or low temperatures affecting the immune system.
- iv. **Poor Ventilation:** Inadequate airflow causing accumulation of harmful gases or pathogens.

b. Nutritional Factors

- i. **Malnutrition:** Deficiency or imbalance of essential nutrients weakening the immune system.
- ii. **Contaminated Food/Water:** Presence of toxins, bacteria, or parasites in food or water.

c. Genetic Factors

- i. **Inherited Conditions:** Genetic predisposition to certain diseases.
- ii. **Inbreeding:** Increased risk of genetic disorders and reduced genetic diversity.

d. Stress Factors

- i. **Handling and Transport:** Rough handling or long transport causing physical and psychological stress.
- ii. **Social Stress:** Aggression or bullying within a group leading to injuries and stress.

e. Physiological Factors

- i. **Age:** Very young or old animals with weaker immune systems.
- ii. **Reproductive Status:** Pregnancy, lactation, or hormonal changes affecting immunity.

f. Immunological Factors

- i. **Vaccination Status:** Lack of or outdated vaccinations.
- ii. **Previous Illnesses:** Past diseases affecting current immunity.

g. Parasitic Factors:

- i. **External Parasites:** Ticks, fleas and mites which cause irritation, anaemia, and disease transmission in farm animals.

- ii. **Internal Parasites:** Worms, protozoa affecting internal organs and nutrient absorption.

4. Factors Predisposing Fish to Diseases

a. Water Quality

- i. **Poor Water Conditions:** High levels of ammonia, nitrite or nitrate.
- ii. **Inadequate Filtration:** Insufficient biological or mechanical filtration.
- iii. **Incorrect pH Levels:** pH that is too high or too low for the specific fish species.
- iv. **Temperature Fluctuations:** Sudden or extreme changes in water temperature.

b. Nutritional Factors

- i. **Poor Diet:** Lack of essential nutrients or feeding inappropriate food.
- ii. **Overfeeding/Underfeeding:** Both can lead to health issues and water quality problems.

c. Stress Factors

- i. **Handling and Transport:** Stress from capture, handling or transportation.
- ii. **Aggression:** Aggressive tank mates causing injuries and stress.
- iii. **Parasitic and Pathogenic Factors**
- iv. **Parasites:** Internal (e.g., worms) and external (e.g., ich) parasites.
- v. **Bacterial/Fungal Infections:** Opportunistic infections taking advantage of weakened fish.

d. Genetic Factors

- i. **Inbreeding:** Reduced genetic diversity leading to increased susceptibility to diseases.
- ii. **Genetic Disorders:** Inherited diseases or conditions affecting health.
- iii. **Immunological Factors**
- iv. **Immune Suppression:** Stress, poor nutrition or environmental factors weakening the immune system.
- v. **Previous Illnesses:** Past infections or diseases affecting current immunity.

e. Chemical Exposure

- i. **Toxins and Pollutants:** Exposure to harmful chemicals, heavy metals or pollutants.
- ii. **Medications:** Incorrect or overuse of medications leading to toxicity or resistance.

Learning Tasks

1. List the main causes of animal/fish diseases.
2. Discuss the classifications of animal/fish diseases.
3. Examine the factors that pre-dispose animal/fish to diseases.

Pedagogical Exemplars

1. **Inquiry-based learning:** Teacher puts learners in mixed-ability groups to search the internet for information on the causes of animal and fish diseases. Provide learners with internet sites that will help them get the information and supervise them to prevent them from going into unapproved or illegal sites. Allow learners who are proficient on the internet to take lead roles to support learners with additional support needs .
2. **Collaborative learning:** Learners in mixed-gender groups classify animal/fish diseases and discuss the factors that predispose animals/fish to diseases and pest infestation. Teachers should ensure that all learners participate in the activity. Use leading questions to guide learners to identify and classify the factors that predispose animal/fish to diseases.
3. **Experiential learning (Homework):** Learners in mixed-ability groups build a picture album on the diseases, pest and parasites of ruminants, monogastrics and fish indicating their classification, causative agents and pre-disposing factors. Teachers should monitor learners when they are using the internet. The teacher should use leading questions to support some learners in the classification, causes and pre-disposing factors of animal/fish diseases, pests and parasites.

Key Assessment

Assessment Level 1: List at least five (5) causes of animal/fish diseases.

Assessment Level 2: Explain at least three (3) factors that pre-dispose animal/fishes to diseases.

Assessment Level 3: Analyse how nutritional deficiencies can impact the performance of animal/fish.

Assessment Level 4

1. Create a photo album of the causes of diseases in fish.
2. State one class of diseases that affect animals/fish under the following and give 2 examples of each class.
 - i. Based on Causative Agents
 - ii. Based on Mode of Transmission
 - iii. Based on Duration and Severity
 - iv. Based on Geographic Distribution
 - v. Based on Zoonotic Potential

Hint



*The recommended mode of assessment for week 19 is **class exercise**. Use the level 4 question 2 as a sample question.*

WEEK 20

Learning Indicator: Examine the preventive and control measures in controlling diseases and pest in animals/fishes in animal production under food safety measures

Focal Area 1: Preventive and Control Measures of Diseases in Animal/Fish Production

1. Preventive Measures of Diseases in Animal Production

a. Biosecurity Measures

- i. **Quarantine:** Isolate new or sick animals to prevent the spread of diseases.
- ii. **Sanitation:** Regular cleaning and disinfection of animal housing, equipment and vehicles.
- iii. **Visitor Control:** Limit access to animal facilities and enforce hygiene protocols for visitors. For instance, the use of regularly disinfected footbaths at the entrance of animal pens will help reduce the incidence of pathogen attack.
- iv. **Routine Vaccination:** Administer vaccines according to a schedule to prevent common diseases.
- v. **Using Boosters:** Farmers can also provide booster shots as needed to maintain immunity.

b. Proper Nutrition

- i. **Balanced Diet:** Farmers should ensure that animals receive a balanced diet with necessary nutrients to support their immune systems and to promote growth.
- ii. **Supplements:** Provide vitamins and mineral supplements to prevent nutrient deficiencies.

c. Regular Health Monitoring

- i. **Veterinary Check-ups:** Schedule regular veterinary visits for health assessments and early disease detection.
- ii. **Observation:** Train staff to recognise signs of illness and report them promptly.

d. Environmental Management

- i. **Adequate Housing:** Provide proper ventilation, temperature control and space to reduce stress and disease risk.
- ii. **Waste Management:** Implement effective waste disposal systems to prevent contamination.

e. Parasite Control

- i. **De-worming:** Regularly de-worm animals to control internal parasites such as tape worm, ascarids, liver fluke etc.
- ii. **Pest Control:** Implement measures to control external parasites and pests like flies and rodents. For instance, regular disinfection of the pen to control pest attack.

f. Breeding Management

- i. **Genetic Selection:** Select breeds with known resistance to certain diseases.
- ii. **Controlled Breeding:** Monitor breeding practices to prevent genetic disorders and manage reproductive health.
- iii. **Genetic Testing:** Implement genetic testing to identify and manage hereditary diseases.

g. Stress Reduction

- i. **Handling Practices:** Use gentle and humane handling practices to reduce stress, which can weaken the immune system.
- ii. **Social Environment:** Provide opportunities for social interaction to promote well-being.

h. Education and Training

- i. **Staff Training:** Educate staff on disease prevention, recognition and response.
- ii. **Farmer Education:** Provide resources and training for farmers on best practices in animal health management.

i. Surveillance and Record Keeping

- i. **Health Records:** Maintain detailed health records for all animals.
- ii. **Disease Surveillance:** Participate in local and national disease surveillance programmes to detect and respond to outbreaks quickly.

2. Control Measures of Diseases in Animal Production

a. Isolation and Quarantine

- i. **Immediate Isolation:** Isolate sick animals immediately to prevent disease spread.
- ii. **Quarantine New Arrivals:** Quarantine new animals for a specified period to monitor for any signs of illness.

b. Treatment Protocols

- i. **Veterinary Intervention:** Seek veterinary assistance for diagnosis and treatment of diseases.
- ii. **Medications:** Administer appropriate medications, such as antibiotics, antivirals or antifungals, as prescribed by a veterinarian.
- iii. **Supportive Care:** Provide supportive care, including fluids, nutrition and rest, to aid in recovery.

c. Vaccination

- i. **Outbreak Response:** In case of an outbreak, vaccinate at-risk animals to control the spread.
- ii. **Emergency Vaccination:** Use emergency vaccination strategies for highly contagious diseases.

d. Biosecurity Enhancement

- i. Strengthened Biosecurity:** Increase biosecurity measures, including enhanced cleaning and disinfection protocols.
- ii. Controlled Access:** Restrict access to infected areas and implement strict hygiene protocols for personnel.

e. Environmental Management

- i. Sanitation:** Intensify cleaning and disinfection of animal housing, equipment and surrounding areas.
- ii. Waste Disposal:** Ensure proper disposal of animal waste and carcasses to prevent environmental contamination.

f. Culling and Depopulation

- i. Culling:** Cull infected and high-risk animals to control the spread of severe diseases.
- ii. Depopulation:** In extreme cases, depopulate affected herds or flocks to eradicate the disease.

g. Movement Control

- i. Movement Restrictions:** Implement restrictions on the movement of animals, feed and equipment to prevent disease spread.
- ii. Transport Regulations:** Enforce stringent transport regulations for animals and animal products.

h. Monitoring and Surveillance

- i. Enhanced Surveillance:** Increase surveillance and monitoring for early detection of diseases.
- ii. Health Records:** Maintain detailed health records and track the progress of disease control measures.

i. Education and Training

- i. Staff Training:** Train staff on disease recognition, reporting, and response protocols.
- ii. Farmer Education:** Educate farmers on disease control measures and the importance of early reporting.

j. Collaboration and Reporting

- i. Government Collaboration:** Work with government and veterinary authorities for coordinated disease control efforts.
- ii. Reporting:** Report outbreaks to relevant authorities for assistance and to help prevent wider spread.

k. Nutritional Support

- i. Enhanced Nutrition:** Provide enhanced nutritional support to boost the immune system of affected and at-risk animals.

- ii. **Supplements:** Use immune-boosting supplements as part of the recovery and control strategy.

I. Community Engagement

- i. **Public Awareness:** Raise awareness about the disease and control measures among the local community.
- ii. **Stakeholder Involvement:** Engage stakeholders, including farmers, veterinarians and public health officials, in control efforts.

3. Preventive Measures of Diseases in Fish Production

a. Biosecurity Measures

- i. **Quarantine:** Isolate new or sick fish to prevent the introduction and spread of diseases.
- ii. **Sanitation:** Regular cleaning and disinfection of tanks, ponds and equipment.
- iii. **Visitor Control:** Limit and manage access to fish farming areas to prevent contamination.

b. Water Quality Management

- i. **Regular Monitoring:** Monitor water quality parameters such as temperature, pH, oxygen levels, and ammonia.
- ii. **Water Treatment:** Use filtration, aeration, and appropriate chemical treatments to maintain optimal water conditions.

c. Stock Management

- i. **Stock Density:** Maintain appropriate stock densities to reduce stress and the spread of diseases.
- ii. **Species Selection:** Choose species and strains that are resistant to local diseases.

d. Nutrition

- i. **Balanced Diet:** Provide a balanced diet with all necessary nutrients to support fish health.
- ii. **Quality Feed:** Use high-quality feed to prevent nutritional deficiencies and support the immune system.

e. Vaccination

- i. **Prophylactic Vaccination:** Administer vaccines to prevent common diseases in fish.
- ii. **Booster Shots:** Provide booster vaccinations as needed to maintain immunity.

f. Regular Health Monitoring

- i. **Routine Inspections:** Conduct regular health inspections to detect early signs of disease.
- ii. **Diagnostic Testing:** Utilise diagnostic tests to identify pathogens and monitor fish health.

g. Environmental Management

- i. Habitat Management:** Maintain a clean and stable habitat, free from pollutants and harmful substances.
- ii. Pest and Predator Control:** Implement measures to control pests and predators that can carry or cause diseases.

h. Stress Reduction

- i. Handling Practices:** Use gentle handling practices to minimise stress and injury.
- ii. Environmental Enrichment:** Provide an environment that meets the behavioural needs of the fish.

i. Education and Training

- i. Farmer Training:** Train farmers and staff in best practices for fish health management and disease prevention.
- ii. Awareness Programs:** Conduct awareness programmes about the importance of preventive measures.

j. Surveillance and Record Keeping

- i. Health Records:** Maintain detailed health records for all fish stocks.
- ii. Disease Surveillance:** Participate in local and national disease surveillance programmes to detect and respond to outbreaks quickly.

k. Genetic Improvement

- i. Selective Breeding:** Select and breed fish that show resistance to common diseases.
- ii. Genetic Testing:** Use genetic testing to enhance disease resistance in breeding programs.

l. Probiotics and Immunostimulants

- i. Probiotics:** Use beneficial bacteria to enhance the gut health and immune system of fish.
- ii. Immunostimulants:** Add immunostimulants to feed to boost the natural defence mechanisms of fish.

m. Waste Management

- i. Effluent Treatment:** Treat and manage waste and effluent to prevent the spread of pathogens.
- ii. Proper Disposal:** Dispose of dead fish and waste materials in a safe and sanitary manner.

n. Community and Stakeholder Involvement

- i. Collaboration:** Work with local communities, government agencies, and stakeholders to implement effective disease prevention strategies.
- ii. Public Awareness:** Raise awareness about the importance of disease prevention and responsible fish farming practices.

