



MINISTRY OF EDUCATION

AGRICULTURE

for Senior High Schools

TEACHER MANUAL



YEAR THREE



NATIONAL COUNCIL FOR
CURRICULUM & ASSESSMENT
OF MINISTRY OF EDUCATION

MINISTRY OF EDUCATION



REPUBLIC OF GHANA

AGRICULTURE

For Senior High Schools Teacher Manual

Year Three



**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 the third and final set of curriculum materials to support the implementation of the new Senior High School curriculum.

This Year Three Teacher Manual for Agriculture covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively support learners in their final year of Senior High School. All the necessary information for the Student Assessment Portal has been included in the Year Three Teacher Manual to simplify the development of weekly learning plans, meaning that teachers have a single reference document.

The Year Three Teacher Manual has two main objectives:

- To support learners to consolidate and deepen their understanding of the content, pedagogy, and assessment across all three years of the new Senior High School curriculum in preparation for the West Africa Senior Secondary Certificate Examination (WASSCE).
- To equip teachers with the tools and resources needed to deliver revision-focused, assessment-led lessons that build on the knowledge learners have acquired from Year One to Year Three.

In this third year, teachers will be supporting learners to prepare for the WASSCE. Each section of the Teacher Manual is therefore structured around the highest Depth of Knowledge (DoK) levels, allowing learners to build progressively on knowledge acquired from Year One to Year Three. For each week, learning tasks and pedagogy are built around the assessment, ensuring that classroom activities directly prepare learners for the demands of the examination. Two sets of sample examination papers are also provided; one administered by Week 12 as a first semester practice examination, and one by Week 20 as a mock examination, to gauge learners' competencies and identify areas requiring remediation.

To further support teachers in delivering Year Three, NaCCA, working with the Ghana Education Service, has developed a subject specific App for each subject.

The Year Three PLC sessions have been revised in response to findings from the 2025 annual evaluation survey. The survey confirmed that teachers have made strong progress in lesson planning, use of varied instructional methods, ICT integration and modes of assessment. To address the identified gap in explaining concepts clearly using examples familiar to learners, each PLC session now includes a dedicated Content Exploration segment. This ten-

minute segment brings the subject group together to work through one challenging problem or concept from the week's Teacher Manual content, not to plan how to teach it, but to ensure that every teacher in the group fully understands it.

The PLC sessions in Year Three also place particular emphasis on connecting the week's content to equivalent topics taught in Years One and Two. Teachers are encouraged to note the recap weeks signposted throughout the Teacher Manual and to use the App to explore how content across all three years links together.

As in previous years, teachers are expected to integrate National Values, Gender Equality and Social Inclusion (GESI), Social and Emotional Learning (SEL), and 21st-century skills into their learning activities, assessment tasks, and rubrics and mark schemes. The subject-specific App will support teachers in doing this throughout the year.

Ghana Education Service acknowledges the dedication of the teachers who have implemented the new curriculum across Years One and Two and recognises that Year Three represents both the culmination of that effort and a critical moment for learners. The Year Three Teacher Manual and its accompanying resources have been developed to ensure that every learner, regardless of background, ability, or school context, is fully prepared to demonstrate what they know and can do in the WASSCE and to progress confidently to further studies, the world of work, and adult life.

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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

Learning Outcome: Use the knowledge acquired to promote good Agricultural practices and sustainable Agriculture.

Content Standard: Demonstrate knowledge, understanding and skills of the principles of good Agricultural practices and sustainable Agriculture in an industrialising society.

INTRODUCTION AND SECTION SUMMARY

Good Agricultural Practices (GAP) and sustainable agriculture are essential frameworks developed to guide modern farming toward food safety, environmental stewardship, and economic viability. As agriculture faces growing challenges such as climate change, soil degradation, water scarcity, and food insecurity, adopting practices that ensure responsible production has become more critical than ever. The widespread implementation of GAP, supported by policy, education, and incentives, is crucial for transforming agriculture into a resilient and sustainable system for future generations. Agricultural activities also generate a significant amount of waste, including crop residues, animal manure and agro-industrial by-products. If not properly managed, these wastes can contribute to environmental pollution, greenhouse gas emissions, and health hazards. However, when approached using sustainable practices, agricultural waste can be transformed into valuable resources, promoting circular agriculture and environmental health. This section will expose learners to good agricultural practices (GAP), sustainable agriculture and how to sustainably handle agriculture wastes. The principles of good agricultural practices (GAP), and sustainable agriculture are particularly important in globalised food markets where traceability, hygiene, and quality control are essential. This section is linked with subjects such as Agricultural Science, Applied Technology, Engineering, General Science, Geography, Manufacturing Engineering and Robotics.

The weeks covered by the section are:

Week 1: Explain the meaning, practices and factors influencing sustainable Agriculture and relate it to good Agricultural practices.

Week 2

1. Apply good Agricultural practices to promote sustainable Agriculture.
2. Employ sustainable techniques to manage Agricultural wastes.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical strategies to be used for this section are initiating talk for learning, structuring talk for learning, think-pair-share and project-based learning. The use of initiating talk for learning, structuring talk for learning, think-pair-share will offer learners the opportunity to express their views and share their knowledge on good agricultural practices (GAP), sustainable agriculture, the influence of GAP on sustainable agriculture, and modern technologies that promote sustainable agriculture. Project-based learning will offer learners the chance to cultivate maize/cowpea, using GAP and to conduct research on the sustainable Agricultural technologies available in Ghana. Project work will mainly be done as homework and the results presented in class. Learners will work in pairs, mixed-ability groups and mixed-gender groups to promote teamwork, gender and differentiation. Critical thinking skills, creative skills, analytical skills, communication, digital literacy and collaboration skills of learners will be enhanced as they surf the internet, share their views and experiences, undertake project works and make presentations in class. Teachers should ensure that all learners are involved in all learning activities that will be carried out. Teachers should also ensure that learners do not sway into unapproved sites when they are surfing for information from the internet.

ASSESSMENT SUMMARY

Assessment for this section will focus on the meaning, practices and factors of good agricultural practices (GAP) and sustainable agriculture, the influence of GAP on sustainable agriculture, application of modern technologies in sustainable agriculture and how to sustainably manage agricultural waste. Assessment questions will adequately cover 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 numbers of demonstrations, oral and written responses. He/she should develop rubrics and/or marking schemes and score all assignments. The group project can be given in week 2 and collected in week 9.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Explain the meaning, practices and factors influencing sustainable Agriculture and relate it to good Agricultural practices.	Level 3 (Week 1)	Essay Type Question/Class Exercise and/or Essay Type Question/Homework
Apply good Agricultural practices to promote sustainable Agriculture.	Level 4 (Week 2)	Case Study/Class Exercise
Employ sustainable techniques to manage Agricultural wastes.	Level 4 (Week 2)	Research/Homework

WEEK 1

Learning Indicator: Explain the meaning, practices and factors influencing sustainable Agriculture and relate it to good Agricultural practices

Recap

Year 1	Week 1 1. Explain the meaning and importance of Agriculture. 2. Discuss the branches and sectors of Agriculture and their related career opportunities. 3. Examine and dispel the misconceptions associated with the study of Agriculture.
Year 2	Week 1 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: Meaning, Practices and Factors of Good Agricultural Practices (GAP) and Sustainable Agriculture

1. Meaning of Good Agricultural Practices (GAP)

Good Agricultural Practices (GAP) refers to a set of guidelines and recommendations aimed at promoting sustainable and safe agricultural production. GAP aims to ensure safe and quality agricultural products while minimising harmful environmental and social impacts.

2. Practices of Good Agricultural Practices

The practices of GAP include:

- a. Soil Management** – using organic matter, crop rotation, and conservation tillage.
- b. Water Management** – efficient irrigation, water conservation, and pollution control.
- c. Crop Protection** – integrated pest management (IPM), safe pesticide use.
- d. Harvesting and Post-Harvest Handling** – hygienic storage and handling procedures.
- e. Worker Health and Safety** – providing protective equipment and training.
- f. Record Keeping** – maintaining records on inputs, harvests, and treatments.

3. Meaning of Sustainable Agriculture

Sustainable agriculture is a farming approach that meets current food needs without compromising the ability of future generations to meet theirs. It focuses on maintaining ecological balance, preserving natural resources, and supporting the economic viability and social well-being of farming communities.

4. Practices of Sustainable Agriculture

The practices of sustainable agriculture include:

- a. Agroecology** – mimicking natural processes in farming.

- b. Organic Farming** – Using natural materials and ecological methods to grow crops and raise animals without synthetic chemicals.
- c. Agroforestry** – combining trees and crops/livestock.
- d. Crop Diversification** – reducing dependency on single crops.
- e. Soil Conservation** – reducing erosion and improving fertility.
- f. Water Conservation** – rainwater harvesting and drip irrigation.
- g. Renewable Energy Use** – solar, biogas, and wind on farms.

5. Factors affecting GAP and Sustainable Agriculture

The factors affecting GAP and sustainable agriculture span from environmental, economic, social, technological and policy and institutional factors.

a. Environmental Factors

- i. Climate change (droughts, floods, temperature shifts).
- ii. Soil degradation (erosion, salinisation).
- iii. Water availability and quality.

b. Economic Factors

- i. Access to credit and investment.
- ii. Market demand for sustainably grown products.
- iii. Cost of inputs like organic fertilisers or irrigation systems.

c. Social Factors

- i. Education and training of farmers.
- ii. Cultural practices and traditional knowledge.
- iii. Labour availability and working conditions.

d. Technological Factors

- i. Access to modern tools and precision farming.
- ii. Information technology for weather forecasts and market prices.
- iii. Research and development in crop varieties and soil health.

e. Policy and Institutional Factors

- i. Government support and subsidies.
- ii. Land tenure security.
- iii. Certification standards (e.g., Ghana Standards Authority, Food and Drugs Authority, Ghana).

The meaning and factors affecting good agricultural practices and sustainable agriculture are shown in Table 1.1.

Table 1.1: *Meaning and factors affecting good agricultural practices and sustainable agriculture*

MEANING	SUSTAINABLE AGRICULTURE		
GOOD AGRICULTURAL PRACTICES (GAP)	PRACTICES		
Practices that ensure safe and high-quality agricultural products	• Soil management • Agronomy • Water management • Organic farming • Crop protection • Agroforestry		
FACTORS AFFECTING GAP AND SUSTAINABLE AGRICULTURE			
ENVIRONMENTAL FACTORS	ECONOMIC FACTORS	SOCIAL FACTORS	TECHNOLOGICAL FACTORS
• Climate change • Soil degradation • Water availability	• Access to credit • Market access • Cost inputs	• Education and training • Cultural practices • Labour availability	• Modern tools • Information technology • Research and development

6. The Influences of GAP on Sustainable Agriculture

- a. **Environmental Protection:** GAP promotes responsible use of natural resources such as soil, water, and biodiversity. Practices such as crop rotation, cover cropping, integrated pest management (IPM), and efficient irrigation help maintain ecological balance, reduce soil erosion, prevent water pollution, and conserve biodiversity.
- b. **Soil Health and Fertility:** Through practices such as minimum tillage, organic manure application, and crop residue management, GAP improves soil structure and fertility. Healthy soil supports higher crop productivity and acts as a carbon sink, contributing to climate change mitigation.
- c. **Water Conservation:** GAP encourages judicious water use through techniques such as drip irrigation, rainwater harvesting, and scheduling irrigation based on crop needs. These methods reduce water waste and ensure sustainability in water-scarce regions.
- d. **Reduced Chemical Use:** By promoting integrated pest and nutrient management, GAP minimises the dependence on synthetic fertilisers and pesticides. This not only lowers production costs and chemical residues in food but also protects beneficial organisms and soil microbiomes.
- e. **Food Safety and Quality:** GAP includes guidelines for safe handling of inputs, harvesting, storage, and transport. These practices prevent contamination of produce and ensure that food is safe and of high quality, which benefits consumers and enhances market access for farmers.

- f. Climate Resilience:** GAP supports the use of climate-smart practices, such as the selection of drought-resistant varieties, diversified cropping systems, and resilient farming structures. These help farmers adapt to climate variability and extreme weather events.
- g. Economic Sustainability:** By improving efficiency, productivity, and marketability, GAP helps farmers increase profitability while reducing resource input costs. Certification under GAP schemes can also open up access to premium markets and export opportunities.

Learning Tasks

1. Recap the concepts of agriculture and agriculture development drawing on their influence in the world of work.
2. Explain the meaning, practices and factors that affect Good Agricultural Practices (GAP) and Sustainable Agriculture.
3. Discuss the influence of Good Agricultural Practices (GAP) on Sustainable Agriculture.
4. Apply food safety and quality to cultivate maize/ cowpea as a group project.

Pedagogical Exemplars

- 1. Initiating talk for learning:** Learners in mixed-ability groups use the internet and discuss the meaning of Good Agricultural Practices (GAP) and sustainable Agriculture.
- 2. Structuring talk for learning:** Learners in mixed-ability groups discuss the practices of GAP and sustainable Agriculture.
- 3. Think-pair-share:** Learners in pairs discuss the factors that influence GAP and sustainable Agriculture in society.
- 4. Project-based learning (homework):** Learners in mixed-gender groups undertake research on cultivation of maize/cowpea, using GAP and present their report in a plenary section in class.

Key Assessments Level 3: Individual Class Exercise

1. Critically evaluate the concept of Good Agricultural Practices (GAP) and discuss how they contribute to the sustainability of maize production systems. (10 marks)
2. Analyse the factors influencing the adoption of good agricultural practices in cowpea production among smallholder farmers in developing countries. (10 marks)

PLC Session 1

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to

- a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
- a. suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
- a. The key assessment for the week is individual class exercise. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exercise (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.

- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 2

Learning Indicators

1. *Apply good Agricultural practices to promote sustainable Agriculture*
2. *Employ sustainable techniques to manage Agricultural wastes*

Recap

Year 1	Week 2 1. Explain the meaning and importance of Agriculture education. 2. Describe the types of Agriculture education.
Year 2	Week 2 1. Explain the meaning of Land Tenure Systems in Ghana. 2. Effects of Land Tenure Systems on Agricultural Production.

Focal Area 1: Modern Technologies that Promote Sustainable Agriculture

The modern technologies that are used to promote sustainable agriculture include:

1. Precision Agriculture

Precision Agriculture uses data and technology to optimise field-level management.

- a. **Global Positioning System (GPS) & Geographic Information System (GIS):** Help farmers map fields and monitor crop conditions.
- b. **Soil sensors:** Measure moisture, nutrients, and temperature.
- c. **Variable Rate Technology (VRT):** Applies fertilisers, pesticides, and water precisely where needed.

2. Drones and Aerial Imaging

Drones and aerial imaging improve monitoring and analysis of large areas.

- a. They provide real-time data on crop health, irrigation, and pest infestations.
- b. They also reduce the need for chemical applications through targeted spraying.

3. IoT (Internet of Things) in Smart Farming

IoT connects sensors, devices, and software to monitor and automate farm operations.

- a. They monitor livestock health, greenhouse climates, and soil conditions.
- b. They automate irrigation and fertilisation systems to reduce waste.

4. Blockchain Technology in Sustainable Agriculture

Blockchain, a decentralised and secure digital ledger, that improves transparency, traceability, and trust across the food supply chain.

- a. **Supply chain transparency:** Tracks every stage from farm to fork, ensures authenticity and reduces fraud and mislabelling.
- b. **Traceability of inputs:** Records the origin of seeds, fertilisers, pesticides, and livestock feed and encourages the use of eco-friendly inputs.
- c. **Smart contracts:** Automates agreements between farmers, suppliers, and buyers, and ensures fair pricing, timely payments, and reduced transaction costs.
- d. **Certification and compliance:** Store digital records of GAP, organic, or fair-trade certifications for easy verifications by regulators and consumers.
- e. **Access to finance:** Transparent records improve creditworthiness and enables microloans or insurance through verified blockchain data.

5. Climate-Smart Agriculture Tools

Adapt farming practices to changing climate conditions.

- a. **Crop modelling software:** Predicts optimal planting and harvesting times.
- b. **Decision-support systems:** Offer recommendations based on weather forecasts and historical data.

6. Biotechnology and Genetic Engineering

Biotechnology and genetic engineering enhance crop and animal traits to improve yields and reduce inputs.

- a. **Drought- and pest-resistant crops/animals:** Reduce reliance on irrigation and pesticides.
- b. **Biofertilizers and biopesticides:** They serve as natural alternatives to chemicals.

7. Vertical and Indoor Farming

Reduces land use and conserves water.

- a. Uses LED lighting, hydroponics, and aeroponics to grow food indoors year-round.
- b. Significantly lowers transportation emissions by producing food closer to urban centres.

8. Renewable Energy Integration

Reduces the carbon footprint of farming operations.

- a. Solar-powered irrigation systems.
- b. Wind turbines and bioenergy from agricultural waste.

9. Big Data and Artificial Intelligence

Enable predictive analytics and smarter decision-making.

- a. Analyse trends in weather, soil health, and market demands.
- b. Optimise crop planning and resource use.

Figure 2.1 shows some modern technologies that promote sustainable agriculture.

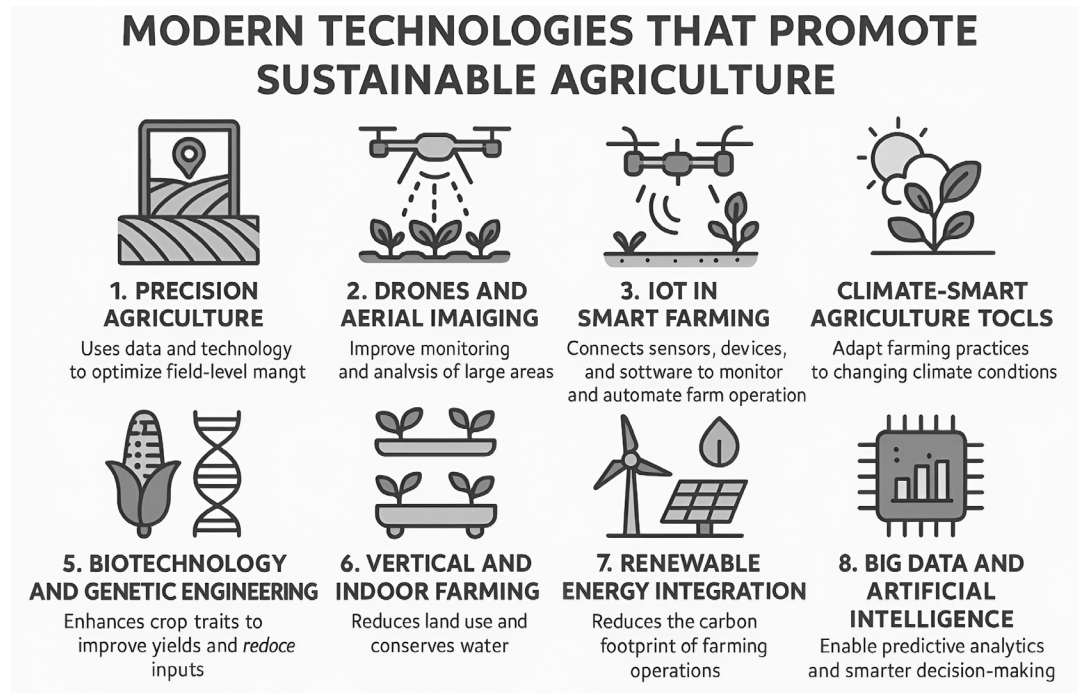


Figure 2.1: Some modern technologies that promote sustainable agriculture

Learning Tasks

1. Recap on Agriculture education and its application for higher education and the world of work.
2. Discuss the various modern technologies used in sustainable agriculture.

Pedagogical Exemplars

1. **Structuring talk for learning:** Learners in mixed-gender groups have a discussion to create a list of modern technologies used in sustainable Agriculture after researching information on the internet and other sources.
2. **Think-pair-share:** Learners in pairs discuss the various technologies of sustainable Agriculture.
3. **Project-based learning:** Learners in mixed-gender groups research the sustainable Agricultural technologies available in Ghana and deliver a presentation to the class.

Key Assessment Level 4: Case Study

Question 1. Farmers and agricultural planners in a region with different types of farms are exploring modern technologies to support sustainable cultivation of cassava. They want a method that can work in difficult terrain, give real-time information, and help with fast field inspections.

- 1a. What is the most suitable modern technology for this purpose?
- 1b. Discuss the key things to consider and the steps involved in using this technology to support sustainable crop production. **(20 marks)**

Focal Area 2: Sources of Agricultural Wastes and Sustainable Techniques to Manage Agricultural Wastes

1. Meaning of Agricultural Wastes

Agricultural waste, also known as agro-waste, refers to the by-products and residues generated from agricultural activities. These wastes can originate from crop farming (such as example leaves, straw, husks) and animal farming (such as manures, slurries). They can be solid, liquid, or slurry. Figure 2 (Week 2) shows some sources of agricultural wastes.

2. Sources of Agricultural Wastes

The sources of Agricultural waste include:

a. Crop Farming

- i. **Crop residues:** Straw, stovers, husks, leaves, and other plant parts left after harvest.
- ii. **Agro-industrial by-products:** Oilseed meals, distillery wastes, and fruit/vegetable processing residues.
- iii. **Food processing waste:** Fruit and vegetable scraps, peels, and other inedible parts from processing.
- iv. **Weeds and unmarketable produce:** Weeds and crops that do not meet quality standards for sale.

b. Animal Farming

- i. **Animal manures:** Solid and liquid waste from livestock, poultry, and other animals.
- ii. **Slurries:** Liquid waste from animal farming, such as manure slurry.
- iii. **Animal bedding:** Material such as straw or wood shavings used for animal housing, which becomes waste when soiled.



Figure 2.2: Sources agriculture wastes

3. Sustainable Techniques to Manage Agricultural Waste

The sustainable techniques for managing Agricultural wastes include composting and vermicomposting, biochar production, biogas production, crop rotation and diversity conservation tillage, sustainable livestock farming and the 5 Rs. Figure 2.3 shows some sustainable techniques to manage agricultural wastes.

a. Composting and Vermicomposting

- i. **Composting:** This process breaks down organic matter (crop residues, animal manure) into nutrient-rich compost, which can be used as a soil amendment to improve fertility and soil structure.
- ii. **Vermicomposting:** This involves using worms to accelerate the composting process, producing a high-quality compost called vermicompost.

b. Biochar Production

Biochar: This is a charcoal-like material produced from the pyrolysis (heating) of agricultural waste. It can be used to improve soil structure, water retention, and nutrient availability, as well as sequester carbon.

c. Biogas Production

Biogas: This is a fuel produced from the anaerobic digestion of organic waste. It can be used for heating, electricity generation, and transportation.

d. Other Sustainable Practices

- i. **Crop Rotation and Diversity:** Rotating crops helps to prevent soil erosion, improves soil health, and reduces the need for synthetic fertilisers and pesticides.
- ii. **Conservation Tillage:** This practice minimises soil disturbance, reducing erosion and improving water infiltration.
- iii. **Sustainable Livestock Farming:** Practices such as rotational grazing and feeding animals on crop residues can improve livestock health and reduce waste generation.
- iv. **The 5 Rs:** Refuse, Reduce, Reuse, Repurpose, and Recycle waste materials to minimise landfill disposal and maximise resource utilisation.

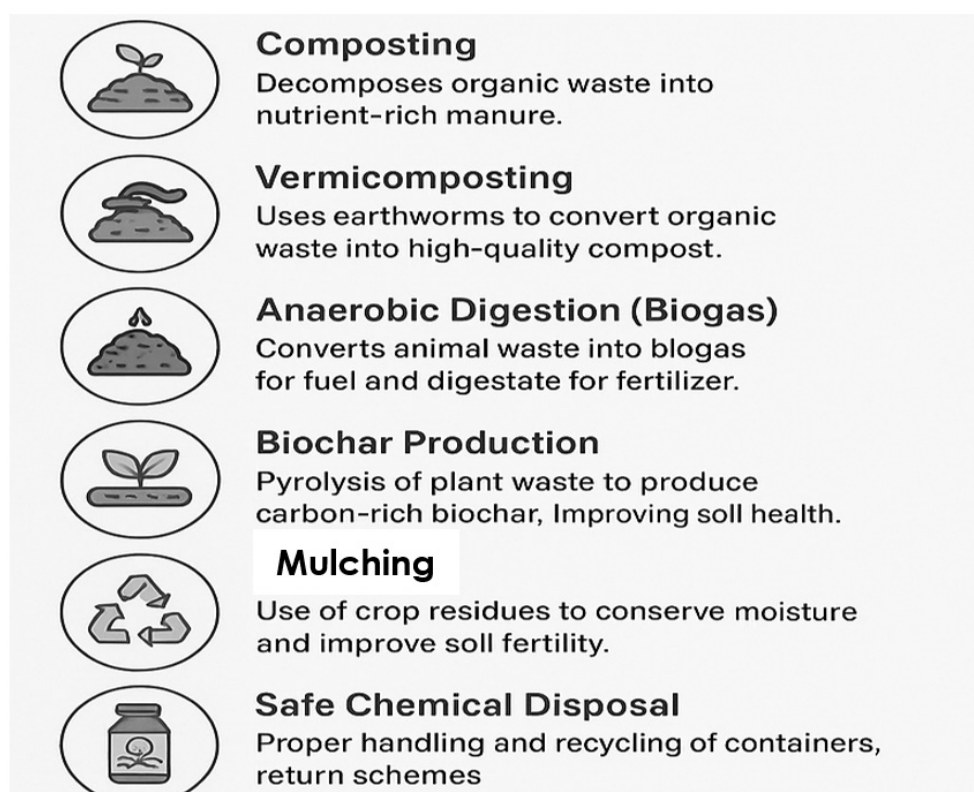


Figure 2.3: Sustainable techniques to manage agriculture wastes

Learning Tasks

1. Recap on land tenure systems in Ghana to unravel the issues with the acquisition of land for agriculture production and establishment of agriculture and its related factories.
2. Identify the sources of Agricultural wastes.
3. Discuss the sustainable techniques for managing Agricultural wastes.

Pedagogical Exemplars

1. **Initiating talk for learning:** Learners in mixed ability groups brainstorm to come up with the sources of Agricultural wastes.
2. **Collaborative learning:** Learners in mixed-ability groups discuss sustainable techniques for managing Agricultural wastes and make their presentation in class.
3. **Experiential learning:** Learners in mixed-ability groups prepare compost from Agricultural wastes with the help of a resource person.

Key Assessment Level 4: Group Research Work

Question: Mr. Asante, a resident of a semi-urban area, has recently begun vegetable farming in his backyard. With the goal of reducing household organic waste and improving soil fertility sustainably, he decides to produce compost at home using kitchen and garden wastes. Critically explain the systematic process Mr. Asante should follow to prepare high-quality compost for

his vegetable production. In your response, evaluate the materials required, the conditions necessary for decomposition, the stages of composting, and how the final product supports sustainable Agriculture. **(25 marks)**

Hint



- Assign a group research work to learners and give them a reasonable time to complete it. Use the SS App to generate the research work and the rubric. Learners' works should be marked immediately and scores entered into the SAP.

PLC Session 2

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. Identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (nts 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q).
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP)
 - a. The key assessment for the week is group research work. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the research work (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through the problem individually for 3–4 minutes
 - c. The group then works through it together the problem, step by step
 - d. Highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Section One Review

Good Agricultural Practices (GAP) refers to a set of guidelines and recommendations aimed at promoting sustainable and safe agricultural production. The practices of GAP include soil management, water management, crop protection, harvesting and post-harvest handling, worker health and safety, and record keeping.

Sustainable agriculture is a farming approach that meets current food needs without compromising the ability of future generations to meet theirs. The practices of sustainable agriculture include agroecology, organic farming, agroforestry, crop diversification, soil Conservation, water conservation and renewable energy use.

The factors affecting Gap and sustainable agriculture span from environmental, economic, social, technological to Policy and Institutional factors. The influences of GAP on sustainable agriculture positively promote environmental protection, soil health and fertility, water conservation, reduced chemical use, food safety and quality, climate resilience and economic sustainability.

Modern technology enhances sustainability by increasing efficiency and reducing environmental footprints. Precision agriculture, drones and aerial imaging, IoT (Internet of Things) in smart farming, blockchain technology, climate-smart agriculture tools, biotechnology and genetic engineering, vertical and Indoor farming, renewable energy Integration and big data and Artificial Intelligence (AI) are the modern technologies that are used to promote sustainable agriculture.

Agricultural waste refers to the by-products and residues generated from agricultural activities. Agricultural waste comes from crop and animal farming, and they can be managed sustainably through composting and vermicomposting, biochar production, biogas production, crop rotation and diversity, conservation tillage and sustainable livestock farming. Sustainable waste management transforms agricultural waste into valuable resources, minimising pollution and promoting resource efficiency.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 1

Question 1 (10 marks)

1. Evaluation of the concept of GAP

a. Definition

Good Agricultural Practices (GAP) are a collection of principles and codes of practice that aim to ensure agricultural production is safe, sustainable, environmentally friendly, and socially responsible.

b. GAP includes practices such as:

- i. Crop rotation and diversification
- ii. Integrated pest management (IPM)
- iii. Proper use of fertilizers and pesticides
- iv. Efficient water management

- v. Soil health preservation
- vi. Record keeping and traceability

1 mark for the correct definition of GAP and 1 mark each for providing any four (4) GAP practices, totalling 6 marks. (Any other correct responses should be accepted)

2. How GAP contributes to sustainable maize production

GAP contributes to sustainable maize production by:

- a. **Environmental Protection:** Reduces chemical inputs, conserves biodiversity, and prevents soil and water degradation.
- b. **Economic Viability:** Enhances productivity and market access due to quality assurance and food safety standards.
- c. **Social Responsibility:** Promotes workers' health and safety, gender inclusivity, and fair labour practices.

1 mark for stating the point and another 1 mark for correct explanation, for any 2 two (2) questions totalling 4 marks) (Any other correct responses should be accepted)

Question 2 (10 marks)

The adoption of GAP by smallholder farmers in developing nations is influenced by a range of **technical, socio-economic, institutional, and environmental factors**:

- 1. **Knowledge and Awareness:** Limited understanding of GAP benefits and procedures restricts adoption partly due to lack of extension services and training programs.
- 2. **Economic Constraints:** The initial cost of implementing GAP (e.g., certification, equipment) can be prohibitive, especially when short-term returns are unclear.
- 3. **Market Access and Incentives:** Farmers with access to GAP-compliant markets (e.g., supermarkets or export markets) are more likely to adopt the practices.
- 4. **Institutional Support:** Availability of credit, subsidies, technical guidance, and cooperative support positively impacts GAP implementation.
- 5. **Land Tenure Security:** Farmers who own land are more likely to invest in long-term sustainable practices.
- 6. **Social Influence and Peer Learning:** Adoption rates improve when local leaders or neighbouring farmers demonstrate success with GAP.

1 mark for stating the point and another 1 mark for correct explanation

Any 5x 2 = 10 marks (Any other correct responses should be accepted)

WEEK 2**FOCAL AREA 1 (19 marks)**

1. The best technology to use is the use of drones (1 mark)
2. Rubrics for considerations and activities involved in using drones (18 marks)

S/N	Parameter	Excellent (3 marks)	Very good (2 marks)	Satisfactory (1 mark)	Needs improvement
1.	Define the Objective, that is, identify the purpose of using the drone:	• Crop monitoring • Soil analysis • Irrigation management • Pest/disease detection • Precision spraying (Provide any 3 for 3 marks)	Provide any 2 for 2 marks	Provide any 1 for 1 mark	Provides none
2.	Plan the Mission	• Set flight path (field boundaries, altitude, pattern) • Choose the right time (weather and lighting conditions) • Ensure compliance with local regulations (licenses, flight permissions) (Provide all the 3 points for 3 marks)	Provide any 2 for 2 marks	Provide any 1 for 1 mark	Provides none
3.	Prepare the Drone	• Charge batteries fully • Calibrate sensors (GPS, camera, multispectral sensors, etc.) • Load any payloads (e.g., pesticide for spraying drones) • Perform a pre-flight check (propellers, connections, signal) (Provide any 3 for 3 marks)	Provide any 2 for 2 marks	Provide any 1 for 1 mark	Provides none

4.	Conduct the Flight	•Launch the drone manually or automatically via software •Monitor the drone in real-time using a ground control system •Ensure safety and compliance during operation (Provide all the 3 points for 3 marks)	Provide any 2 for 2 marks	Provide any 1 for 1 mark	Provides none
5.	Collect and Process Data	•Download aerial images, NDVI maps, or thermal data •Use GIS or farm management software to analyse data •Generate insights (e.g., stress zones, moisture levels, pest hotspots) (Provide all the 3 points for 3 marks)	Provide any 2 for 2 marks	Provide any 1 for 1 mark.	Provides none
6.	Maintain the Drone	• Clean and inspect drone and sensors after use • Store batteries safely • Update firmware/software regularly (Provide all the 3 points for 3 marks)	Provide any 2 for 2 marks	Provide any 1 for 1 mark	Provides none

Answers can be accepted in table form or in prose. Any other correct responses should also be accepted.

FOCAL AREA 2 (25 marks)

No.	Component	Marks
1.	Identification and balancing of composting materials	4
2.	Composting method and setup	4
3.	Monitoring decomposition conditions (O ₂ , H ₂ O, temperature, pH)	5
4.	Description of composting stages	5

5.	Harvesting and application	3
6.	Evaluation of sustainability contributions	4
	Total	25

1. Selection and Preparation of Composting Materials

Mr. Asante should collect two main types of organic materials:

- Green (Nitrogen-rich) materials: Fresh kitchen waste (fruit peels, vegetable scraps, coffee grounds), and fresh grass clippings.
- Brown (Carbon-rich) materials: Dried leaves, shredded paper, sawdust, and small twigs.
- A proper balance of green and brown materials (roughly 1:3) is essential to maintain the Carbon: Nitrogen ratio (C:N) of about 25-30:1, which supports efficient microbial activity.

1 mark for stating the main point, 1 mark each for providing the types of organic materials to be used and 1 mark for providing the carbon/nitrogen or green/brown ratio, totalling 4 marks

2. Construction of Composting Site and Method

- He may use a compost bin or pile in a shaded, well-drained area of the backyard.
- The pile should be at least 1 cubic metre in size to retain heat for microbial decomposition.
- Layers of green and brown materials should be alternated, starting with a coarse brown layer at the bottom for aeration.

1 mark for stating the main point and 1 mark each for correct explanation, totalling 4 marks

3. Monitoring of Conditions for Decomposition

For optimal composting, Mr. Asante must manage the following factors:

- Aeration: Turning the pile every 1–2 weeks introduces oxygen to support aerobic microbes.
- Moisture: Compost should feel like a wrung-out sponge-too dry slows decomposition; too wet causes anaerobic activity.
- Temperature: The internal temperature should reach 55–65°C to kill pathogens and weed seeds. This indicates active microbial breakdown.
- pH: Composting typically begins acidic but stabilises to neutral as it matures.

1 mark for stating the main point and 1 mark each for correct explanation, totalling 5 marks

4. Stages of Composting

- Mesophilic Phase (20-0°C): Initial breakdown by bacteria and fungi.
- Thermophilic Phase (40-65°C): Active decomposition and pathogen kill.
- Cooling Phase: Activity slows, complex materials break down.
- Curing Phase: Compost stabilizes and matures, usually after 8-12 weeks.

1 mark for stating the main point and 1 mark each for correct explanation, totalling 5 marks

5. Harvesting and Use of Compost

- a. Once dark, crumbly, and earthy-smelling, the compost is ready, Mr. Asante should sieve it to remove un-decomposed particles
- b. He should apply it as mulch, top-dressing, or soil amendment to improve water retention, aeration, and nutrient availability.

1 mark for stating the main point and 1 mark each for correct explanation, totalling 3 marks

6. Contribution to Sustainable Agriculture Environmental: Reduces landfill waste and greenhouse gas emissions.

- a. Economic: Cuts costs on chemical fertilizers.
- b. Soil Health: Improves soil structure, microbial activity, and nutrient cycling.
- c. Social: Encourages community awareness and replicable backyard farming models

1 mark each for correct explanation, totalling 4 marks

SECTION 2: AGRICULTURAL DEVELOPMENT IN AN INDUSTRIALISING SOCIETY

STRAND: CONCEPT OF AGRICULTURE IN AN INDUSTRIALISING SOCIETY

Sub-Strand: Modern Mechanised Agriculture

Learning Outcome: Use the knowledge, understanding and skills acquired to explain the meaning, importance, application and challenges of emerging technologies in Agriculture.

Content Standard: Demonstrate the knowledge, understanding and skills of the meaning, importance, application and challenges of emerging technologies in Agriculture.

INTRODUCTION AND SECTION SUMMARY

Emerging technologies in agriculture are transforming the way food is produced, processed, and distributed. As global population continues to rise, the demand for sustainable and efficient agricultural practices has become more urgent. Technological advancements are playing a crucial role in addressing challenges such as climate change, soil degradation, water scarcity, and the need for increased food production. The study of emerging technologies in agriculture focuses on innovations that enhance agricultural productivity, sustainability, and efficiency. Key technologies include precision agriculture, biotechnology, robotics, artificial intelligence (AI) and machine. It also includes sustainable and smart irrigation system technologies such as drip irrigation, smart irrigation systems and blockchain and supply chain management. Emerging technologies in agriculture hold the potential to increase food production while minimising environmental impacts, making them critical for the future of farming. Learners will explore how these technologies are applied in real-world farming systems and their potential to revolutionise agriculture in both local and global contexts. Learners will gain a better understanding of how these technologies can be applied in their local agricultural contexts, preparing them for careers in innovative and sustainable agriculture. This section is linked with the study of Applied Technology, Engineering, ICT, Mathematics, Physics and Robotics.

The weeks and the indicators covered by the section are:

Week 3: Explain the meaning, importance and challenges of emerging technologies in Agriculture.

