Animal Production

Level-IV

Based on March 2022, Version-4 Occupational standard



Module Title: Undertaking Integrated Farm Production System

LG Code: AGR ANP4 M06 LO (1-4) LG (20-24)

TTLM Code: AGR ANP4 TTLM 0923v1

September, 2022

Addis Ababa, Ethiopia

Contents

Introduction to module 2
LO#1. Develop integrated farm production plan 3
Instruction sheet 3
Information sheet-1 4
Self-Check 1 19
LO #2. Implement pasture and crop management program 20
Instruction sheet 20
Information Sheet- 2 21
Self-Check- 2 49
Operation Sheet -1 51
LAP test-1 53
LO#3. Monitor crop/pasture growth and fodder production 54
Instruction sheet 54
Information sheet-3 55
Self-check-3 65
Operation sheet-3 67
LAP test-3 68
LO#4. Review production level 69
Instruction sheet 69
Information sheet- 4 70
Self-check-4 75
Operation sheet-4 76
LAP test-4 77
Reference 78

Introduction to module

This module covers the knowledge, skills and attitude required to develop a pasture and crop program, implement pasture and crop management program, monitor crop/pasture growth and fodder production, develop livestock integrated farming and review production level to support farm community and industry.

Developing integrated farm production systems is a forward-thinking approach to agriculture that aims to create sustainable and efficient farming systems. It involves the integration of various components of the farm, such as crops, livestock, waste management, and energy production, into a cohesive and interconnected system. This integrated approach focuses on optimizing resource utilization, minimizing environmental impact, and maximizing productivity and profitability. One of the key goals of developing integrated farm production systems is sustainability. By integrating different elements of the farm, it becomes possible to minimize inputs, reduce waste, and enhance resource efficiency.

Developing integrated farm production systems requires careful planning, knowledge of local conditions and the willingness to adapt and learn from experience. It often involves a gradual transition and continuous monitoring to optimize the system's performance. By embracing this approach, farmers can create productive, environmentally friendly, and economically viable farming systems that contribute to sustainable agriculture and food security

LG # 21	LO#1. Develop integrated farm production plan

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Identifying livestock-crop integration technologies
- Determining chicken -fish integrated farming
- Selecting plant varieties and livestock
- Identifying and maintaining budgetary constraints

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to –

- Identify livestock-crop integration technologies
- Determine chicken -fish integrated farming
- Select plant varieties and livestock
- Identify and maintain budgetary constraints

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet-1

1.1. Identifying Livestock-crop integration technologies

Integrated farming system is a mixed farming system that consists of at least two separate but logically interdependent parts of a crop and livestock enterprises. According to this concept, integration usually occurs when outputs (usually by products) of one enterprise are used as inputs by another within the context of the farming system. Integrated farming system as a mixed animal crop system where the animal component is often raised on agricultural waste products while the animal is used to cultivate the soil and provide manure to be used as fertilizer and fuel.

1.1.1. Importance of integrated farming

- Accommodation demand for food: Integrated farming allows for increased food production by combining multiple agricultural activities within a single system. This helps meet the growing demand for food and ensures food security.
- Utilization of limited resources: Integrated farming optimizes the use of limited resources such as land, water, and nutrients. By combining different agricultural activities, farmers can make efficient use of available resources, maximizing productivity and minimizing waste.
- Conservation of the environment: Integrated farming promotes sustainable land management practices, reduces the use of synthetic inputs, and enhances nutrient cycling. This contributes to the conservation of natural resources, biodiversity, and ecosystem health.
- Reduction of environmental risk: By diversifying agricultural activities, integrated farming reduces the risk of crop failures or economic losses associated with a single crop or sector. This resilience helps farmers mitigate environmental risks, such as extreme weather events or pest outbreaks.
- Diversification of family food resources: Integrated farming provides a diverse range of food sources for farmers and their families. By combining crop production with livestock

rearing or other activities, farmers can have access to a variety of food products, improving nutrition and food security.

- Increment of employment opportunities: Integrated farming systems often require a mix of skills and labor, creating employment opportunities for farmers and rural communities. It can generate on-farm and off-farm employment, contributing to local economic development.
- Productivity and sustainability: Integrated farming enhances overall productivity by utilizing synergies between different agricultural components. The integration of crops, livestock, and other activities promotes sustainable practices, resource efficiency, and long-term agricultural viability. (https://www.youtube.com/watch?v=tIqvxD7ao74)

1.1.2. Livestock-crop integration technologies

Livestock-crop integration technologies Refer to the practices and techniques that involve the integration of livestock and crop production systems. These technologies aim to maximize the synergies and benefits derived from combining livestock and crop farming. Here are some examples of livestock-crop integration technologies:

- Integrated crop-livestock
- Crop residue and soil management
- Dung and urine use and recycling of nutrients
- Cropping pattern, livestock and nutrient
- Agro-forestry and soil fertility

a) Integrated Crop-Livestock Systems:

Integrated crop and livestock systems are agricultural management systems where land is rotated over space and time between crop, pasture, and livestock uses. A key characteristic of these systems is that the outputs of one land use are used as inputs into another. For example, manure from livestock is used as a fertilizer source for cropland and crop residues are used as feed for livestock. Integrated crop and livestock systems are fundamentally different than

- Continuous cropping systems, where crops are grown repeatedly in low diversity, low rotation, or double cropped systems;

- Continuous pasture systems, where livestock are grazed predominantly on pasture that is not rotated or mixed with row or tree crops; or
- Continuous livestock systems, where livestock are kept in paddocks without access to pasture and fed grains.