4. Control Measures of Diseases in Fish Production

a. Isolation and Quarantine

- i. **Immediate Isolation:** Isolate infected fish immediately to prevent the spread of disease.
- ii. **Quarantine New Stock:** Quarantine new fish for a specified period to monitor for signs of disease before introducing them to the main stock.

b. Treatment Protocols

- i. **Veterinary Intervention:** Consult with aquatic veterinarians for accurate diagnosis and treatment plans.
- ii. **Medication:** Administer appropriate medications, such as antibiotics, antifungals or antiparasitic, as prescribed by a veterinarian.
- iii. **Bath Treatments:** Use bath treatments to administer medications directly in the water.

c. Enhanced Biosecurity

- i. **Sanitation:** Increase the frequency of cleaning and disinfection of tanks, equipment and facilities.
- ii. **Controlled Access:** Restrict access to infected areas and enforce hygiene protocols for personnel.

d. Water Quality Management

- i. **Optimal Conditions:** Maintain optimal water quality by regularly monitoring and adjusting parameters like pH, temperature and oxygen levels.
- ii. **Water Exchange:** Increase water exchange rates to dilute pathogens and improve water quality.

e. Environmental Management

- i. **Habitat Improvement:** Improve the living conditions by removing organic debris and maintaining a clean environment.
- ii. **Waste Management:** Implement efficient waste removal systems to prevent pathogen build-up.

f. Stock Management

- i. **Stock Reduction:** Reduce stock density to lower stress and minimise disease transmission.
- ii. **Segregation:** Segregate fish based on size and species to reduce competition and stress.

g. Vaccination and Immunisation

- i. **Emergency Vaccination:** Implement emergency vaccination programs during outbreaks to boost immunity.
- ii. **Immunostimulants:** Use immunostimulants to enhance the fish's immune response.

h. Monitoring and Surveillance

- i. Regular Health Checks:** Conduct frequent health checks and monitor for early signs of disease.
- ii. Disease Surveillance:** Participate in disease surveillance programmes to track and respond to outbreaks.

i. Education and Training

- i. Staff Training:** Train staff on disease recognition, treatment protocols and biosecurity measures.
- ii. Farmer Education:** Educate farmers on best practices for disease control and the importance of early intervention.

j. Genetic and Breeding Strategies

- i. Selective Breeding:** Breed fish with genetic resistance to specific diseases.
- ii. Genetic Screening:** Implement genetic screening to identify and manage hereditary diseases.

k. Parasite and Pest Control

- i. Parasite Treatment:** Use antiparasitic treatments to control internal and external parasites.
- ii. Pest Management:** Implement measures to control pests that can transmit diseases.

l. Reporting and Documentation

- i. Record Keeping:** Maintain detailed records of disease outbreaks, treatments, and outcomes.
- ii. Reporting:** Report disease outbreaks to relevant authorities for assistance and to help prevent wider spread.

5. Merits and Demerits of Prevention and Control Measures in Animal/Fish Production**a. Merits of Prevention and Control Measures in Animal/Fish Production****i. Improved Animal Health**

- **Reduced Mortality and Morbidity:** Effective prevention and control measures significantly decrease the incidence of diseases, leading to lower mortality and morbidity rates among farm animals.
- **Enhanced Growth and Productivity:** Healthy animals are more productive, resulting in better growth rates, higher milk yields and improved reproductive performance.

ii. Economic Benefits

- **Cost Savings:** Preventing diseases is generally more cost-effective than treating them. This includes savings on veterinary bills, medications and other treatment-related expenses.

- **Increased Profitability:** Healthy animals contribute to higher quality and quantity of animal products, thus boosting the profitability of the farm.

iii. Food Safety and Quality

- **Safe Animal Products:** Healthy animals produce safer and higher-quality meat, milk, and eggs, which are essential for consumer health and market acceptance.
- **Compliance with Regulations:** Implementing disease prevention and control measures helps farmers comply with national and international food safety standards and regulations.

iv. Sustainable Farming Practices

- **Reduced Antibiotic Use:** Emphasising prevention reduces the reliance on antibiotics, which is important for tackling antibiotic resistance.
- **Environmental Benefits:** Healthy animals and sustainable farming practices minimise environmental pollution caused by the overuse of medications and chemicals.

v. Animal Welfare

- **Enhanced Well-being:** Proper disease prevention and control ensure that animals live healthier and stress-free lives to promote growth and development and to increase productivity.

b. Demerits of Prevention and Control Measures in Animal/Fish Production

i. High Initial Costs

- **Investment in Infrastructure:** Implementing effective disease prevention measures often requires significant investment in infrastructure, such as better housing, ventilation systems, and biosecurity measures.
- **Vaccination and Medication Costs:** Regular vaccination and preventive medication programmes can be expensive, especially for large herds.

ii. Labour and Management

- **Increased Labour:** Maintaining high standards of biosecurity and animal health requires additional labour and management efforts.
- **Training Needs:** Farm workers need proper training to implement and maintain disease prevention and control measures effectively.

iii. Potential for Resistance

- **Vaccine Resistance:** Over-reliance on certain vaccines can lead to the emergence of vaccine-resistant strains of pathogens.
- **Medication Resistance:** Misuse or overuse of preventive medications can contribute to the development of drug-resistant diseases.

iv. Complexity and Implementation Challenges

- **Management Complexity:** Implementing comprehensive disease prevention programmes can be complex and require careful planning and execution.

- **Monitoring and Surveillance:** Continuous monitoring and surveillance are essential to detect and respond to disease outbreaks promptly, and which can be resource-intensive.

v. Unintended Consequences

- **Impact on Microbial Ecosystem:** Some preventive measures, such as the use of disinfectants and antibiotics, can disrupt the natural microbial ecosystem in the farm environment.
- **Potential Stress on Animals:** Certain preventive measures, like frequent handling for vaccination or testing, can cause stress to animals, affecting their overall well-being and productivity.

Learning Tasks

1. Explain the preventative measures of diseases used in animal production.
2. Discuss the control measures of diseases used in animal production.
3. Assess the prevention and control measures of diseases employed in fish production.

Pedagogy Exemplars

1. **Experiential learning:** Learners in mixed-ability groups embark on a field trip to a nearby animal/fish farm to observe the control and preventative measures of animal/fish diseases or watch a documentary on preventative and control measures of animal/fish diseases. Ensure that all learners participate in the activity. Teachers should aspire to take learners to visit farms that will help dispel stereotyping in animal production. Videos/documentary used in the class should be gender neutral. Teachers should encourage female learners and learners with additional support needs to take part in the hands-on farm practical activities in the prevention and control of animal/fish diseases.
2. **Collaborative learning:** Learners in mixed-ability groups discuss the control and preventative measures applied in animal/fish production and make a presentation at a plenary section in class. Support and encourage learners with additional support needs and challenge learners who are confident to delve deeper to give more information for others to take inspiration from.
3. **Initiating talk for learning:** Learners discuss the merits and demerits of the methods of prevention and control of animal/fish diseases. Use leading questions to guide learners to identify some of the merits and demerits the prevention and control measures of animal diseases management in animal production. Challenge talented learners to delve deeper to provide more information on the merits and demerits of the prevention and control methods.
4. **Experiential Learning (Homework):** Learners in gender-based groups under the guidance of a technician/master craftsman undertake some of the control and preventive measures of animal/fish diseases in animal production on the field observing all the necessary safety protocols. Teachers should ensure that all learners have a hands-on experience by participating in the controlling diseases and pest activity. Teachers should deliberately choose an animal/fish farm that dispel gender stereotyping where possible.

Key Assessments

Assessment Level 1: State any five (5) preventative measures of managing diseases in farm animals

Assessment Level 2: Explain any two (2) control measures of diseases management in animal and fish production.

Assessment Level 3: Assess the impact of poor environmental conditions on animal health.

Assessment Level 4

1. Evaluate the effectiveness of preventative measures as opposed to control measures of diseases management in fish production.
2. Demonstrate how preventive and control measures of a selected diseases in animal/fish production are carried out.

Hint



*The recommended mode of assessment for week 20 is **practical**. Use the level 4 question 2 as a sample question.*

SECTION 7 REVIEW

Pests, parasites and diseases of crops and farm animals/fish are major challenges to the crop and animal production. They attack crops and animals, and constitute a major threat to sustainable agriculture and food security globally and within Ghana. Insect pests, such as locusts, beetles, aphids, white flies, weevils as well as others are very destructive both on the field and in storage and their destructive nature can lead to a total loss of investment on the farm. These pests can defoliate crop leaves to reduce their photosynthetic potentials and consequently reduce crop yield. Rodents such as rats, squirrels and grasscutters among others feed on fruits, tubers and leaves of crops and can cause extensive damage to the entire crop plants and reduce their survival and productivity. Insect pests can undergo complete or incomplete metamorphosis as part of their growth cycle. They can also be classified into biting and chewing insets, boring insects and piercing sucking insects.

Different types of diseases attack crops, animals and fish to render them unproductive and threaten their very survival. Crop and animal/fish diseases can be both pathogenic and non-pathogenic. Pathogenic diseases are caused by organisms such as bacteria, fungus, viruses and parasites (nematodes). Some of the pathogenic diseases of crops include: bacterial soft rot, bacteria blight (bacteria diseases), fusarium wilt, powdery mildew, rust (fungal disease), tomato yellow mosaic virus, cassava mosaic, groundnut rosette (viral diseases) etc. Common pathogenic diseases of animal/fish include: foot-and mouth disease, anthrax, Newcastle disease, tilapia lake virus, columnaris etc.

Parasites of animals also come in two main classes: ecto-parasites such as ticks, lice, mites etc and endo-parasite such as tape worm, liver fluke ascarids etc. Non-pathogenic diseases essentially are caused by environmental factors, poor nutrition and genetic disorders especially in animal production.

To ensure maximum protection for crops and animal/fish against pests and diseases, prevention and control measure are employed to safeguard the health and welfare of crops and animals/fish to increase productivity, promote food security and ensure good economic growth through agriculture. Prevention and control measures can be cultural such as crop rotation and weeding; biological such as using organisms to attack pest and pathogens; applying biosecurity measures such good farm sanitation; chemical control measures such as application of pesticides; and the use of integrated pests and diseases management approach where a combination of all the prevention and control measures are applied with minimal use of chemicals to manage pests and diseases.

MARKING SCHEME FOR THE QUESTIONING ASSESSMENT TASK

Three differences between healthy and diseased crops on the field are (oral responses) = **2 mark each total marks = 6 marks**

- i. Healthy plants have bright, vibrant green leaves, appropriate for their species while diseased plants have yellow (chlorosis), brown or black leaves, often with distinct patterns.
- ii. Healthy plants have white or light tan, firm and spread out, without signs of rot or excessive browning while diseased plants have black, mushy roots with an unpleasant smell.
- iii. Healthy plants grow steadily and robustly, producing new leaves, shoots or flowers while diseased plants have reduced size or lack of growth in the plant or its parts, etc.

MARKING SCHEME FOR THE CLASS EXERCISE ASSESSMENT TASK

Statement of the class of animal disease = 1

Correct example of the diseases in the class = 2 marks, 1 mark each.

For instance,

- i. Based on Causative Agents
- ii. Bacterial Diseases e.g. Anthrax, Brucellosis
- iii. Based on Mode of Transmission
- iv. Airborne Diseases: Avian Influenza, Foot-and-Mouth Disease.
- v. Based on Duration and Severity
- vi. Chronic Diseases: Tuberculosis, Johne's Disease.
- vii. Based on Geographic Distribution
- viii. Epidemic Diseases: African Swine Fever, Foot-and-Mouth Disease
- ix. Based on Zoonotic Potential

Zoonotic Diseases: Rabies, Salmonellosis, etc.