Week 4: Explain applications and prospects of emerging technologies in Agriculture.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The suggested pedagogical strategies include initiating talk for learning, project-based learning, structuring talk for learning, experiential learning and think-pair-share. Initiating talk for learning, structuring talk for learning and think-pair-share will offer learners the opportunity to surf the internet for information on emerging technologies in Agriculture to improve upon their digital skills and teamwork. They will also offer learners the opportunity to express themselves to each other. Project-based and experiential learning will enable learners to have hands-on practice and conduct research on their own. This will improve their creativity, critical thinking skills, analytical skills, innovativeness and communication skills. Teachers can use simulation software or apps to demonstrate precision farming, where learners can virtually manage farm resources, analyse crop health, and optimise irrigation and fertiliser use. Learners can observe the use of drones for monitoring crop health, capturing aerial images, and gathering data on soil moisture, crop density, and pest infestations. Field visits and organising visits to farms using advanced technologies like automated tractors or smart irrigation systems will give learners first-hand experience with the tools they learn about in class. Learners will interact and engage among themselves in various groupings such as mixed-ability groups, mixed-gender groups and in pairs to promote respect for each other and inclusivity. All learners should be guided and given equal opportunity to participate in all activities.

ASSESSMENT SUMMARY

Assessment for this section will cover the meaning, importance and challenges of emerging technologies in agriculture as well as applications and prospects of emerging technologies in Agriculture. Teachers should assign reflective essays or presentations where learners discuss how emerging technologies can solve specific agricultural challenges in their communities. Evaluate understanding through quizzes, project presentations, or hands-on technology demonstrations. Assessments should judge the various levels of proficiencies of the learner particularly the highest level of the depth of knowledge (DoK). This should be done via group discussions, presentations, homework, class exercises, and project-based work. The teacher should accept varying number of oral and written responses. The teacher can assign individual practical assignments in week 3 for collection in week 8. He/she (Teachers) should develop rubrics or marking schemes to score group presentations, discussions, portfolio and assignments.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Explain the meaning, importance and challenges of emerging technologies in Agriculture.	Level 3 (Week 3)	Quiz/Class Exercise
Explain the applications and prospects of emerging technologies in Agriculture.	Level 3 (Week 4)	Essay Type Question/Class Exercise

WEEK 3

Learning Indicator: Explain the meaning, importance and challenges of emerging technologies in Agriculture

Recap

Year 1	Week 3 1. Explain the meaning and importance of industry in Agriculture 2. Discuss the interdependence of Agriculture and industry. 3. Analyse the economic challenges and solutions of Agriculture in an industrialising society
Year 2	Week 3 1. Examine the industries of crop production. 2. Discuss the importance of raw and waste materials from crop production to the industry.

Focal Area: Meaning, Importance and Challenges of Emerging Technologies in Agriculture.

1. Meaning of Emerging Technologies in Agriculture

Emerging technologies in agriculture refer to new and innovative tools, methods, and systems that are being developed and adopted to improve the efficiency, productivity, sustainability, and profitability of agricultural practices. These technologies often involve the use of advanced science and engineering, including digital tools, biotechnology, automation, artificial intelligence (AI), robotics, satellite imagery, and smart sensors. They are aimed to solve challenges such as climate change, labour shortages, limited natural resources, and the growing demand for food.

Examples of Emerging Technologies in Agriculture:

- a. Precision farming – using GPS, drones, and data analytics to monitor and manage crops.
- b. Biotechnology – developing genetically improved crops that are drought-, pest-, or disease-resistant.
- c. Smart irrigation systems – using moisture sensors and weather data to optimise water use.
- d. Agricultural robotics – automated machines for planting, harvesting, and weeding.
- e. Artificial intelligence (AI) – predicting crop diseases and planning resource use efficiently.
- f. Vertical and indoor farming – using controlled environments to grow crops year-round.

2. Importance of Emerging Technologies in Agriculture

a. Increased Agricultural Productivity

- i. Technologies such as precision farming and genetic engineering help farmers grow more food on the same amount of land.
- ii. Higher yields mean better food security and income for farmers.

b. Efficient Use of Resources

- i. Smart irrigation systems, soil sensors, and GPS-guided equipment ensure that water, fertilisers, and pesticides are used only when and where needed.
- ii. This reduces waste and lowers production costs.

c. Improved Crop and Livestock Health

- i. Drones, AI, and remote sensing help monitor crops and animals for diseases or stress.
- ii. Early detection allows for timely treatment, minimising losses.

d. Environmental Protection and Sustainability

- i. Technologies help reduce soil degradation, water pollution, and greenhouse gas emissions.
- ii. Conservation agriculture practices can be better implemented with the help of emerging tools.

e. Reduction in Labour Intensity

- i. Automation and robotics reduce the need for manual labour, especially in planting, weeding, and harvesting.
- ii. This is particularly helpful where there are labour shortages or high labour costs.

f. Data-Driven Decision Making

- i. Real-time data from sensors, satellites, and apps allow farmers to make more accurate and timely decisions.
- ii. Leads to better planning and reduced risk.

g. Adaptation to Climate Change

- i. Climate-smart technologies help farmers adapt to changing weather patterns, such as drought-resistant seeds or weather-predictive software.
- ii. Protects farming livelihoods from climate-related disruptions.

h. Improved Food Safety and Quality

Technologies such as block chain enable traceability in the food supply chain, reducing contamination and improving consumer confidence.

i. Market Access and Profitability

- i. Mobile apps and digital platforms help farmers to access better markets, get fair prices, and reduce dependency on middlemen.
- ii. Innovation and job creation
- iii. The development and use of new agricultural technologies create opportunities for entrepreneurship and skilled employment in Agro-based and Agri-tech industries.

Figure 3.1: shows a picture of a farmer using drones for farming, while Figure 3.2 shows pictures of some smart irrigation systems.



Figure 3.1: *A farmer using drones for farming*



Figure 3.2: *Smart irrigation systems*

3. Challenges of Emerging Technologies in Agriculture

a. High Cost of Technology

- i. Many emerging technologies such as drones, AI systems, and smart sensors are expensive to acquire, install, and maintain.
- ii. Small-scale farmers often cannot afford them without subsidies or financial support.

b. Lack of Technical Knowledge and Skills

- i. Farmers may not have the training or education needed to use digital tools, data systems, or automated equipment. This limits the effective use of available technology.

- ii. Limited access to infrastructure
- iii. Poor internet connectivity, lack of electricity, and inadequate transportation can hinder the use of smart agricultural tools - especially in rural areas.
- c. **Resistance to Change**
 - i. Some farmers may prefer traditional farming methods due to fear of risk, unfamiliarity, or cultural beliefs.
 - ii. Changing long-standing practices can take time and trust.
- d. **Data Privacy and Ownership Concerns:**

As digital tools collect large amounts of farm data, there are concerns about who owns and controls this data, and how it is used by third parties.
- e. **Limited Government Support and Policy Gaps**
 - i. In many regions, there are no clear policies or incentives for adopting new technologies in agriculture.
 - ii. Lack of investment and regulation slows innovation.
- f. **Incompatibility with Small-Scale Farming**

Many emerging technologies are designed for large commercial farms, making them difficult to adapt to smallholder operations.
- g. **Environmental and Ethical Issues**

Use of biotechnology (e.g., GMOs) raises ethical, health, and environmental concerns in some communities.
- h. **Maintenance and After-Sales Support**

Limited access to technicians or spare parts makes it hard to repair or maintain high-tech equipment in rural areas.
- i. **Language and Literacy Barriers**

Some digital tools or platforms are not available in local languages or require high levels of literacy, excluding many farmers from their use.

Learning Tasks

1. Recap on Agriculture and industry, their relationship and how raw and waste materials are converted to useful products and managed sustainably.
2. Assign individual practical on processing of whole tilapia using brine for fresh cooking and present a report for collection in week 8.
3. Explain the meaning of emerging technologies.
4. Analyse the importance of emerging technologies in Agriculture.
5. Evaluate the challenges involved in the application of emerging technologies.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm or research on the internet to define emerging technologies in Agriculture.
2. **Initiating talk for learning:** Learners in groups discuss the emerging technologies used in Agriculture and present their reports in a plenary section in the class.
3. **Experiential learning:** Learners visit a farm where emerging technologies in Agriculture are being used or watch a video (examples available at: https://www.youtube.com/results?search_query=video+of+emerging+technologies+in+agriculture, on 6/6/2025) on the use of some emerging technologies in Agriculture in crop and animal production. Learners then discuss the importance of the emerging technologies in Agriculture.
4. **Project-based learning:** In gender-based, mixed ability or groups (where appropriate), learners conduct research using internet and other sources on the social, economic and environmental impacts and problems associated with the adoption of emerging technologies in Agriculture.

Key Assessment Level 3: Quiz

Question: Discuss how emerging technologies are changing agricultural production. In your answer, explain any two different technologies and evaluate both their benefits and challenges for farmers in the production of cassava. (15 marks)

PLC Session 3

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app

- The key assessment for the week is quiz. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the quiz (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- All teachers in the group work through a similar problem individually for 3–4 minutes
- The group then works through the problem together step by step
- Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).

- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- After the enactment, ask for structured feedback from the group
 - Was the concept explained in a way that a learner with no prior knowledge could follow?
 - Were the examples grounded in contexts familiar to Ghanaian learners?
 - Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 4

Learning Indicators: Explain the applications and prospects of emerging technologies in Agriculture

Recap

Year 1	Week 4 1. Outline the uses and maintenance procedures of measuring tools used in Agricultural production. 2. Relate the indigenous measuring tools to the standardised units of measurements in Agricultural production. 3. Demonstrate the use of simple scientific measuring tools to calculate parameters related to the various Agricultural sectors.
Year 2	Week 4 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: Applications and Prospects of Emerging Technologies in Agriculture

1. Applications of Emerging Technologies in Agriculture

a. Precision Agriculture

- i. It uses GPS, GIS, drones, and sensors to monitor soil conditions, crop health, and field variability.
- ii. It helps farmers apply the right amount of water, fertiliser, and pesticide at the right place and time.

Example: Soil sensors detect moisture levels and send real-time data to control irrigation systems to reduce water waste.

Figure 4.1 shows a picture of a drone applying pesticides on some crops.



Figure 4.1: Application of pesticides using a drone

b. Biotechnology and Genetic Engineering

- i. Develop genetically modified crops that are resistant to pests, diseases, and harsh weather.
- ii. Enhances crop yield, shelf life, and nutritional value.

Example: Drought-resistant maize or rice varieties allow farmers to grow food in water-scarce regions.

c. Automation and Robotics

- i. Machines and robots are used for planting, weeding, and harvesting crops with minimal human labour.
- ii. Increases efficiency and reduces labour costs.

Example: Robotic harvesters can pick fruits such as apples or strawberries without damaging them.

Figure 4.2: shows a picture of a robot planting seedlings. Figure 3 (Week 4) shows a robot applying water on some crops.



Figure 4.2: *A robot planting seedlings*



Figure 4.3: *Irrigation of a farm by a robot*

d. Remote Sensing and Drone

- i. Drones take aerial images and videos of farmland to assess crop health, detect diseases, and monitor growth.
- ii. Satellite images help in mapping soil conditions and planning farm operations.

Example: A drone can scan an entire farm and identify areas affected by pest infestation, allowing targeted treatment.

e. Artificial Intelligence (AI) and Machine Learning

- i. AI analyses data from weather forecasts, soil sensors, and crop models to make decisions about planting and harvesting.
- ii. Helps predict crop yield and detect early signs of disease.

Example: AI-powered apps give farmers daily updates on when to water or apply fertiliser based on real-time data.

f. Smart Irrigation System

- i. Automated irrigation systems use weather data and soil sensors to optimise watering schedules.
- ii. Ensures crops are given just the right amount of water.

Example: Drip irrigation controlled by smart devices minimises water use and improves crop quality.

g. Vertical and Indoor Farming

- i. Crops are grown in stacked layers under controlled conditions, using LED lights and hydroponic systems.
- ii. Maximises space and enables year-round production.

Example: Urban vertical farms grow lettuce and herbs indoors using nutrient-rich water instead of soil.

h. Mobile Apps and ICT Tools

- i. Mobile apps provide weather updates, market prices, farming tips, and connect farmers to buyers.
- ii. ICT tools also help in training and knowledge sharing.

Example: A farmer uses an app to sell harvested crops directly to consumers or wholesalers, increasing profits.

Figure 4.4 shows a picture of a farmer collecting data using a computer tablet.



Figure 4.4: A farmer collecting data using a computer tablet

2. Prospects of the Emerging Technologies in Agriculture

a. Sustainable Food Production

- i. Technologies such as precision agriculture, smart irrigation, and vertical farming will help produce more food using fewer resources (land, water, energy).
- ii. To achieve sustainable global food security development goals (SDGs) and feed the growing population.

b. Climate-Resilient Agriculture

- i. Emerging tools will help farmers adapt to climate change by improving decision-making based on weather data, soil conditions, and crop models.
- ii. Reduce crop losses from drought, pests, and floods through early warning systems and stress-tolerant crop varieties.

c. Increased Efficiency and Automation

- i. Automation, robotics, and AI may substitute or complement labour-intensive tasks such as planting, weeding, and harvesting.
- ii. Enhances productivity, especially in countries facing labour shortages or high labour costs.

d. Data-Driven Farming

- i. Use of data, satellite imagery and the internet will enable real-time farm monitoring and predictive analytics.
- ii. Helps farmers make precise decisions, reduce input costs, and improve crop yields.

e. Expanded Digital Access and Smart Farming

- i. Mobile apps, remote advisory services, and e-extension platforms will improve farmer education, connectivity, and market access.
- ii. Empowers smallholder farmers with timely information and connects them to value chains.

f. Advanced Breeding and Biotechnology

- i. Gene editing and other biotechnology tools will help develop next-generation crops with better nutrition, shelf life, and stress resistance.
- ii. Promotes health, reduces food waste, and supports agriculture in marginal environments.

g. Enhanced Profitability and Market Integration

- i. Digital platforms and block chain technology will ensure transparent pricing, traceability, and fair trade.
- ii. Increases trust between farmers, processors, and consumers, leading to better market access and income.

h. Urban and Indoor Farming Expansion

- i. Urban areas will adopt vertical farms and container farming to produce fresh food locally.
- ii. Reduces food miles, ensures food availability in cities, and supports year-round production.

Learning Tasks

1. Recap on how Agriculture measuring and indigenous tools relate with emerging technologies to promote and increase food production.
2. Identify the applications of emerging technologies in Agriculture
3. Analyse the prospects of emerging technologies in agriculture
4. Demonstrate the use of the equipment (gadgets) used in emerging technology.

Pedagogical Exemplars

1. **Experiential learning:** Learners in mixed-gender, mixed-ability or groups (where applicable) visit the school or nearby farm to practise the use of some emerging technologies such as disease and pest detection App, GPS etc. with the assistance of the teacher, technician or farmer and write a report on the activity.
2. **Structuring talk for learning:** In the same groups on the farm, learners discuss the prospects of the emerging technologies in enhancing agricultural productivity.

Key Assessment Level 3: Essay

Question: Describe the use of drones and precision agriculture (using GPS, sensors and data analytics) in cocoa production and predict how they might improve the production of cocoa in the future. (10 marks)

PLC Session 4

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
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Note

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- a. The key assessment for the week is essay. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the essay (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
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Enactment

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 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
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9. Remember to
 - a. Transfer your chats into your learning planner template.
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 - c. Integrate national values, *gesi*, *sel*, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

SECTION TWO REVIEW

The agricultural sector is undergoing a transformative evolution driven by emerging technologies that enhance productivity, sustainability, and resilience. These innovations address the pressing challenges of climate change, food security, and resource management. Key among these technologies are Precision agriculture, Biotechnology, Robotics and Automation, Artificial intelligence (AI) and the Internet of Things (IoT).

Precision agriculture utilises GPS, sensors, and data analytics to enable farmers to monitor and manage field variability. This targeted approach to crop management reduces waste, lowers input costs, and improves yields. Similarly, biotechnology, including genetic engineering and gene editing, has revolutionised crop development by introducing traits such as drought tolerance, pest resistance, and enhanced nutritional content. Robotics and Automation are also reshaping modern farming. Automated machinery for planting, harvesting, and weeding reduces labour dependency and increases efficiency.

AI-powered systems enhance decision-making by analysing vast datasets related to weather patterns, soil conditions, and market trends, thereby optimising farming operations. Furthermore, IoT devices such as smart irrigation systems and livestock monitoring tools allow real-time data collection and remote management, promoting resource-efficient practices and improving animal welfare. In conclusion, the integration of emerging technologies in agriculture represents a paradigm shift toward smart, data-driven farming. While these innovations promise substantial benefits, challenges such as high costs, technological accessibility, and the need for farmer education must be addressed to ensure widespread adoption and equitable impact.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 3

Sample Marking Scheme (15 marks)

1. Identification and Explanation of Technology

- a. Drones: used for crop monitoring.
- b. Precision agriculture: involves the use of (GPS) to analyse data to manage farms more efficiently.
- c. Robotics or autonomous machinery: these are machines used to perform various tasks on the farm such as harvesting, weeding, etc.
- d. Biotechnology/GMOs: this involves the use of genetically modified crops that resist pests or grow faster.

Identification of any of the technologies: $3 \times 1 = 3$ marks

Explanation of each of the technologies: $2 \times 1 = 2$ marks

Total: 5 marks

2. Evaluation of Benefits

- a. Increased efficiency: less time with fewer resources used to produce cassava.
- b. Higher yields: ensures better cassava quality
- c. Environmental sustainability: reduced chemical use with precise application in producing cassava.
- d. Labour reduction: technology reduces the need for manual labour in cultivation and harvesting cassava.

Stating any of the benefits: $3 \times 1 = 3$ marks

Explanation of each of the benefits: $2 \times 1 = 2$ marks

Total: 5 marks

3. Evaluation of Challenges

- a. Cost: high initial investment for equipment.
- b. Training and knowledge: farmers may not be familiar with new technologies.
- c. Dependence on technology: breakdowns or malfunctions could affect productivity.
- d. Access inequality: small-scale farmers might struggle to afford or access advanced tools.
- e. Internet facilities may not be available to enhance the use of the technology
- f. Lack/unstable power source may affect the use of the gadgets e.g., drones

Stating any of the challenges: $3 \times 1 = 3$ marks

Explanation of each of the challenges: $2 \times 1 = 2$ marks

Total: 5 marks

WEEK 4**Sample Marking Scheme (10 marks)****1. Drones****a. Description of drones**

In cocoa production drones can be used to:

- i. Monitor crops
- ii. Identify pests and disease
- iii. Spray pesticides or fertilisers
- iv. Check the water level in the soil.

1 mark for each for the use of drones in cocoa production. Also, any other correct responses should be accepted. (Any marks)

b. Future potential:

In the future, drones may become fully automated and integrated with AI to make instant decisions, such as spraying only where needed and this will:

- i. Save time
- ii. Reduce chemical use
- iii. Protect the environment.

1 mark for each of the future use of drones in cocoa production. Also, any other correct responses should be accepted. ($3 \times 1 = 3$ marks)

2. Precision Agriculture (Smart Farming)**a. Description of precision agriculture**

Precision agriculture uses GPS, sensors, and data analytics to monitor and manage farming activities such as

- i. Soil sensors tell farmers exactly where to water/irrigate or add nutrients to the cocoa.
- ii. Tractors with gps plant seeds in perfect rows in cocoa farms
- iii. Reduce waste and maximise space.

1 mark for each for the use of GPS and sensors in cocoa production. Also, any other correct responses should be accepted. (Any marks)

b. Future Potential:

- i. GPS and sensors could evolve to use real-time data from satellites and AI to make planting and harvesting decisions automatically.
- ii. It will make farming more productive
- iii. It will reduce costs
- iv. It will make small-scale farmers become more efficient.

1 mark for each of the future use of GPS and sensors in cocoa production. Also, any other correct responses should be accepted. ($2 \times 1 = 2$ marks)

SECTION 3: FOOD PRODUCTION AND POST-HARVEST TECHNOLOGY

STRAND: FOOD PRODUCTION AND NATURAL RESOURCE CONSERVATION

Sub-Strand: Principles of Food Production and Post Harvest Technology

Weeks 5 and 6

Learning Outcome: Use the knowledge acquired to process, store and market high quality food products under hygienic conditions.

Content Standard: Demonstrate the knowledge, understanding and skills of processing, storage and marketing of safe and quality food products from selected food crops.

Weeks 7, 8, 9 and 10

Learning Outcome: Use the knowledge acquired to process, market and store animal/fish products.

Content Standard: Demonstrate the knowledge, understanding and skills of processing, storage and marketing of safe and quality products from selected animals, including fish.

INTRODUCTION AND SECTION SUMMARY

Processing, storage, and marketing are critical components in the agricultural value chain that ensure food products from selected food crops and animals are safe, high in quality, and accessible to consumers. As global demand for food increases, and food safety standards become stricter, it is essential to handle crops and animals in ways that prevent contamination, preserve nutritional value, and extend shelf life. Processing enhances shelf life and product quality; storage preserves safety and prevents spoilage; and marketing ensures products reach consumers efficiently and attractively. Together, these practices play a vital role in ensuring food security, boosting farmer incomes, and promoting public health. This section will help learners to know the meaning of processing, storage and marketing of selected crops and animals including fish, the methods involved in the processing, storage and marketing of selected crops and animals, meaning of safety and quality practices in crop and animal production, steps involved in producing safe and quality crop and animal products for human and animal consumption, and the importance of applying safety and quality practices to processing, storage and marketing of selected crop and animal produce. This section has links with subjects such as Agricultural Science, Applied Technology, Business, Economics, Engineering, General Science, Manufacturing and Robotics.

The weeks covered by the section are:

Week 5: Describe the procedure for processing, marketing and storing of selected food crops.

Week 6: Apply food safety and quality practices in the processing, storage and marketing of selected food crops.

Week 7: Describe the procedure for processing, marketing and storing of selected produce and products from selected animals/fish.

Week 8: Describe the procedure for processing, marketing and storage of produce and products from selected fish.

Week 9: Apply food safety and quality measures in the processing, marketing and storage of selected animals and their carcasses.

Week 10: Apply food safety and quality measures in the processing, marketing and storage of selected fish and their carcasses.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The suggested pedagogical strategies for this section include think-pair-share, initiating talk for learning, enquiry-based learning and project-based learning. Initiating talk for learning and think-pair-share will be used for learners to explain the meaning and procedures for processing, storage and marketing of selected food crops and animal products as they search the internet and discuss among themselves. This will improve their collaborative skills, communication skills and engender teamwork. Enquiry-based learning and project-based learning will afford learners hands-on experiences on the procedures for processing, storage and marketing of some of the Agricultural produce from crops and animals. The suggested pedagogical strategies will also promote creativity, critical thinking abilities and innovation among learners. The teacher should allow learners to work in groups and encourage all learners to fully participate all the activities. The teacher should also ensure inclusiveness in all activities. Learners should also be guided by teachers and technicians during the hands-on practicals.

ASSESSMENT SUMMARY

The teacher should assign tasks and assess learners on the meaning and procedure for processing, storage and marketing of selected food crops and animals including fish as well as the importance and application of food safety and quality practices in the processing, storage and marketing of selected food crops and animals including fish. The assessment questions should be balanced and should take into consideration the 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. Diagnostic, formative and/or summative assessments using strategies such as group discussions, presentations, homework, class exercises, class tests, practical, case study and project-based work should be employed. A varying number of demonstrations, oral and written responses should be accepted. Marking schemes, rubrics and/or score cards should be developed to score all assignments. Learners should have access to their scored assessments and teachers should endeavour to discuss marked assignments with learners. Mid-semester and mock examinations should be conducted in weeks 6 and 10, respectively.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Describe the procedure of processing, storage and marketing of selected food crops.	Level 4 (Week 5)	Group Practical/Homework
Apply food safety and quality practices in the processing, storage and marketing of selected food crops.	Level 4 (Week 6)	Case study/Class Exercise Mid-Semester Examinations
Describe the procedure for processing, marketing and storage of produce and products from selected animals	Level 4 (Week 7)	Essay Type Question/Class Exercise
Describe the procedure for processing, marketing and storage of produce and products from selected fish.	Level 4 (Week 8)	Individual Practical/Homework
Apply food safety and quality measures in the processing, marketing and storage of selected animals and their carcasses	Level 4 (Week 9)	Group project/Homework
Apply food safety and quality measures in the processing, marketing and storage of selected fish and their carcasses	Level 3 (Week 10)	Essay Type Question/Class Exercise Mock examination practice

WEEK 5

Learning Indicator: Describe the procedure for processing, storage and marketing of selected food crops

Recap

Year 1	Week 5 1. Explain the meaning and importance of farm mechanics and power in Agricultural production. 2. Describe the safety measures employed in operating farm machines and power in Agricultural production.
Year 2	Week 5 1. Explain the meaning and importance of survey and mapping in Agriculture. 2. Describe survey and mapping instruments and their uses in Agriculture production.

Focal Area: Meaning and Procedure for Processing, Storage and Marketing of Selected Food Crops

1. Meaning of Processing, Storage and Marketing of Selected Crops

a. Processing

Processing refers to the set of operations that convert harvested crops into forms suitable for consumption, storage, or further use. This includes cleaning, grading, drying, milling, packaging, and transforming raw products into value-added products.

Processing improves shelf life, increase market value, reduce post-harvest losses, and enhance food safety.

Example: Turning maize into flour or tomatoes into puree.

b. Storage

Storage involves keeping harvested crops under controlled conditions to preserve their quality and prevent spoilage, insect attack, or microbial contamination.

Storage maintains food quality, reduce losses, ensure year-round supply, and stabilise market prices.

Example: Storing grains in silos or vegetables in cold storage.

c. Marketing

Marketing includes all activities involved in moving crops from the farm to the final consumer. It involves pricing, promotion, transportation, and selling of the product.

The purpose of marketing is to ensure farmers get fair prices, consumers access safe and affordable food, and reduce waste in the supply chain.

Example: Selling produce in local markets, to wholesalers, or through e-commerce platforms.

2. Methods Involved in the Processing, Storage, and Marketing of Selected Crops

a. Maize

Processing Methods

- i. Shelling (Threshing): Removing kernels (grains) from the cob.
- ii. Drying: Sun drying or mechanical drying to reduce moisture.
- iii. Milling: Grinding into maize flour or cornmeal.
- iv. Fermentation: Used to make products like banku and kenkey.
- v. Snack production: Roasting or popping to make popcorn.

b. Rice

Processing Methods

- i. Drying: to reduce the moisture content
- ii. Threshing: separate grains from straw and chaff to reduce impurities
- iii. Dehusking (Hulling): Removing outer husk to get brown rice.
- iv. Cleaning (Winnowing): Removal of impurities such as stones and husks.
- v. Parboiling: Soaking, steaming, and drying paddy before milling.
- vi. Polishing: Removing bran layer and germ to grain quality and appearance
- vii. Grading: Sorts grains by size, shape and quality to ensure uniformity.
- viii. Packaging: Bagging into different grades and sizes.

c. Cassava

Processing Methods

- i. Peeling and Washing: To remove outer skin and dirt.
- ii. Grating: Breaking down tubers into pulp.
- iii. Fermentation: For fufu and gari.
- iv. Pressing and Drying: Removing excess water.
- v. Frying/Roasting: Final preparation of products like gari.

d. Tomatoes

Processing Methods

- i. Washing and Sorting: Removing rotten or damaged fruits.
- ii. Blanching: Boiling to remove skin.
- iii. Crushing and Cooking: Making paste, sauce, or puree.
- iv. Canning or Bottling: For long-term storage.
- v. Drying: Producing dried tomato flakes or powder.

e. **Fruits (e.g., Mango, Pineapple, Orange)****Processing Methods**

- i. Cleaning and Peeling: Removing dirt and outer layer.
- ii. Juicing: Extracting liquid using a juice extractor.
- iii. Pasteurisation: Heating to kill microbes and extend shelf life.
- iv. Concentration: Making fruit concentrates or syrups.
- v. Drying: Sun drying or mechanical drying for dried fruit.
- vi. Jam/Jelly Making: Cooking with sugar and pectin.

f. **Groundnuts (Peanuts)****Processing Methods**

- i. Shelling: Removing outer shell.
- ii. Roasting: For consumption or oil extraction.
- iii. Grinding: Making peanut butter or groundnut paste.
- iv. Oil Extraction: Pressing to extract groundnut oil.
- v. Packaging: For roasted nuts or oil.

Learning Tasks

1. Recap on farm machines, power and their operations as well as survey and mapping for agricultural production.
2. Explain the meaning of processing, storage and marketing of selected crops.
3. Discuss the methods involved in the processing, storage and marketing of selected crops in crop production.

Pedagogical exemplars

1. **Think-pair-share:** Learners in pairs brainstorm the meaning of processing, storage and marketing of selected crops.
2. **Inquiry-based learning:** Learners in mixed-ability groups watch a documentary on how harvested crops are processed for usage, storage and marketing.
3. **Problem-based learning:** In the same groups, learners prepare a flow chart on the procedures for processing, storage and marketing of selected crops based on the documentary watched.
4. **Initiating talk for learning:** Learners in mixed-ability group discuss the methods involved in the processing, storage and marketing of selected crops and present their findings in class.
5. **Project-based learning (Homework):** In mixed-ability groups, learners process selected crops into secondary products such as oranges to orange juice, tomatoes to tomatoes paste, groundnut to groundnut paste, etc. and present a report on their project.

Key Assessment Level 4: Group Practical Work

Question: A group of you have been hired as agricultural consultants to assist a tomato-producing cooperative in reducing post-harvest losses and increasing profitability.

1a) Develop a detailed plan outlining the step-by-step procedures involved in the processing, storage, and marketing of tomatoes. **(21 marks)**

1b) For each stage, analyse how the process helps reduce post-harvest losses and increases the market value of tomatoes. **(5 marks)**

1c) Recommend and explain how two modern methods or technologies can improve efficiency, quality, or profitability at any stage of the tomato value chain. Your response should show practical insight, innovation, and expert-level agricultural knowledge. **(4 marks)**

(Total of 30 marks)

PLC Session 5

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is group practical work. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the practical work (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).

9. Remember to

- a. Transfer your chats into your learning planner template.
- b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
- c. Integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 6

Learning Indicator: Apply food safety and quality practices in the processing, storage and marketing of selected food crops

Recap

Year 1	Week 6: Apply the knowledge and skills of safety measures in handling accidents and injuries of an agricultural worker using appropriate first aid.
Year 2	Week 6 1. Demonstrate the procedure for conducting surveys and mapping of farmstead. 2. Prepare map of a farmstead.

Focal Area: Meaning, Importance and Application of Food Safety and Quality Practices in the Processing, Storage and Marketing of Selected Food Crops.

1. Meaning of Safety and Quality Practices in Crop Production

Safety and quality practices in crop production refer to a set of farming methods and procedures that ensure crops are grown, handled, and processed in ways that are safe for human and animal consumption and meet high quality standards.

These practices help to:

- Protect consumers' health by reducing contamination from pesticides, chemicals, or pathogens.
- Ensure the crops are nutritious, clean, and marketable.
- Protect the environment and improve sustainability in agriculture.

2. Steps Involved in Producing Safe and Quality Crop Products for Human and Animal Consumption

a. Land Preparation and Soil Testing

- Test soil to determine nutrient levels and pH.
- Prepare the land properly to prevent contamination and ensure healthy root development.

b. Use of Quality Seeds and Planting Materials

- Select certified, disease-free seeds or seedlings.
- Use crop varieties suited to the local climate and resistant to pests and diseases.

c. Application of Agrochemicals Safely

- Use the correct amount of fertilisers, pesticides, and herbicides according to recommended guidelines.
- Observe pre-harvest intervals (waiting time before harvest after spraying).

d. Proper Irrigation and Water Management

- i. Use clean and safe water sources for irrigation.
- ii. Avoid over-watering and waterlogging to prevent plant diseases.

e. Good Field Hygiene and Crop Handling

- i. Regularly remove weeds and diseased plants.
- ii. Ensure clean tools, equipment, and farm worker hygiene to reduce contamination.

f. Pest and Disease Control

- i. Monitor crops regularly.
- ii. Use integrated pest management (IPM) to reduce chemical use and increase safety.

g. Harvesting at the Right Time

- i. Harvest crops at the correct maturity stage.
- ii. Avoid physical damage during harvesting to maintain quality.

h. Post-Harvest Handling and Storage

- i. Clean produce before packaging.
- ii. Store in cool, dry, and pest-free environments to prevent spoilage or contamination.

i. Proper Packaging and Labelling

- i. Use clean and appropriate packaging materials.
- ii. Label products with details like origin, variety, and harvest date to ensure traceability.

j. Compliance with Food Safety Standards

- i. Follow Good Agricultural Practices (GAPs) and food safety regulations.
- ii. Keep records of all farm activities for transparency and quality control.

3. Importance of Applying Safety and Quality Practices to Processing, Storage and Marketing and of Selected Crop Produce**a. Ensures Food Safety**

- i. Prevents contamination by pests, bacteria, chemicals, or dirt.
- ii. Protects consumers from foodborne illnesses and poisoning.

b. Reduces Post-Harvest Losses

- i. Proper drying, cleaning, and storage techniques prevent spoilage and decay.
- ii. Extends shelf life and reduces economic losses for farmers and traders.

c. Maintains Product Quality and Nutritional Value

- i. Good practices preserve the taste, colour, texture, and nutrients of the produce.
- ii. Improves the appearance and attractiveness of food products to consumers.

d. Increases Market Value and Competitiveness

- i. High-quality, clean, and well-packaged products attract better prices.
- ii. Helps farmers compete in local and international markets.

e. Promotes Consumer Confidence

- i. When customers trust the safety and quality of food, they are more likely to buy and recommend it.
- ii. Builds a reliable reputation for producers and sellers.

f. Minimises Waste and Environmental Impact

- i. Reduces the need to discard spoiled or contaminated produce.
- ii. Helps in sustainable use of resources like water, energy, and packaging materials.

g. Ensures Compliance with Food Safety Regulations

- i. Meeting national and international food safety standards (like GAP or HACCP) avoids legal penalties.
- ii. Opens up access to export markets and certifications.

h. Supports Public Health and National Food Security

- i. Safer food products mean fewer health risks and medical costs for society.
- ii. More preserved food means more supply and availability, even during off-seasons.

Learning Tasks

1. Recap on how to establish farmstead, observance of safety measures and application of first aid in agriculture production to ensure safety of workers and food produced.
2. Discuss the meaning of safety quality practices in crop production.
3. Outline the steps involved in producing safe and quality crop produce.
4. Analyse the importance of applying safety and quality practices to processing, storage and marketing of selected crop produce.

Pedagogy Exemplars

1. **Building on what others say:** In pairs, learners brainstorm the meaning of safety and quality practices in crop production.
2. **Problem-based learning:** In mixed-ability groups, learners use the internet to research the steps involved in producing safe and quality crop products for human and animal consumption.
3. **Think-pair-share:** Learners in pairs discuss the importance of applying safety and quality practices to processing, storage and marketing of selected crop products.

4. **Project-based learning:** In gender-based groups, learners build a pictorial flow chart of the steps and importance of safety and quality in processing, storage and marketing of selected crop products.

Key Assessments: Mid-Semester Examination

Question: You are a food safety officer assigned to support a cassava-processing cooperative in a rural community. The cooperative processes cassava into flour, gari, and fufu for both local and export markets. However, the cooperative is facing the following challenges:

- High levels of spoilage during storage
- Contamination complaints from buyers
- Limited shelf life of final products
- Declining sales due to poor packaging and labelling.

The community wants to scale up operations, improve product quality, reduce losses, and meet both local and international food safety standards.

Task:

As the expert, you are to prepare and write a detailed advisory report for the cooperative.

Your report must:

- 1a) Identify and explain any three critical food safety and quality issues observed in the cassava value chain. **(6 marks)**
- 1b) Describe the appropriate food safety and quality control practices to be applied during processing, storage, and marketing. **(9 marks)**
- 1c) Propose two modern technologies or systems that can help improve food safety, quality, and shelf life of cassava products. **(6 marks)**
- 1d) Evaluate how the application of these practices and technologies will increase profitability and reduce post-harvest losses. **(4 marks)**

(Total of 25 marks)

Hint



- Conduct Mid-semester Examination. It should cover contents taught from Week 1 to 5. Refer to the Table of Specification and Structure of the Paper. Learners' papers should be marked immediately and scores entered into the SAP.

SUGGESTED STRUCTURE OF THE MID-SEMESTER EXAMINATION

Section A: 25 Multiple-choice questions

Section B: 2 Essay Questions

Table of specification for item construction for section A and B

Week	Learning Indicator	Types of questions	DoK Levels				Total
			1	2	3	4	
1	Explain the meaning, practices and factors influencing sustainable Agriculture and relate it to good Agricultural practices	MCQs	2	2	-		4
		ESSAY	-	-	-		-
2	Apply good Agricultural practices to promote sustainable Agriculture Employ sustainable techniques to manage Agricultural wastes	MCQs	2	2	2		6
		ESSAY	-	-	1		1
3	Explain the meaning, importance and challenges of emerging technologies in Agriculture	MCQs	-	2	1		3
		ESSAY	-	-	-		
4	Explain the applications and prospects of emerging technologies in Agriculture	MCQs	3	2	1		6
		ESSAY					
5	Describe the procedure for processing, storage and marketing of selected food crops	MCQs	1	3	2		6
		ESSAY			1		1
		Total	8	11	8		27

Sample Questions

Question 1. How can precision agriculture help farmers?

- A. By using detailed data to manage resources.
- B. By making farmers manage water resources.
- C. By making farmers manage human resources.
- D. By increasing the number of workers needed.

Question 2. Which factor is most important for maintaining the quality of fish during storage in a storage facility?

- A. Air control
- B. Humidity control
- C. Water control
- D. Temperature control

Question 3. Why is it important to dry food crops before storage?