Total = 15 marks

RUBRICS FOR THE PRACTICAL ASSESSMENT TASK

Criteria	Excellent (4 marks)	Very Good (3 marks)	Good (2 marks)	Fair (1 mark)
Understanding of the Disease	Demonstrates the understanding of the disease by giving 4 of the following; Symptoms of the disease, Mode of transmission, Animals that are affected and Prevention and control measure.	Demonstrates the understanding of the disease by giving 3 of the following; Symptoms of the disease, Mode of transmission, Animals that are affected and Prevention and control measure.	Demonstrates the understanding of the disease by giving 2 of the following; Symptoms of the disease, Mode of transmission, Animals that are affected and Prevention and control measure	Demonstrates the understanding of the disease by giving 1 of the following; Symptoms of the disease, Mode of transmission, Animals that are affected and Prevention and control measure
Selection and Explanation of Preventive Measures	Indicate and explain 4 preventive measures in controlling the disease e.g. Vaccination, Proper nutrition, Regular health monitoring, Breeding management, Isolation and Quarantine.	Indicate and explain 3 preventive measures in controlling the disease e.g. Vaccination, Proper nutrition, Regular health monitoring, Breeding management, Isolation and Quarantine	Indicate and explain 2 preventive measures in controlling the disease e.g. Vaccination, Proper nutrition, Regular health monitoring, Breeding management, Isolation and Quarantine	Indicate and explain 1 preventive measure in controlling the disease e.g. Vaccination, Proper nutrition, Regular health monitoring, Breeding management, Isolation and Quarantine

Demonstration Skills and Execution	Demonstrates any 4 skills in preventive and control measures in animal diseases e.g. Assessment of the Animal's Health Status Selection of appropriate drugs/vaccines Use of appropriate tools and materials Disinfecting of tools and animals Implementing restricting of animal Monitoring of animal for Side Effects	Demonstrates any 3 skills in preventive and control measures in animal diseases e.g. Assessment of the Animal's Health Status Selection of appropriate drugs/vaccines Use of appropriate tools and materials Disinfecting of tools and animals Implementing restricting of animal Monitoring of animal for Side Effects	Demonstrates any 2 skills in preventive and control measures in animal diseases e.g. Assessment of the Animal's Health Status Selection of appropriate drugs/vaccines Use of appropriate tools and materials Disinfecting of tools and animals Implementing restricting of animal Monitoring of animal for Side Effects	Demonstrates any 1 skill1 in preventive and control measures in animal diseases, e.g. Assessment of the Animal's Health Status Selection of appropriate drugs/vaccines Use of appropriate tools and materials Disinfecting of tools and animals Implementing restricting of animal Monitoring of animal for Side Effects
Collaboration and Teamwork	Exhibit 4 of these contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility	Exhibit 3 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility	Exhibit 2 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility	Exhibit 1 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility



APPENDIX F: MID SEMESTER EXAMINATION

1. Nature

- Cover content from weeks 13 – 17, taking into consideration DoK levels 1-3.
- The test should be made up of 20 Multiple Choice questions for 20 marks, 1 mark each.
- Time: 30 minutes.
- Total Score: 20 marks

2. Resources

- Answer Booklets
- Learning Material
- Teachers Manual
- Teacher Assessment Manual and Toolkit

3. Sample Questions

- In a hydroponic system, lettuce plants begin to show signs of tip burn, where the edges of the leaves become necrotic. Which nutrient deficiency is most likely causing this issue, and what should be done to mitigate it?
 - Calcium; add calcium nitrate to the nutrient solution.
 - Nitrogen; increase the nitrogen concentration in the nutrient solution.
 - Phosphorus; use a phosphorus-rich fertilizer.
 - Potassium; apply potassium chloride

4. Sample table of Specification

Weeks	Learning indicator(s)	Type of Questions	DoK Levels				Total
			1	2	3	4	
13	Meaning and Importance of Game and Wildlife	Multiple Choice	1	2	1	-	4
14	Economic Importance and Management Practices in Mushroom Production	Multiple Choice	2	1	1	1	5
15	Meaning of Soil Nutrients, Fertility and Productivity	Multiple Choice	1	2	-	-	3
16	Meaning, Types and Effects of Fertilisers on Crop Production	Multiple Choice	1	1	1	-	3
17	Meaning, Common Crop Pests and Diseases and their Effects in Crop Production	Multiple Choice	1	2	1	1	5
	Total		6	8	4	2	20

SECTION 8: CONCEPT OF ECONOMICS, COMMUNICATION AND AGRIBUSINESS

Weeks 21 and 22

Strand: Agricultural Economics, Agribusiness and Communication

Sub-Strand: Economics for Agriculture

Learning Outcome: Apply the knowledge and skills acquired to everyday life, agricultural production activities and business transactions.

Content Standard: Demonstrate knowledge, understanding and skills of the concepts and principles of demand and supply.

Week 23

Strand: Agricultural Economics, Agribusiness and Communication

Sub-Strand: Communication in agriculture

Learning Outcome: Use the knowledge and skills acquired to efficiently communicate in Agriculture and related issues.

Content Standard: Demonstrate knowledge, understanding and skills of human interaction that exist in agricultural enterprises.

Week 24

Strand: Agricultural Economics, Agribusiness and Communication

Sub-Strand: Agribusiness management

Learning Outcome: Use the knowledge and skills acquired to successfully manage an agribusiness.

Content Standard: Demonstrate knowledge, understanding and principles of establishing, financing and record keeping in agribusiness.

Hint

- *Remind learners to submit their Individual Projects in Week 22 for scoring.*
- *Remind learners to submit their Portfolio in Week 23 for scoring.*
- *Remind learners of End of Semester Examination in Week 24*
- *Refer to Appendix G at the end of this section for Table of specification.*

INTRODUCTION AND SECTION SUMMARY

Demand and supply are essential elements to consider in the establishment of an agricultural enterprise. They influence producer behaviour and the overall supply and demand of goods and services worldwide. Human interaction is integral in agricultural production and agribusiness in that it influences decisions, practices and outcomes across both sectors. Agricultural communication facilitates the spread of useful information to help boost agricultural activities. Maintaining accurate and up-to-date farm records help to optimise farm operations, enhance productivity and achieve financial sustainability. Good managerial skills are crucial for the profitability and sustainability of any farm business. This section will introduce learners to demand, supply and their principles. It will also cover the factors that affect demand and supply as well as demand/supply schedules and determinants of prices for an agricultural commodity. It will help learners to know the interactions between the sectors of agricultural production and enterprises, and the extent of human interaction. Learners will acquire the skills and abilities to communicate effectively and to be good managers. The procedure for establishing an agricultural enterprise and sources of finance for agricultural enterprises will be discussed. Learners will also gain the understanding of records and how they are kept. This section has links with other subjects including Business Studies, Economics, Home Economics, Government and Social Studies.

The weeks covered by the section are:

Week 21: Meaning, Principles, Factors and Schedules of Demand and Supply

Week 22: Interactions Among Humans, Agricultural Production and Enterprises, and Modes of Communication in Agriculture

Week 23: Procedure for Establishing Agricultural Enterprise and Sources of Finance for Agricultural Enterprises

Week 24: Meaning, Types, Importance and Methods of Records Keeping and Managerial Characteristics Required for Agribusiness Management.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical exemplars suggested for this section are managing talk for learning, think-pair-share, collaborative learning, initiating talk for learning, individual learning, inquiry-based learning, and problem-based learning. Teachers should use managing talk for learning, think-pair-share, collaborative learning and initiating talk for learning to help learners to express their views, elicit ideas about the various topics for discussion from them, build their confidence and promote good public speaking skills. Individual learning will offer learners the opportunity to express themselves for self-assessment and personal development. In terms of project-based and inquiry-based learning, learners will be expected to search the internet under the guidance and supervision of teachers, watch videos and documentaries, make inquiries for some information, create tables/graph, keep records and role play for hands on experiences.

Learners should be given ample time to embark on projects where necessary and present their results at an agreed time in case the time allocation in the class is not enough. Collaborative, communication, creative, critical thinking, digital literacy and leadership skills of learners will be enhanced as they search the internet, role play, practice hands-on activities, share their experiences and views. Teachers should ensure that learners do not access unapproved or illegal sites in the course of searching the internet for information. Teachers should ensure any videos/pictures used do not enforce stereotyping. All learners should be allowed to take part in all activities, and learn to respect, tolerate and accept the views of others.

ASSESSMENT SUMMARY

Assessment for this section will cover the meaning, principles, factors and schedules of demand and supply the interactions among humans, sectors of agricultural production and enterprises, modes of agricultural communication, establishment of agricultural enterprise, sources of financial for agricultural enterprises, record keeping and other characteristics required for the agribusiness management. The assessment questions should be geared towards the areas above taking into consideration different learning abilities and proficiency of learners. Learners should be assessed individually, in pairs and in various groups using both formative and summative assessment, The questions should also be well balanced with regards to the depth of knowledge (DoK). It should appropriately cover Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and level 4 (extended critical thinking and reasoning). The teacher should exhibit a high level of professionalism when accepting answers whether right or wrong and learners should be encouraged to tolerate, respect and accept the views of other. He/she should set up rubrics, marking schemes or scores cards to assess group presentations, projects, assignment and other works.

WEEK 21

Learning Indicators

1. Explain the meaning and principles of demand and supply.
2. Discuss the factors that influence demand and supply of agricultural commodities.
3. Create demand, supply schedules, and prepare graphs to show the determinants of prices for an agricultural commodity.

Focal Area 1: Meaning and Principles of Demand and Supply.

1. Meaning of Demand

Demand refers to the quantity of a good or service that consumers are willing and able to purchase at various prices over a given period. It is a fundamental concept in economics and is typically represented by the demand curve, which shows the relationship between the price of a good and the quantity demanded.

Key aspects of demand

- a. Price of the Good: Generally, as the price of a good decreases, the quantity demanded increases, and vice versa (law of demand).
- b. Income of Consumers: Higher consumer income typically increases demand for goods and services.
- c. Prices of Related Goods: The demand for a good can be affected by the prices of substitutes (goods that can replace each other) and complements (goods that are used together).
- d. Consumer Preferences: Changes in tastes and preferences can increase or decrease demand.
- e. Expectations of Future Prices: If consumers expect prices to rise in the future, they may increase current demand.
- f. Number of Buyers: An increase in the number of buyers can increase demand.

Demand can be categorised into different types, such as: **Individual Demand:** the demand of a single consumer and **Market Demand:** the total demand of all consumers in the market for a particular good or service.

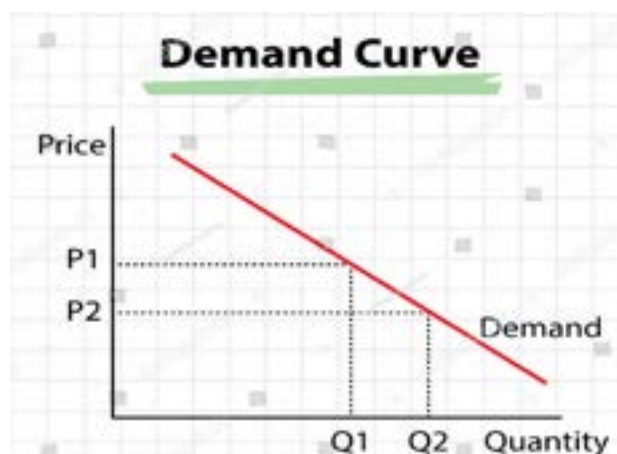


Figure 21.1: The Conventional Demand Curve

2. Change in Quantity Demanded

A change in quantity demanded refers to a movement along the same demand curve, which is caused by a change in the price of the good or service. The only factor that causes a change in quantity demanded is a change in the price of the good or service.

- a. **Price Increase:** Leads to a decrease in quantity demanded (movement up along the demand curve).
- b. **Price Decrease:** Leads to an increase in quantity demanded (movement down along the demand curve).

3. Change in Demand

A change in demand refers to a shift in the entire demand curve, either to the right (an increase in demand) or to the left (a decrease in demand). This shift is caused by factors other than the price of the goods or services. These factors include:

- a. **Consumer Income:** An increase in income can lead to higher demand for normal goods.
- b. **Preferences and Tastes:** Changes in consumer preferences can increase or decrease demand.
- c. **Prices of Related Goods:** The demand for a good can be affected by the prices of substitutes (goods that can replace it) or complements (goods that are used together with it).
- d. **Expectations:** If consumers expect prices to rise in the future, they might increase current demand.
- e. **Number of Buyers:** An increase in the number of consumers can raise demand

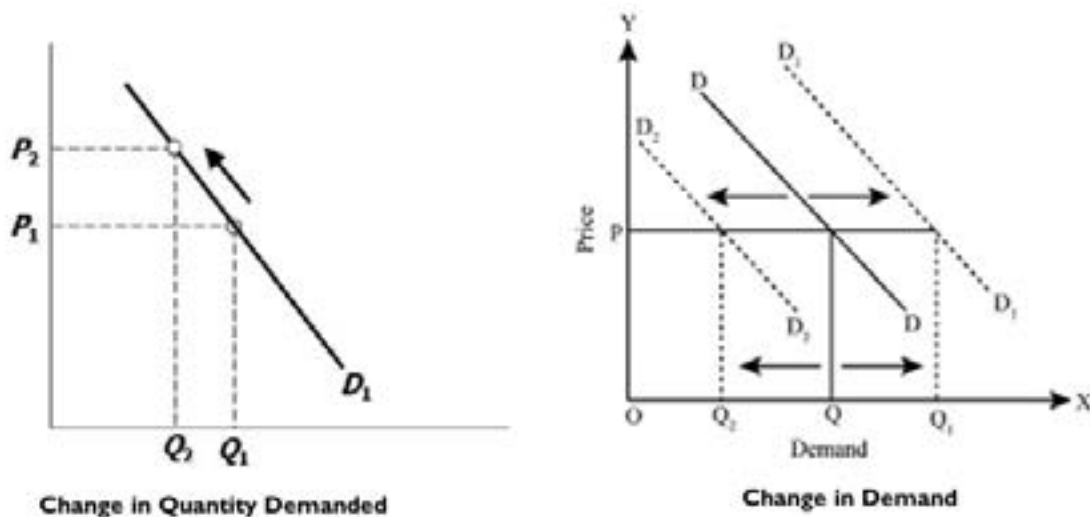


Figure 21.2: Change in Quantity Demanded and Change in Demand

4. Principles of Demand

The principles of demand are fundamental concepts in economics that describe how various factors influence the quantity of a good or service that consumers are willing and able to purchase. The key principles include:

- a. **Law of Demand**
 - i. **Definition:** The law of demand states that, ceteris paribus (all other things being equal), there is an inverse relationship between the price of a good or service and the quantity

demanded. As the price of a good decreases, the quantity demanded increases, and as the price increases, the quantity demanded decreases.