- A. To reduce moisture
- B. To reduce colour
- C. To reduce weight
- D. To reduce pests

Question 4. GPS technology is one of the most important systems for 21st century Agriculture. How can GPS technology help farmers?

- A. By guiding prices in the market accurately
- B. By guiding weather patterns accurately
- C. By guiding farm planning accurately
- D. By guiding farmers accurately

Question 5. A group of farmers transition to Good Agricultural Practices (GAP) by adopting integrated pest management, proper waste disposal, and record-keeping of chemical inputs. Over time, what is the most likely impact of these changes on the sustainability of their agricultural operations?

- A. Improve dependence on chemical pesticides to maintain high productivity
- B. Improve labour requirements for the elimination of post-harvest losses
- C. Improve crop diversity due to focus on a few high-value crops
- D. Improved environmental protection for market access

Sample Marking Scheme (10 marks)

Question 1. Correct Answer: A

Question 2. Correct Answer: D

Question 3. Correct Answer: A

Question 4. Correct Answer: C

Question 5. Correct Answer: D

1 mark for each correct question, totalling 10 marks

Section B: 2 Essay Type Questions

Answer One Question from this Section. Each Question Carries 10 marks

Question 1: A young graduate of Awudome Senior High School wants to go into marketing of agricultural produce to earn some income for his university education.

- i. Critically examine three (3) ways by which poor marketing systems will affect his profits **(6 marks)**
- ii. Outline two (2) strategies to improve market access for his produce **(4 marks)**.

Sample Marking Scheme (10 marks)

1. Poor marketing systems affect food crop profitability in the following ways:

- a. Price volatility:
Farmers may be forced to sell at very low prices during glut periods due to lack of storage or bargaining power.
- b. Middlemen exploitation:
Inadequate access to direct markets means farmers rely on intermediaries who offer lower prices.
- c. Lack of market information:
Without information on prices and demand, farmers cannot make informed production or selling decisions.
- d. Poor infrastructure.
Bad roads and transport networks delay deliveries, reduce produce quality, and increase post-harvest losses.
- e. Limited market diversification.
Farmers often rely on local markets only, missing out on urban, regional, or export opportunities.

1 mark for each of the points, 1 mark for a correct explanation. Any $3 \times 2 = 6$ marks. Accept other correct responses.

2. Strategies to improve market access:

- a. Formation of cooperatives:
Enables bulk marketing, stronger bargaining power, and access to better prices. Market information systems:
Provide real-time data on prices, demand, and weather forecasts.
- b. Improved infrastructure:
Investments in rural roads, storage facilities, and transportation lower costs and expand access.

c. Value addition:

Processing and branding of crops increase shelf-life and attract premium prices.

d. Digital platforms and e-marketing:

Allow farmers to sell directly to consumers or traders without intermediaries

1 mark for each of the points, 1 mark for a correct explanation. Any $2 \times 2 = 4$ marks. Accept other correct responses.

PLC Session 6**45 minutes****Planning & Reviewing the Learning Plan**

1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. Identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q).
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP)
 - a. The key assessment for the week is mid-semester examination. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the mid-semester examination (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- b. All teachers in the group work through the problem individually for 3–4 minutes
- c. The group then works through it together the problem, step by step
- d. Highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 7

Learning Indicator: Describe the procedure for processing, marketing and storage of produce and products from selected animals

Recap

Year 1	Week 7 1. Describe the types and uses of farm machines and power in Agricultural production. 2. Describe the factors that affect the use of farm machines and power
Year 2	Week 7 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: Meaning and Procedure for Processing, Storage and Marketing of Produce and Products from Selected Animals

1. Meaning of Processing in Animals/Products

Processing refers to the conversion of raw animal products into forms that are safer, more durable, and more convenient for consumption or sale. The overall goal of processing is to improve shelf life, food safety, and value addition. It includes:

- Slaughtering and meat cutting
- Pasteurising milk
- Making cheese, butter, and yogurt
- Curing, smoking, or freezing meat
- Egg grading and packaging

2. Meaning of Storage of Animal Products

Storage involves keeping animal products under controlled conditions to maintain their quality, safety, and freshness over time. The overall goal of storage is to prevent spoilage and reduce post-harvest losses. Storage of animal products includes:

- Refrigeration and freezing
- Cold storage warehouses
- Vacuum packaging
- Canning

3. Meaning of Marketing of Animal Products

Marketing is the process of promoting and selling animal-derived products to consumers. The overall goal of marketing is to maximise profit, reach target markets, and meet consumer demands. Marketing of animal products includes:

- a. Packaging and labelling
- b. Transport to markets or retailers
- c. Advertising and branding
- d. Wholesale and retail distribution
- e. Exporting

4. **Procedure for Processing of Animal Products**

a. Slaughter and Primary Processing

- i. Selection and inspection of healthy animals.
- ii. Humane slaughtering under hygienic conditions.
- iii. Evisceration and dressing of the carcass.
- iv. Inspection of meat by a veterinary authority for safety and quality.

b. Secondary Processing

- i. Cutting and deboning of meat.
- ii. Processing into products like:
 - Sausages, bacon, ham (pork)
 - Corned beef, canned beef (cattle)
 - Smoked or dried meat (goats/sheep)
 - Fish filleting, smoking, drying
 - Egg pasteurisation and packaging
 - Cheese, butter, and yogurt from milk
- iii. Rendering of by-products (bones, blood, fat, etc.)

c. Value Addition

- i. Seasoning and marinating.
- ii. Packaging with labels indicating date, nutritional info, and certification.
- iii. Quality control and compliance with food safety standards (HACCP, ISO).

5. **Procedure for Storage of Animal Products**

a. Short-Term Storage

- i. Refrigeration (0–4°C) for fresh meat, milk, and eggs.
- ii. Ice storage for fish.

b. Long-Term Storage

- i. Freezing (-18°C and below) for meat and fish.
- ii. Vacuum sealing to extend shelf-life (meat).
- iii. Curing, drying, and smoking to preserve products (bacon, jerky, dried fish).

c. Storage of Non-Perishables

- i. Use of dry, clean, ventilated areas for eggs and preserved items.
- ii. Controlled humidity for skins/hides to prevent mould.

6. Procedure for Marketing of Animal Products**a. Market Identification**

- i. Local markets (open markets, butcheries, supermarkets).
- ii. Institutional buyers (schools, hospitals, hotels).
- iii. Export opportunities.

b. Packaging and Branding

- i. Hygienic, attractive, and tamper-proof packaging.
- ii. Use of proper labels (nutritional info, expiry, batch number).
- iii. Certification from regulatory bodies.

c. Distribution

- i. Cold chain logistics for perishables.
- ii. Timely delivery to reduce spoilage.
- iii. Partnerships with retailers or online delivery services.

d. Promotion and Sales

- i. Use of social media, farm shops, and e-commerce platforms.
- ii. Attendance at agricultural fairs and expos.
- iii. Offering samples and promotions.

Learning Tasks

1. Recap on how farm machines, power and irrigation are used for food production and relate them to how they support processing, and storage of animal products.
2. Explain the meaning of processing, storage and marketing of animal products.
3. Demonstrate some methods Involved in the processing, storage and marketing of animal products.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs revise the meaning of processing, storage and marketing of animal products.
2. **Problem-based learning:** Learners in mixed-ability groups watch a documentary (examples available at: https://www.youtube.com/results?search_query=a+documentary+of+how+animals+are+processed+for+use%2C+stored+and+marketed on 6/7/2025) or research using internet or other sources on how animals are processed for use, stored and marketed. Learners then present a report on the documentary watched or research conducted in class.
3. **Initiating talk for learning:** Learners in mixed-ability group, discuss the methods involved in the processing, storage and marketing of animal products.
4. **Project-based learning:** In mixed-ability groups, learners process selected animals/animal produce into secondary products such as meat to sausage, smoked meat, egg pasteurisation, yoghurt etc. with the aid of a resource person and present a portfolio on their project.

Key Assessments Level 4: Essay

Question: Critically analyse the implications of inadequate post-harvest handling of beef on public health and trade. Propose policy-level interventions to address these challenges. (20 marks)

PLC Session 7

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app

- The key assessment for the week is essay. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the essay task (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- All teachers in the group work through a similar problem individually for 3–4 minutes
- The group then works through the problem together step by step
- Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).

- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- After the enactment, ask for structured feedback from the group
 - Was the concept explained in a way that a learner with no prior knowledge could follow?
 - Were the examples grounded in contexts familiar to Ghanaian learners?
 - Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 8

Learning Indicator: Describe the procedure for processing, marketing and storage of produce and products from selected fish

Recap

Year 1	Week 8 1. Identify the principal parts of farm machines and implements, and state their functions. 2. Operate and maintain farm machines and implements in Agricultural production.
Year 2	Week 8: Describe the parts and functions of the irrigation and drainage system in Agriculture production and demonstrate the skills of operating them.

Focal Area: Meaning and Procedure for Processing, Marketing and Storage of Produce and Products from Selected Fish

1. Meaning of Processing of Fish

Processing of fish refers to the various steps involved in converting raw fish into products suitable for human consumption or further use. This includes cleaning, cutting, filleting, preserving, packaging, and value addition.

2. Meaning of Storage of Fish

Storage of fish involves maintaining fish and fish products under conditions that prevent spoilage and maintain quality. It includes chilling, freezing, and proper packaging to prolong shelf life.

3. Meaning of Marketing of Fish

Marketing refers to all activities involved in moving fish and fish products from producers to consumers. It includes identifying markets, packaging, pricing, promotion, and distribution.

4. Procedure for Processing of Fish

- a. **Harvesting:** Fish are caught using nets, traps, or lines in rivers, lakes, or oceans, or harvested from fish farms.
- b. **Sorting and Grading**
 - i. Fish are sorted by species, size, and quality.
 - ii. Damaged or spoiled fish are removed.
- c. **Cleaning and Gutting**
 - i. Fish are washed with clean water.
 - ii. Scales, guts, gills, and blood are removed to reduce spoilage risk.
- d. **Filleting and Cutting (optional)**
 - i. Whole fish may be filleted or cut into steaks.
 - ii. Boneless cuts are preferred for certain products.

e. Preservation Methods

- i. **Chilling** (0–4°C): Short-term storage.
 - ii. **Freezing** (–18°C or lower): Long-term preservation.
 - iii. **Smoking**: Enhances flavour and shelf life.
 - iv. **Drying/Sun-drying**: Reduces moisture to prevent spoilage.
 - v. **Salting**: Draws out moisture and prevents bacterial growth.
 - vi. **Canning**: Fish is sealed and heat-treated for long-term shelf stability.
- f. Packaging**: Vacuum sealing, plastic trays, or cans with clear labels (product name, origin, expiry date).

5. Procedures for Storage of Fish**a. Fresh Fish**

- i. Store in crushed ice or refrigerated at 0–2°C.
- ii. Shelf life: 1–3 days.

b. Frozen Fish

- i. Blast freezing at –30°C; store at –18°C or below.
- ii. Shelf life: Up to 6 months or more.

c. Smoked or Dried Fish

- i. Keep in a cool, dry place with low humidity.
- ii. Store in airtight containers to avoid rehydration or pest infestation.

d. Canned Fish

- i. Store at ambient temperature away from sunlight.
- ii. Shelf life: 1–2 years if sealed properly.

6. Marketing of Fish

- a. **Market Identification**: Local fish markets, supermarkets, restaurants, and export markets.
- b. **Packaging and Branding**
 - i. Use of attractive, tamper-proof packaging.
 - ii. Include nutrition labels, certification (e.g., “FDA certified”), and traceability information.
- c. **Transportation and Distribution**
 - i. Use refrigerated trucks for fresh or frozen products.
 - ii. Proper handling to maintain cold chain.

d. Promotion

- i. Use social media, flyers, and community fish markets.
- ii. Participate in seafood expos or local food fairs.
- iii. Provide recipe cards and samples to attract buyers.

e. Pricing and Sales

- i. Consider production costs, market trends, and consumer preferences.
- ii. Offer both retail (small quantities) and wholesale options.

Table 8.1 shows a summary of fish processing, storage and marketing

Table 8.1: *Fish processing, storage and marketing*

Aspect	Meaning	Procedure/Steps/Methods
Processing	Converting raw fish into consumable or marketable forms	1. Harvesting/catching fish 2. Sorting and grading 3. Cleaning and gutting 4. Filleting (optional) 5. Preservation: chilling, freezing, smoking, grilling, drying, salting, curing, canning 6. Packaging with labels
Storage	Preserving fish quality and preventing spoilage	1. Fresh fish: Ice or refrigeration (0-2°C) 2. Frozen fish: -18°C or lower 3. Smoked/dried: Cool, dry storage 4. Canned: Room temperature, away from sunlight
Marketing	Activities to move fish from producer to consumer	1. Market identification (local, export, restaurants) 2. Packaging and branding 3. Transport (cold chain) 4. Promotion (ads, fairs, recipe demos) 5. Pricing and sales strategy

Learning Tasks

1. Recap on how operations of farm machines and power can support fish production, processing and storage of fish products.
2. Explain the meaning of processing, storage and marketing of fish products.
3. Demonstrate some methods Involved in the processing, storage and marketing of fish products.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs revise the meaning of processing, storage and marketing of fish products.
2. **Problem-based learning:** Learners in mixed-ability groups watch a documentary (examples available at: <https://www.youtube.com/watch?v=hnLuA7zjmyM>; <https://www.youtube.com/watch?v=1D4ldTT1RsI> and <https://www.youtube.com/watch?v=UEzDA5zbSho> on 21/6/2025) or research using internet or other sources on how fish is processed for use, stored and marketed. Learners then present a report on the documentary watched or research conducted in class.
3. **Initiating talk for learning:** Learners in mixed-ability group, discuss the methods involved in the processing, storage and marketing of fish products.
4. **Project-based learning:** In mixed-ability groups, learners process selected fish into secondary products such as salting, curing, grilling, smoking, drying etc. with the aid of a resource person and present a portfolio on their project.

Key Assessment Level 4: Individual Practical Task

Question: Demonstrate how to preserve whole tilapia using brine for fresh cooking and present a report on your demonstration. (12 marks)

PLC Session 1

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app

- The key assessment for the week is individual practical task. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the practical task (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- All teachers in the group work through a similar problem individually for 3–4 minutes
- The group then works through the problem together step by step
- Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).

- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- After the enactment, ask for structured feedback from the group
 - Was the concept explained in a way that a learner with no prior knowledge could follow?
 - Were the examples grounded in contexts familiar to Ghanaian learners?
 - Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - i. Transfer your chats into your learning planner template.
 - ii. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - iii. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 9

Learning Indicator: Apply food safety and quality measures in the processing, marketing and storage of selected animals and their carcasses

Recap

Year 1	Week 9 1. Explain the meaning and importance of crops. 2. Describe the classification of crops with examples.
Year 2	Week 9 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: Meaning, Importance and Application of Food Safety and Quality Measures in the Processing, Storage and Marketing of Selected Animals and their Carcasses

1. Meaning of Food Safety and Quality

- a. **Food Safety** refers to practices and conditions that ensure food is free from harmful contaminants and safe for human consumption.
- b. **Food Quality** involves characteristics such as taste, texture, appearance, nutritional value, and freshness that meet consumer expectations.

These measures are applied throughout the food value chain—from slaughter or harvest, through processing and storage, to marketing and consumption. These measures also involve hygiene, temperature control, contamination prevention, and adherence to guidelines such as Hazard Analysis and Critical Control Points (HACCP) and Good Manufacturing Practices (GMP).

2. Importance of Food Safety and Quality

The importance of food safety and quality is shown in Table 9.1. The importance of food safety and quality spans from public health protection, ensuring animal product integrity, boosts market confidence, facilitates export and trade, reduces post-harvest losses and complies with regulations.

Table 9.1: Importance of Food safety and quality

Importance	Explanation
Protects Public Health	Prevents foodborne illnesses and disease outbreaks.
Ensures Animal Product Integrity	Maintains meat and milk freshness, flavour, and texture.
Boosts Market Confidence	Builds consumer trust and promotes repeat sales.

Facilitates Export and Trade	Meets international standards and opens access to global markets.
Reduces Post-Harvest Losses	Prevents spoilage and waste during storage and transport.
Complies with Regulations	Avoids legal penalties and ensures business sustainability.

3. Application of Food Safety and Quality Measures

The application of food safety and quality looks at the following during processing, storage and marketing.

a. Processing

- i. Sanitisation of equipment and work surfaces.
- ii. Proper slaughter practices to avoid contamination.
- iii. Inspection and grading of carcasses.
- iv. Use of protective clothing by workers.
- v. Application of HACCP principles.

b. Storage

- i. Cold chain maintenance (0–4°C for meat, -18°C for frozen products).
- ii. Monitoring humidity and air quality.
- iii. Use of preservatives and vacuum packaging where needed.
- iv. Segregation of raw and processed products to avoid cross-contamination.

c. Marketing

- i. Hygienic packaging and labelling (with expiry dates, storage instructions).
- ii. Refrigeration in display (e.g., supermarket meat sections).
- iii. Transportation in temperature-controlled vehicles.
- iv. Traceability systems to track origin and handling of products.

4. Examples by Animal Type

Table 9.2 shows examples of food safety and quality in specific animals.

Table 9.2: *Examples of food safety and quality in animals*

Animal	Example of Safety/Quality Measures
Cattle	Meat carcasses chilled at 0–4°C within 2 hours post-slaughter to prevent bacterial growth.
Goats	Use of sanitised knives and tables during chevon processing to prevent contamination.
Sheep	Wool and hides cleaned and stored to prevent fungal contamination.
Pigs	Pork cured with nitrites under controlled conditions to inhibit <i>Clostridium botulinum</i> .

Poultry	Eggs washed, graded, and stored at 4°C to prevent <i>Salmonella</i> .
Fish	Immediate icing of fish post-harvest to preserve freshness and prevent spoilage.

Learning Tasks

1. Recap on the importance of crops in animal production as well as how harvest machines support animal production to ensure animals are available for processing, storage and marketing.
2. Explain the meaning of safety and quality practices in processing, storage and marketing of selected animals and their carcasses.
3. List the steps involved in producing safe and quality animal products for human and animal consumption.
4. Discuss the importance of applying safety and quality practices to processing, storage and marketing of selected animal's carcasses.

Pedagogical Exemplars

1. **Building on what others say:** In pairs, learners brainstorm the meaning of safety and quality practices in animal production.
2. **Problem-based learning:** In mixed-ability groups, learners research on the internet for the steps involved in producing safe and quality animal products for human consumption.
3. **Think-pair-share:** Learners in pairs discuss the importance of applying safety and quality practices to processing, storage and marketing of selected animal products.
4. **Project-based learning:** In gender-based, mixed-ability or groups (where applicable), learners build a pictorial flow chart of the steps and importance of safety and quality in processing, storage and marketing of selected animal products.

Key Assessment: Level 4 – Mini-project (Group)

Sample Group Project Work

Question 1: Your group is part of a national food safety innovation competition in Ghana. You represent a team of agricultural science students assigned to design a practical, scalable solution for improving food safety and quality standards in the chicken value chain in both rural and urban Ghana. Your group is tasked to conduct research and present proposal that addresses the following:

- 1a) Identify and analyse three major food safety and quality risks associated with chicken processing, storage, and marketing in Ghana. (3 marks)
- 1b) Propose a detailed step-by-step food safety improvement plan for each stage (processing, storage, and marketing). (12 marks)
- 1c) Recommend two modern technologies or systems that can help ensure safe and high-quality chicken products for consumers. (4 marks)

1d) Evaluate how the application of these solutions will impact public health, business profitability, and food loss reduction. **(6 marks)**

(Total of 26 marks)

PLC Session 9

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is mini-project (group). Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentations of the projects (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes

- c. The group then works through the problem together step by step
- d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 10

Learning Indicator: Apply food safety and quality measures in the processing, marketing and storage of selected fish and their carcasses

Recap

Year 1	Week 10 1. Discuss the principles of crop production. 2. Explain the stages of crop production and its related practices.
Year 2	Week 10: Demonstrate the skills in the operation of simple harvest and postharvest implements and machinery use in Agricultural production.

Focal Area: Meaning, Importance and Application of Food Safety and Quality Measures in the Processing, Storage and Marketing of Selected Fish and their Carcasses

1. Meaning of Food Safety and Quality Measures (Fish and Their Carcasses)

- Food Safety** in fish refers to the practices and conditions that prevent contamination and ensure that fish and their carcasses are safe for human consumption.
- Food Quality** in fish focuses on maintaining desirable characteristics of fish such as freshness, colour, texture, flavour, and nutritional value, ensuring they meet consumer expectations and regulatory standards.

2. Importance of Food Safety and Quality Measures in Fish Products

The importance of food safety and quality is shown in Table 10.1. The importance of food safety and quality spans from public health protection, preservation of quality, market competitiveness, export readiness, minimises post-harvest loss and regulatory compliance.

Table 10.1: Importance of food and safety measures in fish and their carcasses

Aspect	Importance
Public Health Protection	Reduces risks of foodborne illnesses like Salmonella, Listeria, and parasites.
Preservation of Quality	Maintains freshness, texture, and nutritional value.
Market Competitiveness	Builds trust among consumers and retailers.
Export Readiness	Ensures compliance with international standards (e.g., EU, FDA, Codex).
Minimises Post-Harvest Loss	Reduces spoilage and waste through proper storage and handling.
Regulatory Compliance	Avoids legal penalties and upholds food laws and hygiene requirements.

3. Application of Food Safety and Quality Measures

The steps involved in producing safe and quality fish products for human and animal consumption consider the activities carried out during processing, storage and marketing.

a. Processing

- i. Clean and gut fish immediately after harvest.
- ii. Use potable water for washing.
- iii. Maintain personal hygiene (gloves, aprons, hairnets for workers).
- iv. Sanitise knives, cutting boards, and equipment frequently.
- v. Apply HACCP principles to monitor and control contamination points.
- vi. Keep fish at low temperatures ($\leq 4^{\circ}\text{C}$) during processing.

b. Storage

- i. Refrigerate fresh fish ($0-4^{\circ}\text{C}$); freeze for long-term (-18°C or below).
- ii. Store with crushed ice in insulated containers.
- iii. Ensure clean, dry, and well-ventilated storage spaces.
- iv. Use vacuum-sealed or airtight packaging to extend shelf life.
- v. Monitor storage conditions (temperature, humidity, hygiene) regularly.

c. Marketing

- i. Use cold display units in fish markets and supermarkets.
- ii. Transport using chilled or insulated vehicles.
- iii. Label products with name, date of processing, expiry date, and origin.
- iv. Package fish in clean, leak-proof, and food-grade materials.
- v. Educate sellers and consumers about safe handling and storage.
- vi. Follow local and international regulations for seafood marketing.

Learning Tasks

1. Recap on how machines and implements are used for safe harvesting of crops that can serve as sources of feed for fish, thereby making fish available for processing, storage and marketing.
2. Explain the meaning of safety and quality practices in processing, storage and marketing of selected fish and their carcasses.
3. List the steps involved in producing safe and quality fish products for human and animal consumption.
4. Discuss the importance of applying safety and quality practices to processing, storage, marketing of selected fish carcasses.

Pedagogical Exemplars

1. **Building on what others say:** In pairs, learners brainstorm the meaning of safety and quality practices in fish production.
2. **Problem-based learning:** In mixed-ability groups, learners research on the internet for the steps involved in producing safe and quality fish products for human consumption.
3. **Think-pair-share:** Learners in pairs discuss the importance of applying safety and quality practices to processing, storage and marketing of selected fish products.
4. **Project-based learning:** In gender-based, mixed-ability or groups (where appropriate), learners build a pictorial flow chart of the steps and importance of safety and quality in processing, storage and marketing of selected fish products.

Key Assessment Level 4: Class Exercise

Question

- a. Critically evaluate how food safety and quality measures are applied in the processing, storage. **(6 marks)**
- b. Critically evaluate marketing of selected fish and their carcasses. **(6 marks)**
- c. How do these measures vary between artisanal and industrial operations? **(6 marks)**
- d. What integrated strategies can be implemented to bridge safety gaps across the entire fish value chain? **(12 marks)**

(Total of 30 marks)

PLC Session 10

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app

- The key assessment for the week is class exercise. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exercise (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- All teachers in the group work through a similar problem individually for 3–4 minutes
- The group then works through the problem together step by step
- Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).

- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- After the enactment, ask for structured feedback from the group
 - Was the concept explained in a way that a learner with no prior knowledge could follow?
 - Were the examples grounded in contexts familiar to Ghanaian learners?
 - Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

SECTION THREE REVIEW

Ensuring the safety, quality, and marketability of food products derived from crops, animals, and fish is essential for food security, public health, and economic development. From farm to fork, each stage of the food supply chain (processing, storage, and marketing) plays a vital role in preserving nutritional value, extending shelf life, and meeting regulatory and consumer standards. Proper processing transforms raw agricultural products into forms that are safe, palatable, and convenient. Effective storage practices prevent spoilage, maintain quality, and reduce post-harvest losses. Finally, strategic marketing ensures these products reach the right consumers, enabling producers to capture value and respond to demand. This integrated approach supports sustainable food systems, improves livelihoods, and promotes access to high-quality and safe foods globally.

The procedures for processing, storage and marketing selected crop using maize as an example are 1) Processing: Clean equipment and hands before milling, avoid use of mouldy grains and ensure drying is complete to avoid aflatoxins, 2) Storage: Use clean, dry sacks or silos and apply pest control methods like neem or synthetic pesticides appropriately. 3) Marketing: Package maize in hygienic, labelled bags, ensure drying is complete to reduce aflatoxins development and avoid exposure to moisture and dirt during transportation.

The procedures for processing animal products are slaughter and primary processing, secondary processing and value addition. Storage of animal products considers long-term storage and storage of non-perishables. The procedure for marketing animal products includes market Identification, packaging and branding, distribution, and promotion and sales.

The procedures for processing fish are harvesting, sorting and grading, cleaning and gutting, filleting and cutting (optional), preservation methods and packaging. fishes are stored either as fresh fish, frozen fish, smoked or dried or canned fish. Marketing of fish involves market identification, packaging and branding, transportation and distribution, promotion, pricing and sales.

Food safety and quality practices are essential for ensuring that both crop and animal-based foods are safe, nutritious, and suitable for consumption. Food safety focuses on preventing contamination and foodborne illnesses, while food quality ensures the product meets consumer expectations in terms of taste, appearance, and nutritional value. These practices are crucial during processing, storage, and marketing, where poor handling can lead to spoilage, health risks, and economic losses. By applying standards such as Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), and HACCP, producers and marketers can maintain product integrity, comply with regulations, and build consumer trust.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 5 (30 marks)

1a. Step-by-Step Procedures

a. Harvesting

- i. Harvest tomatoes at the mature-green or breaker stage depending on intended market (fresh vs. processed).
- ii. Use clean crates to avoid bruising.

1 mark for stating the point and another mark for each explanation, $3 \times 1 = 3$ marks

b. Sorting and Grading

- i. Separate tomatoes based on ripeness, size, and presence of defects.
- ii. Discard rotten or damaged fruits to prevent spread of decay.

1 mark for stating the point and another mark for each explanation, $3 \times 1 = 3$ marks

c. Processing

- i. Washing and Blanching: Clean thoroughly and blanch to soften skin and reduce microbial load.
- ii. Pulping: Use pulping machines to extract juice or pulp.
- iii. Pasteurisation: Heat treat to destroy pathogens and extend shelf life.
- iv. Packaging: Seal into sterilised containers (cans, jars, or sachets).

1 mark for stating the main point, 1 mark for stating the processing point and 1 mark for each explanation, $1 + 2 \times 4 = 9$ marks

d. Storage

- i. Store fresh tomatoes at 12–15°C with 85–90% humidity to delay ripening.
- ii. Processed tomato products stored in dry, cool rooms or cold storage facilities.

1 mark for stating the point and another mark for each explanation, $3 \times 1 = 3$ marks

e. Marketing

- i. Label products with expiry dates, nutritional content, and brand identity.
- ii. Distribute to supermarkets, restaurants, and agro-processing companies.

iii. Use digital platforms and e-commerce for broader market access.

1 mark for stating the point and another mark for each explanation, Any 3 x 1 = 3 marks

1b. How Each Stage Reduces Post-Harvest Losses and Adds Value

- a. Timely harvesting ensures fruit quality and reduces spoilage in transit.
- b. Sorting and grading remove potential sources of decay and standardize products for market categories.
- c. Processing into paste, puree, ketchup, or dried tomatoes adds shelf life, expands uses, and fetches higher prices.
- d. Pasteurization and safe packaging reduce microbial spoilage and ensure consumer safety.
- e. Proper cold storage extends shelf life of both raw and processed tomatoes, reducing losses during supply gluts.
- f. Marketing with branding adds value, builds consumer trust, and enables penetration into formal markets and exports.

1 mark for each correct answer, Any 5 x 1 = 5 marks

1c. Recommended Modern Methods/Technologies

- a. Evaporative Cool Storage Systems (Zero Energy Cool Chambers)
 - i. Affordable, non-electric technology that maintains lower temperatures for storing fresh tomatoes.
 - ii. Extends freshness by reducing respiration rate and microbial growth.

1 mark for stating the point and another mark for any correct explanation, 2 x 1 = 2 marks

- b. Automated Tomato Grading and Sorting Machines
 - i. Use cameras and sensors to efficiently sort tomatoes by size, color, and defects.
 - ii. Increases processing speed, accuracy, and reduces labour costs and human error.

1 mark for stating the point and another mark for any correct explanation, 2 x 1 = 2 marks

WEEK 6

Sample Marking Scheme (Advisory report) (25 marks)

1a. Critical Food Safety and Quality Issues Identified

- a. Microbial Contamination during Processing: Unhygienic peeling, grating, and fermentation practices introduce pathogens such as *Salmonella* or *E. coli*.
- b. Mycotoxin Contamination in Storage: Poorly dried cassava products stored in humid conditions encourage mould growth, leading to aflatoxin contamination.
- c. Poor Packaging and Labelling: Use of unsealed or reused sacks compromises hygiene and fails to meet labelling requirements for traceability and export compliance.

1 mark for stating the point and another mark for providing a correct explanation, 2 x 3 = 6 marks

1b. Food Safety and Quality Practices to Apply

- a. During Processing
 - i. Use clean, food-grade equipment and enforce regular sanitation protocols.
 - ii. Apply controlled fermentation and drying to reduce cyanide levels and prevent microbial growth.
 - iii. Train workers on Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Points (HACCP).
- b. During Storage
 - i. Ensure complete drying of cassava flour and gari to below 13% moisture content.
 - ii. Store in dry, well-ventilated, rodent-proof warehouses.
 - iii. Use pallets to prevent ground moisture contact and contamination.
- c. During Marketing
 - i. Package products in airtight, food-safe, tamper-proof materials.
 - ii. Include clearly labeled nutritional information, date of production/expiry, and batch numbers.
 - iii. Use barcode or QR coding for traceability and tracking in commercial supply chains.

1 mark for stating the point and another 1 mark for providing any two correct explanations,
 $3 \times 3 = 9$ marks

1c. Modern Technologies or Systems to Implement

- a. Cassava Flash Dryer
 - i. Rapidly dries cassava products under hygienic conditions, improving product consistency and safety.
 - ii. Reduces dependency on sun drying, which can introduce dirt and pests.
- b. Vacuum Packaging Machines with Nitrogen Flushing
 - i. Removes air to slow oxidation and prevents microbial growth.
 - ii. Extends shelf life significantly and maintains freshness, especially for export markets.

1 mark for stating the point and another 1 mark for providing any two correct explanations,
 $3 \times 2 = 6$ marks

1d. Evaluation of Impact on Profitability and Loss Reduction

- a. Food Safety Compliance will allow the cooperative to access premium local and international markets, increasing revenue.
- b. Reduced Spoilage during storage translates to higher yield and better inventory turnover.
- c. Modern drying and packaging lower risks of contamination and product returns, reducing operational losses.

- d. Improved branding and labelling make products competitive and attractive to health-conscious consumers, increasing customer loyalty.

1 mark for providing each correct explanation, any $4 \times 1 = 4$ marks

WEEK 7 (20 marks)

a. Public Health Perspective

- i. Poor handling of beef can lead to contamination with pathogens such as E. coli or Salmonella.
- ii. Lack of refrigeration can cause beef to easily spoil and expose consumers to pathogens.
- iii. Unsanitary equipment can cause outbreaks of foodborne illnesses, which strain health systems.
- iv. Exposure to pests at storage points can also cause the spread of pathogens and lower consumer trust.

1 mark for each correct statement, $1 \times 4 = 4$ marks (Accept other correct responses not provided under the marking scheme)

b. Trade Perspective

- i. Products that do not meet sanitary and phytosanitary standards are rejected.
- ii. For instance, beef contaminated with Salmonella residues can face export bans.
- iii. Also, beef contaminated with antibiotic residues can face export bans.
- iv. This will result in financial loss.
- v. It will damage the beef producing company's reputation.
- vi. It will restrict the company's future access to high-value markets.

1 mark for each correct statement, any $1 \times 6 = 6$ marks (Accept other correct responses not provided under the marking scheme)

c. Address these challenges at policy-level

- i. **Strengthening quality control infrastructure** through mobile testing laboratories and regional cold storage hubs.
- ii. **Training and extension services** to teach hygienic beef handling, temperature control, and basic safety practices.
- iii. **Subsidies or grants** for small-scale processing equipment and solar refrigeration units for beef storage.
- iv. **Developing public-private partnerships** to invest in beef processing factories with compliance certification.
- v. **Regulatory enforcement and traceability systems** to ensure accountability and protect consumers.

1 mark for stating the point and 1 mark for correct explanation, $2 \times 5 = 10$ marks (Accept other correct responses not provided under the marking scheme)

WEEK 8 (12 marks)**Rubrics for Grading Individual Practical on Salting Whole Tilapia with Brine for Fresh Cooking**

	Excellent (3 marks)	Very Good (2 marks)	Satisfactory (1 mark)	Needs improvement (1/2 mark)
Cover page	Provides the: • Topic • Name, • ID, and • Date of submission (Provide all 4 items)	Provides any of these 3 items	Provides any of these 2 items	Provides only one item
Step 1: Select and Clean the Fish	• Use fresh tilapia. • Remove scales, guts, and gills. • Wash thoroughly in clean, cold water. (Provide all 3 points)	Provides 2 of these points	Provides only 1 point	Provides none
Step 2: Brine Salting Method	• Dissolve salt in clean water to 15–20% solution (e.g., 150–200g salt per litre of water). • Submerge fish completely in the brine. • Store in a cool place or refrigerator. • Leave for 12–48 hours, depending on size. (Provide all 4 points)	Provides a maximum of 3 points	Provides a maximum of 2 points	Provides none
Step 3: Rinsing and Drying	• Rinse fish in clean water to remove surface salt. • Pat dry or hang in cool, shaded area if drying. • For fresh cooking, let rest for 30–60 mins before use. (Provide all 3 points)	Provides 2 of these points	Provides only 1 point	Provides none

WEEK 9 (30 marks)**1a. Major Food Safety and Quality Risks in Chicken Handling in Ghana**

- a. Unhygienic Slaughtering and Processing Conditions: Chickens are often slaughtered on bare floors with contaminated water and unsterilized knives, increasing the risk of Salmonella and Campylobacter contamination.
- b. Inadequate Cold Chain Storage: Many retailers lack access to consistent refrigeration, especially in rural markets, leading to rapid spoilage.
- c. Improper Packaging and Handling During Marketing: Chickens are sold in open markets, often exposed to flies, dust, and high temperatures, which compromise safety and shelf life.

1 mark for stating the main point and 1 mark for correct explanation of 3 points, $2 \times 3 = 6$ marks

1b. Food Safety Improvement Plan (Step-by-Step)

- a. Processing Stage
 - i. Train workers on Good Hygienic Practices (GHP) and Standard Operating Procedures (SOPs) for poultry slaughter.
 - ii. Use stainless steel tables, gloves, and footbaths to prevent cross-contamination.
 - iii. Employ hot water scalding tanks and automatic pluckers for hygienic feather removal.
 - iv. Install effluent treatment systems to manage slaughterhouse waste.
- b. Storage Stage
 - i. Maintain chicken at 0°C to 4°C using cold rooms or solar-powered refrigeration units.
 - ii. Implement First-In-First-Out (FIFO) inventory system.
 - iii. Conduct routine checks for freezer burn or microbial spoilage.
- c. Marketing Stage
 - i. Use vacuum-sealed packaging with tamper-proof labels.
 - ii. Sell chicken from display refrigerators or insulated iceboxes in markets.
 - iii. Educate retailers on safe temperature zones and hygiene protocols.
 - iv. Include traceability barcodes on packaging to allow tracking from farm to shelf.

1 mark for stating the main and 1 mark each, for 3 correct statements explaining the point, $4 \times 3 = 12$ marks

1c. Recommended Technologies/Systems

- a. Cold Chain Monitoring System:
 - i. Use digital sensors and mobile apps to track temperature during transportation and storage.
 - ii. Prevent spoilage by alerting handlers if the temperature goes out of range.

b. Hazard Analysis and Critical Control Points (HACCP) Certification Program:

- i. Implement HACCP plans to identify, monitor, and control critical safety points in the chicken processing chain.
- ii. Aligns with Ghana FDA standards and opens doors to export markets.

1 mark for stating the main point and 1 mark for one correct explanation of the points, 2 x 2 = 4 marks

1d. Impact Evaluation

Category	Impact
Public Health	Reduced cases of foodborne illnesses like Salmonellosis and Campylobacteriosis.
Profitability	Longer shelf life leads to reduced spoilage, higher market value, and access to formal retail markets.
Food Loss	Estimated 30–40% reduction in spoilage-related losses during hot seasons.
Market Trust	Branded, traceable chicken builds consumer confidence, encouraging loyalty.

Accept results in table or in prose

1 mark for stating the main point and 1 mark for correct explanation of the points, any 4 x 2 = 8 marks. Accept other correct responses not provided in the marking scheme

WEEK 10 (30 marks)**1. Food Safety and Quality Measures in Fish Processing**

a. Hazard Analysis and Critical Control Points (HACCP)

- i. Used in industrial facilities to identify hazards (e.g., parasites, histamine production, heavy metal contamination) and control them at critical points (e.g., temperature control during gutting).
- ii. Artisanal processors rarely implement HACCP due to lack of training and resources.

b. Good Manufacturing Practices (GMP)

- i. Industrial processors ensure cleanliness, proper handling, and adequate equipment maintenance.
- ii. Industrial processors follow strict GMP protocols; artisanal units often use open-air environments, increasing the risk of contamination.

c. Sanitation Standard Operating Procedures (SSOPs)

- i. Industrial processors ensure routine cleaning of equipment and surfaces.
- ii. Industrial plants have designated sanitation teams; artisanal units rely on manual, often inconsistent, cleaning practices.

1 mark for the main point and 1 mark each for any two correct explanations, any $2 \times 3 = 6$ marks

2. Safety Measures in Fish Storage

a. Cold Chain Systems

- i. Industrial operations use refrigerated storage and blast freezing at -20°C or below.
- ii. Artisanal fishers often depend on ice boxes or sell fresh without refrigeration, accelerating spoilage.

b. Modified Atmosphere Packaging (MAP)

- i. Industrial operations use MAP to prolong shelf life by controlling oxygen and carbon dioxide levels.
- ii. Rarely practiced in artisanal systems due to cost and technical know-how.

c. Use of Clean Ice and Water

- i. Quality of water and ice used for storage is crucial in industry processing.
- ii. Industrial sectors use treated water, while smallholders often use untreated sources, increasing contamination risks.

1 mark for the main point and 1 mark each for any two correct explanations, any $2 \times 3 = 6$ marks

3. Food Safety in Fish Marketing

a. Traceability Systems

- i. Barcode or QR-coded labelling is used in industrial supply chains to track source and distribution.
- ii. Artisanal fish marketing lacks proper traceability, especially in informal markets.

b. Product Display and Packaging

- i. In formal settings, fish is kept in refrigerated displays and sealed packages.
- ii. In open markets, fish is typically sold on tables without protection from flies or dust.

c. Regulatory Oversight and Certification

- i. Exporters adhere to Codex and national safety standards.
- ii. Local artisanal vendors are often unregulated, making enforcement of safety measures difficult.

1 mark for the main point and 1 mark each for any two correct explanations, any $2 \times 3 = 6$ marks

4. Integrated Strategies to Bridge the Safety Gap

a. Capacity Building and Training

- i. Conduct workshops for artisanal processors on hygiene, fish handling, and temperature control.

- ii. Introduce mobile training units and translated visual guides.
- b. **Affordable Cold Storage Access:** Implement **solar-powered cold rooms, insulated boxes, and ice production hubs** at fish landing sites.
- c. **Public-Private Partnerships (PPP):** Support infrastructure development in small-scale fisheries via collaborative investment models.
- d. **Mobile and Digital Technologies:** Use mobile apps to track temperature, record handling practices, and access safety guidelines.
- e. **Cluster Certification Models:** Group artisanal fishers into cooperatives to collectively comply with food safety standards and share resources like storage and transport.
- f. **Policy Enforcement and Incentives:** Governments should offer **certification incentives, tax relief, or market access privileges** to compliant fish processors and vendors.

1 mark for the main point and 1 mark for a correct explanation, $6 \times 2 = 12$ marks (Any other correct responses should be accepted)

SECTION 4: NATURAL RESOURCE CONSERVATION IN AGRICULTURE

STRAND: FOOD PRODUCTION AND NATURAL RESOURCE CONSERVATION

Sub-Strand: Principles of Natural Resource Conservation in Agriculture

Learning Outcome: Use the knowledge acquired to conserve soil and water for Agricultural production.

Content Standard: Demonstrate knowledge understanding and skills on soil and water conservation.

INTRODUCTION AND SECTION SUMMARY

As the global population continues to rise, the demand for food production intensifies. Meeting this demand while maintaining the health of the planet presents a major challenge for modern agriculture. Traditional farming practices, although productive, often strain natural resources such as soil, water, and biodiversity. This has led to widespread concern over environmental degradation, climate change, and long-term food insecurity. Natural resource conservation in agriculture is essential to ensure that farming remains productive and sustainable. It involves careful management of resources like soil fertility, freshwater, forests, and energy to reduce environmental impact and preserve ecosystems. Sustainable agricultural practices aim to strike a balance between increasing food output and protecting the natural systems that support it. These practices include conservation tillage, crop rotation, integrated pest management, and water-efficient irrigation systems. This section highlights the interdependence between agricultural productivity and the sustainable use of natural resources. It will also expose learners to how modern agriculture can meet rising food demands while minimising environmental harm. Key strategies discussed include soil conservation techniques, efficient water management, biodiversity preservation, and the use of renewable energy sources. Emphasis is placed on sustainable farming practices that enhance soil health, reduce water use, and limit chemical inputs, all of which contribute to long-term agricultural viability. This section has links with Agricultural Science, General Science, Geography, and Biology.

The weeks covered by the section are:

Week 11: Explain the meaning, importance and principles of soil and water conservation.

Week 12

1. Describe the types of soil water and their importance in Agricultural production
2. Describe the types of soil erosion and their effects on Agricultural production.

SUMMARY OF PEDAGOGICAL EXEMPLARS

Learners will explore key natural resources such as soil, water, air, vegetation, and biodiversity, and examine how poor agricultural practices lead to resource degradation. The exemplar guides learners through identifying causes of land and water depletion and evaluating sustainable conservation methods, including contour ploughing, agroforestry, mulching, drip irrigation, and integrated pest management. The pedagogical exemplars that would be employed to enhance understanding of the meaning, importance, principles of soil and water conservation include think-pair-share, collaborative learning, inquiry-based learning, experiential learning and project-based learning. Critical thinking, collaboration, and digital literacy are core competencies developed through activities such as group discussions, case study analysis, and problem-solving tasks. Values such as environmental responsibility, stewardship, and appreciation for indigenous and scientific conservation practices are also emphasised. Assessment strategies such as class exercises, assignments and group project work would be used to assess the learners formatively. Through this approach, learners are prepared to make informed, sustainable decisions in agricultural production and to contribute meaningfully to both local and global environmental efforts. All learners should be encouraged and given equal opportunities to participate in all activities. Learners with the potential to play lead roles should be allowed to do so. Learners should work among themselves in mixed-ability groups, mixed-gender (where appropriate) groups, pairs or as individuals. Teachers, technicians and resource persons during hands-on practical work should guide learners. They should ensure that all learners fully participate in all hands-on lessons.

ASSESSMENT SUMMARY

Tasks should be assigned on the meaning, importance and principles of soil and water conservation. Soil water and their importance in Agricultural production should also feature in the assessment of the learners. The assessment questions should be balanced and should take into consideration the different abilities and proficiencies of learners. The questions should be clear, fair and differentiated to cater for learners at all proficiency levels with some emphasis on Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning) assessments. Formative and summative assessments using strategies such as class exercises, class tests, group discussions, homework, presentations, and project-based work should be employed. Varying responses including demonstrations, oral and written responses should be accepted. Marking schemes, rubrics or score cards can be developed and used to assess learners. Learners score marks should be discussed with them to identify and help improve areas the need to be improved. End of semester examinations should be conducted in week 12.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Explain the meaning, importance and principles of soil and water conservation.	Level 2 (Week 11)	Essay Type Question/Homework
Describe the types of soil water and their importance in Agricultural production.	Level 3 (Week 12)	Essay Type Question/Class Exercise
Describe the types of soil erosion and their effects on Agricultural production.	Level 4 (Week 12)	Essay Type Question/Homework End of Semester Examinations

WEEK 11

Learning Indicator: Explain the meaning, importance and principles of soil and water conservation

Recap

Year 1	Week 11: Hands-on farm practical activities to acquire the skills in the principles of crop production.
Year 2	Week 11 1. Explain the economic importance of selected crops. 2. Apply the technologies and techniques to cultivate selected crops (vegetables)

Focal Area: Meaning, Principles and Importance of Soil and Water Conservation

1. Meaning of Soil Conservation

Soil conservation refers to the methods and practices used to protect soil from degradation caused by erosion, compaction, salinisation, and nutrient loss. It aims to maintain soil health and productivity for sustainable agricultural and ecological balance. Soil conservation ensures that the topsoil remains fertile and intact, helping crops grow efficiently and ecosystems remain stable.

2. Principles of Soil Conservation

a. Reduce Soil Erosion

Use methods like contour ploughing, terracing, and vegetative cover to slow down water and wind that can carry soil away.

b. Maintain Soil Cover

Keep the soil covered with crops, cover crops, mulch, or organic matter to protect it from rain, wind, and sun.

c. Enhance Organic Matter

Add compost, green manure, and crop residues to improve soil structure and fertility.

d. Conserve Soil Moisture

Use mulching, no-till farming, and efficient irrigation to retain moisture and prevent drying out.

e. Manage Soil Fertility

Practice crop rotation, balanced fertilisation, and minimal chemical use to maintain nutrient levels.

f. Land Use According to Capability

Match land use with its natural capability (e.g., avoid cultivating steep slopes).

g. Prevent Overgrazing and Deforestation

Control livestock movement and promote reforestation to avoid soil compaction and erosion.

3. Importance of Soil Conservation**a. Preserves Soil Fertility**

Maintains nutrient-rich topsoil for crop growth.

b. Prevents Land Degradation

Avoids turning productive land into unproductive or decertified areas.

c. Supports Agricultural Productivity

Helps ensure long-term food security and stable yields.

d. Controls Erosion and Sedimentation

Reduces runoff into rivers and lakes, protecting water bodies.

e. Improves Water Retention

Healthy soil retains more water, reducing irrigation needs, and boosting drought resistance.

f. Supports Biodiversity

Conserved soil provides habitat for beneficial microbes and organisms.

g. Mitigates Climate Change

Soils store carbon, so conservation helps reduce greenhouse gases.

4. Meaning of Water Conservation

Water conservation refers to the strategies and practices aimed at using water efficiently and reducing unnecessary usage or wastage. The goal is to protect freshwater resources and ensure their availability for future generations, as water is a finite and essential resource for life, agriculture, industry, and ecosystems.

5. Principles of Water Conservation**a. Efficient Water Use**

Employ methods such as drip irrigation, rainwater harvesting, and low-flow appliances to use water efficiently, especially in agriculture and urban settings.

b. Reduce Water Waste

Fix leaks, use water-saving devices, and avoid overwatering crops or lawns to minimise waste.

c. Promote Water Recycling and Reuse

Implement systems for greywater reuse, industrial water recycling, and wastewater reuse and treatment to reduce the demand for freshwater.

d. Control Runoff and Pollution

Use techniques like contour bunding, permeable pavements, and vegetated swales to reduce runoff and prevent water pollution.

e. Rainwater Harvesting

Collect and store rainwater for later use in irrigation, household, and industrial applications.

f. Educate and Raise Awareness

Promote water conservation practices and the importance of sustainable water use at the individual, community, and government levels.

g. Water-Efficient Landscaping (Xeriscaping)

Use drought-resistant plants and landscape designs that require minimal irrigation.

6. Importance of Water Conservation**a. Ensures Sustainable Water Supply**

Conserving water helps ensure there is enough freshwater available for drinking, agriculture, and industrial purposes, especially in water-scarce regions.

b. Prevents Over-exploitation of Water Resources

Helps avoid the depletion of groundwater and surface water bodies, which can lead to droughts, ecosystem damage, and food insecurity.

c. Supports Agricultural Productivity

Efficient irrigation techniques help conserve water while maintaining crop yields, particularly in areas with limited rainfall.

d. Reduces Energy Consumption

Water treatment and transportation require significant energy. Conserving water reduces energy use and carbon emissions.

e. Protects Ecosystems and Biodiversity

Conserving water ensures healthy aquatic ecosystems and supports the species that depend on them.

f. Mitigates Drought and Flood Risks

Proper water management helps reduce the risk of both droughts (by improving water storage) and floods (by reducing runoff).

g. Reduces Water Pollution

Preventing the wastage of water reduces the pollution load on water treatment systems and water bodies, helping preserve water quality.

Table 11.1 shows the differences between soil conservation versus water conservation.

Table 11.1: *Differences between Soil Conservation versus Water Conservation*

Aspect	Soil Conservation	Water Conservation
Definition	Soil conservation involves practices that prevent soil erosion, maintain soil fertility, and preserve soil quality.	Water conservation involves strategies to use water efficiently, minimise wastage, and protect water resources.
Focus	Protecting the soil from erosion, degradation, and nutrient loss.	Managing and conserving water resources for long-term use.

Main Techniques	- Contour ploughing - Terracing - Crop rotation - Mulching - Cover cropping	- Drip irrigation - Rainwater harvesting - Water-efficient appliances - Recycling water - Reducing water waste
Objective	To maintain soil health and prevent erosion, ensuring agricultural productivity and ecosystem stability.	To preserve water for current and future use, ensuring sustainable access to freshwater.
Primary Concern	Erosion, loss of topsoil, soil fertility depletion.	Overuse of water, water scarcity, pollution of water resources.
Impact on Agriculture	Improves soil structure and fertility, leading to better crop yields.	Ensures efficient irrigation, minimising water waste and optimising crop production.
Environmental Impact	Prevents soil degradation, desertification, and loss of habitats.	Protects water bodies, ecosystems, and reduces the risk of droughts and floods.
Practices for Preservation	- Planting vegetation to cover soil - Use of organic matter - Building terraces	- Installing water-saving devices - Using drought-resistant crops - Proper waste management and treatment
Role in Climate Change Mitigation	Helps in carbon sequestration by preserving soil organic matter.	Conserves water, reducing energy consumption and mitigating the impacts of water scarcity.

Learning Tasks

1. Recap on application of techniques and technologies to cultivate crops to make maximum and sustainable use of soil and water.
2. State the meaning of soil and water conservation.
3. Explain the principles of soil and water conservation.
4. Discuss the importance of soil and water conservation.

Pedagogical Exemplars

1. **Initiating talk for learning:** All learners surf the internet and brainstorm to come up with the meaning of soil and water conservation.
2. **Structuring talk for learning:** Learners in gender-based groups research on the principles of soil and water conservation and present their findings in a plenary session in class.
3. **Collaborative learning:** Learners in mixed-ability groups discuss the importance of soil and water conservation in agricultural production.

Key Assessments Level 2: Essay

Question 1. Explain the principles and importance of soil and water conservation. Discuss how these principles can be applied to ensure sustainable agricultural development. (20 marks)

PLC Session 11

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is essay. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the essay (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes

- c. The group then works through the problem together step by step
- d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 12

Learning Indicators

1. Describe the types of soil water and their importance in Agricultural production
2. Describe the types of soil erosion and their effects on Agricultural production

Recap

Year 1	Week 12 1. Explain the meaning and importance of farm animals. 2. Describe the classification of animals with examples. 3. Analyse the distribution of farm animals in Ghana and West Africa.
Year 2	Week 12 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: Types of Soil Water and their Importance in Agricultural Production

1. Types of Soil Water

- a. **Gravitational Water:** It is the water that drains freely through the soil due to gravity. It is found in large pores (macropores) after heavy rainfall or irrigation. This type of water is not available to plants because it drains too quickly. Gravitational water is responsible for waterlogging if it accumulates on poorly drained soils.
- b. **Capillary Water (Available Water):** This is the water held between soil particles in small pores. It is the water that is retained in the soil after gravitational water has drained off. It is the main source of water for plant uptake. Therefore, it is readily available and essential for crop growth.
- c. **Hygroscopic Water:** It is the type of water that forms a thin film tightly bound to soil particles. It is present in all soils but not accessible to plant roots. It is therefore unavailable to plants because it is held too tightly. It helps to maintain soil moisture balance but does not support plant growth directly.
- d. **Chemically Combined Water (Bound Water):** This is the type of water that is part of the chemical structure of minerals and organic matter in the soil. It is located deep within soil particles, not part of the soil solution. It is unavailable to plants and released only under extreme conditions (e.g., during heating).

2. Importance of Soil Water in Agricultural Production

- a. **Water is Essential for Plant Growth**
 - i. Soil water provides moisture that plants need to absorb nutrients and carry out photosynthesis.
 - ii. It helps in cell expansion, seed germination, and overall plant development.

b. Medium for Nutrient Transport

- i. Soil water dissolves nutrients and minerals in the soil and carries them to plant roots.
- ii. Without water, even nutrient-rich soil cannot support healthy crops.

c. Influences Crop Yield

- i. Adequate and timely soil moisture helps achieve optimal crop productivity.
- ii. Water stress (either drought or excess water) can lead to poor yields or crop failure.

d. Supports Microbial Activity

Soil organisms (e.g., bacteria, fungi) that help in decomposing organic matter and fixing nitrogen need water to survive and function.

e. Facilitates Soil Structure and Tillage

- i. Moist soil is easier to till and plant in.
- ii. Proper soil water levels help maintain soil structure, preventing it from becoming too compacted or loose.

f. Regulates Soil Temperature

Water in the soil helps moderate temperature fluctuations, protecting plant roots from extreme heat or cold.

g. Supports Forage for Livestock

Soil water enables the growth of pasture and forage crops, which are essential for feeding livestock.

h. Reduces Soil Erosion

Proper moisture helps bind soil particles together, reducing the risk of erosion by wind and water.

It also allows better water infiltration and reduces surface runoff.

i. Improves Crop Quality

Sufficient water leads to healthy, high-quality produce with better size, taste, and shelf life.

Learning Tasks

1. Recap on the importance of soil water for crop production and the availability of crop residues and other feeds for animal production.
2. Discuss the types of soil water
3. Assess the importance of soil water in Agricultural Production.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs brainstorm to come up with the types of soil water.
2. **Collaborative learning:** Learners in groups discuss the importance of soil water in Agricultural production, and make a presentation in class at a plenary session.

Key Assessments Level 3: Essay

Question: Discuss the different types of soil water and evaluate their importance in agricultural production. (25 marks)

Focal Area 2: Meaning, Agents and Types of Soil Erosion and their Effects on Agricultural Production

1. Meaning of Soil Erosion

Soil erosion in agricultural production refers to the removal or wearing away of the top layer of soil (the most fertile part) by natural forces such as water, wind, or human activity. This process reduces soil fertility, weakens crop productivity, and can lead to long-term damage to farmland.

2. Agents and Types of Soil Erosion

a. Water (Rain and Flowing Water)

- i. The most common and powerful agent.
- ii. Causes erosion through rainfall impact, surface runoff, and rivers.

b. Wind

- i. A major agent in dry, sandy, or bare areas.
- ii. Carries away loose, dry topsoil.

c. Human Activities

Deforestation, overgrazing, improper farming, and construction accelerate natural erosion.

d. Gravity

Causes soil and rocks to move downslope, especially on steep hills (called mass movement or landslides).

e. Ice (Glaciation)

- i. Occurs in very cold regions where glaciers move over land.
- ii. Erodes soil and rock by scraping and carrying materials along.

3. Types of Soil Erosion

a. Splash Erosion

- i. Caused by raindrops hitting bare soil.

- ii. Breaks up soil particles and starts the erosion process.
- iii. It is the first stage of water erosion.

Figure 12.1 shows a picture of splash erosion.



Figure 12.1: *Splash Erosion*

b. Sheet Erosion

- i. In this type of erosion, a thin, uniform layer of soil is removed over a wide area.
- ii. It is hard to detect but very damaging over time.

Figure 12.2 shows a picture of sheet erosion.



Figure 12.2 A typical sheet Erosion

c. Rill Erosion

- i. Water forms small channels or rills on the surface as it flows over the land.
- ii. It can be fixed with light tillage if caught early.

Figure 12.3 shows a picture of rill erosion.



Figure 12.3 Rill Erosion

d. Gully Erosion

- i. It is the advanced stage of rill erosion.
- ii. Deep, wide channels or gullies are formed.
- iii. It is very severe and difficult to control.

Figure 12.4 shows a picture of gully erosion.



Figure 12.4: *Gully Erosion*

e. Wind Erosion

- i. Dry, loose soil is blown away by strong winds.
- ii. Common in arid regions and on overgrazed or bare lands.

Figure 12.5 shows a picture of wind erosion.



Figure 12.5: *Wind Erosion*

f. Stream bank and Riverbank Erosion

- i. Flowing water wears away the sides of rivers and streams.
- ii. Damages nearby farmland and infrastructure.

Figure 12.6 and 12.7 show pictures of stream bank and riverbank erosions respectively.



Figure 12.6: *Stream bank erosion*



Figure 12.7: *Riverbank erosions*

4. Effects of Soil Erosion in Agricultural Production

a. Loss of Fertile Topsoil

- i. The topsoil layer, rich in nutrients and organic matter, is the most productive part of the soil.
- ii. When eroded, it reduces soil fertility, making it harder for crops to grow.

b. Reduced Crop Yields

- i. With fewer nutrients and poor soil structure, plants struggle to grow, leading to lower harvests.
- ii. Farmers may need more fertiliser, increasing production costs.
- iii. Poor Water Retention

- iv. Eroded soils cannot hold water well, leading to increased drought stress.
- v. Crops may wilt or die more quickly during dry periods.

c. Desertification

Continuous erosion can turn productive land into dry, barren areas, especially it is common in semi-arid regions due to overgrazing and deforestation.

d. Damage to Infrastructure

- i. Sediment from eroded soil can clog canals, roads, and irrigation systems.
- ii. Leads to increased maintenance costs and flooding risks.

e. Water Pollution and Siltation

- i. Runoff from eroded fields carries sediments, fertilisers, and pesticides into rivers and lakes.
- ii. Harms aquatic life and pollutes drinking water sources.

f. Increased Farming Costs

- i. Farmers must spend more on fertilisers, irrigation, and soil amendments to maintain yields.
- ii. Leads to lower profits and financial strain.

Learning Tasks

1. Recap on the effects of soil erosion on fish production especially in rivers.
2. Explain the meaning of soil erosion.
3. Discuss the agents of soil erosion.
4. Analyse the effects of soil erosion in Agricultural production.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in mixed-ability groups research the internet for the meaning, agents, types and effects of soil erosion in agricultural production, and discuss their findings in class.
2. **Experiential learning:** Learners in groups observe their school compound or watch a documentary for the types and effects of soil erosion (examples available at: https://www.youtube.com/results?search_query=a+documentary+on+the+types+and+effects+of+soil+erosion,+on+5/6/2025), discuss the ways of reducing the impact of soil erosion in agricultural production and write a short report on their observations.
3. **Collaborative learning:** Learners in mixed-ability groups discuss the economic importance of soil erosion in agricultural production. Learners make a presentation to the class.
4. **Project-based learning (Homework):** Learners in groups undertake a project in controlling erosion on the school farm/compound/community as a project and present a report on it.

Key Assessment: Practice Paper 1

Question 1. Discuss the meaning of soil erosion, identify its major agents and types, and analyse the effects of soil erosion on agricultural production.

Hint



Conduct Practice Paper 1. It should cover contents taught from Year 1 to 3. Refer to the Table of Specification and Structure of the Paper at the end of this section. Learners' papers should be marked immediately and scores entered into the SAP.

SUGGESTED STRUCTURE OF THE PRACTICE PAPER 1

ITEM SPECIFICATION - PAPER ONE

Strand	Sub-strand	Indicator	DOK level				Total
			1	2	3	4	
1. Concept of Agriculture in an Industrialising Society	1. Agriculture and Society	1.1.1.LI.1: Explain the meaning and importance of Agriculture.					
		1.1.1.LI.2: Discuss the branches and sectors of Agriculture and their related career opportunities.					
		1.1.1.LI.3: Examine and dispel the misconceptions associated with the study of agriculture.	1				
		1.1.1.LI.1: Explain the meaning and importance of Agricultural education.					
		1.1.1.LI.2: Describe the types of Agricultural education.		1			
		2.1.1.LI.1: Explain the meaning, importance and stages of Agricultural development.					
		2.1.1.LI.2: Discuss the roles of governmental and non-governmental organisations in Agricultural development.					

		2.1.1.LI.1: Describe the land tenure systems in Ghana.					
		2.1.1.LI.2: Explain the effects of land tenure systems on Agricultural production.					
	2. Agriculture and Society	3.1.1.LI.1: Explain the meaning, practices and factors influencing sustainable agriculture and relate it to good Agricultural practices.	1				
		3.1.1.LI.2: Apply good Agricultural practices to promote sustainable Agriculture.					
		3.1.1.LI.3: Employ sustainable techniques to manage Agricultural wastes.		1			
		1.1.2.LI.1: Explain the meaning, types and importance of industry in Agriculture.					
		1.1.2.LI.2: Discuss the interdependence of Agriculture and industry.					
		1.1.2.LI.3: Analyse the economic challenges and solutions of Agriculture in an industrialising society.					
		2.1.2.LI.1: Examine the industries of crop production.					
		2.1.2.LI.2: Discuss the importance of raw and waste materials from crop production to the industry.					
		2.1.2.LI.1: Explore the industries of animal, including fish production.			1		

		2.1.2.LI.2: Discuss the importance of raw and waste materials from animal production to the industry.					
		Total for stand 1	2	2	1	0	5
3. Modern Technical and Mechanised Agriculture	1. Modern Technical Agriculture	1.2.1.LI.1: Outline the uses and maintenance procedures for measuring tools used in Agricultural production.	1				
		1.2.1.LI.2: Relate the indigenous measuring tools to the standardised units of measurements in Agricultural production.		1			
		1.2.1.LI.3: Demonstrate the use of simple scientific measuring tools to calculate parameters related to the various Agricultural sectors.			1		
		2.2.1.LI.1: Explain the meaning and importance of survey and mapping in Agriculture.		1			
		2.2.1.LI.2: Describe survey and mapping instruments and their uses in Agricultural production.					
		2.2.1.LI.1: Demonstrate the procedure for conducting survey and mapping of farmstead.			1		
		2.2.1.LI.2: Prepare map of a farmstead.					
	2. Modern Mechanised Agriculture	3.2.1.LI.1: Explain the meaning, importance and challenges of emerging technologies in Agriculture.		1			
		3.2.1.LI.2: Explain applications and prospects of emerging technologies in Agriculture.	1				

		1.2.2.LI.1: Explain the meaning and importance of farm mechanisation and power in Agricultural production.		1			
		1.2.2.LI.2 Describe the safety measures employed in operating farm machines and power in Agricultural production					
		1.2.2.LI.3: Apply the knowledge and skills of safety measures in handling accidents and injuries of an Agricultural worker using appropriate first aid.		1			
		1.2.2.LI.1: Describe the types and uses of farm machines and power in Agriculture production.					
		1.2.2.LI.2: Describe the factors that affect the use of farm machines and power.					
		1.2.2.LI.1: Identify the principal parts of farm machines and implements, and state their functions.		1			
		1.2.2.LI.2: Operate and maintain farm machines and implements in Agricultural production.					
		2.2.2.LI.1: Explain the meaning and benefits of Agricultural irrigation and drainage systems.					
		2.2.2.LI.2: Describe the methods and uses of irrigation and drainage systems in Agricultural production.		1			

		2.2.2.LI.3: Describe the parts and functions of the irrigation and drainage system in Agriculture production and demonstrate the skills of operating them.					
		2.2.2.LI.1: Classify harvest and post-harvest implements and machinery.					
		2.2.2.LI.2: Describe the uses of harvest and post-harvest tools, implements and machinery in Agricultural production.					
		2.2.2.LI.3: Demonstrate the skills in the operation of simple harvest and post-harvest implements and machinery use in Agricultural production.			1		
		Total for stand 2	3	6	3	0	12
3. Food Production and Natural Resource Conservation	1. Principles of Agriculture in Food Production	1.3.1.LI.1: Explain the meaning and importance of crops.					
		1.3.1.LI.2: Describe the classification of crops with examples.					
		1.3.1.LI.1: Explain the meaning of the principles of crop production.	1				
		1.3.1.LI.2: Discuss the stages of crop production and its related practices.		1			
		1.3.1.LI.3: Apply the principles in the crop production practices.			1		
		1.3.1.LI.1: Explain the meaning and importance of farm animals.					
		1.3.1.LI.2: Describe the classification of farm animals with examples.		1			

		1.3.1.LI.3: Analyse the distribution of farm animals in Ghana and West Africa.			1		
		1.3.1.LI.1: Explain the meaning and objectives of the general management practices in animal production.					
		1.3.1.LI.2: Discuss the management practices involved in animal production.		1			
		1.3.1.LI.3: Apply the skills in farm animal management practices for rearing animals.					
		2.3.1.LI.1: Explain the economic importance of selected crops.	1				
		2.3.1.LI.2: Apply the technologies and techniques to cultivate selected crops (vegetables).			1		
		2.3.1.LI.1: Explain the economic importance of the selected animal. Including fish.					
		2.3.1.LI.2: Demonstrate the ability to perform the various management practices involved in the rearing of the selected animal, including fish (poultry).					
		3.3.1.LI.1: Describe the procedure of processing, storage and marketing of selected food crops.					
		3.3.1.LI.2 Apply food safety and quality practices in the processing, storage and marketing of selected food crops.					

		3.3.1.LI.1: Describe the procedure for processing, marketing and storage of produce and products from selected animals.			1		
		3.3.1.LI.2: Describe the procedure for processing, marketing and storage of produce and products from selected fish.					
		3.3.1.LI.3: Apply food safety and quality measures in the processing, marketing and storage of selected animals and their carcasses.			1		
		3.3.1.LI.4: Apply food safety and quality measures in the processing, marketing and storage of selected fish and their carcasses.					
	2. Principles of Natural Resource Conservation in Agriculture	1.3.2.LI.1: Explain the meaning of importance and principles of forestry and forest management.	1				
		1.3.2.LI.2: Discuss the concept and the importance of the interrelationships between forestry and Agriculture.					
		1.3.2.LI.3: Discuss agroforestry practices and systems in forest management.					
		1.3.2.LI.1: Explain the meaning, importance and nature of soil.	1				
		1.3.2.LI.2: Describe the physical and chemical properties of soil and their importance.		1			
		1.3.2.LI.3: Discuss the composition of soil.					

		1.3.2.LI1.1: Explain the meaning and effect of climate change on food production.					
		1.3.2.LI.2: Discuss the effect of climate change on food production and the mitigating strategies.		1			
		2.3.2.LI.1: Explain the meaning and importance of game and wildlife.					
		2.3.2.LI.2: Discuss the need for conserving game and wildlife.					
		2.3.2.LI.1: Explain the economic importance and management practices in mushroom production.					
		2.3.2.LI.2: Demonstrate the skills in the cultivation of mushrooms.					
		2.3.2.LI.1: Explain the meaning of soil nutrients, fertility and productivity.	1				
		2.3.2.LI.2: Discuss the soil nutrients and their importance in crop production.					
		2.3.2.LI.3: Describe the types of fertilisers and their effects on crop production.					
		3.3.2.LI.1: Explain the meaning, importance and principles of soil and water conservation					
		3.3.2.LI.2: Describe the types of soil water and their importance in Agricultural production.			1		
		3.3.2.LI.3: Describe the types of soil erosion and their effects on Agricultural production.					
		Total for strand 3	5	5	6	0	16

4. Agriculture, Health and Environment	1. Health Issues in Crop Production	1.4.1.LI.1: Explain the meaning and importance of farm hygiene and sanitation and its effect on crop production.					
		1.4.1.LI.2: Describe the farm hygiene and sanitation activities in crop production.	1				
		1.4.1.LI.3: Apply farm hygiene and sanitation principles in the crop production processes.		1			
		2.4.1.LI.1: Identify common crop pests and diseases and their effects in crop production.					
		2.4.1.LI.2: Classify crops and diseases.					
		2.4.1.LI.3: Discuss the preventive and control measures of pests and diseases in crop production.		1			
		3.4.1.LI.1: Explain the meaning and classification of weeds and their economic importance in Agricultural production.					
		3.4.1.LI.2: Describe the methods of weed dispersal.					
		3.4.1.LI.3: Discuss the methods of weed control in Agricultural production.			1		

	2. Health Issues in Animal Production	1.4.2.LI.1: Explain the meaning and importance of farm hygiene and sanitation and its effect on animal production.	1				
		1.4.2.LI.2: Discuss farm hygiene and sanitation activities in animal production.					
		1.4.2.LI.3: Apply farm hygiene and sanitation principles in the animal production process.	1				
		2.4.2.LI.1: Identify common diseases, pests and parasites of animals/ fish and their effects in animal, including fish production.					
		2.4.2.LI.2: Describe the classification, causes and symptoms of animal, including fish diseases in animal production.	1				
		2.4.2.LI.3: Discuss the preventive and control measures of diseases animals, including fish in animal production.			1		
		Total for strand 4	3	3	2	0	8
5. Agricultural Economics, Agribusiness and Communication	1. Economics for Agriculture	1.5.1.LI.1: Explain the meaning and importance of the basic principles of Agricultural economics.					
		1.5.1.LI.2: Discuss the farm as an economic unit.	1				
		1.5.1.LI.3: Apply the principles of Agricultural economics in the management of an Agricultural enterprise.					
		2.5.1.LI.1: Explain the meaning and principles of demand and supply.		1			

		2.5.1.LI.2: Discuss the factors that influence demand and supply of Agricultural commodity.					
		2.5.1.LI.3: Create demand and supply schedules and prepare graphs to show the determinants of price for an Agricultural commodities.			1		
		3.5.1.LI.1: Discuss the meaning and importance of the factors of production, functional production and marginal diminishing returns.					
		3.5.1.LI.2: Apply the concepts of functional production and diminishing marginal returns in Agricultural production.		1			
		3.5.1.LI.3: Draw production curves showing the relationship between fixed inputs and variable inputs for given resources in Agricultural production.			1		
	2. Communication in Agriculture	1.5.2.LI.1: Explain the meaning and importance of Agricultural communication.	1				
		1.5.2.LI.2: Outline the strategies for effective communication and the various branches of communication in Agriculture.					
		2.5.2.LI.1: Discuss the interactions between the sectors of Agricultural production and enterprises, and the extent of human interaction.		1			

		2.5.2.LI.2: Discuss the various modes of communication in Agriculture.					
	3. Agribusiness Management	3.5.2.LI.1: Establish a crop production or processing enterprise for sustenance and livelihood.	1				
		3.5.2.LI.2: Establish an animal/fish production or processing enterprise for sustenance and livelihood.					
		1.5.3.LI.1: Explain the meaning and importance of agribusiness management.					
		1.5.3.LI.2: Catalogue the activities carried out in agribusiness management and outline their function.					
		1.5.3.LI.3: Describe the procedure for writing an agribusiness plan.					
		2.5.3.LI.1: Discuss the procedure for the establishment of Agricultural enterprise.		1			
		2.5.3.LI.2: Discuss the sources of finance for Agricultural enterprises.					
		2.5.3.LI.3: Explain the types of records keeping in Agricultural enterprises.					
		2.5.3.LI.4: Discuss the managerial characteristics required for the management of agribusiness					
		Total for strand 5	3	4	2		9
OVERALL TOTAL			15	20	15		50

TEST SPECIFICATION TABLE FOR PAPER 2 (ESSAY-TYPE PAPER)

STRAND	SUB-STRAND	NO. OF QUESTIONS	TOTAL
Concept of Agriculture in Industrialising Society	Agriculture and Society	1	2
	Agriculture and Industry	1	
Modern Technical and Mechanised Agriculture	Modern Technical Agriculture	1	2
	Modern Mechanised Agriculture	1	
Food Production and Natural Resource Conservation	Principles of Agriculture in Food Production	1	2
	Principles of Natural Resource Conservation in Agriculture	1	
Agriculture, Health and Environment	Health Issues in Crop Production	1	2
	Health Issues in Animal production	1	
Agricultural Economics, Agribusiness and Communication	Economics for Agriculture	1	2
	Communication in Agriculture	1	
	Agribusiness Management		
TOTAL		10	10

TEST SPECIFICATION TABLE FOR PAPER 3 (PRACTICAL WORK)

STRAND	SUB-STRAND	NO. OF QUESTIONS
Concept of Agriculture in Industrialising Society	Agriculture and Society	1
	Agriculture and Industry	
Modern Technical and Mechanised Agriculture	Modern Technical Agriculture	1
	Modern Mechanised Agriculture	
Food Production and Natural Resource Conservation	Principles of Agriculture in Food Production	2
	Principles of Natural Resource Conservation in Agriculture	
Agriculture, Health and Environment	Health Issues in Crop Production	1
	Health Issues in Animal production	
Agricultural Economics, Agribusiness and Communication	Economics for Agriculture	
	Communication in Agriculture	
	Agribusiness Management	
TOTAL		4

PLC Session 12**45 minutes****Planning & Reviewing the Learning Plan**

1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. Identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q).
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP)
 - a. The key assessment for the week is practice paper 1. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/ rubrics for the practice paper (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through the problem individually for 3–4 minutes
 - c. The group then works through it together the problem, step by step
 - d. Highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

SECTION FOUR REVIEW

Soil conservation refers to the methods and practices used to protect soil from degradation caused by erosion, compaction, salinisation, and nutrient loss. The principles of soil conservation are to reduce soil erosion, maintain soil cover, enhance organic matter, conserve soil moisture, manage soil fertility, land use according to capability, and prevention of overgrazing and deforestation. The reasons for the importance of soil conservation are preserves soil fertility, prevents land degradation, supports agricultural productivity,

controls erosion and sedimentation, improves water retention, supports biodiversity and mitigates climate change.

Water conservation refers to the strategies and practices aimed at using water efficiently and reducing unnecessary usage or wastage. The principles of water conservation are efficient water use, reduce water waste, promote water recycling and reuse, control runoff and pollution, rainwater harvesting, educate and raise awareness and water-efficient landscaping (xeriscaping). The reasons for the importance of water conservation are that it ensures sustainable water supply, prevents over-exploitation of water resources, supports agricultural productivity, reduces energy consumption, protects ecosystems and biodiversity, mitigates drought and flood risks and reduces water pollution.