- ii. **Reason:** This occurs because consumers tend to buy more of a good when it is cheaper and less of it when it becomes more expensive.

b. Diminishing Marginal Utility

- i. **Definition:** This principle states that as a person consumes more units of a good or service, the additional satisfaction (utility) gained from consuming each additional unit decreases.
- ii. **Impact on Demand:** Because the additional satisfaction decreases with each additional unit consumed, consumers are generally willing to pay less for additional units, contributing to the downward slope of the demand curve.

c. Substitution Effect

- i. **Definition:** When the price of a good rises, consumers will typically substitute it with a cheaper alternative, leading to a decrease in the quantity demanded of the more expensive good.
- ii. **Example:** If the price of coffee increases significantly, consumers might buy more tea instead, assuming tea is a substitute for coffee.

d. Income Effect

- i. **Definition:** The change in consumption resulting from a change in real income (purchasing power) due to a change in the price of a good.
- ii. **Example:** If the price of a good decreases, consumers effectively have more real income to spend on that good or other goods, increasing the quantity demanded.

e. Tastes and Preferences

- i. **Definition:** Changes in consumer tastes and preferences can affect demand. If a good becomes more fashionable or popular, demand for it can increase, and vice versa.
- ii. **Example:** The rise in popularity of electric cars has increased demand for them.

f. Expectations of Future Prices

- i. **Definition:** If consumers expect prices to rise in the future, they may increase their current demand to avoid higher future prices. Conversely, if they expect prices to fall, they may delay purchases.
- ii. **Example:** If people expect the price of housing to increase, they may buy houses now rather than later.

g. Number of Buyers

- i. **Definition:** An increase in the number of consumers in a market increases the overall market demand for a good or service.
- ii. **Example:** An influx of new residents in a city can increase the demand for housing, groceries, and other goods and services in that area.

5. Meaning of Supply

Supply refers to the quantity of a good or service that producers are willing and able to offer for sale at various prices over a given period. 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:

- a. **Price of the Good:** Generally, as the price of a good increases, the quantity supplied also increases, and vice versa. This is because higher prices can lead to higher potential profits, motivating producers to increase production.
- b. **Cost of Production:** The cost of inputs (such as labour, raw materials, and capital) affects the supply. If production costs increase, the supply may decrease because it becomes less profitable for producers to make the goods or supply the services.
- c. **Technology:** Advances in technology can make production more efficient, increasing the supply of a good by reducing costs and increasing output.
- d. **Number of Producers:** An increase in the number of producers in the market increases the overall supply of goods.
- e. **Expectations of Future Prices:** If producers expect prices to rise in the future, they may hold back current production to sell more later at higher prices, reducing current supply.
- f. **Government Policies:** Taxes, subsidies, and regulations can impact supply. For example, subsidies can increase supply by lowering production costs, while taxes and regulations might decrease supply by increasing costs.
- g. **Natural Conditions:** Factors such as weather, natural disasters, and seasonal changes can affect the supply of goods, particularly agricultural products.

Supply can be categorised into different types: Individual Supply: The supply of a single producer and Market Supply: The total supply of all producers in the market for a particular good or service.

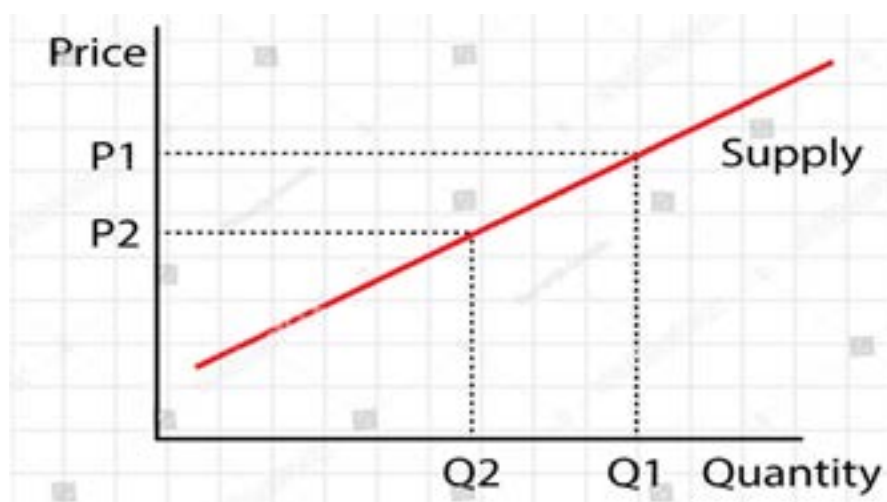


Figure 21.3: *The Conventional Supply Curve*

6. Change in Quantity Supplied

A change in quantity supplied refers to a movement along the same supply curve, which is caused by a change in the price of the good or service. The only factor that causes a change in quantity supplied is a change in the price of the good or service.

- a. **Price Increase:** Leads to an increase in quantity supplied (movement up along the supply curve).
- b. **Price Decrease:** Leads to a decrease in quantity supplied (movement down along the supply curve).

7. Change in Supply

A change in supply refers to a shift in the entire supply curve, either to the right (an increase in supply) or to the left (a decrease in supply). This shift is caused by factors other than the price of the goods or service. These factors include:

- a. **Production Costs:** Changes in the cost of inputs (e.g., raw materials, labour) can affect supply.
- b. **Technology:** Advances in technology can make production more efficient, increasing supply.
- c. **Number of Sellers:** An increase in the number of sellers typically increases supply.
- d. **Expectations:** If producers expect higher prices in the future, they might reduce current supply.
- e. **Government Policies:** Taxes, subsidies, and regulations can influence supply.

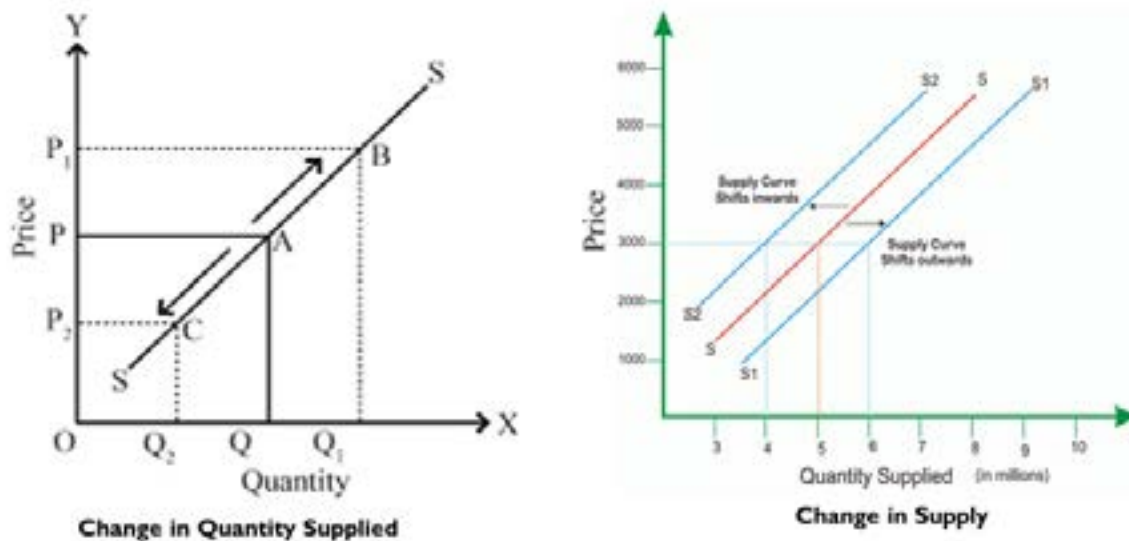


Figure 21.4: Change in Quantity Supplied and Change in Supply

8. Principles of Supply

The principles of supply are fundamental concepts in economics that describe how various factors influence the quantity of a good or service that producers are willing and able to offer for sale. The key principles include:

- a. **Law of Supply**
 - i. **Definition:** The law of supply states that, ceteris paribus (all other things being equal), there is a direct relationship between the price of a good or service and the quantity supplied. As the price of a good increases, the quantity supplied also increases, and as the price decreases, the quantity supplied decreases.

- ii. **Reason:** Higher prices provide an incentive for producers to supply more of a good because higher prices can lead to higher potential profits.

b. **Cost of Production**

- i. **Definition:** The cost of inputs required to produce a good (such as labour, raw materials, and capital) affects the quantity supplied. If production costs increase, the supply may decrease because it becomes less profitable for producers to make the good.
- ii. **Impact:** Producers will supply more at higher prices to cover higher production costs and still make a profit.

c. **Technological Advances**

- i. **Definition:** Improvements in technology can increase supply by making production more efficient, reducing costs, and increasing output.
- ii. **Impact:** Technological advancements can shift the supply curve to the right, indicating an increase in supply at all price levels.

d. **Number of Producers**

- i. **Definition:** An increase in the number of producers in the market increases the overall supply of a good.
- ii. **Impact:** More producers entering the market can lead to greater competition and higher overall supply.

e. **Expectations of Future Prices**

- i. **Definition:** If producers expect prices to rise in the future, they may hold back current production to sell more later at higher prices, reducing current supply.
- ii. **Impact:** Future price expectations can lead to changes in current supply levels as producers adjust their output in anticipation.

f. **Government Policies**

- i. **Taxes:** Taxes on production can increase costs and decrease supply.
- ii. **Subsidies:** Subsidies can lower production costs and increase supply.
- iii. **Regulations:** Regulations can either increase production costs (leading to decreased supply) or provide incentives for increased supply through favorable policies.
- iv. **Impact:** Government interventions can significantly impact supply by altering production costs and incentives.

g. **Natural Conditions**

- i. **Definition:** Factors such as weather, natural disasters, and seasonal changes can affect the supply of goods, particularly agricultural products.
- ii. **Impact:** Favourable natural conditions can increase supply, while adverse conditions can decrease it.

Learning Tasks

1. State the meaning of demand and supply.
2. Explain the factors that influence demand and supply of Agricultural commodity.
3. Draw demand and supply curves and discuss the determinants of prices for an Agricultural commodity.

Pedagogical Exemplars

1. **Managing talk for learning:** Learners in mixed-ability groups surf the internet for information on demand and supply and discuss their findings in class. Learners who have difficulties in using the internet should be provided with links and support that will help them search for the needed information. Remind learners not to go into unapproved or illegal sites as they surf the internet. Confident learners should be allowed to play lead roles in the discussion under the guidance of the teacher. All learners should accept and respect each other's views during the discussion.
2. **Think-pair-share:** In pairs, learners discuss the meaning and principles of demand and supply. The teacher can use leading questions to help learners to come up with the meaning and principles of demand and supply. All learners should accept and respect each other's views. Teachers should praise learners for their contributions and learners could be invited to applaud their peers.
3. **Individual learning:** Individual learners watch videos/charts on how demand and supply affect pricing of agricultural produce and write a report on their findings. Teachers should ensure that the videos/pictures used do not enforce stereotyping and if they do, teachers should discuss with learners.

Key Assessments

Assessment Level 1: State the meaning of demand and supply.

Assessment Level 2: Explain at least two (2) principles of demand.

Assessment Level 3: Discuss the extent to which the cost of production and number of producers can impact on the supply of an agricultural commodity.

Assessment Level 4: Draw a demand curve and analyse how consumer preferences and expectations of future prices will influence the demand for maize.

Focal Area 2: Factors that Influence Demand and Supply of Agricultural Commodities

1. 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:

- a. **Price of the Commodity:** As with most goods, the price of the commodity itself is a primary factor. Generally, a decrease in price will increase the quantity demanded, while an increase in price will decrease the quantity demanded.
- b. **Income of Consumers:** Higher consumer incomes typically increase the demand for agricultural products, especially for higher-quality or organic goods. Conversely, lower incomes can decrease demand, particularly for non-essential or premium products.
- c. **Population Growth:** An increasing population generally leads to higher demand for agricultural commodities as more people need food.
- d. **Consumer Preferences and Tastes:** Changes in consumer preferences, influenced by trends, health consciousness, cultural factors, and information about the nutritional benefits or risks associated with certain foods, can significantly impact demand. For example, a trend toward plant-based diets can increase the demand for vegetables and legumes.
- e. **Substitute Goods:** The availability and price of substitute goods can influence demand. For instance, if the price of poultry increases, consumers might switch to beef or pork, affecting the demand for these commodities.
- f. **Complementary Goods:** The demand for agricultural commodities can also be affected by the demand for complementary goods. For example, an increase in demand for peanut butter can lead to an increase in demand for peanuts.
- g. **Seasonality:** Some agricultural products have seasonal demand. For instance, the demand for certain animals, fruits and vegetables increases during specific seasons or holidays.
- h. **Government Policies and Subsidies:** Policies such as subsidies, tariffs and import/export regulations can impact the demand for domestic agricultural products. Subsidies might lower prices and increase demand, while tariffs on imported goods can boost demand for local products.
- i. **Global Market Trends:** Agricultural commodities are often traded globally. International demand, influenced by global economic conditions, trade policies, and changes in dietary habits, can affect local demand.
- j. **Health and Safety Concerns:** Food safety scares or health concerns related to specific agricultural products can drastically reduce demand. Conversely, positive health reports can boost demand.
- k. **Advertising and Marketing:** Effective advertising and marketing campaigns can increase consumer awareness and preference for certain agricultural commodities, thereby boosting demand.
- l. **Technological Advancements:** Technological advancements in food processing, preservation and transportation can influence demand by making certain agricultural products more accessible or appealing.
- m. **Economic Conditions:** General economic conditions, such as inflation, unemployment rates, and economic growth, can impact consumer purchasing power and demand for agricultural commodities.
- n. **Availability and Accessibility:** The availability of agricultural products in local markets and the efficiency of distribution networks can affect demand. Limited availability or accessibility can constrain demand even if consumers desire the product.