The types of soil water are gravitational water, capillary water, hygroscopic water, and chemically combined water. Soil water is important for plant growth, as medium for nutrient transport, influences crop yield, supports microbial activity, facilitates soil structure and tillage, regulates soil temperature, supports forage for livestock, reduces soil erosion and improves crop quality.

Soil erosion in agricultural production refers to the removal or wearing away of the top layer of soil (the most fertile part) by natural forces such as water, wind, or human activity. Water, wind, human activities and gravity are the agents of soil erosion. The types of soil erosion are splash erosion, sheet erosion, rill erosion, gully erosion, wind erosion and stream bank and riverbank erosion. Soil erosion causes loss of fertile topsoil, reduced crop yields, desertification, damage to infrastructure, water pollution and siltation, and increased farming costs.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 11

1. Principles of Soil and Water Conservation:

- a. **Prevention of Soil Erosion:** Erosion by water or wind is a primary threat to fertile soil. Conservation practices aim to control surface runoff, stabilise slopes, and reduce wind velocity.
- b. **Maintaining Soil Fertility:** Practices such as crop rotation, organic farming, and use of green manure help preserve or enhance the nutrient content of the soil.
- c. **Water Harvesting and Management:** Harvesting rainwater and recharging groundwater are crucial to ensure a sustainable water supply, especially in arid and semi-arid areas.
- d. **Improving Infiltration and Reducing Runoff:** Techniques like contour ploughing, terracing, and mulching help increase water infiltration and reduce runoff, preventing both soil erosion and water wastage.
- e. **Vegetative Cover:** Maintaining vegetation, including grasslands, trees, and cover crops, protects the soil from erosion and enhances water retention.
- f. **Integrated Land Use Planning:** Land should be used according to its capability, combining agriculture, forestry, and pasture in a balanced way to avoid degradation.

1 mark for stating the correct point and 1 mark for correct explanation of the point, any 3 x 2 = 6 marks. Accept other correct responses not provided in the marking scheme

2. Importance of Soil and Water Conservation:

- a. **Agricultural Productivity:** Conserved soil retains more nutrients and moisture, leading to higher crop yields and better-quality produce.
- b. **Water Security:** Conservation promote water resilient and availability by improving groundwater recharge and maintaining stream flows.
- c. **Climate Change Mitigation:** Healthy soils sequester carbon and reduce greenhouse gas emissions. Conservation also helps in adapting to extreme weather events.
- d. **Biodiversity Preservation:** Conservation helps sustain ecosystems by maintaining the habitats of diverse plant and animal species.
- e. **Economic Stability:** Improved soil and water management leads to better farm incomes and reduces the risk of crop failure due to land degradation.
- f. **Preventing Natural Disasters:** Soil and water conservation reduces the risk of floods, landslides, and droughts by improving landscape resilience.

1 mark for stating the correct point and 1 mark for correct explanation of the point, any 3 x 2 = 6 marks. Accept other correct responses not provided in the marking scheme

3. Application of Principles in Sustainable Agriculture

- a. **Contour Farming and Terracing:** Used in hilly areas to reduce erosion and manage runoff.
- b. **Drip Irrigation and Sprinklers:** Efficient water use in irrigation helps conserve water.
- c. **Agroforestry:** Integrating trees into farmland stabilises soil, improves biodiversity, and enhances water retention.
- d. **Rainwater Harvesting:** Collecting and storing rainwater for irrigation and domestic use.
- e. **Organic Farming:** Reduces chemical use, improves soil health, and increases water holding capacity.

1 mark for stating the correct point and 1 mark for correct explanation of the point, any 4 x 2 = 8 marks. Accept other correct responses not provided in the marking scheme

WEEK 12

FOCAL AREA 1

1. Types of Soil Water

a. Gravitational Water

- i. This type of water moves freely through the soil under the influence of gravity.
- ii. It occupies the macropores of the soil and is typically found after heavy rainfall or irrigation.
- iii. While gravitational water may seem beneficial, it is usually not available to plants because it drains away quickly beyond the root zone.
- iv. However, it can help recharge groundwater and maintain deeper soil moisture.

b. Capillary Water

- i. Capillary water is the most important type for plant growth.
- ii. It is held in the micropores of the soil and forms a continuous film around soil particles.
- iii. It is available to plants because it can be absorbed by roots.
- iv. Capillary water moves through the soil by capillary action and is replenished by rainfall or irrigation.
- v. Its retention depends on soil texture; clay soils hold more capillary water than sandy soils.

1 mark for stating the correct point and 1 mark each for a correct explanation of a point, 5 x 2 = 10 marks

Accept other correct responses not provided in the marking scheme

2. Importance in Agricultural Production**a. Plant Growth and Development:**

- i. Water is a key component of photosynthesis and nutrient transport.
- ii. Without sufficient capillary water, crops cannot grow optimally, leading to reduced yields.

b. Nutrient Availability:

- i. Nutrients in the soil must be dissolved in water before plants can absorb them.
- ii. Capillary water ensures that nutrients are accessible in the root zone.

c. Soil Microbial Activity:

- i. Soil organisms that enhance fertility and decompose organic matter depend on moisture to function effectively.
- ii. Proper moisture levels from capillary water promote healthy soil biology.

d. Water Management:

- i. Knowing the types of soil water helps farmers plan irrigation.
- ii. For example, excessive gravitational water can lead to waterlogging and root rot, while too little capillary water causes drought stress.

e. Soil Texture and Crop Suitability:

- i. Understanding how different soils hold water helps in selecting appropriate crops and irrigation practices.
- ii. For instance, sandy soils require more frequent watering than clay soils due to lower water retention.

1 mark for stating the correct point and 2 marks for 2 correct explanations of the point, any 3 x 5 = 15 marks. Accept other correct responses not provided in the marking scheme

FOCAL AREA 2

1. Meaning of Soil Erosion

Soil erosion is the process by which the uppermost layer of the soil (topsoil) is worn away and transported from one place to another by natural agents such as water, wind, and ice, or through anthropogenic activities like deforestation, overgrazing, and poor farming methods. The topsoil contains essential nutrients and organic matter required for plant growth, making its loss detrimental to agriculture. 2 marks for correct definition of soil erosion.

2. Agents of Soil Erosion

The primary agents of soil erosion include:

- a. **Water:** This is the most common agent, especially during heavy rains. Surface runoff can wash away large quantities of topsoil.
- b. **Wind:** In arid and semi-arid regions, strong winds blow loose soil particles from barren lands, reducing soil fertility.
- c. **Ice (Glaciers):** In colder regions, glacial movement can erode large areas of land.
- d. **Human Activity:** Deforestation, construction, mining, and inappropriate farming practices disturb the soil structure and increase erosion rates.

1 mark for stating the correct point and 1 mark for correct explanation of the point, $4 \times 2 = 8$ marks. Accept other correct responses not provided in the marking scheme

3. Types of Soil Erosion

There are several types of soil erosion, mainly categorized by their causes and patterns:

- a. **Sheet Erosion:** This occurs when a thin layer of soil is removed uniformly across a large area by rainwater. It is often hard to detect initially but can lead to serious nutrient loss over time.
- b. **Rill Erosion:** Caused by surface runoff forming small channels (rills) in the soil. These rills can grow larger if not controlled.
- c. **Gully Erosion:** An advanced stage of rill erosion where deep channels or gullies form, making land unsuitable for cultivation.
- d. **Splash Erosion:** The impact of raindrops on the soil surface dislodges particles, which are then easily washed away.
- e. **Wind Erosion:** Occurs when fine soil particles are lifted and carried away by the wind, common in dry, bare fields.

1 mark for stating the correct point and 1 mark for correct explanation of the point, Any $4 \times 2 = 8$ marks. Accept other correct responses not provided in the marking scheme

4. Effects of Soil Erosion on Agricultural Production

Soil erosion has far-reaching effects on agriculture, including:

- a. **Loss of Fertile Topsoil:** This reduces the availability of nutrients necessary for crop growth, leading to lower yields.

- b. Reduced Soil Moisture Retention:** Eroded soils often lose their ability to retain water, making them less effective for crop support during dry periods.
- c. Increased Use of Fertilizers:** Farmers may need to use more chemical fertilizers to compensate for nutrient loss, increasing production costs and environmental risks.
- d. Crop Damage and Lower Productivity:** Severe erosion can expose plant roots, damage crops, and ultimately reduce farm output.
- e. Siltation of Water Bodies:** Eroded soil may be deposited in rivers, lakes, and reservoirs, leading to reduced water quality and capacity, affecting irrigation.
- f. Land Degradation and Abandonment:** In extreme cases, land becomes unfit for agriculture and must be abandoned.

1 mark for stating the correct point and 1 mark for correct explanation of the point, $6 \times 2 = 12$ marks. Accept other correct responses not provided in the marking scheme

SECTION 5: CROP AND ANIMAL HEALTH ISSUES

STRAND: AGRICULTURE AND HEALTH

Sub-Strand: Health Issues in Crop Production

Learning Outcome: Employ the knowledge of the importance of classification and dispersal of weeds to select appropriate method of control in Agricultural production.

Content Standard: Demonstrate knowledge, understanding and skills of the meaning, importance, classification, dispersal and control of weeds in Agricultural production.

INTRODUCTION AND SECTION SUMMARY

Weeds are often considered unwanted plants in agricultural fields, competing with crops for essential resources such as water, nutrients, light, and space. Their impact on crop productivity can be significant, and understanding what constitutes weed, how they are classified, and their effects on agriculture is vital for effective weed management. Proper knowledge of weeds does not only aid in their control but also helps in maximising crop yields and sustaining farm profitability. Weed dispersal refers to the process by which weed seeds or plant parts spread from one location to another. This natural or artificial movement is a key factor in the persistence and spread of weeds in agricultural fields. Various agents, including wind, water, animals, humans, and farm machinery, contribute to the dispersal of weeds. Understanding these methods is essential for developing effective control strategies. While weed dispersal often poses challenges to crop production, it also offers certain ecological benefits such as biodiversity maintenance and plant adaptation. This section will introduce learners to the meaning and classification of weeds and their economic importance in agricultural production. It will also expose learners to the meaning, agents/methods, and benefits of weed dispersal. This section has links with other subjects including Agricultural Science, Applied Technology, Engineering, Manufacturing Engineering and Robotics.

The weeks covered by the section are:

Week 13: Explain the Meaning and Classification of Weeds and their Economic Importance in Agricultural Production.

Week 14

1. Describe the Methods of Weed Dispersal.
2. Discuss the Methods of Weed Control in Agricultural Production

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical strategies to be employed in this section are initiating talk for learning, collaborative learning, experiential learning, project-based learning, think-pair-share, structuring talk for learning, and managing talk for learning. The use of initiating talk for learning, structuring talk for learning and managing talk for learning will provide the platform for learners to express their views on the meaning of weeds, their economic importance, agents of dispersal, and the advantages and disadvantages of weed dispersal. Collaborative and think-pair-share will build teamwork among learners and help them to tolerate each other's view. Experiential learning and project-based learning will offer learners the opportunity to have hands-on experience on the collection, identification and creation of photo albums of weeds. Learners should be guided by a resource person or the teacher in the identification of weeds and creation of photo albums. Creative, critical thinking, collaborative, communication and analytical skills of learners will be enhanced when taught using the suggested pedagogical strategies. All learners should be encouraged to respect each other and to participate in all activities.

ASSESSMENT SUMMARY

The assessment for this section will encompass the meaning and classification of weeds and their economic importance in agricultural production as well as the meaning, agents/methods and advantages and disadvantages of weed dispersal. Assessment should sufficiently consider the various assessment strategies and modes. It should also consider the various depth of knowledge being Level 1 (recall/reproduce/remember), Level 2 (skills of conceptual understanding), Level 3 (strategic reasoning) and Level 4 (extended critical thinking and reasoning). Practical and individual projects on rabbit and snail production and processing can be given to learners in week 14 for submission in week 22. Learners should be appreciated for their efforts in answering questions and should be made to know the outcome of their answers. Teachers should support learners in areas that they require support after scoring their responses. Rubrics or marking schemes can be used to guide teachers in assessing responses from learners.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Explain the meaning and classification of weeds and their economic importance in Agricultural production.	Level 3 (Week 13)	Essay Type Questions/Class Exercise
Describe the methods of weed dispersal.	Level 3 (Week 14)	Essay Type Question/Class Exercise
Discuss the methods of weed control in Agricultural production.	Level 3 (Week 14)	Practical/Homework

WEEK 13

Learning Indicator: Explain the meaning and classification of weeds and their economic importance in Agricultural production

Recap

Year 1	Week 13 1. Explain the meaning and objectives of the general management practices in animal production. 2. Discuss the management practices involved in animal production.
Year 2	Week 13 Explain the meaning and importance of game and wildlife. Discuss the need for conserving game and wildlife.

Focal Area: Meaning and Classification of Weeds and their Economic Importance in Agricultural Production

1. Meaning of Weeds in Agricultural Production

In agricultural production, weeds refer to unwanted plants that grow in crop fields and they compete with cultivated crops for resources such as water, nutrients, light and space. Some key notes about weeds include:

- a. Competition:** Weeds often grow faster and stronger than crops, which can reduce crop yields significantly.
- b. Resource Drain:** Weeds make use of vital nutrients and water and limit the availability of these resources for the main crops.
- c. Pest and Disease Hosts:** Some weeds serve as hosts for pests and diseases, increasing the risk to crops.
- d. Harvesting Problems:** Dense weed growth can interfere with mechanised harvesting or manual labour.
- e. Economic Impact:** Controlling weeds requires time, labour, and money, making them a costly issue for farmers.

2. Classification of Weeds in Agricultural Production

Weeds in agricultural production can be classified based on several factors, including their life cycle, morphology (plant type) and habitat. Below are the major classifications:

a. Based on Life Cycle

This classification is according to how long the weeds live and reproduce as shown in Table 13.1.

Figures 13.1a- 13.1f show pictures of some weeds classified based on their life cycle.

Table 13.1 Classification of weeds based on their life cycle

Type	Description	Example
Annual Weeds	Complete their life cycle (germination to seed production) within one season or year.	Pigweed, Crabgrass
Biennial Weeds	It takes two years to complete their life cycle. First year – vegetative growth; second year – flowering and seed production.	Wild carrot, Bull thistle
Perennial Weeds	Live for more than two years; regenerate from roots, stems, or seeds. Difficult to control.	Bermuda grass, Nutgrass

**Figure 13.1a:** *Pig weed***Figure 13.1b:** *Crabgrass***Figure 13.1c:** *Wild carrot***Figure 13.1d:** *Bull thistle***Figure 13.1e:** *Bermuda grass***Figure 13.1f:** *Nut grass*

b. Based on Morphology (Plant Type)

This classification is based on the morphology or plant type as represented in Table 13.2. Figures 13.2a-13.2d show pictures of some weeds classified based on their morphology.

Table 13.2: *Classification of weeds based on their morphology or plant type*

Type	Description	Example
Grassy Weeds	Monocotyledonous weeds with narrow leaves; resemble cereal crops.	Guinea grass, Goosegrass
Broadleaf Weeds	Dicotyledonous weeds with broad leaves; easier to distinguish from grasses.	Morning glory, Sida
Sedges	Grass-like plants with triangular stems, mostly found in wetlands.	Purple nutsedge, Yellow nutsedge



Figure 13.2a: *Guinea grass*



Figure 13.2b: *Goose grass*



Figure 13.2c: *Morning glory*



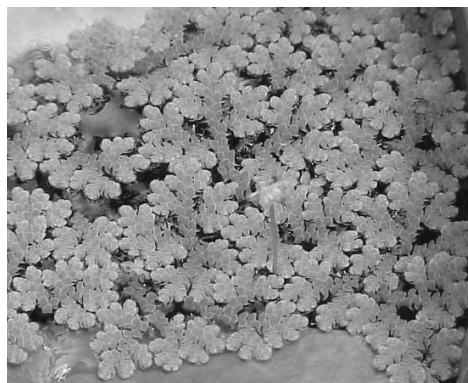
Figure 13.2d: *Sida*

c. Based on Habitat (Where They Grow)

This classification is based on the habitat or where they grow as presented in Table 13.3. Figures 13.3a- 13.3d show pictures of some weeds classified based on their habitat.

Table 13.3: *Classification of weeds based on their habitat or where they grow*

Type	Description	Example
Aquatic Weeds	Grow in water or waterlogged areas; interfere with irrigation and drainage.	Water hyacinth, Duckweed
Terrestrial Weeds	Grow on land; most common type in crop fields.	Spear grass, Couch grass

**Figure 13.3a:** *Water hyacinth***Figure 13.3b:** *Duckweed***Figure 13.3c:** *Spear grass***Figure 13.2d:** *Couch grass*

d. Based on Origin

This classification is based on the origin of the weeds as shown in Table 13.4.

Figures 13.4a-13.4d show pictures of some weeds classified based on their origin.

Table 13.4: *Classification of weeds based on their origin*

Type	Description	Example
Native Weeds	Naturally found in a particular area.	Tridax, Ageratum
Alien/Exotic Weeds	Introduced from another region or country; can become invasive.	Water hyacinth, Parthenium



Figure 13.4a: *Tridax*



Figure 13. 4b: *Ageratum*



Figure 13.3a: *Water hyacinth*

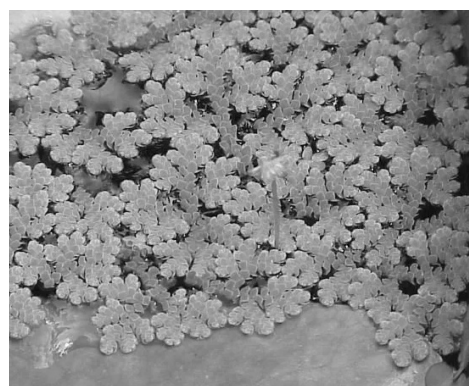


Figure 13. 3b: *Duckweed*

e. Based on Usefulness

This classification is based on the usefulness of weeds as presented in Table 13.4.

Figures 5a-5d (Week 13) show pictures of some weeds classified based on their usefulness.

Table 13.4: Classification of weeds based on their usefulness

Type	Description	Example
Useful Weeds	May have medicinal, soil protection, or other beneficial properties.	Chromolaena, Mexican sunflower
Harmful Weeds	Compete with crops, host pests, or are toxic to humans/livestock.	<i>Prosopis glandulosa</i> , <i>Leucaena leucocephala</i>



Figure 13.5a: *Chromolaena*



Figure 13.5b: *Mexican sunflower*



Figure 13.5c: *Prosopis glandulos*



Figure 13.5d: *Leucaena leucocephala*

3. Economic Importance of Weeds in Agricultural Production

Weeds have both negative and positive impacts on agriculture, and understanding their economic importance helps farmers make informed management decisions.

a. Negative Economic Importance of Weeds

Weeds are generally considered harmful in crop production due to the following reasons:

- i. **Reduced crop yields:** Weeds compete with crops for water, nutrients, light, and space. This leads to lower productivity and economic losses. Example: *Striga* reduces maize yields by up to 80%.
- ii. **Increased production costs:** Farmers spend more on weed control measures such as herbicides, labour, and machinery. Repeated weeding raises the overall cost of production.
- iii. **Harbouring pests and diseases:** Weeds can host insects, fungi, and viruses that attack crops. This increases the cost of pest and disease control.
- iv. **Harvesting difficulties:** Dense weed growth can interfere with mechanical or manual harvesting, leading to delays and additional costs.
- v. **Quality reduction:** Weed seeds and plant parts can contaminate harvested crops, reducing their market quality and value.
- vi. **Toxicity to livestock and humans:** Some weeds are poisonous and harmful if consumed. Example: *Parthenium* can cause skin irritation and respiratory problems.

b. Positive Economic Importance of Weeds

Although mostly harmful, some weeds have economic benefits when managed properly:

- i. **Soil protection and improvement:** Some weeds prevent soil erosion and help improve soil structure and fertility. Example: Deep-rooted weeds bring nutrients to the surface.
- ii. **Medicinal and industrial uses:** Certain weeds have medicinal properties and are used in traditional medicine. Example: *Chromolaena odorata* for wound healing.
- iii. **Fodder for livestock:** Some weeds can be used as forage or feed for animals, especially in areas with limited pasture.
- iv. **Biodiversity support:** Weeds provide habitats for beneficial insects like pollinators and natural pest predators.
- v. **Indicator plants:** Some weeds indicate soil fertility, pH level, or drainage problems, helping guide farm management.

Learning Tasks

1. Recap the meaning, general objectives and management practices involved in animal production as well as the need to conserve game and wildlife, and relate that to how weeds can serve as feed for animals to increase productivity.
2. Explain the meaning of weeds in agricultural production.
3. Classify weeds that affect agricultural production.
4. Analyse the economic importance of weeds in agricultural production.
5. Build a weed album of the common weeds collected from your immediate environment.

Pedagogical Exemplars

1. **Initiating talk for learning:** Learners discuss to come up with the meaning of weeds in Agricultural production.
2. **Collaborative learning:** Learners in groups search the internet for information on the characteristics and economic importance of weeds. In the same group, learners discuss the characteristics of weeds and their economic importance in Agricultural production.
3. **Experiential learning:** Learners in mixed-gender, mixed-ability or groups (where appropriate) embark on nature's walk in their school compound guided by a facilitator to identify and collect the common weeds on their school compound. Learners then search the internet for information required to determine the botanical names and other relevant information about weeds collected. Learners should be guided by the teacher/resource person to ensure safe collection, handling and identification of potentially invasive or toxic species. The teacher should also make accommodations for learners with any form of disability to fully take part in all activities.
4. **Project-based learning:** In the same groups, learners build a weed album of the common weeds collected from the school compound, indicating their common names, botanical names and their economic importance.

Key Assessments Level 3: Essay

Question: With reference to their morphological, ecological, and lifecycle characteristics, discuss the classification of weeds in agricultural production. Provide examples and explain the importance of proper weed classification in effective farm management. (24 marks)

PLC Session 13

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand

- b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is essay. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the essay (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 14

Learning Indicators

1. *Describe the methods of weed dispersal*
2. *Discuss the methods of weed control in Agricultural production*

Recap

Year 1	Week 14: Apply the skills in farm animal management practices for rearing animals.
Year 2	Week 14 1. Explain the economic importance and management practices in mushroom production. 2. Demonstrate the skills in the cultivation of mushroom.

Focal Area 1: Meaning, Agents/Methods and Benefits of Weed Dispersal

1. Meaning of Weed Dispersal

Weed dispersal refers to the process by which weed seeds or plant parts are spread from one location to another, allowing weeds to grow and establish in new areas.

2. Agents and Methods of Weed Dispersal and the Conditions Under which the Dispersal Occurs

Weeds spread from place to place through various agents and methods, depending on the environmental conditions and characteristics of the weed species.

a. Wind Dispersal (Anemochory)

- i. **Method:** Weeds produce lightweight seeds or seeds with wings, hairs, or parachutes that allow them to be carried by wind.
- ii. **Examples:** Dandelion, Tridax, Spear grass
- iii. **Conditions:** Dry, windy environments; Open fields with minimal barriers; Seeds must be light or adapted to float in the air.

b. Water Dispersal (Hydrochory)

- i. **Method:** Weed seeds or parts are carried by rainwater, rivers, streams, or irrigation canals. Some seeds are buoyant and float over long distances.
- ii. **Examples:** Water hyacinth, Duckweed, Typha (cattail)
- iii. **Conditions:** Wetlands, flooded fields, irrigation systems; Rainy seasons or areas with poor drainage.

c. Animal Dispersal (Zoochory)

- i. **Method:** Seeds attach to fur, feathers, hooves, or are eaten by animals and passed out in droppings. Some have hooks or sticky surfaces for attachment.
- ii. **Examples:** Desmodium, Blackjack (*Bidens pilosa*), Cocklebur
- iii. **Conditions:** Areas with frequent animal movement; Grazing lands or areas near wildlife and livestock; Presence of fruit or seeds attractive to animals.

d. Human and Machinery Dispersal (Anthropochory and Mechanical Means)

- i. **Method:** Weed seeds spread through contaminated crop seeds, clothing, footwear, tools, and farm machinery. Weeds are also spread during the transport of harvested crops or soil.
- ii. **Examples:** Couch grass, Striga seeds in crop seeds
- iii. **Conditions:** Poor farm hygiene; Reuse of unclean equipment between fields or farms; Movement of people or vehicles across fields.

e. Explosive Mechanism (Autochory or Ballochory)

- i. **Method:** Some weeds have seed pods that burst open and scatter seeds when they are mature.
- ii. **Examples:** Balsam plant, Witchweed (*Striga*), Castor plant.
- iii. **Conditions:** Hot, dry conditions that cause pod drying and bursting; Areas where weeds are allowed to mature and set seed.

Table 14.1 provides a summary of the agents and methods of weed dispersal and the conditions under which the dispersal occurs.

Table 14.1: A summary of the agents and methods of weed dispersal and the conditions under which the dispersal occurs

Agent	Method	Examples	Conditions
Wind	Light or hairy seeds blown by air	Dandelion, Spear grass	Dry, windy areas
Water	Floating or water-borne seeds	Water hyacinth, Duckweed	Wetlands, flooded fields
Animals	Seeds stick to body or passed in droppings	Blackjack, Desmodium	Grazing lands, forest edges
Humans/ Machines	Contaminated tools, clothes, crop seeds	Couch grass, Striga	Human activity, farm equipment use
Explosive Pods	Seeds burst and scatter around the parent plant	Balsam, Castor, Striga	Dry, sunny conditions with mature pods

3. Advantages and Disadvantages of Weed Dispersal in Agriculture

Weed dispersal plays a significant role in how weeds impact agricultural production. While mostly negative, there are a few situations where weed dispersal can offer some benefits.

a. Advantages of Weed Dispersal in Agriculture

Although generally undesirable, weed dispersal can have a few beneficial effects under specific conditions:

- i. Soil protection: Some dispersed weeds grow rapidly and cover the soil, helping to prevent erosion in bare or sloped areas.
- ii. Improved soil fertility: Deep-rooted weeds brought by dispersal can mine nutrients from deep soil layers and return them to the surface through leaf fall and decay.
- iii. Medicinal and economic use: Some weeds that spread to new areas may have medicinal, fodder, or biofuel uses, e.g., *Chromolaena*, Mexican sunflower.
- iv. Support for biodiversity: Dispersed weeds can serve as habitats or food sources for beneficial insects and pollinators, aiding natural pest control and ecosystem balance.

b. Disadvantages of Weed Dispersal in Agriculture

In most cases, weed dispersal has negative impacts on crop production, resulting in economic and environmental challenges.

- i. Increased weed infestation: Dispersed weeds spread quickly and colonise new fields, making them harder to control over time.
- ii. Reduced crop yields: New weeds compete with crops for nutrients, water, light, and space, reducing crop growth and harvest quantity.
- iii. Higher weed control costs: More dispersed weeds mean increased need for herbicides, labour, and time, raising the cost of production.
- iv. Spread of invasive and harmful species: Some weeds (e.g., *Striga*, *Parthenium*) are highly invasive and toxic, causing serious damage to crops, livestock, and humans.
- v. Contamination of harvested crops: Weed seeds or plant parts mixed with harvested crops reduce market value and quality.
- vi. Interference with farming operations: Dense weed growth from dispersal may obstruct planting, weeding, or harvesting activities, affecting efficiency.

Table 14.2 provides a summary of the advantages and disadvantages of weed dispersal in Agriculture.

Table 14.2: A summary of the advantages and disadvantages of weed dispersal in Agriculture

Advantages	Disadvantages
Prevents soil erosion	Increases weed infestation
Improves soil fertility (in some cases)	Reduces crop yields
Provides medicinal/fodder resources	Raises cost of weed control
Supports biodiversity	Spreads invasive or harmful species
	Contaminates harvested crops
	Interferes with farming operations

Learning Tasks

1. Recap on the skills in farm animal management practices and how weed dispersal contributes to making feed available for animals.
2. Explain the meaning of weed dispersal.
3. Discuss the agents and methods of weed dispersal and the conditions under which the dispersal occurs.
4. Analyse the advantages and disadvantages of weed dispersal in agriculture.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs discuss the meaning of weed dispersal using pictures and relevant resources.
2. **Collaborative learning:** Learners in mixed-gender, mixed-ability or groups (where appropriate) search the internet for information on the agents and methods of weed dispersal and discuss their findings in class.
3. **Structuring talk for learning:** Learners in mixed-gender, mixed-ability or groups (where appropriate) discuss the characteristics of weeds that influence their dispersal by the various agents and present a report at a plenary session in class.
4. **Managing talk for learning:** Learners in mixed-gender, mixed-ability or groups (where appropriate) discuss the advantages and disadvantages of weed dispersal in agriculture.

Key Assessments Level 3: Class Exercise

Question 1. Discuss the various agents and methods of weed dispersal in agricultural environments. Explain the conditions under which each method occurs and analyse how this knowledge can be applied to the development of effective weed management strategies. (26 marks)

Focal Area 2: Weed Control Methods in Agricultural Production and Tools/Equipment Used

1. Methods of Controlling Weeds in Agricultural Production and their Benefits

Effective weed control is essential in agriculture to maximise crop yield, reduce competition, and improve farm profitability. There are several methods used to control weeds, each with its own advantages.

a. Cultural Methods

- i. **Description:** These are traditional farming practices that reduce weed growth and spread.
- ii. **Examples:** Crop rotation, cover cropping, timely planting and harvesting, mulching, using certified, weed-free seeds.
- iii. **Benefits:** Environmentally friendly; improves soil health and fertility; reduces reliance on chemicals; interrupts weed life cycles.

b. Mechanical/Physical Methods

- i. Description: Involves manual or machine-based removal of weeds.
- ii. Examples: Hand weeding, hoeing, slashing, ploughing, burning of weed residues, using mechanical weeders.
- iii. Benefits: Immediate results, no chemical residues, suitable for small farms, helps in weed removal before seed formation.

c. Chemical Methods

- i. Description: Use of herbicides (weed-killing chemicals) to eliminate or suppress weed growth.
- ii. Examples: Pre-emergence herbicides (applied before weeds emerge), post-emergence herbicides (applied after weed growth).
- iii. Benefits: Saves time and labour, effective over large areas, controls a wide range of weed species, reduces competition with crops quickly.

d. Biological Methods

- i. Description: Use of natural enemies of weeds, such as insects, fungi, or grazing animals, to control weed populations.
- ii. Examples: Use of insects to feed on specific weeds (e.g., weevils for water hyacinth), controlled grazing by animals like goats.
- iii. Benefits: Eco-friendly and sustainable, targets specific weeds, reduces long-term weed growth, leaves no chemical residues.

e. Integrated Weed Management (IWM)

- i. Description: Combines two or more control methods (e.g., cultural + chemical + mechanical) for more effective and sustainable weed control.
- ii. Benefits: More efficient and cost-effective, reduces over-reliance on any single method, environmentally safe, reduces herbicide resistance in weeds.

Table 14.3 provides a summary of weed control methods in agricultural production and their key benefits.

Table 14.3: A summary of weed control methods in agricultural production and their key benefits

Method	Description	Key Benefits
Cultural	Use of good farming practices	Sustainable, improves soil, breaks weed cycles
Mechanical	Manual or machine-based removal	No chemicals, quick removal
Chemical	Use of herbicides	Fast, effective over large areas
Biological	Use of living organisms	Eco-friendly, long-term solution
Integrated (IWM)	Combines multiple methods	Most effective, sustainable, and adaptive

2. Tools and Equipment Used in Controlling Weeds in Agricultural Production

In agriculture, various **manual, mechanical, and chemical tools** are used to manage weeds effectively. These tools help reduce weed competition, increase crop yields, and improve farm operations.

a. Manual Tools

These are hand-operated tools suitable for small-scale farming and close-range weeding. Examples of manual tools, their descriptions and functions are shown in Table 14.4.

Table 14.4: *Examples of manual tools, their description and functions*

Tool	Description	Function
Hand Hoe	Short-handled tool with a flat blade	Used for uprooting or cutting weeds
Cutlass	Long broad blade with a handle	Used for slashing tall weeds and grasses
Weeding Fork	Forked tool with a long handle	Loosens soil and removes deep-rooted weeds
Hand Trowel	Small spade-like tool	Used in vegetable beds and nursery areas

The benefits of using manual tools include:

- i. Inexpensive and easy to use
- ii. Effective in small plots or gardens
- iii. Minimal soil disturbance

b. Mechanical Equipment

These tools use animal or engine power and are ideal for medium to large-scale farms. Examples of mechanical equipment, their descriptions and functions are shown in Table 14.5.

Table 14.5: *Examples of machine/equipment, their description and functions*

Equipment	Description	Function
Rotary Weeder	Rotating blades mounted on wheels	Cuts and uproots weeds between rows
Cono Weeder	Used in paddy fields	Operated manually to uproot submerged weeds
Wheel Hoe	Push-type tool with a wheel and blade	Weeds between crop rows
Power Tiller	Small tractor with attachments	Equipped with blades for inter-row weeding
Mechanical Sprayer	Motorised sprayer	Applies herbicides uniformly on large farms

The benefits of using mechanical equipment include:

- i. Saves time and labour
- ii. Suitable for larger areas
- iii. Increases efficiency of weed control

c. Chemical Application Equipment

These are used to apply herbicides safely and effectively.

Examples of chemical application equipment, their descriptions and functions are shown in Table 6.

Table 14.6: *Examples of chemical application equipment, their description and functions*

Equipment	Description	Function
Knapsack Sprayer	Carried on the back with a hand-pumped lever	Sprays liquid herbicides on crops or soil
Boom Sprayer	Mounted on tractors with horizontal nozzles	Sprays over wide rows or fields
Cut-off Sprayer	Handheld sprayer with targeted nozzle	Used for selective spot spraying

The benefits of using chemical application equipment include:

- i. Uniform application of herbicides
- ii. Reduces manual labour
- iii. Targets specific weed types

d. Animal-Drawn Implements

Used in traditional or semi-mechanised farming systems. Examples of animal-drawn implements, their descriptions and functions are shown in Table 14.7.

Table 14.7: *Examples of animal-drawn implements, their description and functions*

Tool	Function
Animal-drawn cultivator	Cuts and buries weeds in rows
Animal-drawn hoe	Inter-row weed control in tilled fields

The benefits of animal-drawn implements include:

- i. Cost-effective in rural areas
- ii. Increases efficiency in larger plots than manual tools

Table 14.8 shows a summary of the tools and equipment used in controlling weeds in agricultural production.

Table 14.8: *A summary of the tools and equipment used in controlling weeds in agricultural production*

Category	Examples	Main Use
Manual Tools	Hoe, cutlass, trowel, weeding fork	Small-scale weeding, nursery management
Mechanical Equipment	Rotary weeder, wheel hoe, tiller	Medium to large-scale field weeding
Chemical Equipment	Knapsack sprayer, boom sprayer	Herbicide application
Animal-Drawn Tools	Hoe, cultivator	Inter-row weeding in traditional farming

Learning Tasks

1. Recap on importance and skills in mushroom management practices and relate that to the control of weeds in mushroom production.
2. Explain the methods of controlling weeds in agricultural production.
3. Analyse the benefits of controlling weeds.
4. Discuss the tools and equipment used in controlling weeds in agricultural production.
5. Demonstrate the use of various weed control methods to control weeds on the school farm.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in mixed-gender, mixed-ability or groups (where appropriate) search the internet for information on weed control.
2. **Managing talk for learning:** Learners in mixed-gender, mixed-ability or groups (where appropriate) discuss the methods of controlling weeds in farms and indicate their advantages and disadvantages.
3. **Think-pair-share:** Learners in pairs discuss the materials, tools and equipment used in controlling weeds in farms.
4. **Experiential learning (An arranged lesson):** Learners in mixed-gender, mixed-ability or groups (where appropriate) apply various weed control methods on the school farm under the guidance of a technician, observing all the safety protocols.

Key Assessments Level 3: Class Exercise

Question: You are given a small plot of land (10 m × 10 m) that is heavily infested with different types of weeds. Demonstrate three different methods of weed control you can apply on the plot. For each method:

- 1a. Identify and describe the method (**1 mark per method, total of 3 marks**)
- 1b. Outline the materials/tools needed (**3 marks per method, total of 9 marks**)

1c. Explain the procedure involved (**4 marks per method, total of 12 marks**)

1d. State two benefits of using that method. (**2 marks per method, total of 6 marks**)

(Total of 30 marks)

PLC Session 14

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is class exercise. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exercise (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes

- c. The group then works through the problem together step by step
- d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

SECTION FIVE REVIEW

Weeds are unwanted plants that grow in crop fields and compete with cultivated crops for resources such as water, nutrients, light and space. They are classified based on their life cycle morphology, habitat, origin, and usefulness. Weeds have both negative and positive effects. The negative effects include reduction in crop yields, increased production costs, harbour pests and diseases, potential difficulties during harvest, reduction in quality of crops and potentially a risk of toxicity to livestock and humans. The positive effects include soil protection and improvement, medicinal and industrial uses, fodder for livestock, biodiversity support and as Indicator plants for detecting soil fertility, pH level, or drainage problems.

Weed dispersal refers to the process by which weed seeds or plant parts are spread from one location to another, allowing weeds to grow and establish in new areas. The agents of weed dispersal are wind, water, animal, human and machinery, and explosive mechanism. Weed dispersal also has some advantages such as soil protection, improvement of soil fertility, medicinal and economic use and biodiversity support; and disadvantages such as increased weed infestation, reduced crop yields, higher weed control costs, spread of invasive and harmful species, contamination of harvested crops and interference with farming operations. Weeds are controlled using mechanical/physical methods, chemical methods, biological methods, integrated weed management methods by tools/equipment/implements such as manual tools, mechanical equipment, chemical application equipment and **animal-drawn implements**.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 13 (24 marks)

1. Classification Based on Morphology (Growth Form)

This classification groups weeds according to their visible plant structures and forms:

- Grasses (Poaceae): These have narrow leaves with parallel veins and hollow stems. They include problematic weeds such as *Eleusine indica* (goosegrass) and *Cynodon dactylon* (Bermuda grass).
- Sedges (Cyperaceae): These resemble grasses but have triangular stems and solid internodes. An example is *Cyperus rotundus* (nutgrass), which is difficult to eradicate due to underground tubers.
- Broadleaf weeds (Dicotyledons): These weeds have wide leaves with net-like veins. Examples include *Amaranthus* spp. (pigweed) and *Chromolaena odorata* (Siam weed).

1 mark for the main point and 1 mark for a correct explanation of the point, $3 \times 2 = 6$ marks

2. Classification Based on Life Cycle

This approach classifies weeds by their lifespan and reproductive behaviour:

- Annual weeds: Complete their life cycle in one season (within 12 months). They grow rapidly and produce numerous seeds. Examples include *Ageratum conyzoides* and *Bidens pilosa*.
- Biennial weeds: Complete their life cycle in two years. The first year is for vegetative growth, and the second year for flowering and seed production. Example: *Daucus carota* (wild carrot).

- c. Perennial weeds: Live for more than two years and reproduce by seeds and vegetative parts like rhizomes or tubers. Examples include *Imperata cylindrica* (spear grass) and *Cyperus esculentus* (yellow nutsedge).

1 mark for the main point and 1 mark for a correct explanation of the point, $3 \times 2 = 6$ marks

3. Classification Based on Ecology (Habitat)

Ecological classification is based on the environments where weeds thrive:

- a. Aquatic weeds: Grow in water bodies. They may be floating (e.g., *Eichhornia crassipes* – water hyacinth) or submerged (e.g., *Hydrilla verticillata*).
- b. Terrestrial weeds: Found on dry land. These are the most common on farmlands and can be further divided into upland or lowland weeds depending on soil moisture conditions.
- c. Obligate and Facultative weeds: Obligate weeds grow exclusively in disturbed areas (e.g., croplands), while facultative weeds can grow in both disturbed and undisturbed ecosystems.

1 mark for the main point and 1 mark for a correct explanation of the point, $3 \times 2 = 6$ marks

4. Importance of Weed Classification in Agricultural Production

- a. Targeted Control Strategies: Knowing the type of weed helps in selecting the most effective management methods. For instance, annual weeds are easier to manage with pre-emergent herbicides, while perennial weeds may require systemic herbicides and mechanical removal.
- b. Improved Herbicide Selection: Different herbicides are effective on different morphological types (e.g., broadleaf vs. grasses), so classification helps avoid misuse or resistance development.
- c. Better Crop Planning: Understanding weed ecology helps in planning cropping systems, rotations, and timing of planting to suppress specific weed types.
- d. Cost-Effective Management: Efficient identification and classification reduce trial-and-error control methods, saving labour and resources.
- e. Environmental Protection: Appropriate weed classification enables integrated weed management (IWM), reducing overreliance on chemicals and minimising environmental impact.

1 mark for the main point and 1 mark for a correct explanation of the point, any $3 \times 2 = 6$ marks. Accept other correct responses not provided in the marking scheme

WEEK 14

FOCAL AREA 1 (26 marks)

1. Dispersal by Wind (Anemochory)

Mechanism:

Some weed seeds are light, small, and equipped with structures like wings, hairs, or parachutes (e.g., pappus) that allow them to be carried over long distances by the wind.

Examples:

- a. *Tridax procumbens* (coat buttons)
- b. *Chromolaena odorata* (Siam weed)
- c. *Asclepias* spp. (milkweed)

Conditions for Dispersal:

- a. Dry, windy conditions.
- b. Open fields or deforested areas with little obstruction.
- c. Seeds must be mature and dry.

1 mark for stating the correct mechanism, 2 marks for given two examples and 2 marks for stating two conditions, totalling 5 marks

2. Dispersal by Water (Hydrochory)

Mechanism:

Seeds or vegetative parts are carried by surface runoff, streams, rivers, or floods to new locations.

Examples:

- a. *Eichhornia crassipes* (water hyacinth)
- b. *Cyperus* spp. (sedges)
- c. *Marsilea* spp. (aquatic ferns)

Conditions for Dispersal:

- a. Rainy seasons with heavy runoff.
- b. Flooded fields or irrigation systems.
- c. Poorly drained soils or riverine environments.

1 mark for stating the correct mechanism, 2 marks for given two examples and 2 marks for stating two conditions, totally 5 marks

3. Dispersal by Animals (Zoochory)

Mechanism:

Seeds attach to animal fur or feathers (epizoochory) or are ingested and later excreted (endozoochory), still viable.

Examples:

- a. *Bidens pilosa* (blackjack) – sticky barbed seeds cling to fur.
- b. *Amaranthus* spp. – seeds pass through digestive systems of birds and livestock.

Conditions for Dispersal:

- a. Presence of grazing animals or wildlife.
- b. Proximity to animal movement routes.
- c. Mature seeds with barbs or palatable fruit.

1 mark for stating the correct mechanism, 2 marks for given two examples and 2 marks for stating two conditions, totally 5 marks

4. **Dispersal by Human Activities (Anthropochory)**

Mechanism:

Human movement and farming practices such as tillage, harvesting, and transport inadvertently spread weed seeds or vegetative parts.

Examples:

- a. *Imperata cylindrica* (spear grass) – spreads through contaminated machinery or clothing.
- b. *Parthenium hysterophorus* – transported through contaminated crop seeds.

Conditions for Dispersal:

- a. Use of unclean tools or machinery.
- b. Shared or rented farm equipment.
- c. Poor seed certification and storage practices.

1 mark for stating the correct mechanism, 2 marks for given two examples and 2 marks for stating two conditions, totally 5 marks

5. **Dispersal by Explosive Mechanism (Autochory)**

Mechanism:

Some weeds have fruits that burst open when mature, forcefully ejecting seeds away from the parent plant.

Examples:

- a. *Impatiens* spp. (touch-me-not)
- b. *Oxalis* spp. (wood sorrel)

Conditions for Dispersal:

- a. Hot, dry weather for drying pods.
- b. Maturity of seed pods.
- c. Mechanical disturbance (e.g., wind or animal touch).

1 mark for stating the correct mechanism, 2 marks for given two examples and 2 marks for stating two conditions, totally 5 marks

6. **Importance of Weed Management**

Understanding the mechanisms and conditions under which weed dispersal occurs helps in:

- a. Prevention: Avoiding the introduction of weeds via contaminated equipment, seed, or water sources.
- b. Control Timing: Managing weeds before they set seed to minimise dispersal.
- c. Field Sanitation: Cleaning tools and machinery to prevent seed spread.

- d. **Buffer Zones:** Establishing vegetation-free borders to reduce wind and water dispersal from adjacent lands.
- e. **Community Action:** Coordinating weed control across farms to prevent re-infestation from neighbouring fields.

1 mark for stating the correct point and 1 mark for correct explanation of the point, any 3 x 2 = 6 marks. Accept other correct responses not provided in the marking scheme

FOCAL AREA 2 (30 marks)

1. Method 1: Manual (Mechanical) Weed Control

a. Description

Manual or mechanical weed control involves physically removing weeds using hand tools such as hoes or cutlasses.

b. Materials/Tools Needed

- i. Hoe
- ii. Cutlass
- iii. Hand gloves
- iv. Wheelbarrow for collection

c. Procedure

- i. Wear gloves to protect hands.
- ii. Use a hoe or cutlass to uproot weeds from the soil surface.
- iii. Ensure removal includes the roots to prevent regrowth.
- iv. Collect and dispose of the weeds properly to prevent seed spread.

d. Benefits

- i. Environmentally friendly (no chemical use).
- ii. Suitable for small plots and allows selective weeding.

1 mark for correct description, 3 marks for providing three tools, 4 marks for providing four procedures, 2 marks for providing two benefits, totally 10 marks

2. Method 2: Cultural Weed Control (Mulching)

a. Description

Cultural control involves practices that suppress weeds through competition, such as using mulch to block sunlight and prevent weed germination.

b. Materials/Tools Needed

- i. Dry grasses or leaves
- ii. Black polythene sheets (optional)
- iii. Rake

c. Procedure

- i. Clear existing weeds from the plot.
- ii. Spread dry mulch materials or polythene evenly on the soil surface.
- iii. Ensure good coverage, especially around crop bases.
- iv. Monitor for any emerging weeds and spot-remove them.

d. Benefits

- i. Conserves soil moisture and improves soil fertility.
- ii. Suppresses weed growth naturally without labour-intensive weeding.

1 mark for correct description, 3 marks for providing three tools, 4 marks for providing four procedures, 2 marks for providing two benefits, totally 10 marks

3. **Method 3: Chemical Weed Control**

a. Description

This method uses herbicides to kill or suppress weeds effectively.

b. Materials/Tools Needed

- i. Selective or non-selective herbicide (e.g., glyphosate)
- ii. Knapsack sprayer
- iii. Protective gear (gloves, boots, goggles)

c. Procedure

- i. Wear appropriate protective clothing.
- ii. Calibrate and fill the knapsack sprayer with the recommended herbicide solution.
- iii. Spray evenly on the weed-infested area, avoiding contact with desirable crops if using non-selective herbicides.
- iv. Allow sufficient time for the chemical to act before planting or further cultivation.

d. Benefits

- i. Efficient for large areas and saves time.
- ii. Kills a wide range of weeds quickly and effectively.

1 mark for correct description, 3 marks for providing three tools, 4 marks for providing four procedures, 2 marks for providing two benefits, totally 10 marks

Accept other correct responses not provided in the marking scheme

SECTION 6: CONCEPT OF FUNCTIONAL PRODUCTION AND MARGINAL DIMINISHING RETURNS IN AGRICULTURAL PRODUCTION

STRAND: AGRICULTURAL ECONOMICS, AGRIBUSINESS AND COMMUNICATION

Sub-Strand: Economics for Agriculture

Learning Outcome: Use the knowledge acquired on the factors of production, functional production and diminishing marginal returns to understand the operation of Agricultural enterprises.

Content Standard: Demonstrate knowledge, understanding and skills of the factors of production, functional production and diminishing marginal returns.

INTRODUCTION AND SECTION SUMMARY

Agricultural production, like any economic activity, relies on a combination of resources known as factors of production: land, labour, capital, and entrepreneurship. These factors function together to produce crops, livestock, and other outputs. Understanding how each factor contributes to agricultural productivity is essential for effective resource management and sustainable farming. Moreover, the principle of marginal diminishing returns plays a crucial role in determining how output changes when one input increases while others remain constant. Understanding how various inputs contribute to output is also crucial for effective farm management. This is where the concept of functional production comes into play. Functional production refers to the relationship between inputs (like land, labour, capital) and output in a structured, measurable form. When applying these inputs, farmers often face a common economic phenomenon known as diminishing marginal returns. Understanding how these principles apply in agriculture is vital for ensuring efficiency, sustainability, and profitability in food production systems. This section will emphasise the meaning, importance and effects of the factors of functional production and marginal diminishing returns in agricultural production. Furthermore, it will consider the application and characteristics of functional production and diminishing marginal returns in agriculture production. This section has links with other subjects including Business Studies, Computing, Economics, Home Economics, Government, and Mathematics.

The weeks and the indicators covered by the section are:

Week 15: Discuss the Meaning, Importance and Effects of the Factors of Functional Production and Marginal Diminishing Returns in Agricultural Production.

Week 16

1. Apply The Concepts of Functional Production and Diminishing Marginal Returns in Agricultural Production
2. Draw Production Curves Showing the Relationship Between Fixed Inputs and Variable Inputs for Given Resources in Agricultural Production.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The suggested pedagogical strategies to be used in this section are inquiry-based learning, structuring talk for learning, inquiry-based learning, initiating talk for learning, collaborative learning and experiential learning. Inquiry-based learning will be used to come up with information on the meaning of fixed and variable inputs, and to search the internet for the application and characteristics of functional production and diminishing marginal returns. Initiating talk for learning and structuring talk for learning has been proposed to be used to discuss the factors and the characteristics of graphs of functional production and marginal diminishing returns. In groups, learners will watch a documentary on functional production and diminishing marginal returns to foster collaborative learning among themselves. Experiential learning will be used to support learners to catalogue farm items and equipment into fixed and variable costs. Teachers can adapt, modify or use other pedagogies they seem appropriate to support learners to achieve the learning outcomes for this section. Teachers should ensure that all learners actively take part in all the learning activities both in class and as homework. Also, learners should be monitored to prevent them from searching unapproved sites on the internet for information. Learners should be allowed to work in mixed-ability, mixed-gender groups, in pairs or as individuals as much as possible.

ASSESSMENT SUMMARY

This section's assessment will encompass the meaning, importance and effects of the factors of functional production and marginal diminishing returns in agricultural production. It will also cover the application and characteristics of functional production and diminishing marginal returns in agriculture production. The assessments should be done using multiple choice questions, essay types and practicals given as class exercise, homework or mid-semester examination. The assessment should cover the various depths of knowledge and proficiency level but with some emphasis on levels 3 (strategic reasoning) and 4 (extended critical thinking and reasoning). Varying responses (oral, written) should be accepted. Feedback on learners' responses should always be made available to them, and they should be supported to overcome weaknesses identified. Rubrics or marking schemes for scoring learners work as much as possible should be valid, reliable, practical, and fair.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Discuss the meaning and importance of the factors of production, functional production and marginal diminishing returns.	Level 3 (Week 15)	Quiz/Class Exercise

Apply the concepts of functional production and diminishing marginal returns in Agricultural production.	Level 4 (Week 16)	Essay Type Question/Homework
Draw production curves showing the relationship between fixed inputs and variable inputs for given resources in Agricultural production.	Level 3 (Week 16)	Essay Type Question/Class Exercise

WEEK 15

Learning Indicator: Discuss the meaning and importance of the factors of production, functional production and marginal diminishing returns

Recap

Year 1	Week 15 1. Explain the meaning, importance and principles of forestry and forest management. 2. Discuss the concepts and the importance of the interrelations between forestry and Agriculture. 3. Discuss agroforestry practices and systems in forest management.
Year 2	Week 15 1. Explain the meaning of soil nutrients, fertility and productivity. 2. Discuss the soil nutrients and their importance in crop production.

Focal Area: Meaning, Importance and Effects of the Factors of Functional Production and Marginal Diminishing Returns in Agricultural Production

1. Meaning of Factors of Functional Production and Marginal Diminishing Returns in Agricultural Production

a. Meaning of Factors of Functional Production in Agriculture

These refer to the inputs or resources used in the production of agricultural goods. They are the key functional elements that contribute to crop or livestock production. The main factors include:

- Land:** The physical space where farming occurs. It includes soil fertility, topography, and climate conditions.
- Labour:** Human effort used in farming operations such as planting, weeding, harvesting, etc.
- Capital:** Man-made resources like machinery, tools, irrigation systems, and storage facilities.
- Management/Entrepreneurship:** The decision-making and organisation aspect — how resources are allocated, when to plant, what to plant, etc.

These are called functional because they directly affect how production happens.

b. Meaning of Marginal Diminishing Returns (Law of Diminishing Returns)

This is a principle in economics that applies when one input increases while other inputs remain constant.

In Agricultural terms, if a farmer increases the amount of one input (e.g., fertiliser) while keeping other inputs constant (e.g., land and labour), there comes a point where each additional unit of that input will result in a smaller increase in output. For example:

- i. Initially, adding fertiliser boosts crop yield significantly.
- ii. After a certain point, more fertiliser increases the yield only slightly.
- iii. Eventually, adding even more might have no effect or a negative effect (e.g., over-fertilisation damages crops).

This concept helps farmers understand the optimal level of input to use for maximum productivity and cost-efficiency.

2. Importance of Factors of Functional Production and Marginal Diminishing Returns in Agricultural Production

a. Importance of Factors of Functional Production in Agriculture

- i. Efficient resource allocation: Understanding these factors helps farmers allocate resources (land, labour, capital, management) more effectively to maximise output.
- ii. Improved productivity: When the right combination of inputs is used, farm productivity increases - e.g., fertile land + skilled labour + modern tools = higher yields.
- iii. Improve decision-making and planning: Knowledge of these factors aids in planning what crops to grow, how much labour is needed, and when to invest in equipment.
- iv. Cost control and profitability: By balancing inputs properly, farmers can avoid waste, reduce costs, and increase profits.
- v. Adaptation to changing conditions: Helps farmers adapt production to environmental or economic changes by adjusting their use of land, labour, or capital.

b. Importance of Marginal Diminishing Returns in Agriculture

- i. Input efficiency: Teaches farmers not to overuse a single input (e.g., fertiliser, seeds, water) beyond the point of highest return.
- ii. Cost-benefit analysis: Helps in determining the most cost-effective level of input use. It avoids spending more for less output.
- iii. Maximising yield: Ensures that each input used contributes meaningfully to production, leading to optimal crop yield.
- iv. Sustainable farming: Prevents overuse of land and resources, which can degrade soil or harm the environment.
- v. Economic decision-making: Supports rational decisions on when to increase or decrease an input based on its marginal return.

3. Effect of Factors of Functional Production and Marginal Diminishing Returns in Agricultural Production

a. Effects of Factors of Functional Production in Agricultural Production

- i. Determines the level of output: The quantity and quality of land, labour, capital, and management directly affects how much a farm can produce.
- ii. Influences the type of farming activities: Availability of resources may influence whether a farmer engages in crop production, livestock, or mixed farming.
- iii. Affects the use of technology: Capital availability determines whether modern machinery or traditional tools are used, which impacts efficiency.

- iv. Impacts employment and labour demand: The type and scale of production affect how much labour is required - manual labour in small farms, mechanisation in large ones.
- v. Influences farm income and profitability: Efficient combination of factors leads to increased yield, reduced waste, and higher income.
- vi. Determines scale of production: The more resources a farmer can access, the larger the scale of operations.

b. Effects of Marginal Diminishing Returns in Agricultural Production

- i. Reduced productivity from overuse of inputs: When one input (e.g., fertiliser) is increased excessively without changing others, productivity per unit declines.
- ii. Increased cost of production: Continuing to add inputs with little to no return leads to wasted resources and higher production costs.
- iii. Environmental degradation: Overuse of inputs like chemical fertilisers or water can lead to soil degradation, pollution, or poor crop quality.
- iv. Limits to expansion: Shows that simply increasing inputs cannot increase yield indefinitely - there are biological and physical limits.
- v. Helps identify optimal input levels: Understanding this effect allows farmers to stop at the point where input use is most efficient, saving money and resources.
- vi. Influences agricultural policy and extension services: Governments and organisations use this principle to guide farmers on best practices and input usage limits.

Learning Tasks

1. Recap on how functional production and marginal diminishing returns as well as soil nutrients influence forestry and forest production in real world situation.
2. Explain the meaning of functional production and marginal diminishing returns in agricultural production.
3. Discuss the importance of functional production and marginal diminishing returns in agricultural production.
4. Analyse the effects of functional production and marginal diminishing returns in agricultural production.

Pedagogical Exemplars

1. **Inquiry-based learning:** Learners in pairs, mixed-gender, mixed-ability or groups (where appropriate) search the internet for information on the meaning and importance of factors of functional production and marginal diminishing returns in agricultural production.
2. **Structuring talk for learning:** Learners in pairs, mixed-gender, mixed-ability or groups (where appropriate) research into how the factors of functional production and marginal diminishing returns affect crops and animal production and present their findings in a plenary session.

Key Assessments Level 3: Quiz

Question: Analyse the effect of the factors of functional production on agricultural productivity and explain how the law of diminishing marginal returns influences their effectiveness in the long run. (25 marks)

PLC Session 15

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is quiz. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the quiz (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step

- d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, *gesi*, *sel*, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 16

Learning Indicators

1. *Apply the concepts of functional production and diminishing marginal returns in Agricultural production*
2. *Draw production curves showing the relationship between fixed inputs and variable inputs for given resources in Agricultural production*

Recap

Year 1	Week 16 1. Explain the meaning, importance and nature of soil. 2. Describe the physical and chemical properties of soils and their importance.
Year 2	Week 16: Describe the types of fertilisers and their effects on crop production.

Focal Area 1: Application and Characteristics of Functional Production and Diminishing Marginal Returns in Agriculture Production

1. Application of Functional Production and Diminishing Marginal Returns in Agriculture Production

a. Application of Functional Production in Agriculture

The factors of functional production (land, labour, capital, and management) are applied in many practical ways:

- i. **Land:** Used for cultivating crops or rearing animals; Farmers assess soil fertility, drainage, and topography before planting; Crop rotation and land use planning help maximise productivity.
- ii. **Labour:** Employed in various stages of farming: land preparation, planting, weeding, harvesting, processing, etc.; In small farms, manual labour is often used. In large farms, mechanised labour (e.g., tractors and harvesters) may replace human labour.
- iii. **Capital:** Invested in purchasing inputs like seeds, fertilisers, pesticides, irrigation systems, tools, and machinery. Also used for infrastructure such as storage facilities, greenhouses, and transportation.
- iv. **Management/Entrepreneurship:** The farmer or farm manager makes decisions on what to produce, how to produce, when to produce, and how to market produce. Applies record keeping, budgeting, risk management, and marketing strategies.

b. Application of Diminishing Marginal Returns in Agriculture

The law of diminishing marginal returns is applied by farmers and agricultural economists to improve efficiency:

- iii. **Input optimisation:** Helps farmers decide how much fertiliser or water to apply. Prevents over-application, which could lead to waste or reduced crop performance.

- i. **Profit maximisation:** Farmers analyse how much additional cost per input yields additional profit. Inputs are used up to the point where marginal cost equals marginal revenue.
- ii. **Avoiding resource waste:** Shows that increasing only one factor (e.g., more seeds) without increasing others (e.g., land or labour) leads to less additional output.
- iii. **Farm planning and budgeting:** Helps farmers plan input levels that give maximum return per cedi/dollar spent. Guides budgeting for labour, machinery use, and seasonal planting.
- iv. **Extension services and policy making:** Agricultural extension officers use the principle to educate farmers on efficient input use. Helps in developing subsidy policies for inputs such as fertiliser.

Table 16.1 shows a summary of the areas for the application of functional production and diminishing marginal returns in agricultural production

Table 16.1: *Application of functional production and diminishing marginal returns in agricultural production*

Application Area	Functional Production	Diminishing Marginal Returns
Land	Used for crop/livestock production	Overuse may lead to soil exhaustion with decreasing yield
Labour	Employed in farm operations	Too many workers may reduce output per worker
Capital	Used to buy tools, inputs, and infrastructure	Excessive investment in one area (e.g., irrigation) may not pay off
Management	Guides planning and decisions	Ensures inputs are used at optimal levels

2. Characteristics of graph of Functional Production and Diminishing Marginal Returns in Agriculture Production

a. Characteristics of Graph of Functional Production

The graphs of functional production and diminishing marginal returns in agriculture show that Total Product (TP), Marginal Product (MP), and Average Product (AP) as inputs (such as labour or fertiliser) increase while other factors (e.g., land) remain fixed.

- i. **Total Product** refers to the total amount of output that a firm produces within a given period, utilising given inputs.

Total Product Formula is: $TP = AP \times L$.

Where AP = product/ labour unit; L = Labour.

- ii. **Average Product** refers to output per unit of inputs of variable factors.

Average Product (AP) = Total Product (TP)/ Labour (L).

- iii. **Marginal Product** denotes the addition of variable factors to the total product. Thus, Marginal product = Changed output/changed input. In other ways, marginal product leads to an increase of total product with the help of additional workers or input.

$MP = \Delta \text{Output} / \Delta \text{Input}$

Table 16.2 shows a summary of the key characteristics of total, average and marginal products

Table 16. 2: *Key characteristics of total, average and marginal products*

Curve	Description	Shape	Interpretation
Total Product (TP)	Total output produced as input increases	Rises at first, then slows, eventually flattens or falls	Shows how output grows with more input
Marginal Product (MP)	Additional output from one more unit of input	Rises, reaches a peak, then falls (may become negative)	Indicates efficiency of added inputs
Average Product (AP)	Total output divided by number of input units	Rises, peaks, then falls	Shows average contribution per input

b. Characteristics of Graph of Diminishing Marginal Returns

This concept is best shown using the Marginal Product (MP) curve, as one input is increased (e.g., labour) while keeping others constant (e.g., land). The key characteristics of the graph of diminishing marginal returns are:

- i. Initially rising MP: Productivity increases due to better utilisation of fixed resources.
- ii. Point of diminishing returns: MP reaches its maximum - this is the optimal use point.
- iii. Declining MP: Beyond this point, adding more input yields less additional output.
- iv. Eventually, MP can become zero or negative: Too much input leads to overcrowding or overuse, reducing total output.

Table 16.3 shows a summary table of the characteristics of functional production and diminishing marginal returns.

Table 16.3: *Summary table of the characteristics of functional production and diminishing marginal returns*

Aspect	Functional Production Graphs	Diminishing Marginal Returns (DMR) Graphs
Type of Graph	TP, MP, and AP curves	MP curve (sometimes TP curve)
TP Curve Shape	Increases, then flattens, possibly declines	Similar – flattens as diminishing returns set in
MP Curve Shape	Rises, peaks, then declines	Same – highlights the diminishing return after the peak
AP Curve Shape	Rises slowly, peaks, then declines	Less emphasised in DMR, but still follows the MP relationship
Key Turning Point	Point of maximum MP – optimal input use	Point where diminishing returns begin

c. Graphs Illustrating the Characteristics of Functional Production and Diminishing Marginal Returns

Graphs illustrating the characteristics of functional production and diminishing marginal returns is shown in Figure 16.1.

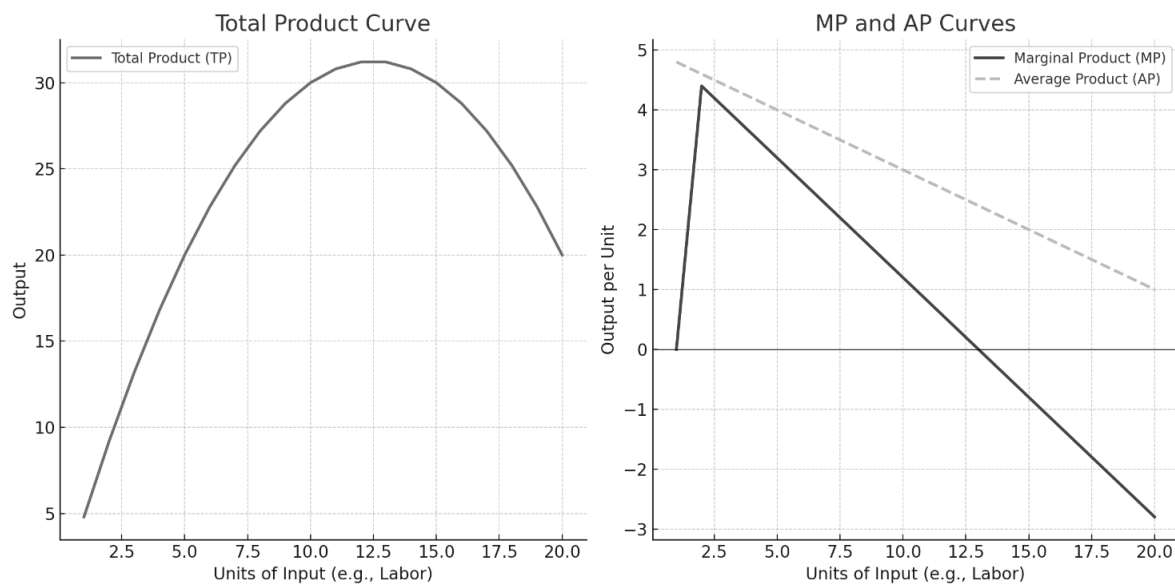


Figure 16.1: *Graphs illustrating the characteristics of functional production and diminishing marginal returns*

- i. Total Product (TP) Curve (left graph)
 - Rises initially as input increases.
 - Growth slows down, then starts to level off — showing the effect of limited fixed resources.
- ii. Marginal Product (MP) and Average Product (AP) Curves (right graph)
 - MP rises, peaks, then declines - demonstrating diminishing marginal returns.
 - AP rises more slowly, peaks, then also declines.
 - MP intersects AP at AP's maximum point - a key feature of these curves.

Learning Tasks

- a. Recap on how agricultural inputs in farming influence the nature of soil thereby affecting output.
- b. Apply functional production and diminishing marginal returns in agriculture production
- c. Draw and discuss the characteristics of graphs of functional production and diminishing marginal returns in agriculture production.

Pedagogical Exemplars

1. **Inquiry-based learning:** In mixed-gender, mixed-ability or groups (where appropriate), learners search the internet for information on the application and characteristics of functional production and diminishing marginal returns.
2. **Initiating talk for learning:** In the same groups, discuss the application of functional production and diminishing marginal returns in agricultural production.
3. **Structuring talk for learning:** Learners in groups discuss the characteristics of graphs of diminishing returns and relate them to factors of production. The teacher should guide learners to practice worked examples, differentiated datasets and extension tasks. Numerical/graphical tasks, requiring learners to construct and interpret TP, AP and MP relationships should also be added. Learners can watch youtube videos for more examples.
4. **Collaborative learning:** Learners in groups watch a documentary on functional production and diminishing marginal returns in agricultural production and write a report on their findings. Examples of such documentaries can be found at:

<https://www.youtube.com/watch?v=PstuC6PKY1g>,

<https://www.youtube.com/watch?v=1plq76fVMPPM>,

<https://www.youtube.com/watch?v=xLSRMt-wWAM>,

<https://www.youtube.com/watch?v=u89Nr8cwBbI> as at 30/06/2025.

Key Assessments Level 4: Homework

Question: Critically evaluate the application of functional production theory and the Law of Diminishing Marginal Returns in modern agricultural systems. In your answer, analyse their relevance in both subsistence and commercial farming, and assess how these economic principles influence decisions regarding input use, technological innovation, and environmental sustainability. (25 marks)

Focal Area 2: Meaning and Relationship Between Fixed Inputs and Variable Inputs in Agricultural Production

1. Meaning of Fixed and Variable Inputs in Agricultural Production

a. Fixed Inputs in Agricultural Production

Fixed inputs are those resources or factors of production that do not change in quantity during a specific production period, regardless of how much is produced. The characteristics of fixed inputs are: quantity remains constant in the short run; cannot be increased or decreased immediately; and often represents long-term investments. Examples of fixed inputs in agriculture are land (size of farm), farm buildings (barns, silos, greenhouses), irrigation systems and tractors and large machinery (when already purchased).

b. Variable Inputs in Agricultural Production

Variable inputs are those factors of production that can be adjusted (increased or decreased) during a production period to influence output. The characteristics of variable inputs are: change with the level of production; can be easily adjusted in the short term;

and are often recurrent expenses. Examples of variable inputs in agriculture are seeds, fertilisers and pesticides, fuel, water (for irrigation) and labour (seasonal or casual workers).

Table 16.4 shows a summary of the differences between fixed and variable inputs

Table 16.4: *Differences between fixed and variable inputs*

Feature	Fixed Inputs	Variable Inputs
Change with production	No	Yes
Time frame	Long-term (short run fixed)	Short-term (easily adjustable)
Cost behaviour	Fixed cost	Variable cost
Examples	Land, tractors, buildings	Seeds, fertilisers, labour, fuel

2. Relationship between Fixed and Variable Inputs in Agricultural Production

Fixed and variable inputs work together to determine the level of agricultural output. Their interaction directly influences productivity, efficiency, and profitability on the farm.

a. Complementarity in Production

- i. Variable inputs depend on the availability of fixed inputs to be productive.
- ii. Example: Fertilisers (variable input) increase yield only if the land (fixed input) is suitable and well-managed.

b. Efficiency and Utilisation

- i. Efficient use of fixed inputs (e.g., using all available land or fully operating a tractor) depends on the quantity of variable inputs applied.
- ii. Underutilisation of variable inputs leads to inefficiency - the fixed input is not used to full capacity.

c. Output Determination

- i. Output increases when variable inputs are added to fixed inputs, but only up to a point.
- ii. Beyond a certain level, diminishing marginal returns set in - adding more variable inputs leads to less additional output.

d. Cost Implications

- i. Fixed inputs involve fixed costs (do not change with output).
- ii. Variable inputs involve variable costs (increase with more production).
- iii. The balance between the two affects the farm's break-even point and profitability.

e. Input Adjustment Over Time

- i. In the short run, only variable inputs can be changed.
- ii. In the long run, both fixed and variable inputs can be adjusted - for example, a farmer may decide to buy more land or machinery if long-term demand increases.

Learning Tasks

1. Recap on how fertilisers as an input affect crop and animal production.
2. Explain the meaning of fixed and variable inputs in agricultural production.
3. Analyse the relationship between fixed and variable inputs in agricultural production.

Pedagogical Exemplars

1. **Inquiry-based learning:** In pairs, mixed-gender, mixed-ability or groups (where appropriate) learners discuss to come up with the meaning of fixed input and variable input in Agricultural production.
2. **Initiating talk learning:** In the same groups, learners discuss the relationship between fixed input and variable input in agricultural production.
3. **Experiential learning (Homework):** In mixed-gender, mixed-ability or groups (where appropriate) learners visit a farm to catalogue items and equipment with fixed and variable costs and then present a report on their findings.

Key Assessments Level 3: Homework

Question: How does the relationship between fixed and variable inputs influence the efficiency and output levels in maize production on small- to medium-scale farms? (15 marks)

PLC Session 16

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app

- The key assessment for the week is homework. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the homework (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- All teachers in the group work through a similar problem individually for 3–4 minutes
- The group then works through the problem together step by step
- Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).

- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- After the enactment, ask for structured feedback from the group
 - Was the concept explained in a way that a learner with no prior knowledge could follow?
 - Were the examples grounded in contexts familiar to Ghanaian learners?
 - Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

SECTION SIX REVIEW

Factors of functional production in agriculture refer to the inputs or resources used in the production of agricultural goods. The main factors/resources are land, labour, capital and management/entrepreneurship. Diminishing marginal returns is a principle in economics that applies when one input increases while other inputs remain constant.

The importance of factors of functional production in agriculture are efficient resource allocation, improve productivity, improve decision-making and planning, cost control and profitability, and adaptation to changing conditions, while the importance of marginal diminishing returns in agriculture are that they ensure or promote input efficiency, cost-benefit analysis, maximise yield, sustainable farming, and economic decision-making.

The effects of factors of functional production in agricultural production are that they determine the level of output, influence the type of farming activities, affect the use of technology, impact employment and labour demand, influence farm income and profitability, and determine scale of production.

The effects of marginal diminishing returns in agricultural production are that they reduce productivity from overuse of inputs, increase cost of production, promote environmental degradation, limit expansion, help identify optimal input levels, and influence agricultural policy and extension services.

Fixed inputs are those resources or factors of production that do not change in quantity during a specific production period, regardless of how much is produced while variable inputs are those factors of production that can be adjusted (increased or decreased) during a production period to influence output. The relationship between fixed and variable inputs in agricultural production influences complementarity in production, efficiency and utilisation, output determination, cost implications, and input adjustment over time.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 15 (25 marks)

1. Effect of Factors of Functional Production in Agriculture

- a. Land
 - i. Effect on productivity: Land provides the base for crop and livestock production. Its size, fertility, and suitability directly affect yield levels.
 - ii. Constraints: Land is fixed in supply, making its management crucial. Overuse or poor practices can lead to erosion, salinity, and loss of productivity.
- b. Labour
 - i. Effect on productivity: Labour contributes to land preparation, planting, irrigation, harvesting, and marketing. Skilled labour can enhance the use of technologies and increase efficiency.
 - ii. Constraints: Labour shortages or low skill levels can reduce the potential productivity of other inputs.
- c. Capital
 - i. Effect on productivity: Tools, machinery, irrigation, and fertilisers increase efficiency and output. Capital facilitates modernisation.
 - ii. Constraints: High cost of capital goods can limit access for smallholders. Misuse or overuse of capital inputs (e.g., excessive chemical use) can damage ecosystems and reduce future productivity.
- d. Entrepreneurship
 - i. Effect on productivity: Entrepreneurship integrates the other factors, making decisions on resource allocation, technology adoption, and market access.
 - ii. Constraints: Poor management decisions or lack of innovation can reduce the returns from even high-quality land, labour, or capital.

1 mark for the main point, 1 mark each for two sub-points and 1 mark each for correct explanations of the sub-points, any $3 \times 5 = 15$ marks. (Accept other correct responses not provided in the marking scheme)

2. Effect of the Law of Diminishing Marginal Returns

In agriculture, this principle manifests in the following ways:

- a. Fertiliser Use: Applying more fertiliser initially increases yield, but beyond a certain point, the yield gain per unit of fertilizer drops. Eventually, excessive use can harm soil health.
- b. Labour Input: Adding more workers to a fixed area of land may improve productivity up to a point, but after that, overcrowding can lead to inefficiency.
- c. Capital Application: Adding more tractors or irrigation systems to a fixed-size farm eventually yields smaller gains in output.

1 mark for stating the point and another 1 mark for correct explanation of the point, $3 \times 2 = 6$ marks. (Accept other correct responses not provided in the marking scheme)

3. Long-Term Implications

- a. Resource Efficiency: Farmers must monitor input-output relationships carefully to avoid diminishing returns. Precision agriculture is one response to this need.
- b. Sustainable Practices: Awareness of diminishing returns promotes sustainable land and resource management.
- c. Policy Influence: Governments and institutions use this principle to guide subsidy design, research investment, and extension services to ensure productivity gains without resource exhaustion.