2. 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:

- a. **Weather and Climate:** Weather conditions and climate are critical factors. Favourable weather conditions can enhance crop yields, while adverse weather such as droughts, floods or storms can reduce supply.
- b. **Technological Advancements:** Improvements in agricultural technology, such as better irrigation methods, genetically modified crops and advanced machinery, can increase the efficiency, quality and quantity of agricultural production.
- c. **Cost of Inputs:** The costs of inputs like seeds, fertilisers, pesticides, water and labour directly affect the supply. Higher input costs can reduce supply as it becomes more expensive for farmers to produce goods.
- d. **Government Policies:** Subsidies, taxes and regulations can significantly influence supply. Subsidies can lower production costs and increase supply, while taxes and stringent regulations can raise costs and reduce supply. Import and export policies also impact supply by either restricting or promoting the flow of agricultural goods across borders.
- e. **Market Prices:** The expected market prices of agricultural commodities can influence supply. Higher expected prices can encourage farmers to increase production, while lower expected prices can have the opposite effect.
- f. **Availability of Resources:** The availability of natural resources such as arable land, water and minerals are crucial for agricultural production. Limited access to these resources can constrain supply.
- g. **Access to Credit and Financing:** Farmers' ability to access credit and financing can impact their capacity to invest in inputs, technology and infrastructure, thereby influencing supply.
- h. **Pest and Disease Outbreaks:** Outbreaks of pests and diseases can severely affect crop yields and livestock health, reducing the supply of affected commodities.
- i. **Labour Availability:** The availability and cost of labour are important factors. Shortages of labour, especially during critical periods like planting and harvesting, can limit supply.
- j. **Global Trade Conditions:** International trade agreements, tariffs and trade barriers affect the global supply of agricultural commodities. For example, trade restrictions can limit the supply of imported agricultural goods.
- k. **Storage and Transportation Infrastructure:** Adequate storage facilities and efficient transportation networks are essential for maintaining the supply of agricultural products. Poor infrastructure can lead to losses and reduced supply.
- l. **Technological Diffusion:** The rate at which new technologies are adopted by farmers can influence supply. Rapid adoption of high-yield varieties or efficient farming techniques can increase supply.
- m. **Economic Conditions:** Overall economic conditions, including inflation, interest rates, and economic growth, can affect the cost of inputs and the availability of investment in agriculture, thereby influencing supply.

Learning Tasks

1. State the factors that influence the demand of an agricultural commodity.
2. Explain the factors that influence the supply of an agricultural commodity.
3. Discuss how the factors of supply influence agricultural production.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in mixed-gender groups search the internet for information on the factors that affect demand and supply. Learners who are proficient in the use of the internet should be encouraged to support those with difficulties in searching for information. The teacher should also monitor the content of what learners browse to make sure no inappropriate or illegal sites are accessed. Teacher should ensure that all learners fully participate in the exercise.
2. **Think-pair-share:** Learners in pairs discuss the factors that affect demand and supply and build a portfolio using the factors identified. The teacher can use probing questions to assist learners to come up with the meaning factors that affect demand and supply. The teacher can also support learners with samples of portfolios. All learners should be encouraged to take part in all activities and accept and respect each other's views.
3. **Project-based learning:** Learners in mixed-ability groups watch a video on the effects of shifts in the demand and supply curves, and discuss and write a report on it. Teachers should ensure that the videos/pictures used should not enforce stereotyping and if they do, teachers should discuss it with learners. Teachers should ensure that all learners are involve in the class discussions and report presentation.

Key Assessments

Assessment Level 1: List the factors that influence the supply of an agricultural commodity.

Assessment Level 2: Explain the factors that influence the demand of an agricultural commodity.

Assessment Level 3: Analyse how government policies influence supply of an agricultural commodity.

Assessment Level 4: Build and present a portfolio on the factors that affect demand and supply of an agricultural commodity.

Focal Area 3: Demand and Supply Schedules and Determinants of Prices for an Agricultural Commodity

1. 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., Maize:

Week 21, Table 1: Demand Schedule for Maize

Price per bag	Quantity Demanded (Maize)
GHS 500.00	1000
GHS 450.00	1200
GHS 400.00	1500
GHS 350.00	1800
GHS 300.00	2200

In this schedule, as the price of maize decreases, the quantity demanded increases, illustrating the law of demand.

a. **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.

i. **Demand-Side Determinants**

- **Consumer Income:** Higher incomes can increase the demand for agricultural commodities, potentially raising prices, especially for premium products.
- **Consumer Preferences:** Changes in tastes and preferences, influenced by trends, health information and cultural factors, can affect demand and thus prices. For example, increased demand for organic produce can drive up prices for those goods.
- **Population Growth:** An increasing population generally leads to higher demand, potentially raising prices.
- **Prices of Substitute Goods:** The availability and prices of substitute goods can affect demand. If the price of a substitute (e.g., rice) rises, the demand for corn may increase, leading to higher prices.
- **Prices of Complementary Goods:** The demand for goods used together with the agricultural commodity can influence the price. For example, if the price of livestock feed rises, it can reduce the demand for corn used in feed, affecting corn prices.
- **Seasonality:** Seasonal variations can affect demand. For example, demand for certain fruits may increase during specific seasons, affecting their prices.
- **Consumer Expectations:** Expectations about future prices can influence current demand. If consumers expect prices to rise, they may purchase more now, increasing current prices.

ii. **Supply-Side Determinants**

- **Weather and Climate:** Adverse weather conditions such as droughts or floods can reduce supply, driving up prices. Conversely, favourable weather can increase supply and lower prices.
- **Technological Advancements:** Improvements in agricultural technology can increase supply, potentially lowering prices. For instance, better irrigation techniques or pest-resistant crops can enhance yields.

- **Cost of Inputs:** Changes in the cost of inputs like seeds, fertilisers, and labour directly impact production costs and supply. Higher input costs can reduce supply, raising prices.
- **Government Policies:** Subsidies, taxes, tariffs and regulations can significantly impact prices. Subsidies might lower production costs and increase supply, reducing prices. Conversely, tariffs on imported goods can increase domestic prices.
- **Global Trade Conditions:** International trade agreements, tariffs and trade barriers affect global supply and prices. For example, restrictions on exports can reduce global supply and increase prices.
- **Pest and Disease Outbreaks:** Outbreaks of pests and diseases can significantly reduce or decimate crop yields, decreasing supply and increasing prices.
- **Natural Disasters:** Events like hurricanes, earthquakes and floods can disrupt supply chains and reduce supply, driving up prices.
- **Economic Conditions:** Inflation, interest rates and overall economic health can influence production costs and consumer purchasing power, affecting supply and prices.
- **Storage and Transportation:** Efficient storage and transportation infrastructure can reduce losses and increase supply, potentially lowering prices. Conversely, inefficiencies can lead to higher prices.

iii. Interplay Between Supply and Demand

The equilibrium price of an agricultural commodity is determined by the intersection of supply and demand in the market. Changes in any of the above determinants can shift the supply and demand curves, leading to new equilibrium prices. For example:

- An increase in consumer income can shift the demand curve to the right, raising prices.
- A technological breakthrough that lowers production costs can shift the supply curve to the right, lowering prices.
- Adverse weather that reduces crop yields can shift the supply curve to the left, raising prices.

2. 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., rice:

Week 21, Table 2: Supply Schedule for Rice

Price per Bag (GHS)	Quantity Supplied (Bags)
200	1000
400	2000
600	3000
800	4000
1000	5000

In this schedule, as the price of rice increases, the quantity supplied also increases, illustrating the law of supply.

a. **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:

i. **Supply-Side Determinants**

- **Weather and Climate Impact:** Favourable weather conditions can enhance crop yields and increase supply, leading to lower prices. Conversely, adverse weather such as droughts, floods or extreme temperatures can reduce supply and increase prices.
- **Technological Advancements Impact:** Technological improvements in farming methods, irrigation, pest control and crop varieties can increase production efficiency and output, leading to an increase in supply and potentially lower prices.
- **Cost of Inputs Impact:** The costs of inputs such as seeds, fertilisers, pesticides, machinery and labour directly affect the cost of production. Higher input costs can decrease supply by making production less profitable, leading to higher prices. Conversely, lower input costs can increase supply and lower prices.
- **Government Policies Impact:** Policies such as subsidies, taxes, tariffs and regulations can significantly influence supply. Subsidies can reduce production costs and increase supply, lowering prices. Taxes and tariffs can increase costs and reduce supply, raising prices. Regulations can either support or hinder production.
- **Global Trade Conditions Impact:** International trade agreements, tariffs and trade barriers affect the global supply and prices of agricultural commodities. For example, trade restrictions can reduce the availability of certain commodities in the global market, raising prices.
- **Pest and Disease Outbreaks Impact:** Outbreaks of pests and diseases can devastate crops and reduce supply, leading to higher prices. Effective pest and disease management can help maintain supply and stabilise prices.
- **Natural Disasters Impact:** Events such as hurricanes, earthquakes and floods can disrupt Agricultural production and supply chains, reducing supply and increasing prices.
- **Labour Availability Impact:** The availability and cost of labour is crucial for agricultural production. Labour shortages can reduce supply and increase prices, while an abundant and affordable labour force can enhance supply and lower prices.
- **Storage and Transportation Impact:** Adequate storage facilities and efficient transportation infrastructure are essential for maintaining the supply of agricultural products. Poor infrastructure can lead to losses and reduced supply, driving up prices.
- **Access to Credit and Financing Impact:** Farmers' ability to access credit and financing can impact their capacity to invest in inputs, technology and infrastructure, thereby influencing supply. Limited access to financing can constrain supply, while easy access can boost it.

ii. Demand-Side Determinants

- **Consumer Income Impact:** Higher consumer incomes can increase the demand for agricultural commodities, potentially raising prices, especially for premium or organic products.
- **Consumer Preferences and Tastes Impact:** Changes in consumer preferences, influenced by trends, health information and cultural factors, can affect demand and thus prices. For example, increased demand for organic produce can drive up prices for those goods.
- **Population Growth Impact:** An increasing population generally leads to higher demand, potentially raising prices.
- **Prices of Substitute Goods Impact:** The availability and prices of substitute goods can affect demand. If the price of a substitute (e.g., rice) rises, the demand for maize may increase, leading to higher prices.
- **Prices of Complementary Goods:** Impact: The demand for goods used together with the agricultural commodity can influence the price. For example, if the price of livestock feed rises, it can reduce the demand for maize used in feed, affecting maize prices.
- **Seasonality:** Impact: Seasonal variations can affect demand. For example, demand for certain fruits may increase during specific seasons, affecting their prices.
- **Consumer Expectations Impact:** Expectations about future prices can influence current demand. If consumers expect prices to rise, they may purchase more now, increasing current prices.

iii. Interplay Between Supply and Demand

The equilibrium price of an agricultural commodity is determined by the intersection of supply and demand in the market. Changes in any of the above determinants can shift the supply and demand curves, leading to new equilibrium prices. For example:

- **Increase in Supply:** Technological advancements or favourable weather can shift the supply curve to the right, increasing supply and potentially lowering prices.
- **Decrease in Supply:** Adverse weather, pest outbreaks or increased input costs can shift the supply curve to the left, decreasing supply and raising prices.
- **Increase in Demand:** Population growth, higher incomes or changes in consumer preferences can shift the demand curve to the right, raising prices.
- **Decrease in Demand:** Lower incomes, availability of substitutes or changing tastes can shift the demand curve to the left, lowering prices.

Learning Tasks

1. State the meaning of demand and supply schedules.
2. Explain the demand schedules and determinants of prices for an agricultural commodity.
3. Discuss the supply schedules and determinants of prices for an agricultural commodity.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in a mixed-gender groups watch a video on the determinants of price for an agricultural commodity and prepare a table/graph on the demand and supply schedules. In the same groups learners mimic a demand and supply scenario. Teachers should encourage all learners to pay attention when watching video and actively participate in the drawing of table/graph on the demand and supply schedules. Confident learners can take lead roles in preparing the table/graphs for the learners with additional support needs to draw inspiration from them.
2. **Project-based learning (Homework):** In mixed-ability groups, learners design a questionnaire with a maximum of eight questions on supply and demand schedules and determinants of prices. Learners administer the question at the school market and present their report. Teachers should encourage all learners to participate in all activities (design, and administration questionnaire, data analysis, reporting writing and presentation).