1 mark for stating the point and another 1 mark for correct explanation of the point, any
 $2 \times 2 = 4$ marks (Accept other correct responses not provided in the marking scheme)

WEEK 16

FOCAL AREA 1

Sample Mark Scheme

1. Application of Functional Production in Agricultural Systems

- a. Production Planning
 - i. Commercial farms often use input-output models or production functions to plan and simulate output scenarios based on varying resource allocations.
 - ii. In subsistence farming, though less formal, farmers use observational learning and traditional knowledge to optimise scarce resources.
- b. Decision-Making Tools: Precision agriculture leverages production functions to fine-tune input levels (e.g., fertiliser or irrigation) per unit area, maximising returns and minimising waste.
- c. Technological Adoption: By analysing how new technologies shift the production function (usually upward), farmers can evaluate marginal gains and decide whether adoption is economically justified.

1 mark for stating the point and another 1 mark for correct explanation of the point, $3 \times 2 = 6$ marks (Accept other correct responses not provided in the marking scheme)

2. Real-World Application of the Law of Diminishing Marginal Returns under

- a. Input Efficiency
 - i. Commercial farms use marginal analysis to determine the optimal level of inputs such as nitrogen, pesticides, and labour.
 - ii. For example, yield maps and soil tests can identify the input threshold beyond which gains are negligible or harmful.
- b. Labour Allocation in Subsistence Systems: In smallholder systems, over-concentration of family labour on a small plot often results in low productivity per worker, illustrating diminishing returns.
- c. Environmental Thresholds: Beyond certain input levels, particularly with agrochemicals, diminishing returns may turn negative due to soil degradation, water pollution, and biodiversity loss.

1 mark for stating the point and another 1 mark for correct explanation of the point, $3 \times 2 = 6$ marks (Accept other correct responses not provided in the marking scheme)

3. Cross-System Comparison

Cross-System Comparison

Criteria	Subsistence Farming	Commercial Farming
Input Access	Limited and irregular	High, but cost-sensitive
Data Utilisation	Traditional knowledge, informal experiments	Data-driven, supported by extension and analytics
Response to Returns	Often reactive	Proactive, economically modelled
Application Strategy	Trial-and-error	Precision and optimisation-based

1 mark for stating the correct criteria, and 1 mark each for a correct explanation of the criteria under subsistence and commercial farming, $3 \times 3 = 9$ marks. (Accept other correct responses not provided in the marking scheme)

4. Implications for Sustainability and Innovation

a. Sustainability

- i. Diminishing returns highlight the biophysical limits of production. Over-application of inputs can cause irreversible environmental harm, including nutrient runoff, groundwater depletion, and ecosystem disruption.
- ii. Thus, internalising this economic law into farming practices supports long-term resource conservation.

b. Innovation and Technological Response

- i. The Green Revolution succeeded in temporarily pushing back diminishing returns by introducing high-yield varieties, synthetic fertilisers, and irrigation. However, returns have since plateaued in many regions.
- ii. Emerging technologies like AI, IoT, and biotechnology seek to further shift the production function upward by enhancing input efficiency.

- c. Policy Formulation: Policymakers use these principles to design subsidy programs, environmental regulations, and research initiatives that align economic incentives with sustainable production.

1 mark for stating the correct point, and 1 mark each for a correct explanation, Any $2 \times 2 = 4$ marks. (Accept other correct responses not provided in the marking scheme)

FOCAL AREA 2 (15 marks)

The relationship between fixed and variable inputs is crucial in determining both the level of output and the efficiency of resource use in maize production.

1. Impact on Output

When variable inputs (like fertilisers and labour) are increased while fixed inputs (like land) remain constant:

- Initially, output increases at an increasing rate due to better utilisation of fixed inputs.
- Later, output increases at a diminishing rate because of the law of diminishing marginal returns.
- Eventually, too many variable inputs on the same fixed area of land may lead to overcrowding, soil degradation, or inefficiency, causing no further gains or even decreases in output.
- Example (Hypothetical Data):

Fertiliser Applied (kg/ha)	Maize Yield (tonnes/ha)
0	2.0
50	3.5
100	5.0
150	5.8
200	6.0
250	5.9

- Yield increases rapidly at first, but plateaus after a certain level of fertiliser input, demonstrating diminishing returns on a fixed land area.

2 marks for each correct point including the example provided sequentially

2 x 5 = 10 marks (Accept other correct responses not provided in the marking scheme)

2. Impact on Cost Efficiency

- Using too few variable inputs leads to underutilisation of fixed assets (e.g., a tractor working only once a month).
- Using too many variable inputs leads to waste and higher cost per unit of output.
- Therefore, identifying the optimal ratio of variable to fixed inputs (input mix) is key to maximising profits.

1 mark for each correct point

3 x 1 = 3 marks (Accept other correct responses not provided in the marking scheme)

3. Strategic Implications for Farmers

- Small-scale farmers with limited land (fixed input) must optimise variable inputs to avoid diminishing returns.
- Medium-scale farmers might invest in moderate expansion of fixed inputs (e.g., land or storage) if variable inputs are already maxed out efficiently.

1 mark for each correct point 2 x 1 = 2 marks

(Accept other correct responses not provided in the marking scheme)

SECTION 7: ENTERPRISES FOR SUSTAINABLE LIVELIHOOD

STRAND: AGRICULTURAL ECONOMICS, AGRIBUSINESS AND COMMUNICATION

Sub-Strand: Agribusiness Management

Learning Outcome: Use the knowledge and skills acquired to successfully process and market Agricultural produce.

Content Standard: Demonstrate knowledge, understanding and skills of processing and marketing of Agricultural produce.

INTRODUCTION AND SECTION SUMMARY

Crop production and processing enterprises play a vital role in ensuring food security, economic development, and sustainable livelihoods, especially in agrarian communities. These enterprises involve the cultivation of crops and the transformation of harvested produce into value-added products through various processing techniques. Establishing such enterprises requires proper planning, resource management, and knowledge of sustainable agricultural practices. By combining production with processing, farmers and entrepreneurs can minimise post-harvest losses, increase profitability, and create employment opportunities along the agricultural value chain. Animal and fish production and processing enterprises are also critical components of the agricultural sector, contributing significantly to food security, employment, and rural development. These enterprises involve the rearing of livestock and fish, as well as the processing of their products such as meat, milk, eggs, hides, and fish fillets into marketable forms. Establishing such ventures requires knowledge of animal husbandry, aquaculture practices, value addition, and sustainable resource management. When properly planned and managed, these enterprises can provide consistent income, improve nutrition, and support the livelihoods of individuals and communities. This section will enable learners to explore the meaning, significance, and practical steps involved in setting up crop-based enterprises with a focus on sustainability and income generation. It will also enable learners to examine the meaning and foundational steps in setting up animal and fish-based enterprises geared towards sustainability and long-term livelihood improvement. This section has links with Applied Technology, Biology, Business, Chemistry, Economics, Engineering, Home, Economics, Geography, Manufacturing, Robotics, and Science.

The weeks covered by the section are:

Week 17: Establish a Crop Production or Processing Enterprise for Sustenance and Livelihood.

Week 18: Establish a Crop Production or Processing Enterprise for Sustenance and Livelihood.

Week 19: Establish a Crop Production or Processing Enterprise for Sustenance and Livelihood.

Week 20: Establish a Crop Production or Processing Enterprise for Sustenance and Livelihood.

Week 21: Establish an Animal/Fish Production or Processing Enterprise for Sustenance and Livelihood.

Week 22: Establish an Animal/Fish Production or Processing Enterprise for Sustenance and Livelihood.

Week 23: Establish an Animal/Fish Production or Processing Enterprise for Sustenance and Livelihood.

Week 24: Establish an Animal/Fish Production or Processing Enterprise for Sustenance and Livelihood.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical exemplars proposed for teaching and learning for learners to acquire knowledge, understanding and skills in the meaning and establishment of crop, animal and fish production, and processing enterprises for sustainable livelihood are think-pair-share, inquiry-based learning, project-based learning, and experiential learning. Think-pair-share will be used for learners to come up with the meaning of enterprises in crop, animal and fish production. Inquiry-based learning will support learners to watch a documentary on the establishment, harvesting, processing, storage and marketing of selected crops, animals and fish. Project-based and experiential learning will offer learners the opportunity to conduct practicals, surveys and build portfolios on the enterprises in crop, animal and fish production and present a report on their findings. The utilisation of think-pair-share, inquiry-based learning, project-based learning, and experiential learning will promote analytical thinking, collaboration, communication, creativity, critical thinking and digital literacy skills among learners. Learners can work in various groups such as mixed-ability groups, mixed-gender groups, in pairs or individually to achieve the learning outcomes. Teachers and/or resource persons should be available to guide learners in all activities, especially where hands-on practicals are involved.

ASSESSMENT SUMMARY

Assessments will cover the meaning and establishment of crop production and processing enterprises for sustainable livelihood as well as the meaning and establishment of animal/fish production and processing enterprises for sustainable livelihood. The assessment modes and strategies may include class exercise, homework, discussion, presentation, mid-semester examinations, individual project, group project, and end of semester examinations administered as formative and summative assessments. The assessments should adequately cover recall/reproduce/remember, skills of conceptual understanding, strategic reasoning, and extended critical thinking and reasoning, different abilities and proficiencies of learners. Responses for the project and practical given in week 14 can be collected in week 22. Teacher assessment manual and toolkits and professional learning community handbook for Agriculture can be referred to for samples of individual portfolio assessment. Responses from learners in various forms such as oral, written and demonstration should be accepted. Learners should also be made known about the outcome of their responses and where a learner requires support, that should be provided.

Summary of the assessments used against indicators

Indicators	DOK Level	Assessment Strategy and/or Mode
Establish a crop production or processing enterprise for sustenance and livelihood.	Level 3 (Week 17)	Class Project
Establish a crop production or processing enterprise for sustenance and livelihood.	Level 3 (Week 18)	Practice Paper 2
Establish a crop production or processing enterprise for sustenance and livelihood.	Level 3 (Week 19)	Project and Practical
Establish a crop production or processing enterprise for sustenance and livelihood.	Level 3 (Week 20)	Practical
Establish an animal/fish production or processing enterprise for sustenance and livelihood.	Level 3 (Week 21)	Project
Establish an animal/fish production or processing enterprise for sustenance and livelihood.	Level 3 (Week 22)	Project and Practical
Establish an animal/fish production or processing enterprise for sustenance and livelihood.	Level 3 (Week 23)	Project
Establish an animal/fish production or processing enterprise for sustenance and livelihood.	Level 3 (Week 24)	Project

WEEK 17

Learning Indicator: Establish a crop production or processing enterprise for sustenance and livelihood

Recap

Year 1:	Week 17: Discuss the composition of the soil.
Year 2:	Week 17 Identify common crop pests and diseases and their effects on crops. Classify crop pests and diseases.

Focal Area: Meaning and Establishment of Crop Production and Processing Enterprises for Sustainable and Livelihood

1. Meaning of Enterprises in Crop Production

Enterprises in crop production refer to the different types of crop-based activities or specialised crop systems that a farmer or agricultural business engages in to produce income or sustain farm operations.

An enterprise in crop production is **a distinct unit or type of crop activity** on a farm that is planned, managed, and evaluated separately for its costs, returns, and production needs.

The types of crop enterprises are:

- Cereal Crop Enterprise e.g., maize, rice, sorghum
- Vegetable Enterprise e.g., tomatoes, okra, pepper
- Root and Tuber Enterprise e.g., yam, cassava, potato
- Legume Enterprise e.g., cowpea, groundnut, soybean
- Fruit Crop Enterprise e.g., mango, orange, pineapple
- Industrial Crop Enterprise e.g., cotton, sugarcane, tobacco

It should be noted that a single farm may have multiple enterprises (e.g., rice + tomatoes + yams)

2. Establishment of Crop Production and Processing as an Enterprise

Establishing crop production and processing as an enterprise involves careful planning, implementation, and management of crop farming and the value-adding processing activities that follow harvest with the goal of making profit, improving food security, or supporting agro-industrial development. The key stages in establishing a crop production and processing enterprise are:

a. Enterprise Planning

- Identify the crop (e.g., maize, cassava, tomato) based on soil and climate conditions, market demand and profitability, and available inputs and labour.
- Set enterprise goals: profit, food supply, raw material for processing, etc.
- Conduct a feasibility study: cost-benefit analysis, input availability, and market access.

b. Land Preparation and Crop Establishment

- i. Choose a suitable site (good soil, drainage, access).
- ii. Clear and till the land (manual or mechanised).
- iii. Apply manure/fertilisers as needed.
- iv. Plant at the right time, using high-quality seeds or planting materials.
- v. Provide proper spacing, irrigation, and weed control.

c. Crop Maintenance

- i. Regular weeding and pest/disease control.
- ii. Fertiliser application and watering schedules.
- iii. Thinning or staking if required.
- iv. Monitoring crop growth for timely harvesting.

d. Harvesting

- i. Harvest at maturity to ensure quality and minimise losses.
- ii. Use appropriate tools or machines depending on the crop.
- iii. Handle produce carefully to avoid damage.

- e. **Processing of Produce:** Processing involves converting raw crops into finished or semi-finished products to improve value, shelf life, or ease of use.

Table 17.1 shows examples of some crops, processing activity and final products

Table 17.1: *Examples of some crops, processing activity and final products*

Crop	Processing Activity	Final Product
Cassava	Peeling, grating, drying	Garri, flour, starch
Maize	Shelling, grinding	Maize flour, animal feed
Tomato	Sorting, crushing, cooking	Tomato paste, puree
Rice	Dehusking, polishing	White or parboiled rice

f. Packaging and Marketing

- i. Package attractively and hygienically.
- ii. Label with name, date, and nutritional info if needed.
- iii. Transport to markets, shops, or wholesalers.
- iv. Consider direct sales, agro-markets, or contract supply.

g. Record-Keeping and Evaluation

- i. Maintain records of input costs, yields, labour, income, and losses.
- ii. Assess the profitability and efficiency of both production and processing activities.
- iii. Use the evaluation to improve future cycles.

Learning Tasks

1. Recap on how soil composition as well as pests and diseases can impact enterprises in crop production.
2. Explain the meaning of enterprises in crop production.

Pedagogical exemplars

1. **Think-pair-share:** Learners in pairs discuss to come up with the meaning of enterprises in crop production.
2. **Inquiry-based learning:** In mixed-gender, mixed-ability or groups (where appropriate), learners watch a documentary on the establishment, harvesting, processing, storage and marketing of selected crops (vegetable e.g., tomatoes, peppers and onions; arable crops e.g., maize, cassava and yams; cash crops e.g., cocoa, shea and cashew nuts). Learners write a report on their findings. Examples of such documentaries can be found at:

https://www.youtube.com/results?sp=mAEB&search_query=processing+of+cassava;

[https://www.youtube.com/results?search_query=processing+of+tomatoes,](https://www.youtube.com/results?search_query=processing+of+tomatoes;)

https://www.youtube.com/results?search_query=planting+and+processing+of+maize

https://www.youtube.com/results?search_query=planting+and+processing+of+onion, as at 10/06/2025.

Project-based learning (Homework): Learners in mixed-gender, mixed-ability or groups (where appropriate) conduct survey in their community on the enterprises in crop production and present a report on their findings.

Key Assessments Level 3: Class Project

Question: You are required to plan and establish a maize production and processing enterprise on a 6-hectare farm. Describe the steps involved in establishing the enterprise, including land preparation, crop production, processing methods, marketing strategies, and management of challenges. Provide a plan that ensures profitability and sustainability. (30 marks)

PLC Session 17

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to

- a. suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
- b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
- c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app

- a. The key assessment for the week is class project. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentations (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- b. All teachers in the group work through a similar problem individually for 3–4 minutes
- c. The group then works through the problem together step by step
- d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 18

Learning Indicator: Establish a crop production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 18 1. Explain the meaning and effects of climate change on food production. 2. Discuss the effects of climate on food production and the mitigating factors.
Year 2	Week 18: Discuss the preventive and control measures of pests and diseases in crop production.

Focal Area: Establishment of Crop Production and Processing Enterprises for Sustainable and Livelihood

Establishment of Crop Production and Processing as an Enterprise

Refer to Week 17, Focal Area 2.

Learning Tasks

1. Recap on how climate change as well as preventive and control measures of pests and diseases can impact enterprises in crop production.
2. Demonstrate the establishment of selected crop production and processing as an enterprise.

Pedagogy Exemplars

1. **Project-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners undertake the cultivation, processing storage and marketing of the selected vegetable and arable crops.
2. **Experiential learning:** Learners build a portfolio and prepare a report on their activities on the field and make presentations to the class.

Key Assessment: Practice Paper 2

Practical: You are planning to establish a tomato production and processing enterprise on a 3-hectare farm. Describe the key steps you would take in the establishment, including site preparation, production practices, processing methods, and marketing. Also, discuss common challenges you might face and how you would overcome them. (30 marks)

Hint



Conduct Practice Paper 2. It should cover the contents taught from Year 1 to 3. Refer to the Table of Specification and Structure of the Paper at the end of this section. Learners' papers should be marked immediately and scores entered into the SAP.

AGRICULTURE

ITEM SPECIFICATION - PAPER ONE

Strand	Sub-strand	Indicator	DOK level				Total
			1	2	3	4	
1. Concept of Agriculture in an Industrialising Society	1. Agriculture and Society	1.1.1.LI.1: Explain the meaning and importance of Agriculture.					
		1.1.1.LI.2: Discuss the branches and sectors of Agriculture and their related career opportunities.					
		1.1.1.LI.3: Examine and dispel the misconceptions associated with the study of agriculture.					
		1.1.1.LI.1: Explain the meaning and importance of Agricultural education.	1				
		1.1.1.LI.2: Describe the types of Agricultural education.					
		2.1.1.LI.1: Explain the meaning, importance and stages of Agricultural development.		1			
		2.1.1.LI.2: Discuss the roles of governmental and non-governmental organisations in Agricultural development.					

		2.1.1.LI.1: Describe the land tenure systems in Ghana.					
		2.1.1.LI.2: Explain the effects of land tenure systems on Agricultural production.					
	2. Agriculture and Society	3.1.1.LI.1: Explain the meaning, practices and factors influencing sustainable agriculture and relate it to good Agricultural practices.					
		3.1.1.LI.2: Apply good Agricultural practices to promote sustainable Agriculture.	1				
		3.1.1.LI.3: Employ sustainable techniques to manage Agricultural wastes.					
		1.1.2.LI.1: Explain the meaning, types and importance of industry in Agriculture.		1			
		1.1.2.LI.2: Discuss the interdependence of Agriculture and industry.					

		1.1.2.LI.3: Analyse the economic challenges and solutions of Agriculture in an industrialising society.					
		2.1.2.LI.1: Examine the industries of crop production.					
		2.1.2.LI..2: Discuss the importance of raw and waste materials from crop production to the industry.			1		
		2.1.2.LI.1: Explore the industries of animal, including fish production.					
		2.1.2.LI.2: Discuss the importance of raw and waste materials from animal production to the industry.					
		Total for stand 1	2	2	1	0	5
2. Modern Technical and Mechanised Agriculture	1. Modern Technical Agriculture	1.2.1.LI..1: Outline the uses and maintenance procedures for measuring tools used in Agricultural production.					
		1.2.1.LI.2: Relate the indigenous measuring tools to the standardised units of measurements in Agricultural production.	1				

		1.2.1.LI.3: Demonstrate the use of simple scientific measuring tools to calculate parameters related to the various Agricultural sectors.		1			
		2.2.1.LI.1: Explain the meaning and importance of survey and mapping in Agriculture.			1		
		2.2.1.LI.2: Describe survey and mapping instruments and their uses in Agricultural production.		1			
		2.2.1.LI.1: Demonstrate the procedure for conducting survey and mapping of farmstead.					
		2.2.1.LI.2: Prepare map of a farmstead.			1		
	2. Modern Mechanised Agriculture	3.2.1.LI.1: Explain the meaning, importance and challenges of emerging technologies in Agriculture.	1				
		3.2.1.LI.2: Explain applications and prospects of emerging technologies in Agriculture.		1			

		1.2.2.LI.1: Explain the meaning and importance of farm mechanisation and power in Agricultural production.					
		1.2.2.LI.2 Describe the safety measures employed in operating farm machines and power in Agricultural production		1			
		1.2.2.LI.3: Apply the knowledge and skills of safety measures in handling accidents and injuries of an Agricultural worker using appropriate first aid.					
		1.2.2.LI.1: Describe the types and uses of farm machines and power in Agriculture production.		1			
		1.2.2.LI.2: Describe the factors that affect the use of farm machines and power.					
		1.2.2.LI.1: Identify the principal parts of farm machines and implements, and state their functions.					

		1.2.2.LI.2: Operate and maintain farm machines and implements in Agricultural production.		1			
		2.2.2.LI.1: Explain the meaning and benefits of Agricultural irrigation and drainage systems.					
		2.2.2.LI.2: Describe the methods and uses of irrigation and drainage systems in Agricultural production.					
		2.2.2.LI.3: Describe the parts and functions of the irrigation and drainage system in Agriculture production and demonstrate the skills of operating them.	1				
		2.2.2.LI.1: Classify harvest and post-harvest implements and machinery.					
		2.2.2.LI.2: Describe the uses of harvest and post-harvest tools, implements and machinery in Agricultural production.			1		

		2.2.2.LI.3: Demonstrate the skills in the operation of simple harvest and post-harvest implements and machinery use in Agricultural production.					
		Total for stand 2	3	6	3	0	12
3. Food Production and Natural Resource Conservation	1. Principles of Agriculture in Food Production	1.3.1.LI.1: Explain the meaning and importance of crops.					
		1.3.1.LI.2: Describe the classification of crops with examples.	1				
		1.3.1.LI.1: Explain the meaning of the principles of crop production.		1			
		1.3.1.LI.2: Discuss the stages of crop production and its related practices.			1		
		1.3.1.LI.3: Apply the principles in the crop production practices.					
		1.3.1.LI.1: Explain the meaning and importance of farm animals.					
		1.3.1.LI.2: Describe the classification of farm animals with examples.			1		
		1.3.1.LI.3: Analyse the distribution of farm animals in Ghana and West Africa.					

		1.3.1.LI.1: Explain the meaning and objectives of the general management practices in animal production.		1			
		1.3.1.LI.2: Discuss the management practices involved in animal production.					
		1.3.1.LI.3: Apply the skills in farm animal management practices for rearing animals.	1				
		2.3.1.LI.1: Explain the economic importance of selected crops.					
		2.3.1.LI.2: Apply the technologies and techniques to cultivate selected crops (vegetables).					
		2.3.1.LI.1: Explain the economic importance of the selected animal. Including fish.			1		
		2.3.1.LI.2: Demonstrate the ability to perform the various management practices involved in the rearing of the selected animal, including fish (poultry).					

		3.3.1.LI.1: Describe the procedure of processing, storage and marketing of selected food crops.		1			
		3.3.1.LI.2 Apply food safety and quality practices in the processing, storage and marketing of selected food crops.			1		
		3.3.1.LI1: Describe the procedure for processing, marketing and storage of produce and products from selected animals.					
		3.3.1.LI.2: Describe the procedure for processing, marketing and storage of produce and products from selected fish.			1		
		3.3.1.LI.3: Apply food safety and quality measures in the processing, marketing and storage of selected animals and their carcasses.					
		3.3.1.LI.4: Apply food safety and quality measures in the processing, marketing and storage of selected fish and their carcasses.	1				

	2. Principles of Natural Resource Conservation in Agriculture	1.3.2.LI.1: Explain the meaning of importance and principles of forestry and forest management.					
		1.3.2.LI.2: Discuss the concept and the importance of the interrelationships between forestry and Agriculture.					
		1.3.2.LI.3: Discuss agroforestry practices and systems in forest management.	1				
		1.3.2.LI.1: Explain the meaning, importance and nature of soil.					
		1.3.2.LI.2: Describe the physical and chemical properties of soil and their importance.					
		1.3.2.LI.3: Discuss the composition of soil.		1			
		1.3.2.LI.1: Explain the meaning and effect of climate change on food production.					
		1.3.2.LI.2: Discuss the effect of climate change on food production and the mitigating strategies.					

		2.3.2.LI.1: Explain the meaning and importance of game and wildlife.		1			
		2.3.2.LI.2: Discuss the need for conserving game and wildlife.					
		2.3.2.LI.1: Explain the economic importance and management practices in mushroom production.					
		2.3.2.LI.2: Demonstrate the skills in the cultivation of mushrooms.					
		2.3.2.LI.1: Explain the meaning of soil nutrients, fertility and productivity.					
		2.3.2.LI.2: Discuss the soil nutrients and their importance in crop production.	1				
		2.3.2.LI.3: Describe the types of fertilisers and their effects on crop production.			1		
		3.3.2.LI.1: Explain the meaning, importance and principles of soil and water conservation					
		3.3.2.LI.2: Describe the types of soil water and their importance in Agricultural production.					

		3.3.2.LI.3: Describe the types of soil erosion and their effects on Agricultural production.					
		Total for strand 3	5	5	6	0	16
4. Agriculture, Health and Environment	1. Health Issues in Crop Production	1.4.1.LI.1: Explain the meaning and importance of farm hygiene and sanitation and its effect on crop production.	1				
		1.4.1.LI.2: Describe the farm hygiene and sanitation activities in crop production.					
		1.4.1.LI.3: Apply farm hygiene and sanitation principles in the crop production processes.		1			
		2.4.1.LI.1: Identify common crop pests and diseases and their effects in crop production.					
		2.4.1.LI.2: Classify crops and diseases.					
		2.4.1.LI.3: Discuss the preventive and control measures of pests and diseases in crop production.			1		

		3.4.1.LI.1: Explain the meaning and classification of weeds and their economic importance in Agricultural production.					
		3.4.1.LI.2: Describe the methods of weed dispersal.		1			
		3.4.1.LI.3: Discuss the methods of weed control in Agricultural production.					
	2. Health Issues in Animal Production	1.4.2.LI.1: Explain the meaning and importance of farm hygiene and sanitation and its effect on animal production.	1				
		1.4.2.LI.2: Discuss farm hygiene and sanitation activities in animal production.		1			
		1.4.2.LI.3: Apply farm hygiene and sanitation principles in the animal production process.					
		2.4.2.LI.1: Identify common diseases, pests and parasites of animals/fish and their effects in animal, including fish production.	1				

		2.4.2.LI.2: Describe the classification, causes and symptoms of animal, including fish diseases in animal production.			1		
		2.4.2.LI.3: Discuss the preventive and control measures of diseases animals, including fish in animal production.					
		Total for strand 4	3	3	2	0	7
5. Agricultural Economics, Agribusiness and Communication	1. Economics for Agriculture	1.5.1.LI.1: Explain the meaning and importance of the basic principles of Agricultural economics.	1				
		1.5.1.LI.2: Discuss the farm as an economic unit.					
		1.5.1.LI.3: Apply the principles of Agricultural economics in the management of an Agricultural enterprise.					
		2.5.1.LI.1: Explain the meaning and principles of demand and supply.					
		2.5.1.LI.2: Discuss the factors that influence demand and supply of Agricultural commodity.		1			

		2.5.1.LI.3: Create demand and supply schedules and prepare graphs to show the determinants of price for an Agricultural commodities.					
		3.5.1.LI.1: Discuss the meaning and importance of the factors of production, functional production and marginal diminishing returns.			1		
		3.5.1.LI.2: Apply the concepts of functional production and diminishing marginal returns in Agricultural production.		1			
		3.5.1.LI.3: Draw production curves showing the relationship between fixed inputs and variable inputs for given resources in Agricultural production.					
	2. Communication in Agriculture	1.5.2.LI.1: Explain the meaning and importance of Agricultural communication.					

		1.5.2.LI.2: Outline the strategies for effective communication and the various branches of communication in Agriculture.	1				
		2.5.2.LI.1: Discuss the interactions between the sectors of Agricultural production and enterprises, and the extent of human interaction.			1		
		2.5.2.LI.2: Discuss the various modes of communication in Agriculture.		1			
	3. Agribusiness Management	3.5.2.LI.1: Establish a crop production or processing enterprise for sustenance and livelihood.				1	
		3.5.2.LI.2: Establish an animal/fish production or processing enterprise for sustenance and livelihood.					
		1.5.3.LI.1: Explain the meaning and importance of agribusiness management.	1				

		1.5.3.LI.2: Catalogue the activities carried out in agribusiness management and outline their function.					
		1.5.3.LI.3: Describe the procedure for writing an agribusiness plan.					
		2.5.3.LI.1: Discuss the procedure for the establishment of Agricultural enterprise.					
		2.5.3.LI.2: Discuss the sources of finance for Agricultural enterprises.		1			
		2.5.3.LI.3: Explain the types of records keeping in Agricultural enterprises.					
		2.5.3.LI.4: Discuss the managerial characteristics required for the management of agribusiness					
		Total for strand 5	3	4	2	1	10
OVERALL TOTAL			15	20	14	1	50

TEST SPECIFICATION TABLE FOR PAPER 2 (ESSAY-TYPE PAPER)

AGRICULTURE

SUMMARY

STRAND	SUB-STRAND	NO. OF QUESTIONS	TOTAL
Concept of Agriculture in Industrialising Society	Agriculture and Society	1	2
	Agriculture and Industry	1	

Modern Technical and Mechanised Agriculture	Modern Technical Agriculture	1	2
	Modern Mechanised Agriculture	1	
Food Production and Natural Resource Conservation	Principles of Agriculture in Food Production	1	2
	Principles of Natural Resource Conservation in Agriculture	1	
Agriculture, Health and Environment	Health Issues in Crop Production	1	2
	Health Issues in Animal production	1	
Agricultural Economics, Agribusiness and Communication	Economics for Agriculture	1	2
	Communication in Agriculture		
	Agribusiness Management	1	
TOTAL		10	10

TEST SPECIFICATION TABLE FOR PAPER 3 (PRACTICAL WORK)

AGRICULTURE

SUMMARY

STRAND	SUB-STRAND	NO. OF QUESTIONS
Concept of Agriculture in Industrialising Society	*Agriculture and Society	1
	Agriculture and Industry	
Modern Technical and Mechanised Agriculture	Modern Technical Agriculture	
	Modern Mechanised Agriculture	
Food Production and Natural Resource Conservation	Principles of Agriculture in Food Production	1
	Principles of Natural Resource Conservation in Agriculture	

Agriculture, Health and Environment	Health Issues in Crop Production	2
	Health Issues in Animal production	
Agricultural Economics, Agribusiness and Communication	Economics for Agriculture	
	Communication in Agriculture	
	Agribusiness Management	
TOTAL		4

*Not practically examinable

PLC Session 18

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. Identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q).
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP)
 - a. The key assessment for the week is practice paper 2. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the practice paper (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through the problem individually for 3–4 minutes
 - c. The group then works through it together the problem, step by step
 - d. Highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar ghanaiian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to ghanaiian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 19

Learning Indicator: Establish a crop production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 19 1. Explain the meaning of farm hygiene and sanitation and their effects on crop production. 2. Describe the farm hygiene and sanitation activities in crop production. 3. Apply farm hygiene and sanitation principles in the crop production processes.
Year 2	Week 19 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: Establishment of Crop Production and Processing as an Enterprise

Establishment of Crop Production and Processing as an Enterprise

Refer to Week 17, Focal Area 2.

Learning Tasks

1. Recap on how farm hygiene and sanitation can promote the establishment of crop production and processing as an enterprise as well as how animal diseases and pests can affect crop production thereby influencing the availability of crops for processing and sale.
2. Demonstrate the establishment of selected crop production and processing as an enterprise.

Pedagogical Exemplars

1. **Project-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners undertake the cultivation, processing storage and marketing of the selected vegetable and arable crops.
2. **Experiential learning:** Learners build portfolio and prepare report on their field activities.

Key Assessments Level 3: Practical

Question 1. You have been given a 5-hectare farm to establish a cassava production and processing enterprise. Describe the key steps you would take to establish this enterprise,

including site selection, crop production, processing methods, and marketing. Also, identify challenges you might face and suggest ways to overcome them. (25 marks)

Sample Practical Question

Question: You are assigned to plan and establish a carrot production and processing enterprise on a 4-hectare farm. Outline the key steps you would take in the establishment, including site selection, crop production, processing, marketing, and management of challenges. Also, suggest strategies to ensure the enterprise is profitable and sustainable. (30 marks)

PLC Session 19

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is practical. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the practical (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)

- b. All teachers in the group work through a similar problem individually for 3–4 minutes
- c. The group then works through the problem together step by step
- d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 20

Learning Indicator: Establish a crop production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 20 Explain the meaning of farm hygiene and sanitation and their effects on animal production. Discuss the farm hygiene and sanitation activities in animal production.
Year 2	Week 20: Discuss the preventive and control measures of diseases animals/fishes in animal production.

Focal Area: Establishment of Crop Production and Processing Enterprises for Sustainable Livelihood

Establishment of Crop Production and Processing as an Enterprise

Refer to Week 17, Focal Area 2.

Learning Tasks

1. Recap on how farm hygiene and sanitation and the prevention of diseases in animal/fish can support crop production and processing enterprises.
2. Demonstrate the establishment of selected crop production and processing as an enterprise.

Pedagogical Exemplars

1. **Project-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners undertake the cultivation, processing storage and marketing of the selected vegetable and arable crops.
2. **Experiential learning:** Learners build portfolio and prepare report on their field activities. Learners then present their report on all field activities at a plenary session in class.

Key Assessment Level 3: Practical

Question: You have been assigned to establish an onion production and processing enterprise on a 3-hectare farm. Outline the key steps you would take, including site selection, crop production, processing methods, marketing strategies, and challenges management. Also, provide recommendations for ensuring the enterprise's profitability and sustainability. (30 marks)

PLC Session 20**45 minutes****Planning & Reviewing the Learning Plan**

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is practical. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the practical (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 21

Learning Indicator: Establish an animal/fish production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 21 1. Explain the meaning and importance of the basic principles of Agricultural economics. 2. Discuss the farm as an economic unit. 3. Apply the principles of Agricultural economics in the management of an Agricultural enterprise.
Year 2	Week 21 1. Explain the meaning and principles of demand and supply. 2. Discuss the factors that influence demand and supply of Agricultural commodity. 3. Create demand and supply schedules and prepare graphs to show the determinants of prices for an Agricultural commodity.

Focal Area: Meaning and Establishment of Animal/Fish Production and Processing Enterprises for Sustainable and Livelihood

1. Meaning of Enterprises in Animal/Fish Production

In the context of animal and fish production, the term “enterprises” refers to the distinct types of business or farming activities focused on raising animals or fish for commercial or subsistence purposes.

Enterprises are the specific production units or activities within agriculture that involve breeding, rearing, and managing animals or fish to produce products like meat, milk, eggs, leather, wool, or fish.

Examples of Animal Production Enterprises

- a. Cattle Enterprise – for beef or dairy production.
- b. Poultry Enterprise – for eggs, broilers (meat), or breeding.
- c. Goat or Sheep Enterprise – for meat, milk, or wool.
- d. Pig (Swine) Enterprise – for pork production.
- e. Rabbit Enterprise – for meat or fur.

Examples of Fish Production Enterprises (Aquaculture)

- a. Catfish Farming Enterprise
- b. Tilapia Farming Enterprise
- c. Shrimp or Prawn Farming Enterprise

- d. Ornamental Fish Enterprise
- e. Integrated Fish Farming – combining fish with crop or animal production (e.g., fish + poultry).

2. Establishment of Animal Production and Processing as an Enterprise

Establishing an animal production and processing enterprise involves setting up a business that focuses on the rearing of animals for products like meat, milk, eggs, or wool, and may include processing these products into forms that are ready for market or consumption. The steps involved in establishing an animal production and processing enterprise are:

a. Feasibility Study and Planning

- i. Assess market demand for animal products.
- ii. Identify available resources (land, capital, labour).
- iii. Choose the type of animal enterprise (e.g., poultry, dairy, piggery).
- iv. Plan for processing options (e.g., slaughtering, packaging, freezing).

b. Site Selection and Preparation

- i. Choose a location with good access to water, roads, and market.
- ii. Ensure proper drainage, ventilation, and biosecurity.
- iii. Build necessary structures (animal houses, feed stores, processing unit).

c. Acquisition of Stock and Inputs

- i. Select high-quality breeds suitable for the environment and purpose.
- ii. Procure feeds, medicines, tools, and equipment.
- iii. Plan for veterinary services and nutrition.

d. Rearing and Management

- i. Provide feeding, housing, health care, and breeding.
- ii. Practice proper record-keeping (growth rate, feeding, sales).
- iii. Implement waste management and disease control measures.

e. Processing of Animal Products

- i. Use approved methods to process meat, milk, or eggs.
- ii. Meat – slaughtering, cleaning, cutting, freezing, packaging.
- iii. Milk – pasteurisation, packaging.
- iv. Eggs – grading, cleaning, packaging.
- v. Follow hygiene and food safety standards.

f. Marketing and Sales

- i. Develop marketing strategies for local and regional markets.
- ii. Package products attractively.
- iii. Use branding and advertising to build customer trust.

Table 21.1 shows some requirements for establishing an animal production enterprise.

Table 21.1: *Requirements for establishing an animal production enterprise*

Requirement	Details
Capital	To build infrastructure and buy animals and equipment
Land	Suitable area for housing and grazing
Labour	Skilled workers for animal care and processing
Knowledge	Training in animal husbandry and product processing
Licenses/Permits	Health and safety certifications from regulatory bodies

Learning Tasks

1. Recap on how agricultural economics as well as demand and supply enhance the establishment of animal/fish production and processing enterprises
2. Explain the meaning of enterprises in animal/fish production.
3. Demonstrate the establishment of selected animal/fish and processing as an enterprise.

Pedagogical Exemplars

1. **Think-pair-share:** Learners in pairs discuss to come up with the meaning of enterprises in animal/fish production.
2. **Inquiry-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners watch a documentary on the rearing, processing, storage and marketing of selected animals/fish (Ruminants e.g., cattle, sheep and goats; Non-ruminant e.g., pigs; Poultry e.g., domestic fowl, guinea fowl and ducks; Non-traditional e.g. rabbit, grasscutter and snails; Fish e.g. tilapia, mud fish and cut fish). Learners write a report on their findings.