Key Assessments

Assessment Level 1: Define what is meant by a demand schedule in agricultural production.

Assessment Level 2: Explain the meaning of supply schedules in agricultural production.

Assessment Level 3:

1. Examine the effects of the interplay between supply and demand on a particular agricultural commodity.
2. Explain five determinants of price for an agricultural commodity in your local market.

Assessment Level 4: Prepare a table on demand and supply schedules and show how they determine prices of an agricultural commodity.

Hint



*The recommended mode of assessment for week 21 is **peer assessment**. Use the level 3 question 2 as a sample question.*

WEEK 22

Learning Indicators

1. *Discuss the interactions between the sectors of agricultural production and enterprises, and the extent of human interaction.*
2. *Discuss the various modes of communication in agriculture.*

Focal Area 1: Interactions Between the Sectors of Agricultural Production and Enterprises, and the Extent of Human Interaction

1. The Interactions Between the Sectors of Agricultural Production and Enterprises, and the Extent of Human Interaction

The interactions between the sectors of agricultural production and enterprises are complex and multifaceted, involving various aspects of the economy, society and environment. Human interaction plays a crucial role in these interactions, influencing and being influenced by a range of factors.

Overview

a. Supply Chain and Market Dynamics

- i. **Production to Market:** Agricultural production is the starting point of the supply chain, providing raw materials for food processing enterprises, textile industries, biofuel companies and other businesses.
- ii. **Market Demand:** Enterprises influence agricultural production through market demand. Consumer preferences and purchasing power affect what crops or livestock are produced.
- iii. **Price Setting:** Market prices are determined by the interaction between agricultural producers and enterprises, with factors such as supply, demand and external economic conditions playing a role.

b. Technological Advancements

- i. **Innovation:** Enterprises often drive technological advancements that can be adopted by agricultural producers, such as precision farming technologies, biotechnology and sustainable farming practices.
- ii. **Research and Development (R&D):** Collaboration between agricultural sectors and enterprises in R&D can lead to innovations that enhance productivity and sustainability.

c. Policy and Regulation

- i. **Government Policies:** Agricultural policies, subsidies and regulations affect how agricultural production is conducted and how enterprises operate. Policies on trade, environmental protection and food safety are particularly influential.
- ii. **Corporate Practices:** Enterprises may adopt practices that impact agricultural production, such as sourcing policies, sustainability commitments and corporate social responsibility initiatives.

d. Environmental Impact

- i. **Sustainable Practices:** Both sectors have a significant impact on the environment. Enterprises can promote sustainable agricultural practices by demanding eco-friendly products and supporting sustainable farming initiatives.
- ii. **Resource Management:** Efficient management of natural resources (water, soil, biodiversity) is essential. Enterprises can contribute by investing in sustainable resource management practices.

e. Economic and Social Factors

- i. **Employment:** Agricultural production and enterprises both provide employment opportunities, contributing to rural and urban economies.
- ii. **Rural Development:** Enterprises investing in rural areas can stimulate economic development, improve infrastructure and enhance the quality of life for agricultural communities.

f. Global Trade

- i. **Exports and Imports:** Agricultural products are traded globally, and enterprises play a key role in exporting and importing these products. Trade agreements and global market conditions significantly influence these interactions.
- ii. **Supply Chain Resilience:** Ensuring a resilient supply chain involves collaboration between agricultural producers and enterprises, particularly in the face of global challenges such as climate change and pandemics.

g. Human Interaction

- i. **Farmers and Workers:** Farmers, labourers and workers are directly involved in agricultural production and related enterprises. Their skills, knowledge and labour are critical to the success of both sectors.
- ii. **Consumers:** Consumer choices and preferences influence both agricultural production and enterprise operations. Trends such as organic farming, local sourcing and fair-trade impact how businesses and farms operate.
- iii. **Stakeholder Engagement:** Effective communication and collaboration among stakeholders (farmers, enterprises, governments, NGOs, and consumers) are essential for addressing challenges and leveraging opportunities in both sectors.

Learning Tasks

1. List some of the interactions between the sectors of agricultural production and enterprises.
2. Explain the interactions between the sectors of agricultural production and enterprises.
4. Discuss the interactions between the sectors of agricultural production and enterprises, and the extent of human interaction.

Pedagogical Exemplars

1. **Inquiry-based Learning:** In mixed-gender groups, learners search the internet for information on the sectors of agricultural production and enterprises and the extent of human interaction. Learners who are proficient in the use of the internet should be encouraged to support those with additional support needs in searching for information. The teacher should monitor the content of what learners browse to make sure no inappropriate or illegal sites are accessed. Where necessary the teacher should support learners with useful websites on the sectors of agricultural production and enterprises and the extent of human interaction. The teacher should also ensure that all learners actively participate in the exercise.
2. **Think-pair-share:** Learners in pairs discuss the sectors of agricultural production and enterprises and the degree of human interaction and present a report from their discussions. Teacher should involve all learners in class discussions and presentation of reports. The teacher can use leading questions to support learners to come up with a list of the sectors of agricultural production and enterprises. Others should be allowed to explain or discuss the interactions between the sectors of agricultural production and enterprises, and the extent of human interaction. Learners should tolerate and respect each other's views during discussions. Both teachers and learners should recognise and respect all contributions from learners.

Key Assessments

Assessment Level 1: State at least three (3) interactions between the sectors of agricultural production and enterprises.

Assessment Level 2: Explain how government policies play a crucial role in agricultural production.

Assessment Level 3: Discuss the interactions between the sectors of agricultural production and enterprises, and the extent of human interaction.

Assessment Level 4: Conduct simple research on the interactions between the sectors of agricultural production and enterprises, and indicate how these benefit humans.

Focal Area 2: Various Modes of Communication in Agriculture

1. The Modes of Communication in Agriculture

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:

a. Traditional Methods

- i. Face-to-Face Meetings:** Direct interaction between farmers, extension workers, and other stakeholders.
- ii. Field Days and Demonstrations:** Events where farmers can see new techniques and technologies in action.
- iii. Farmer Cooperatives and Associations:** Group meetings where members meet, share information and discuss new techniques and resources.

b. Print Media

- i. Newspapers and Magazines:** Articles and advertisements about agricultural practices, news and market trends.
- ii. Brochures and Flyers:** Printed materials distributed during events or through agricultural offices.

c. Electronic Media

- i. Radio:** Programs and announcements targeting rural communities with information on weather, prices and best practices.
- ii. Television:** Agricultural shows and news segments that highlight innovations, weather forecasts and market updates.

d. Digital and Online Communication

- i. Mobile Phones and SMS:** Alerts and updates on weather, market prices and pest outbreaks.
- ii. Social media:** Platforms like Facebook, WhatsApp, and YouTube can be used for sharing information, training videos and highlighting farmer groups.
- iii. Websites and Blogs:** Online resources providing detailed articles, guides and updates on current and new agricultural topics.
- iv. Email Newsletters:** Regular updates sent to subscribers about new research, events and market trends.

e. Educational and Extension Services

- i. Workshops and Training Programs:** Organised by agricultural extension services, NGOs and educational institutions.
- ii. Extension Agents:** Professionals who visit farms to provide advice, training and support.
- iii. Farmer Field Schools:** Collaborative learning sessions conducted in the field.

f. Interactive Platforms

- i. Webinars and Online Courses:** Virtual training sessions that allow for interaction, and quality and assurance purposes.
- ii. Mobile Apps:** Applications providing information on crop management, pest control, and market prices.
- iii. Online Forums and Discussion Groups:** Platforms where farmers and experts can share experiences and advice.

g. Innovative Technologies

- i. Drones and Remote Sensing:** Tools for monitoring crop health and providing real-time data.
- ii. GIS and Precision Agriculture Tools:** Systems for managing resources more efficiently and making data-driven decisions.

- iii. **Artificial Intelligence and Machine Learning:** Tools for predicting trends, diagnosing issues and optimising processes.



Figure 22.1: Various methods used for communication in agriculture

Learning Tasks

1. Identify common communication modes in agricultural production
2. Explain the various communication modes in agricultural production
3. Discuss how digital and online communication can promote agricultural production.

Pedagogical Exemplars

1. **Think-pair-share:** In pairs, learners search the internet for information on the modes of communication in agriculture and present their findings in class. Teachers should ensure that all learners fully participate in the exercise. Learners having difficulty in searching the internet should be helped with the sites for the needed information. Learners who are proficient in searching the internet can help those who have difficulty under the teacher's supervision to prevent them from accessing into unapproved or illegal sites. Allow each learner to present his/her work to a different person in class for feedback. Learners should accept and respect the view of others.
2. **Project based learning:** In a mixed- gender groups, learners watch a short documentary on the various modes of communication in agriculture. They can then practice the various modes of communication among other groups in class. Videos/pictures used should not enforce stereotyping and if they do, teachers should discuss them with learners.

Key Assessments

Assessment Level 1: List at least three (3) modes of communication in Agriculture.

Assessment Level 2: Explain at least two (2) modes of communication in Agriculture.

Assessment Level 3: Discuss the extent to which interactive and online platforms can contribute to agriculture production.

Assessment Level 4:

1. Demonstrate the use of face-to-face meetings to communicate an innovative agricultural activity you have learnt to the class.
2. Role play an agricultural educator explaining sustainable farming practices to a group of farmers during a field day demonstration.

Hint



The recommended mode of assessment for week 22 is role play. Use the level 4 question 2 as a sample question.

WEEK 23

Learning Indicators

1. *Discuss the procedure for the establishment of agricultural enterprises*
2. *Discuss the sources of finance for agricultural enterprises*

Focal Area 1: Procedure for the Establishment of Agricultural Enterprises

1. The Procedure for Establishment of Agricultural Enterprise

Establishing an agricultural enterprise involves several critical steps that range from planning and legal compliance to financing and operational setup. The detailed process for establishing an agricultural enterprise is:

a. Conduct Market Research

- i. **Identify Market Needs:** Understand the demand for specific agricultural products or services in your target market.
- ii. **Analyse Competition:** Assess the competitive landscape to identify potential opportunities and threats.
- iii. **Evaluate Market Trends:** Investigate current and future trends in the agricultural sector, including consumer preferences, technological advancements and regulatory changes.

b. Develop a Business Plan

- i. **Define Business Goals:** Outline the short-term and long-term objectives of your enterprise.
- ii. **Detail Products/Services:** Specify the agricultural products or services you will offer.
- iii. **Market Strategy:** Develop strategies for marketing, sales, and distribution.
- iv. **Financial Projections:** Prepare detailed financial statements, including profit and loss projections, cash flow analysis and funding requirements.
- v. **Operational Plan:** Describe the operational processes, including production methods, equipment needed and staffing requirements.

c. Legal and Regulatory Compliance

- i. **Choose a Business Structure:** Decide on the legal structure of your enterprise (e.g., sole proprietorship, partnership, corporation, cooperative).
- ii. **Register the Business:** Register your enterprise with the relevant government authorities to obtain a business license and tax identification number.
- iii. **Obtain Permits and Licenses:** Secure the necessary permits and licenses specific to Agricultural operations (e.g., environmental permits, health and safety permits).
- iv. **Comply with Zoning Laws:** Ensure that your agricultural activities comply with local zoning regulations.

d. **Secure Financing**

- i. **Identify Funding Sources:** Explore various funding options such as personal savings, loans, grants, venture capital or group loans
- ii. **Prepare Funding Proposals:** Create compelling proposals and business plans to present to potential investors or lenders.
- iii. **Apply for Grants and Subsidies:** Research and apply for agricultural grants and subsidies offered by government agencies or NGOs.

e. **Acquire Land and Resources**

- i. **Select Suitable Land:** Choose land based on factors such as soil quality, climate, water availability and proximity to markets.
- ii. **Purchase or Lease Land:** Depending on your budget and long-term plans, decide whether to purchase or lease the land.
- iii. **Procure Equipment and Inputs:** Acquire the necessary farming equipment, seeds, fertilisers, pesticides and other inputs.

f. **Infrastructure Development**

- i. **Develop Infrastructure:** Build or improve necessary infrastructure such as irrigation systems, storage facilities, greenhouses and processing units.
- ii. **Ensure Utilities:** Set up essential utilities, including water supply, electricity and waste management systems.

g. **Hiring and Training**

- i. **Recruit Staff:** Hire skilled and unskilled labour as per the operational needs of your enterprise.
- ii. **Training Programmes:** Implement training programmes to enhance the skills and knowledge of your workforce, focusing on modern agricultural practices and safety standards.

h. **Implement Production Plan**

- i. **Begin Production:** Start the agricultural production process following best practices and sustainability principles.
- ii. **Monitor and Manage:** Regularly monitor the production process to ensure quality and efficiency. Implement management practices for pest control, soil health and crop/livestock management.

i. **Marketing and Sales**

- i. **Develop Marketing Materials:** Create marketing materials such as brochures, websites, and social media profiles to promote your products.
- ii. **Establish Distribution Channels:** Set up distribution channels to ensure your products reach the market efficiently. This can include direct sales, farmers' markets, wholesalers, and retailers.
- iii. **Build Customer Relationships:** Develop relationships with customers, providing excellent service and gathering feedback to improve your offerings.

j. Financial Management

- i. **Set Up Accounting Systems:** Implement robust accounting systems to manage finances, track expenses, and monitor cash flow.
- ii. **Budgeting and Forecasting:** Regularly update financial forecasts and budgets to ensure financial health and plan for future growth.
- iii. **Tax Compliance:** Ensure timely payment of taxes and compliance with all financial regulations.

k. Continuous Improvement

- xii. **Evaluate Performance:** Regularly assess the performance of your agricultural enterprise against the set goals and objectives. Where appropriate or required, adjust what you do to meet market demand and keep the business in operation.
- xiii. **Adopt Innovations:** Stay updated with the latest agricultural technologies and practices to continuously improve productivity and sustainability.
- xiv. **Seek Feedback:** Gather feedback from customers, employees and other stakeholders to identify areas for improvement.