Examples of such documentaries are available at: <https://www.youtube.com/watch?v=WF-bx29s4gDk>; https://www.youtube.com/watch?v=8-0qlqp_2Z0, <https://www.youtube.com/watch?v=5xObcs2B97A>; https://www.youtube.com/results?search_query=documentary+on+the+rearing%2C+processing%2C+storage+and+marketing+of+fish, as at 10/06/2025.

3. **Project-based learning (Homework):** Learners in mixed-gender, mixed-ability or groups (where appropriate) conduct survey in their community on the enterprises in animal/fish production and present a report on their findings.

Key Assessment Level 3: Mini-Project

Question 1. You are tasked with establishing a poultry production and processing enterprise on a 2-hectare farm. Outline the key steps you would take in setting up the enterprise, including site selection, bird selection, housing, feeding, health management, processing methods, marketing strategies, and challenges management. Also, propose strategies to ensure the enterprise is profitable and sustainable. **(30 marks)**

PLC Session 21**45 minutes****Planning & Reviewing the Learning Plan**

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is mini-project. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the project (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 22

Learning Indicator: Establish an animal/fish production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 22 1. Explain the meaning and importance of Agricultural communication. 2. Outline the strategies for effective communication and the various branches of communication in Agriculture.
Year 2	Week 22 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: Establishment of Animal Production and Processing Enterprises for Sustainable and Livelihood

Establishment of Animal Production and Processing as an Enterprise

Refer to Week 21, Focal Area 2.

Learning Tasks

1. Recap on how machines and implements are used for safe harvesting of crops that can serve as sources of feed for fish thereby making fish available for processing, storage and marketing.
2. Demonstrate the establishment of selected animal and processing as an enterprise.

Pedagogical Exemplars

1. **Project-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners undertake the rearing, processing storage and marketing of the selected farm animals.
2. **Experiential learning:** Learners build portfolio and prepare report on their field activities.

Key Assessment Level 3: Practical

Question 1: You are tasked with establishing a rabbit production and processing enterprise on a 1-hectare farm. Outline the steps you would take, including site selection, breed selection, housing, feeding, health management, processing, marketing, and management of challenges. Also, suggest strategies to ensure the enterprise is profitable and sustainable. (30 marks)

Question 2: You have been tasked to establish a snail production and processing enterprise on a 1-hectare farm. Describe the key steps involved in setting up this enterprise, including site selection, snail species selection, housing and breeding, feeding, processing methods, marketing,

and management of challenges. Also, provide recommendations for ensuring the enterprise is profitable and sustainable. (30 marks)

PLC Session 22

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is practical. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the practical (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 23

Learning Indicator: Establish an animal/fish production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 23 1. Explain the meaning and importance of agribusiness management. 2. Catalogue the activities carried out in agribusiness management and outline their functions.
Year 2	Week 23 1. Discuss the procedure for the establishment of Agricultural enterprises. 2. Discuss the sources of finance for Agricultural enterprises.

Focal Area: Establishment of Animal Production and Processing Enterprises for Sustainable and Livelihood

Establishment of Animal Production and Processing as an Enterprise

Refer to Week 21, Focal Area 2.

Learning Tasks

1. Recap on how machines and implements are used for safe harvesting of crops that can serve as sources of feed for fish thereby making fish available for processing, storage and marketing.
2. Demonstrate the establishment of selected animal processing as an enterprise.

Pedagogical Exemplars

1. **Project-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners undertake the rearing, processing storage and marketing of the selected farm animals.
2. **Experiential learning:** Learners build portfolio and prepare report on their field activities.

Key Assessment Level 3: Mini-Project

Question: You have been given a 2-hectare farm to establish a pig production and processing enterprise. Outline the steps you would take to set up and manage the enterprise, covering site selection, breed choice, housing, feeding, health care, processing, marketing, and challenges management. Also, suggest strategies to ensure the enterprise remains profitable and sustainable. **(35 marks)**

PLC Session 23**45 minutes****Planning & Reviewing the Learning Plan**

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is mini-project. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the project (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 24

Learning Indicator: Establish an animal/fish production or processing enterprise for sustenance and livelihood

Recap

Year 1	Week 24: Describe the procedure for writing an agribusiness plan
Year 2	Week 24 1. Explain the types of records keeping in Agricultural enterprises. 2. Discuss the managerial characteristics required for the management of agribusiness.

Focal Area: Establishment of Fish Production and Processing Enterprises for Sustainable Livelihood

Establishment of Animal Production and Processing as an Enterprise

Refer to Week 21, Focal Area 2.

Learning Tasks

1. Recap on how machines and implements are used for safe harvesting of crops that can serve as sources of feed for fish thereby making fish available for processing, storage and marketing.
2. Demonstrate the establishment of selected fish and processing as an enterprise.

Pedagogical Exemplars

1. **Project-based learning:** In mixed-gender, mixed-ability or groups (where appropriate) learners undertake the rearing, processing storage and marketing of the selected fishes (tilapia, catfish and mud fish).
2. **Experiential learning:** Learners build portfolio and prepare report on their field activities. Learners then present their report on all field activities at a plenary session in class.

Key Assessment Level 3: Project

Question: You are given a 2-hectare fishpond to establish a tilapia production and processing enterprise. Describe the steps you would take in setting up and managing this enterprise, covering site selection, pond preparation, fingerling sourcing, feeding, health management, harvesting, processing, marketing, and challenges management. Also, suggest strategies for ensuring profitability and sustainability. (35 marks)

PLC Session 24**45 minutes****Planning & Reviewing the Learning Plan**

1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. Explain the week's concepts in a practical way that will make it easier for learners to understand
 - b. Identify two or three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. Suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. Suggest learning activities, differentiation and essential questions based on the method of teaching (nts 3a-3q)
 - c. Review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

**Note**

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week's key assessment with your app
 - a. The key assessment for the week is project. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the project (NTS 3k-3q).

10 minutes**Content Exploration**

5. As a subject group, select one problem or idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. Use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. All teachers in the group work through a similar problem individually for 3–4 minutes
 - c. The group then works through the problem together step by step
 - d. Highlight the most common errors made at each step and discuss (nts 1c, 1e, 2c, 2e, 3e-3j).

**Note**

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes**Enactment**

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. Was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. Were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. Did any misconceptions surface and if so, how were they addressed?

5 minutes**Reflection**

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. Transfer your chats into your learning planner template.
 - b. Read your teacher manual and related learner material in preparation for the next session. Take note of the recap weeks, which are linked to years 1 and 2 (nts 3a).
 - c. Integrate national values, gesi, sel, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

SECTION SEVEN REVIEW

Crop production and processing enterprises are agricultural ventures that involve both growing crops and converting them into finished or semi-finished products for consumption or sale. These enterprises contribute to sustainable livelihoods by increasing incomes, reducing waste, and adding value to agricultural outputs. The types of crop enterprises are: Cereal Crop Enterprise – e.g., maize, rice, sorghum; Vegetable Enterprise – e.g., tomatoes,

okra, pepper; Root and Tuber Enterprise – e.g., yam, cassava, potato; Legume Enterprise – e.g., cowpea, groundnut, soybean; Fruit Crop Enterprise – e.g., mango, orange, pineapple; Industrial Crop Enterprise – e.g., cotton, sugarcane, tobacco. Establishment of crop production and processing as an enterprise involves enterprise planning, land preparation and crop establishment crop maintenance, harvesting, processing of produce, packaging and marketing, record-keeping and evaluation.

Animal and fish production and processing enterprises refer to the organised activities of raising livestock and fish and transforming their products into usable or sellable forms. These enterprises are vital for enhancing incomes, generating employment, and ensuring the efficient use of agricultural resources. Examples of animal production enterprises are: Cattle Enterprise – for beef or dairy production; Poultry Enterprise – for eggs, broilers (meat), or breeding; Goat or Sheep Enterprise – for meat, milk, or wool; Pig (Swine) Enterprise – for pork production; Rabbit Enterprise – for meat or fur. Examples of fish production enterprises (aquaculture) are: Catfish Farming Enterprise; Tilapia Farming Enterprise; Shrimp or Prawn Farming Enterprise; Ornamental Fish Enterprise; Integrated Fish Farming – combining fish with crop or animal production (e.g., fish + poultry). Establishment of animal and fish production and processing as an enterprise involves feasibility study and planning, site selection and preparation, acquisition of stock and inputs, rearing and management, processing of animal products, and marketing and sales.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 17 (30 marks)

1. Land Preparation

- b. Select land with fertile, well-drained soil and access to irrigation or reliable rainfall.
- c. Clear the land of weeds, debris, and previous crop residues.
- d. Plough and harrow to break up soil clumps and prepare a fine seedbed.
- e. Conduct soil testing to determine nutrient needs; apply organic manure or basal fertilisers.

1 mark for each correct explanation, $4 \times 1 = 4$ marks

2. Maize Crop Production

- a. Select high-yielding, drought-resistant maize varieties suited to local climate.
- b. Use proper planting techniques: planting seeds at recommended spacing (e.g., 75 cm between rows, 25 cm between plants).
- c. Plant during the optimal season to match rainfall patterns or irrigation schedules.
- d. Apply fertilisers as per soil test recommendations; split applications if necessary.
- e. Implement pest and disease control strategies, including scouting and using approved pesticides.
- f. Practice timely weeding and ensure adequate water supply through irrigation or rainfall.
- g. Monitor crop growth for any nutritional deficiencies or pest attacks.

1 mark for each correct explanation, $7 \times 1 = 7$ marks

3. Processing Methods

- a. Harvest maize when kernels reach physiological maturity (moisture content around 20-25%).
- b. Dry maize properly to reduce moisture content to safe storage levels (below 13%).
- c. Use mechanical shellers or hand shell maize from cobs.
- d. Set up milling equipment to produce maize flour, meal, or animal feed.
- e. Ensure hygiene during processing to maintain product quality.
- f. Package processed products in suitable materials with labels showing production and expiry dates.

1 mark for each correct explanation, any $4 \times 1 = 4$ marks

4. Marketing Strategies

- a. Identify markets such as local retailers, supermarkets, bakeries, and animal feed producers.
- b. Develop branding for maize flour and meal products to build customer loyalty.
- c. Utilise direct sales, local markets, and digital platforms for promotion.
- d. Establish supply contracts with bulk buyers for consistent demand.
- e. Diversify products by producing both maize flour for human consumption and animal feed.

1 mark for each correct explanation, any $4 \times 1 = 4$ marks

5. Management of Challenges

- a. Pests and diseases: employ integrated pest management and crop rotation to minimise outbreaks.
- b. Water supply: Invest in irrigation infrastructure and water conservation methods. Post-harvest losses: use proper drying and storage facilities to reduce losses due to pests or mould.
- c. Capital requirements: plan finances carefully; seek loans, grants, or partnerships for initial investments.
- d. Market Fluctuations: diversify products and markets to reduce dependency on a single buyer.

1 mark for the main point and 1 mark for correct explanation of the point, any $4 \times 2 = 8$ marks

6. Profitability and Sustainability Plan

- a. Calculate input costs and expected yields to set realistic profit targets.
- b. Optimise input use to avoid waste and reduce costs.
- c. Use sustainable practices such as crop rotation, organic fertilisers, and efficient water use to maintain soil health and environmental quality.

- d. Regularly monitor financial performance and adjust practices to improve efficiency.

1 mark for each correct explanation, any 3 x 1 = 3 marks. Accept other correct responses not provided in the marking scheme

WEEK 18 (30 marks)

1. Site Preparation

- a. Select land with well-drained, fertile soil and good access to water for irrigation.
- b. Clear the land of weeds and debris.
- c. Plough and harrow the soil to create a fine tilth suitable for tomato seedlings.
- d. Conduct soil tests to determine nutrient needs and apply organic manure or fertilisers accordingly.

1 mark for each correct answer, 4 x 1 = 4 marks

2. Tomato Production Practices

- a. Choose high-yielding, disease-resistant tomato varieties suitable for the local climate.
- b. Start seedlings in a nursery for 4-6 weeks before transplanting.
- c. Transplant seedlings in well-spaced rows to allow air circulation and reduce disease risk.
- d. Use drip irrigation or sprinkler systems to maintain consistent soil moisture levels.
- e. Apply balanced fertilisers based on soil nutrient analysis.
- f. Implement integrated pest management (IPM) to control pests and diseases.
- g. Practice staking or trellising to support plants and reduce fruit damage.
- h. Monitor plants regularly for signs of stress, pests, or diseases.

1 mark for each correct answer, 8 x 1 = 8 marks

3. Processing Methods

- a. Harvest tomatoes at the appropriate maturity stage for processing (usually fully ripe but firm).
- b. Wash and sort tomatoes to remove damaged or diseased fruit.
- c. Use processing equipment to produce tomato products such as:
 - i. Tomato paste
 - ii. Tomato sauce
 - iii. Canned tomatoes
- d. Ensure hygienic conditions during processing to maintain quality and food safety.
- e. Package finished products with clear labelling including production and expiry dates.

1 mark for each correct answer, 5 x 1 = 5 marks

4. Marketing

- a. Identify target markets such as local supermarkets, food vendors, and processing companies.
- b. Develop branding and attractive packaging to differentiate products.
- c. Use social media and local fairs to promote the enterprise.
- d. Build relationships with buyers to secure regular orders.
- e. Consider both fresh tomato sales and processed products to diversify income streams.

1 mark for each correct answer, 5 x 1 = 5 marks

5. Common Challenges and Solutions

- a. Pest and disease pressure: use IPM strategies including crop rotation, resistant varieties, and biological controls.
- b. Water availability: install efficient irrigation systems and collect rainwater to supplement irrigation.
- c. Market competition: differentiate products through quality and branding; explore niche markets such as organic or specialty tomatoes.
- d. Post-harvest losses: Improve harvesting techniques, storage, and transportation logistics to maintain product quality.
- e. Capital investment: seek financial support through loans or grants for initial setup costs.

**1 mark for the main point, 1 mark for each correct answer, any 4 x 2 = 8 marks.
Accept other correct responses not provided in the marking scheme**

WEEK 19 (25 marks)**Question 1****1. Site Selection**

- a. Choose well-drained land with fertile, loamy soil and good water availability.
- b. The site should have good sunlight and be free from waterlogging to prevent root rot.
- c. Accessibility to markets and roads for transportation is important.

1 mark for each correct explanation, any 2 x 1 = 2 marks

2. Crop Production

- a. Select high-yielding and disease-resistant cassava varieties suitable for the area.
- b. Prepare the land by clearing, ploughing, and ridging to improve soil aeration and root development.
- c. Plant healthy stem cuttings, each about 20–30 cm long, at recommended spacing (e.g., 1 m x 1 m).
- d. Apply fertilisers based on soil test results, especially phosphorus and potassium.
- e. Control weeds by manual weeding or herbicides during early growth stages.

- f. Monitor for pests such as cassava mealybug and diseases like cassava mosaic virus and use integrated pest management.
- g. Maintain proper agronomic practices, including soil moisture conservation through mulching.

1 mark for each correct explanation, 7 x 1 = 7 marks

3. Processing Methods

- a. Harvest cassava roots between 8 to 12 months, depending on variety and market needs.
- b. Wash and peel roots before processing.
- c. Process cassava into products such as:
 - i. Cassava flour
 - ii. Gari (fermented, grated cassava)
 - iii. Tapioca
 - iv. Starch extraction
- d. Use appropriate equipment for grating, fermenting, drying, and milling.
- e. Ensure hygienic processing and proper packaging to maintain quality and shelf life.

1 mark for each correct explanation, 5 x 1 = 5 marks

4. Marketing

- a. Identify target markets such as local consumers, bakeries, and food processors.
- b. Develop attractive packaging and branding to differentiate products.
- c. Use local markets, shops, and digital platforms to promote products.
- d. Explore contracts with food manufacturers or export markets.

1 mark for each correct explanation, any 3 x 1 = 3 marks

5. Challenges and Solutions

- a. Pests and diseases: use resistant varieties, timely weeding, and biological controls.
- b. Post-harvest losses: use proper storage and timely processing to prevent root deterioration.
- c. Limited capital: seek loans, cooperatives, or government support for funding.
- d. Market access: build relationships with buyers and improve product quality and packaging.
- e. Processing equipment availability: start with small-scale manual equipment and gradually invest in mechanisation.

1 mark for the main point and 1 mark for correct explanation of the point, any 4 x 2 = 8 marks. Accept other correct responses not provided in the marking scheme

Question 2 (30 marks)**1. Site Selection**

- a. Choose land with light, sandy loam soil that is well-drained and rich in organic matter.
- b. Ensure the site has access to adequate irrigation water.
- c. The climate should be cool to moderate, as carrots grow best in such conditions.
- d. Accessibility to markets and transport infrastructure is important.

1 mark for each point correct explanation, any 3 x 1 = 3 marks

2. Crop Production

- a. Prepare the land by deep ploughing and harrowing to loosen soil, removing stones that can deform roots.
- b. Conduct soil tests and apply appropriate fertilizers, focusing on potassium and phosphorus.
- c. Use certified high-quality carrot seeds.
- d. Sow seeds in well-prepared seedbeds at recommended spacing and depth.
- e. Thin seedlings to prevent overcrowding and promote root development.
- f. Irrigate regularly to maintain consistent moisture, avoiding water stress.
- g. Control weeds through manual weeding or appropriate herbicides.
- h. Monitor and manage pests such as carrot flies and diseases like powdery mildew using integrated pest management.

1 mark for each correct explanation, 8 x 1 = 8 marks

3. Processing Methods

- a. Harvest carrots when they reach marketable size (usually 70–80 days after sowing).
- b. Wash and sort carrots to remove dirt and damaged roots.
- c. Process carrots into products such as:
- d. Fresh-cut carrots
- e. Carrot juice or puree
- f. Frozen carrots for longer shelf life
- g. Use hygienic processing methods and proper packaging.
- h. Store products under suitable conditions to maintain quality.

1 mark for each correct explanation, any 4 x 1 = 4 marks

4. Marketing Strategies

- a. Identify markets including local supermarkets, restaurants, and juice processors.
- b. Develop branding and attractive packaging to enhance product appeal.
- c. Use local markets and online platforms to promote products.
- d. Establish supply contracts to ensure steady demand.

1 mark for each correct explanation, 4 x 1 = 4 marks

5. Challenges and Management

- a. Pests and diseases: employ crop rotation, use resistant varieties, and IPM.
- b. Soil compaction: avoid heavy machinery that can compact soil; maintain soil health with organic matter.
- c. Water management: use drip irrigation and mulching to conserve moisture.
- d. Post-harvest losses: improve storage facilities and handling practices.
- e. Market competition: differentiate products through quality and value addition.

1 mark for each point and 1 mark for each correct explanation, any 4 x 2 = 8 marks

6. Profitability and Sustainability

- a. Prepare a detailed budget considering input costs and expected yields.
- b. Optimise input use to reduce costs without sacrificing quality.
- c. Use sustainable farming practices such as organic fertilisation and integrated pest management.
- d. Continuously monitor financial performance and adapt management practices.

1 mark for each correct explanation, any 3 x 1 = 3 marks. Accept other correct responses not provided in the marking scheme

WEEK 20 (30 marks)**1. Site Selection**

- a. Select land with well-drained, sandy loam soil rich in organic matter.
- b. Ensure access to adequate water supply for irrigation.
- c. The climate should be cool and dry during harvesting to prevent bulb rot.
- d. Choose a location close to markets and with good transport infrastructure.

1 mark for each correct explanation, any 3 x 1 = 3 marks

2. Crop Production

- a. Prepare the land by clearing, ploughing, and harrowing to create a fine seedbed.
- b. Conduct soil tests and apply fertilisers based on nutrient requirements, especially nitrogen, phosphorus, and potassium.
- c. Use certified onion seeds or seedlings of high-yielding and disease-resistant varieties.
- d. Sow seeds in seedbeds and transplant seedlings when they reach 6–8 weeks old.
- e. Use recommended spacing (e.g., 10–15 cm between plants, 30 cm between rows).
- f. Irrigate regularly to maintain consistent soil moisture, avoiding waterlogging.
- g. Practice weed control through manual weeding or herbicides.
- h. Monitor and manage pests such as onion thrips and diseases like downy mildew using integrated pest management (IPM).

1 mark for each correct explanation, 8 x 1 = 8 marks

3. Processing Methods

- a. Harvest onions when bulbs mature and tops have dried.
- b. Cure onions by drying them in a well-ventilated area to improve storage life.
- c. Sort and grade onions according to size and quality.
- d. Process onions into products such as:
 - i. Dried onion flakes or powder
 - ii. Pickled onions
 - iii. Onion paste or puree
- e. Use hygienic processing methods and appropriate packaging.
- f. Store processed products under suitable conditions to maintain quality.

1 mark for each correct explanation, any 5 x 1 = 5 marks

4. Marketing Strategies

- a. Identify target markets such as local supermarkets, food processors, and exporters.
- b. Develop branding and packaging to enhance product appeal.
- c. Use local markets, wholesale dealers, and digital marketing platforms.
- d. Establish long-term contracts with buyers to ensure steady demand.

1 mark for each correct explanation, any 3 x 1 = 3 marks

5. Challenges and Management

- a. Pests and diseases: use resistant varieties, crop rotation, and IPM techniques.
- b. Water management: install efficient irrigation systems such as drip irrigation.
- c. Post-Harvest Losses: Improve curing and storage facilities to reduce spoilage.
- d. Market price fluctuations: diversify products and buyers to reduce risk.
- e. Capital requirements: access financing options such as loans, grants, or cooperatives.

1 mark for each correct point and 1 mark for each correct explanation, any 4 x 2 = 8 marks

6. Profitability and Sustainability Recommendations

- a. Prepare a detailed budget to manage costs and forecast income.
- b. Optimise input use to minimise waste and improve efficiency.
- c. Implement sustainable farming practices, including organic fertilisation and soil conservation.
- d. Regularly monitor crop and financial performance to adjust practices as needed.
- e. Engage in value addition through processing to increase income streams.

1 mark for each correct explanation, any 3 x 1 = 3 marks

Accept other correct responses not provided in the marking scheme

WEEK 21 (30 marks)**1. Site Selection**

- a. Choose land that is well-drained, elevated, and away from residential areas to minimise odour and disease transmission.
- b. Ensure access to clean water and electricity.
- c. The site should have good road access for transporting inputs and products.

1 mark for each correct point, 3 x 1 = 3 marks

2. Bird Selection

- a. Select poultry breeds based on enterprise goals:
 - i. Broilers for meat production (fast growth) or
 - ii. Layers for egg production (high egg yield).
- b. Choose disease-resistant, high-yielding breeds from reputable sources.

1 mark for each correct point, 2 x 1 = 2 marks

3. Housing

- a. Construct well-ventilated poultry houses with proper lighting and temperature control.
- b. Ensure adequate space per bird (e.g., 0.1 to 0.2 m² for broilers, 0.2 to 0.3 m² for layers).
- c. Provide biosecurity measures to prevent disease entry.

1 mark for each correct point, 3 x 1 = 3 marks

4. Feeding

- a. Provide balanced diets formulated for the specific poultry type and age.
- b. Ensure continuous access to clean water.
- c. Use commercial feeds or prepare feed mixtures with locally available ingredients.

1 mark for each correct point, 3 x 1 = 3 marks

5. Health Management

- a. Implement a vaccination schedule to prevent common diseases (e.g., Newcastle disease, Marek's disease).
- b. Practice regular cleaning and disinfection of poultry houses.
- c. Monitor flock health daily for early detection of illness.
- d. Isolate and treat sick birds promptly.

1 mark for each correct point, any 3 x 1 = 3 marks

6. Processing Methods

- a. Process poultry products hygienically:
 - i. For meat, humane slaughter followed by cleaning, dressing, and packaging or
 - ii. For eggs, grading, cleaning, and packaging.

- b. Use cold storage facilities to preserve product quality.
- c. Comply with food safety standards during processing.

1 mark for each correct point, any 2 x 1 = 2 marks

7. Marketing Strategies

- a. Identify potential buyers including local markets, supermarkets, restaurants, and processors.
- b. Develop branding and packaging to increase product appeal.
- c. Use direct sales and digital marketing to reach a wider customer base.
- d. Establish contracts with bulk buyers for steady income.

1 mark for each correct point, any 3 x 1 = 3 marks

5. Challenges and Management

- a. Disease outbreaks: implement strict biosecurity and vaccination protocols.
- b. Feed costs: optimise feed formulation using local ingredients and reduce waste.
- c. Market fluctuations: diversify products (meat and eggs) and markets to reduce risk.
- d. Capital constraints: access loans, grants, or form cooperatives to raise funds.
- e. Waste management: implement proper disposal or recycling of poultry waste.

1 mark for the main point and 1 mark for each correct explanation of the point, any 4 x 2 = 8 marks

6. Profitability and Sustainability

- a. Prepare a detailed budget including startup and operational costs.
- b. Monitor feed conversion ratios and growth rates to optimise productivity.
- c. Adopt sustainable practices like waste recycling and energy-efficient housing.
- d. Keep accurate records for continuous performance evaluation and improvement.

1 mark for each correct point, any 3 x 1 = 3 marks

Accept other correct responses not provided in the marking scheme

WEEK 22

Question 1 (30 marks)

1. Site Selection

- a. Choose well-drained land with good ventilation to prevent dampness.
- b. Ensure easy access to clean water and feed supplies.
- c. Site should be away from predators and human disturbance.
- d. Proximity to markets and roads is important for distribution.

1 mark for each correct point, 4 x 1 = 4 marks

2. Breed Selection

- a. Select high-yielding, disease-resistant breeds suited to the local climate.
- b. Common breeds include New Zealand White, Californian, and Rex.
- c. Consider crossbreeding for improved performance.

1 mark for each correct point, any 2 x 1 = 2 marks

3. Housing

- a. Construct spacious, well-ventilated hutches or cages to provide comfort and reduce stress.
- b. Ensure proper drainage to avoid dampness and diseases.
- c. Provide shelter from extreme weather conditions.

1 mark for each correct point, any 2 x 1 = 2 marks

4. Feeding

- a. Provide balanced diets comprising fresh forage (grass, legumes), commercial pellets, and water.
- b. Include fibre-rich feeds for digestion.
- c. Ensure constant access to clean drinking water.

1 mark for each correct point, 3 x 1 = 3 marks

5. Health Management

- a. Maintain hygiene by regularly cleaning hutches.
- b. Vaccinate rabbits against common diseases such as myxomatosis and viral hemorrhagic disease.
- c. Monitor for parasites and provide appropriate treatments.
- d. Isolate sick rabbits to prevent disease spread.

1 mark for each correct point, any 3 x 1 = 3 marks

6. Processing

- a. Process rabbits humanely when they reach market weight (usually 3-4 months).
- b. Slaughter, dress, and package meat under hygienic conditions.
- c. Explore value addition such as rabbit fur products or organic fertiliser from waste.

1 mark for each correct point, any 2 x 1 = 2 marks

7. Marketing

- a. Identify buyers such as local markets, restaurants, supermarkets, and hotels.
- b. Develop branding and packaging to enhance product appeal.
- c. Use direct sales and digital marketing platforms.
- d. Establish reliable supply contracts to ensure steady income.

1 mark for each correct point, any 3 x 1 = 3 marks

8. Challenges and Management

- a. Predators and theft: use secure housing and fencing.
- b. Disease outbreaks: follow vaccination and biosecurity protocols.
- c. Feed availability: grow forage on-farm and supplement with commercial feeds.
- d. Market access: develop good customer relationships and diversify markets.
- e. Capital constraints: seek funding through loans, grants, or cooperatives.

1 mark for the main point and 1 mark for correct explanation of the point, any 4 x 2 = 8 marks

6. Profitability and Sustainability

- g. Prepare a detailed business plan including budgets and expected returns.
- h. Monitor growth rates and feed efficiency to optimise productivity.
- i. Adopt sustainable practices like waste recycling and forage production.
- j. Keep detailed records for continuous improvement.

1 mark for each correct point, any 3 x 1 = 3 marks

Accept other correct responses not provided in the marking scheme

Sample Practical Question (30 marks)**Question 2 (30 marks)****1. Site Selection**

- a. Choose land that is well-drained and shaded, as snails require moist but not waterlogged conditions.
- b. Ensure the site has a moderate climate with adequate rainfall or access to water for moisture maintenance.
- c. The location should be close to markets and have good access roads.

1 mark for each correct explanation, 3 x 1 = 3 marks

2. Snail Species Selection

- a. Select fast-growing, hardy snail species suitable for farming such as *Archachatina marginata* (Giant African land snail) or *Achatina achatina*.
- b. Choose species adapted to local environmental conditions.

1 mark for each correct explanation, 2 x 1 = 2 marks

3. Housing and Breeding

- a. Construct snail pens or enclosures with shaded areas to protect from direct sunlight.
- b. Use natural or artificial shelters like leaves, grasses, and mulch to maintain humidity.
- c. Ensure fencing to protect snails from predators such as rodents and birds.
- d. Provide breeding stock with adequate space for mating.

- e. Maintain optimal breeding conditions: temperature around 25-30°C and humidity of 75-90%.

1 mark for each correct explanation, 5 x 1 = 5 marks

4. Feeding

- a. Provide a balanced diet including leafy vegetables, fruits, calcium supplements (crushed eggshells or limestone), and commercial feeds if available.
- b. Ensure constant availability of clean water for moisture.

1 mark for each correct explanation, 2 x 1 = 2 marks

5. Processing Methods

- a. Harvest snails when they reach marketable size (usually after 6-12 months).
- b. Purge snails by fasting for 24-48 hours to clean their digestive systems.
- c. Clean and remove shells if producing snail meat products.
- d. Process into products such as dried snail meat, smoked snails, or packaged fresh snails.
- e. Package products hygienically to preserve quality.

1 mark for each correct explanation, any 4 x 1 = 4 marks

6. Marketing Strategies

- a. Identify local markets, supermarkets, restaurants, and specialty food stores as potential buyers.
- b. Develop attractive packaging and branding.
- c. Use direct sales, market stalls, and online platforms to promote products.
- d. Establish contracts with bulk buyers for steady demand.

1 mark for each correct explanation, any 3 x 1 = 3 marks

7. Challenges and Management

- a. Predators: Use secure fencing and pest control methods.
- b. Climate sensitivity: provide adequate shade and irrigation during dry periods.
- c. Slow growth: select fast-growing breeds and optimise feeding.
- d. Disease: maintain hygienic conditions and isolate sick snails.
- e. Market awareness: educate consumers on snail nutrition and benefits to increase demand.

1 mark for each point and another 1 mark for any 4 correct explanations of the point, any 4 x 2 = 8 marks

8. Profitability and Sustainability

- a. Prepare a detailed business plan including production costs and revenue forecasts.
- b. Optimise resource use by recycling farm waste such as snail feed.
- c. Use organic farming practices to appeal to health-conscious markets.

- d. Maintain records to monitor growth, mortality, and financial performance.

1 mark for each correct explanation, any 3 x 1 = 3 marks

Accept other correct responses not provided in the marking scheme

WEEK 23

Sample Marking Scheme (35 marks)

1. Site Selection

- a. Choose well-drained land away from flood-prone areas to prevent disease.
- b. Ensure access to clean water and electricity.
- c. The site should be accessible to markets and suppliers.
- d. Locate the piggery away from residential areas to minimise odour and nuisance.

1 mark for each correct explanation, 4 x 1 = 4 marks

2. Breed Choice

- a. Select breeds suited to local climate and market demand, such as Large White, Landrace, or crosses.
- b. Choose breeds known for good growth rate, reproductive performance, and disease resistance.

1 mark for each correct explanation, 2 x 1 = 2 marks

3. Housing

- a. Build well-ventilated pig pens with concrete floors for easy cleaning.
- b. Provide adequate space (e.g., 0.7 to 1.0 m² per piglet, 1.5 to 2.0 m² per adult pig).
- c. Design separate pens for different pig categories: piglets, growers, breeders.
- d. Implement biosecurity measures to prevent disease.

1 mark for each correct explanation, any 3 x 1 = 3 marks

4. Feeding

- a. Provide balanced diets appropriate for different growth stages (starter, grower, finisher).
- b. Use commercial feeds or formulate feed using local ingredients.
- c. Ensure continuous access to clean water.
- d. Supplement feeds with minerals and vitamins.

1 mark for each correct explanation, 4 x 1 = 4 marks

5. Health Care

- a. Establish vaccination and deworming schedules.
- b. Practice routine cleaning and disinfection of pens.
- c. Monitor pigs daily for signs of disease.

- d. Quarantine new or sick pigs to prevent disease spread.
- e. Engage a veterinarian for regular check-ups and advice.

1 mark for each correct explanation, any 4 x 1 = 4 marks

6. Processing

- a. Process pigs humanely at market weight (usually 5-6 months old).
- b. Slaughter, dress, and package pork under hygienic conditions.
- c. Consider value addition such as smoked pork or sausages.
- d. Store products in refrigerated facilities to maintain quality.

1 mark for each correct explanation, any 3 x 1 = 3 marks

7. Marketing

- a. Identify buyers such as local markets, supermarkets, restaurants, and butchers.
- b. Develop branding and attractive packaging.
- c. Use direct sales, contract farming, and digital marketing platforms.
- d. Establish reliable buyer contracts to ensure steady sales.

1 mark for each correct explanation, any 3 x 1 = 3 marks

8. Challenges and Management

- a. Disease outbreaks: strict biosecurity, vaccination, and good hygiene.
- b. Feed costs: optimise feed use, incorporate local feed resources.
- c. Waste management: proper disposal or use as organic fertiliser.
- d. Market fluctuations: diversify markets and product lines.
- e. Capital constraints: access funding through loans, grants, or cooperatives.

1 mark for each point and another 1 mark for any 4 correct explanations of the point, any 4 x 2 = 8 marks

9. Profitability and Sustainability

- a. Prepare detailed budgets and monitor input-output ratios.
- b. Improve productivity through good breeding and management.
- c. Adopt sustainable waste recycling practices.
- d. Keep accurate records for performance and financial management.
- e. Train staff regularly to improve enterprise management.

1 mark for each correct explanation, any 4 x 1 = 4 marks

Accept other correct responses not provided in the marking scheme

WEEK 24 (35 marks)**1. Site Selection**

- a. Choose a site with access to clean water supply, preferably near a reliable source such as a river, stream, or borehole.
- b. Ensure the land is flat with a good soil type (clay or loam) that can retain water.
- c. The site should have good road access for transportation of inputs and fish products.
- d. Avoid areas prone to flooding or pollution.

1 mark for each correct explanation, any 3 x 1 = 3 marks

2. Pond Preparation

- a. Clear vegetation and debris from the pond site.
- b. Construct earthen ponds with suitable dimensions and depth (about 1.2 metres).
- c. Install inlet and outlet structures for water management.
- d. Dry the pond for several weeks to eliminate predators and parasites.
- e. Lime the pond to balance pH and improve water quality.
- f. Fill the pond with water and allow it to stabilise before stocking.

1 mark for each correct explanation, any 5 x 1 = 5 marks

3. Fingerling Sourcing and Stocking

- a. Source healthy, disease-free tilapia fingerlings from reputable hatcheries.
- b. Stock fingerlings at recommended densities (e.g., 3-5 fish per square metre) depending on the production system.
- c. Acclimatise fingerlings before releasing them into ponds.

1 mark for each correct explanation, 3 x 1 = 3 marks

4. Feeding

- a. Provide balanced feed with adequate protein content (around 25-35%) for tilapia growth.
- b. Feed fish 2-3 times daily at 3-5% of their body weight.
- c. Use commercial pellets or formulate feeds from local ingredients.
- d. Monitor feeding behaviour to avoid overfeeding and wastage.

1 mark for each correct explanation, any 3 x 1 = 3 marks

5. Health Management

- a. Monitor water quality parameters regularly (dissolved oxygen, pH, temperature).
- b. Prevent disease by maintaining clean ponds and avoiding overcrowding.
- c. Quarantine new fingerlings before introduction.
- d. Treat diseases promptly with appropriate medications.
- e. Maintain good biosecurity practices.

1 mark for each correct explanation, any 4 x 1 = 4 marks

6. Harvesting

- a. Harvest fish when they reach marketable size (usually 6-9 months).
- b. Use nets or draining methods to collect fish.
- c. Handle fish carefully to minimise stress and damage.

1 mark for each correct explanation, any 2 x 1 = 2 marks

7. Processing

- a. Clean and gut fish promptly after harvesting.
- b. Process fish into fresh, smoked, dried, or frozen products.
- c. Package processed products hygienically to maintain quality.
- d. Store fish products in cold storage or drying facilities as appropriate.

1 mark for each correct explanation, any 3 x 1 = 3 marks

8. Marketing

- a. Identify markets such as local fish markets, supermarkets, restaurants, and processors.
- b. Develop branding and attractive packaging.
- c. Use direct sales and online platforms for promotion.
- d. Establish contracts with bulk buyers for consistent demand.

1 mark for each correct explanation, any 3 x 1 = 3 marks

9. Challenges and Management

- a. Water quality issues: regular monitoring and pond management.
- b. Predators and diseases: use netting and biosecurity protocols.
- c. Feed costs: use cost-effective feed formulations and avoid waste.
- d. Market fluctuations: diversify products and buyers.
- e. Capital: access financing through loans or cooperatives.

1 mark for each point and another 1 mark for any 3 correct explanations of the point, any 3 x 2 = 6 marks

10. Profitability and Sustainability

- a. Prepare a detailed budget including capital and operational costs.
- b. Optimise stocking density and feed efficiency.
- c. Adopt sustainable practices such as integrated fish farming.
- d. Keep records of production, health, and finances for ongoing evaluation.

1 mark for each correct explanation, any 3 x 1 = 3 marks

Accept other correct responses not provided in the marking scheme

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