Learning Tasks

1. List the procedures for the establishment of an agricultural enterprise.
2. Explain how to conduct market research prior to establishing an agricultural enterprise.
3. Discuss the procedures for establishment of an agricultural enterprise.

Pedagogical Exemplars

1. **Initiating talk for learning:** Brainstorm in pairs to come up with the procedures for establishing an agricultural enterprise. The teacher should ensure that all learners actively participate in the brainstorming and discussions. Use leading questions to help elicit responses from learners with additional support needs. Learners who have the ability should be encouraged to provide further explanation or discussions on the procedures for establishment of agricultural enterprise.
2. **Inquiry-based learning:** In mixed-ability groups, learners inquire about agricultural enterprises in their community and how they were established or watch a video on the procedures for establishing an agricultural enterprise. Learners then make a presentation on the procedures involved in establishment of a chosen agricultural enterprise. Teachers should ensure that videos do not enforce stereotyping and if they do, teachers should discuss them with learners. Confident learners should be allowed to play lead roles in the discussion under the guidance of the teacher. All learners should tolerate and respect each other's views during the discussion.

Key Assessments

Assessment Level 1: State at least three (3) procedures for establishing an agricultural enterprise.

Assessment Level 2: Explain how land acquisition and resource contribute to establishing an agricultural enterprise.

Assessment Level 3: Discuss the extent to which infrastructure development can enhance the development of an agricultural enterprise to boost Ghana's economy.

Assessment Level 4: Develop a simple agricultural enterprise for maize or poultry production.

Focal Area 2: Sources of Finance for Agricultural Enterprises

1. 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:

a. Traditional Bank Loans

- i. **Commercial Banks:** Offer loans and credit facilities tailored for agricultural purposes, including short-term and long-term loans.
- ii. **Development Banks:** Specialised banks that provide financial services to support agricultural development.

b. Government Programmes and Subsidies

- i. **Subsidies:** Financial support from the government to lower the cost of inputs or encourage certain agricultural practices.
- ii. **Grants:** Non-repayable funds provided by government bodies for specific projects or research.
- iii. **Low-Interest Loans:** Loans provided at lower interest rates to support agricultural activities.

c. Cooperative Financing

- i. **Credit Unions:** Member-owned financial cooperatives that provide credit at competitive rates.
- ii. **Farmer Cooperatives:** Groups of farmers pooling resources to access financing and share risks.

d. Microfinance Institutions

- i. **Microloans:** Small loans offered to individual farmers or small agricultural businesses, often with flexible repayment terms.

e. Private Equity and Venture Capital

- i. **Agribusiness Investment Funds:** Investment funds that target agricultural enterprises for growth and expansion.
- ii. **Impact Investors:** Investors focused on funding projects that generate social and environmental benefits along with financial returns.

f. **Non-Governmental Organisations (NGOs) and Foundations**

- i. **Grants and Donations:** Financial support provided by NGOs and philanthropic foundations for agricultural projects and initiatives.

g. **Input Suppliers and Contract Farming**

- i. **Supplier Credit:** Credit extended by suppliers for the purchase of seeds, fertilisers and other inputs.
- ii. **Contract Farming Agreements:** Arrangements where buyers provide upfront finance or inputs in exchange for future production.

h. **Leasing and Hire Purchase**

- i. **Equipment Leasing:** Financing arrangement where farmers lease machinery and equipment instead of purchasing them outright.
- ii. **Hire Purchase Agreements:** Farmers purchase equipment through installment payments.

i. **Insurance**

- i. **Crop Insurance:** Policies that provide financial protection against losses due to weather, pests and other risks.
- ii. **Livestock Insurance:** Coverage for losses related to livestock health and productivity.

j. **Community-Based Savings and Credit Groups**

- i. **Village Savings and Loan Associations (VSLAs):** Self-managed groups that provide savings and credit services to members.

Learning Tasks

1. List the sources of finance for establishment an agricultural enterprise.
2. Explain how microfinance institutions can support with the establishment of agricultural enterprise.
3. Discuss the sources of finance for establishment an agricultural enterprise.

Pedagogical Exemplars

1. **Collaborative learning:** In gender-based groups, learners brainstorm to come up with the sources of finance for agricultural enterprises to build a portfolio using the sources identified. The teacher can use leading questions to support learners to come up with the sources of finance for establishing agricultural enterprises. The teacher can also support learners with samples of portfolios. All learners should be encouraged to take part in all activities, tolerate and respect each other's views.
2. **Problem-based learning:** In pairs, learners search the internet for information on the sources of finance for an agricultural enterprise. Learners discuss the degree of difficulty for women and persons with disabilities to secure finance for their agricultural enterprises. Teachers should encourage female learners and learners with additional support needs to take part in searching the internet for information. Encourage learners who are good at using the internet to help those with

difficulty. Ensure that learners do not access unapproved or illegal websites. Learners having difficulty should be guided with probing questions that will help them state the sources of finance for establishing an agricultural enterprise. Challenge confident learners to explain or discuss in more detail the sources of finance for establishing an agricultural enterprise.

Assessment Level 1: State at least three (3) sources of finance for agricultural enterprises.

Assessment Level 2: Explain how insurance contributes to establishing an agricultural enterprise.

Assessment Level 3: Analyse the extent to which sources of finance for agricultural enterprises can boost Ghana's agricultural economy.

Assessment Level 4

1. Create a table for the sources of agricultural enterprise and indicate how they help in promoting food security.
2. Analyse the case and provide answers to the questions below;

Case

Green Harvest Farms is a medium-sized Agricultural enterprise located in a rural area of Takoradi. The farm produces maize, beans and vegetables, which it supplies to local markets and supermarkets in nearby towns. Recently, the farm's management has noticed an increase in demand for its products, and they are considering expanding their operations by purchasing more land, investing in modern irrigation systems, hiring additional farm workers and purchasing high-quality seeds and fertilisers. To expand, Green Harvest Farms needs to raise approximately ₵200,000.

Questions

- a. Give three (3) options of funding that are available for Green Harvest Farms.
- b. State one (1) advantage and one (1) disadvantage of each source of funding.
- c. Which source of finance should the farm consider first, and why?

Hint



The recommended mode of assessment for week 23 is case study. Use the level 4 question 2 as a sample question.

WEEK 24

Learning Indicators

1. *Analyse the types of records keeping in agricultural enterprises*
2. *Discuss the managerial characteristics required for the management of agribusiness*

Focal Area 1: **Meaning, Types and Importance of Records Keeping in Agricultural Enterprises.**

1. Meaning of Farm Records

Farm records refer to the systematic documentation of various activities, inputs, outputs, financial transactions and other relevant information related to the operation of a farm. These records are essential for effective farm management, decision-making and financial planning.

2. Types of Farm Records

- a. **Production Records:** Details of crop yields, livestock performance, planting and harvesting dates, breeding records and feed consumption.
- b. **Financial Records:** Records of income and expenses, including sales, purchases, wages, loans and other financial transactions.
- c. **Inventory Records:** Information on the quantity and value of farm assets, such as equipment, machinery, livestock and inputs like seeds and fertilisers.
- d. **Labour Records:** Documentation of labour hours, wages paid, tasks performed, and employee information.
- e. **Input Records:** Details of inputs used, including seeds, fertilisers, pesticides, feed and water usage.
- f. **Maintenance Records:** Records of maintenance and repairs on equipment, machinery and infrastructure.
- g. **Sales and Marketing Records:** Information on product sales, market prices, customer details and marketing activities.
- h. **Compliance Records:** Documentation related to regulatory compliance, certifications, permits and inspections.

3. Importance of Farm Records

- a. **Financial Management:** Helps in tracking income and expenses, budgeting and preparing financial statements.
- b. **Decision Making:** Provides data for making informed decisions about crop selection, livestock management, resource allocation and investments.
- c. **Performance Monitoring:** Enables the monitoring of productivity and efficiency, identifying areas for improvement.
- d. **Risk Management:** Assists in managing risks by providing information on production trends, weather impacts and pest outbreaks.

- e. **Regulatory Compliance:** Ensures compliance with legal and regulatory requirements, including environmental and safety standards.
- f. **Access to Finance:** Facilitates access to credit and loans by providing evidence of financial stability and performance to lenders.
- g. **Record Keeping for Taxes:** Simplifies the process of preparing and filing tax returns by maintaining accurate records of income and expenses.

4. Methods of Keeping Farm Records

- a. **Manual Record Keeping:** Using notebooks, ledgers and paper forms to document farm activities and transactions.
- b. **Electronic Record Keeping:** Utilising spreadsheets, databases and specialised farm management software to record and manage data.
- c. **Mobile Apps:** Using mobile applications designed for farm record keeping, which allow for easy data entry and access in the field.

Learning Tasks

1. State the meaning of farm records.
2. Explain the types of farm records.
3. Discuss the importance of keeping accurate farm records.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm to come up with the meaning, types and importance of farm records. Learners with additional support needs should be assisted with leading questions that will help them state the meaning, types and importance of farm records. Challenge others to explain or discuss the types and importance of farm records. Learners should respect and accept each other's view.
2. **Experiential based learning:** Learners in pairs design a typical record keeping for a particular agricultural business operation. Learners discuss the various ways that illiterates can keep records on their activities in agricultural enterprises. The teacher should encourage all learners to take part in all the activities.

Key Assessments

Assessment Level 1: Define what is meant by farm records

Assessment Level 2: Explain at least two (2) methods of keeping farm records

Assessment Level 3: Discuss at least three (3) reasons for keeping farm records

Assessment Level 4: Develop a simple farm production record for cattle

Focal Area 2: Managerial Characteristics Required for the Management of Agribusiness

1. The Managerial Characteristics Required for the Management of Agribusiness

Effective management of an agribusiness requires technical knowledge, practical skills and personal attributes.

Key managerial characteristics essential for the successful management of an agribusiness

a. Technical Knowledge

- i. **Agricultural Expertise:** Understanding of crop and livestock production, soil management, pest control and sustainable farming practices.
- ii. **Business Acumen:** Knowledge of business principles, including marketing, finance, accounting and strategic planning.

b. Leadership Skills

- i. **Vision and Strategy:** Ability to set a clear vision for the agribusiness and develop strategies to achieve long-term goals.
- ii. **Motivation and Inspiration:** Inspiring and motivating employees and team members to achieve their best performance.

c. Decision-Making Abilities

- i. **Analytical Skills:** Ability to analyse data, assess risks and make informed decisions based on available information.
- ii. **Problem-Solving:** Competence in identifying problems, generating solutions and implementing effective actions.

d. Financial Management

- i. **Budgeting and Planning:** Proficiency in preparing budgets, financial forecasts, and managing cash flow.
- ii. **Cost Control:** Implementing measures to control costs and improve efficiency.

e. Marketing and Sales

- i. **Market Analysis:** Understanding market trends, customer needs and competitive landscape.
- ii. **Sales Strategies:** Developing and executing sales and marketing strategies to increase revenue and market share.

f. Operational Management

- i. **Resource Allocation:** Efficiently managing resources, including labour, equipment and materials.
- ii. **Supply Chain Management:** Coordinating the supply chain to ensure timely delivery of inputs and distribution of products.

g. **Communication Skills**

- i. **Interpersonal Communication:** Building strong relationships with employees, customers, suppliers and stakeholders.
- ii. **Negotiation Skills:** Negotiating favourable terms with suppliers, buyers and other business partners.

h. **Human Resource Management**

- i. **Recruitment and Training:** Attracting, hiring and training skilled workers and ensuring ongoing professional development.
- ii. **Employee Relations:** Managing employee relations, resolving conflicts and fostering a positive work environment.

i. **Adaptability and Innovation**

- i. **Flexibility:** Adapting to changing market conditions, technological advancements and regulatory requirements.
- ii. **Innovation:** Encouraging innovation and the adoption of new technologies and practices to improve productivity and sustainability.

j. **Risk Management**

- i. **Risk Assessment:** Identifying potential risks and implementing strategies to mitigate them.
- ii. **Crisis Management:** Handling crises and unexpected events effectively.

k. **Technological Proficiency**

- i. **Digital Tools:** Utilising farm management software, mobile applications and other digital tools to enhance efficiency.
- ii. **Precision Agriculture:** Implementing precision Agriculture technologies to optimise resource use and improve yields.

Learning Tasks

1. List the managerial characteristics required for the management of an agribusiness.
2. Explain how effective communication skills can promote the establishment of an agricultural enterprise.
3. Discuss the managerial characteristics required for the management of an agribusiness.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in mixed-ability groups search the internet for managerial characteristics required for the management of agribusiness. Teachers should ensure that all learners fully participate in the exercise. Learners with difficulty in searching the internet should be helped with the sites for the needed information. Teachers should monitor learners to prevent them from accessing unapproved or illegal sites. Allow each learner to write down his/her and discuss it with the group for feedback. Learners should tolerate, accept and respect the view of others.
2. **Think-pair-share:** Learners in pairs discuss the characteristics of a good manager. The teaching should use leading questions to support learners to discuss the characteristics of a good manager. Where necessary, the teacher can show a short video and documentary on qualities of a good leader to support learners in discussing the qualities of a good manager.
3. **Project-based learning:** Learners in mixed-gender groups role play the characteristics of a good manager. Teacher should consciously involve all learners in the role play to diffuse gender stereotyping about managerial positions.

Key Assessments

Assessment Level 1: State at least three (3) qualities of a good manager.

Assessment Level 2: Explain at least two (2) managerial characteristics required for the management of agribusiness.

Assessment Level 3: Discuss the extent to which human resource management can be used to promote and sustain an agribusiness enterprise.

Assessment Level 4: Evaluate the characteristics of a good farm manager.

Hint



- The recommended mode of assessment for **week 24** is end of semester examination.
- Refer to Appendix G at the end of this section for Table of specification.

SECTION 8 REVIEW

Demand and supply help in making informed decisions about pricing, production and market strategies. The interactions between agricultural production and enterprises are essential for the growth, sustainability and resilience of both sectors. Communication helps bridge information gaps and promote the adoption of best practices. Keeping records is crucial for the successful management and growth of agricultural enterprises. Good managerial characteristics help agribusiness managers to effectively lead their organisations, navigate challenges, and capitalise on opportunities to achieve success and sustainability in the agricultural sector.

Demand refers to the quantity of a good or service consumers are willing and able to purchase at various prices over a given period. It is a fundamental concept in economics and is typically represented by the demand curve, which shows the relationship between the price of a good

and the quantity demanded. The principles of demand are fundamental concepts in economics that describe how various factors influence the quantity of a good or service that consumers are willing and able to purchase.

Supply refers to the quantity of a good or service that producers are willing and able to offer for sale at various prices over a given period. 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. The principles of supply are fundamental concepts in economics that describe how various factors influence the quantity of a good or service that producers are willing and able to offer for sale.

The Factors that Influence Demand of Agricultural Commodity are Price of the Commodity, Income of Consumers, Population Growth, Consumer Preferences and Tastes, Substitute Goods, Complementary Goods, Seasonality, Government Policies and Subsidies, Global Market Trends, Health and Safety Concerns, Advertising and Marketing, Technological Advancements, Economic Conditions, and Availability and Accessibility.

Factors that Influence Supply of Agricultural Commodity includes Weather and Climate, Technological Advancements, Cost of Inputs, Government Policies, Market Prices, Availability of Resources, Access to Credit and Financing, Pest and Disease Outbreaks, Labor Availability, Global Trade Conditions, Storage and Transportation Infrastructure, Technological Diffusion and Economic Conditions.

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, while 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.

The Interactions Between the Sectors of Agricultural Production and Enterprises, and the Extent of Human Interaction include Supply Chain and Market Dynamics, Technological Advancements, Policy and Regulation, Environmental Impact, Economic and Social Factors, Global Trade, and Human Interaction. The Modes of Communication in Agriculture are Traditional Methods, Print Media, Electronic Media, Digital and Online Communication, Educational and Extension Services, Interactive Platforms and Innovative Technologies.

The Procedure for Establishment of Agricultural Enterprise include Conduct Market Research, Develop a Business Plan, Legal and Regulatory Compliance, Secure Financing, Acquire Land and Resources, Infrastructure Development, Hiring and Training, Implement Production Plan, Marketing and Sales, Financial Management, and Continuous Improvement. Sources of Finance for Agricultural Enterprises include: Traditional Bank Loans, Government Programmes and Subsidies, Cooperative Financing, Microfinance Institutions, Private Equity and Venture Capital, Non-Governmental Organisations (NGOs) and Foundations, Input Suppliers and Contract Farming, Leasing and Hire Purchase, Insurance and Community-Based Savings and Credit Groups.

Farm records refer to the systematic documentation of various activities, inputs, outputs, financial transactions and other relevant information related to the operation of a farm. These records are essential for effective farm management, decision-making and financial planning. The Types of Farm Records include: Production Records, Financial Records,

Inventory Records, Labour Records, Input Records, Maintenance Records, Sales and Marketing Records, and Compliance Records. Farm Records are Important for Financial Management, Decision Making, Performance Monitoring, Risk Management, Regulatory Compliance, Access to Finance, and Record Keeping for Taxes. The Methods of Keeping Farm Records are Manual Record Keeping, Electronic Record Keeping and Mobile Apps.

The Managerial Characteristics Required for the Management of Agribusiness are Technical Knowledge, Leadership Skills, Decision-Making Abilities, Financial Management, Marketing and Sales, Operational Management, Communication Skills, Human Resource Management, Adaptability and Innovation, Risk Management and Technological Proficiency.

MARKING SCHEME FOR THE PEER ASSESSMENT TASK

Explanation of the determinant of price for Agricultural produce in their local market = 2 marks each.

The explanation should focus on how;

1. Consumer income affects the demand of goods
2. Consumer preferences affect their demand for goods
3. Population growth affects demand of goods
4. Seasonal variations affect demand
5. Consumer expectations about future prices can influence current demand

Total marks=10 marks

MARKING SCHEME FOR THE CASE STUDY ASSESSMENT TASK

- a. Statement of one sources of funding for Green Harvest Farms such as: Bank Loans, Government agricultural grant, partnering with agribusiness investors, Using the farm's existing profits or savings, Access to cooperative funds or pooled resources, etc. (1 mark)
- b. Statement of 1 advantage and 1 disadvantage for each source such as;

Bank Loans

Advantages

- i. Large sums of money are available

Disadvantages

- i. Interest rates can be high
- ii. Government agricultural grant

Advantages

- i. No repayment required

Disadvantages:

- i. Competitive application process = 2 marks

Statement of the source of funding that should be considered first e.g. Bank Loans =1 mark

Reasons for the recommendation = 1 marks

e.g. Reason: Bank loans, particularly from agricultural development banks, provide a reliable source of large capital. The structured repayment terms allow for planning and management of cash flows, and the farm retains full ownership and control over operations.

Total = 5 marks

RUBRICS FOR THE ROLE PLAY ASSESSMENT TASK

Criteria	Excellent (4 marks)	Very good (3 marks)	Good (2 marks)	Fair (1 mark)
Clarity of Communication	Shows 4 of the following skills; Audible voice Easy to understand message, Keeping eye contact with audience Pay attention to audience Engaging the audience with interaction Use of gesture	Shows 3 of the following skills; Audible voice Easy to understand message, Keeping eye contact with audience Pay attention to audience Engaging the audience with interaction Use of gesture	Show 2 of the following skills; Audible voice Easy to understand message, Keeping eye contact with audience Pay attention to audience Engaging the audience with interaction Use of gesture	Shows 1 of the following skills; Audible voice Easy to understand message, Keeping eye contact with audience Pay attention to audience Engaging the audience with interaction Use of gesture
Use of Appropriate Language	Demonstrate any 4 of the following; Explaining technical terms Frequent use of local dialect Avoidance of Technical jargons Avoid the use of idiomatic expressions Respectful tone.	Demonstrate any 3 of the following; Explaining technical terms Frequent use of local dialect Avoidance of Technical jargons Avoid the use of idiomatic expressions Respectful tone.	Demonstrate any 2 of the following; Explaining technical terms Frequent use of local dialect Avoidance of Technical jargons Avoid the use of idiomatic expressions Respectful tone.	Demonstrate any 1 of the following; Explaining technical terms Frequent use of local dialect Avoidance of Technical jargons Avoid the use of idiomatic expressions Respectful tone.

Active Listening and Response	Demonstrates 4 of the following; Responds to questions and concerns Clarify points to avoid confusion Uses encouraging words during questioning Never interrupts when someone is speaking Receptive to feedback	Demonstrates 3 of the following; Responds to questions and concerns Clarify points to avoid confusion Uses encouraging words during questioning Never interrupts when someone is speaking Receptive to feedback .	Demonstrates 2 of the following; Responds to questions and concerns Clarify points to avoid confusion Uses encouraging words during questioning Never interrupts when someone is speaking Receptive to feedback	Demonstrates 1 of the following; Responds to questions and concerns Clarify points to avoid confusion Uses encouraging words during questioning Never interrupts when someone is speaking Receptive to feedback
Collaboration and Teamwork	Exhibit 4 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility Working seamlessly together.	Exhibit 3 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility Working seamlessly together.	Exhibit 2 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility Working seamlessly together.	Exhibit 1 of these Contributing to the group. Respecting the views of others Tolerating others Resolving conflicts Taking responsibility Working seamlessly together.



APPENDIX G: END OF SEMETER EXAMINATION

1. Nature

- a. Cover content from weeks 13-24. taking into consideration DoK levels 1-4.
- b. The test should include
 - i. Section A- Multiple choice questions (40 questions, 1 mark each)
 - ii. Section B- (5 Essay questions, 3 to be selected out of 5 questions, maximum 20 marks for each question)
 - iii. Test of Practical Section – (5 questions, Answer all questions, maximum of 100 marks)
- c. **Time:** 1 hours 30 minutes for Section A and B and 1 hour for Practical examination.
- d. **Total Score:** 200 marks to be scaled down to 60 marks for submission.

2. Resources

- a. Answer Booklets
- b. Learners' Manual
- c. Teachers' Manual
- d. Teachers' Assessment Manual and Toolkit
- e. Specimen and Materials for Practical Examination (including graph sheets)

Sample Questions

Multiple Choice Questions

Answer the following questions by circling the correct answer.

1. Which method of communication would be most appropriate for quickly informing a large number of farmers about an upcoming pest outbreak?
 - a. Extension bulletins
 - b. Field days
 - c. Peer learning
 - d. SMS alerts

Section B: Essay Type Questions

Read the scenario carefully and answer the questions that follows

At a local market in Ejura, the initial supply and demand for maize are represented by the following linear equations:

- **Demand Curve:** $Q_D = 100 - 2P$
- **Supply Curve:** $Q_S = 20 + 3P$

Where:

QD is the quantity of maize demanded in kilograms.

QS is the quantity of maize supplied in kilograms.

P is the price of maize per kilogram in cedis.

Answer the following questions

- Plot the demand and supply curves on a graph sheet with price (P) on the vertical axis and quantity (Q) on the horizontal axis.
- Calculate the equilibrium price and quantity where the supply and demand curves intersect.

Suppose the government introduces a subsidy that effectively lowers the cost of producing maize, shifting the supply curve to $QS=30+3P$

- Plot the new supply curve on the same graph.
- Determine the new equilibrium price and quantity.
- Discuss how the subsidy affects the market for maize.

Section C: Test of Practicals

Study the pictures A – D carefully and answer the questions that follows



A



B



C



E



F



D

- Identify specimen A to E in the picture above.
- State 2 factors that predisposes specimen D to diseases.
- State one economic importance each of specimen C and F.
- Write the causes of the disease in specimen A and how it can be controlled.
- What two control measures will you put in place as a farmer to prevent the spread of the disease in specimen D.

Sample table of specification for end of semester examination

Weeks	Learning indicator(s)	Type of Questions	DoK Levels				Total
			1	2	3	4	
13 and 14	Meaning and importance of game and wildlife, economic importance and management practices in mushroom production	Multiple Choice	3	3	-	-	6
		Essay	-	1	1	1	3
		Test of Practical	-	-	-	1	1
15 and 16	Meaning of soil nutrients, fertility and productivity and types and effects of fertilisers on crop production	Multiple Choice	2	3	1		6
		Essay	-	-	1	-	1
		Test of Practical	-	1	-	1	2
17 and 18	Common Crop Pests/ Parasites, Diseases and their Effects on Crop Production, and Preventive and Control Measures of Pest and Diseases in Crop Production	Multiple Choice	3	3	-	-	6
		Essay	-	1	1	-	2
		Test of Practical	-	-	-	1	1
19 and 20	Common Diseases, Pests and Parasites of Animals/ Fish, their Symptoms and Effects on Animal/Fish Production, and preventive and Control Measures of Diseases in Animal/Fish Production	Multiple Choice	3		-	-	3
		Essay	-	1	1	1	3
		Test of Practical	-	1	-	1	2
21	Meaning and Principles of Demand and Supply	Multiple Choice	2	3		-	5
		Essay	-	-	1	-	1
		Test of Practical	-	-	1	-	1
23	Procedure for the Establishment of Agricultural Enterprises	Multiple Choice	2	3	-	-	5
		Essay			1	1	2
		Practical	-	-	-	-	-

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