b) Crop residue and soil management

Crop residue management plays a crucial role in maintaining soil health and productivity. Proper management of crop residues involves practices that maximize their benefits while minimizing potential negative impacts. Here are some key aspects of crop residue and soil management:

- Retaining Crop Residues: Leave crop residues on the soil surface after harvest rather than removing or burning them. Crop residues act as a protective layer, reducing soil erosion by wind and water, and preventing moisture loss. Retained residues also contribute to the organic matter content of the soil, improving soil structure and nutrient-holding capacity.
- Conservation Tillage: Adopt conservation tillage practices like no-till or reduced tillage systems. Minimize soil disturbance by reducing the number and depth of tillage operations. Conservation tillage helps preserve crop residues on the soil surface, maintaining soil cover and organic matter.
- Mulching: Use crop residues as mulch to cover the soil surface around growing plants. Mulching conserves soil moisture, suppresses weed growth, and moderates soil temperature. Organic mulch gradually decomposes, releasing nutrients into the soil.
- Crop Residue Decomposition: Allow crop residues to decompose naturally in the field. Microorganisms break down the residues, releasing nutrients and organic matter into the soil. Decomposition rates can be enhanced by maintaining optimal soil moisture, temperature, and nutrient conditions.
- Nutrient Management: Consider the nutrient content of crop residues when developing fertilizer and nutrient management plans. Crop residues contain varying amounts of nutrients, including nitrogen, phosphorus, potassium, and micronutrients. Adjust nutrient application rates based on the nutrient contributions from crop residues to avoid over- or under-fertilization.

- Cover Crops: Plant cover crops during fallow periods or between cash crop cycles. Cover crops help protect the soil, reduce erosion, and scavenge nutrients. When cover crops are terminated, their biomass contributes to soil organic matter and nutrient availability.
- Crop Rotation: Incorporate diverse crop rotations to manage crop residues effectively. Different crops leave residues with varying decomposition rates and nutrient contents. Rotating crops helps balance residue inputs, nutrient cycling, and soil organic matter accumulation.

c) Dung and urine use and recycling of nutrients

Dung and urine from livestock can be valuable sources of nutrients for agricultural systems. Proper management and recycling of dung and urine can help improve soil fertility, nutrient cycling, and reduce the reliance on synthetic fertilizers. Here are some key considerations for dung and urine use and nutrient recycling:

- Collection and Storage: Establish proper systems for collecting and storing dung and urine to prevent nutrient losses and ensure hygiene. Designate specific areas for dung deposition and urine collection to facilitate easy collection and minimize contamination.
- Composting: Composting is a common method for processing dung and other organic materials. Mix dung with other organic materials like crop residues or bedding materials to create a balanced carbon-to-nitrogen ratio. Regularly turn the compost pile to ensure proper aeration and decomposition. Composting helps break down organic matter, kill pathogens, reduce odor, and produce nutrient-rich compost for use as a soil amendment.
- Anaerobic Digestion: Anaerobic digestion is a process that converts organic materials, including dung and urine, into biogas and digestate. Biogas can be used as a renewable energy source, while digestate is a nutrient-rich byproduct suitable for fertilization. Anaerobic digestion helps in pathogen destruction, odor reduction, and nutrient stabilization.
- Nutrient Application: Apply dung and urine-based fertilizers to agricultural fields following appropriate nutrient management plans. Determine the nutrient content of the dung and urine

through laboratory analysis or established guidelines. Adjust application rates based on crop nutrient requirements, soil nutrient levels, and the nutrient content of the dung and urine.

- Nutrient Distribution: Ensure even and uniform distribution of dung and urine-based fertilizers across the field. Utilize appropriate equipment such as sprayers, injectors, or broadcast spreaders to achieve uniform coverage. Consider incorporating dung and urine-based fertilizers into the soil during tillage or apply directly to the crop root zone.
- Timing of Application: Time dung and urine application to coincide with crop nutrient demand. Apply the nutrients when crops can effectively utilize them to maximize nutrient uptake and minimize losses. Consider split applications or timed applications based on crop growth stages or specific nutrient requirements.
- Crop-Livestock Integration: Integrate livestock grazing with crop production to facilitate direct nutrient cycling. Allow livestock to graze on pastures or cover crops, where dung and urine are directly deposited, contributing to nutrient recycling and organic matter incorporation.
- Environmental Considerations: Avoid excessive application of dung and urine-based fertilizers that may lead to nutrient runoff or groundwater contamination. Consider the nutrient loading capacity of the soil and the specific nutrient requirements of the crops being grown. Implement best management practices such as buffer strips, contour plowing, or precision application to minimize environmental impacts.

d) Cropping pattern, livestock and nutrient

- Cropping Patterns: In integrated systems, farmers often adopt diverse cropping patterns that involve growing a combination of crops and forages. The choice of crops and their sequence depends on factors such as climate, soil type, market demand, and livestock feed requirements. Crop rotation is commonly practiced to manage pests, diseases, and weeds effectively. For example, leguminous forage crops like alfalfa or clover can be grown to improve soil fertility through nitrogen fixation.
- Livestock Integration: Livestock play a crucial role in integrated crop-livestock systems. They provide a market for crop residues, such as straw or stover, and contribute to nutrient cycling through manure deposition. Livestock can graze on crop residues or

forage crops, reducing the need for external feed sources. Additionally, livestock manure serves as a valuable source of organic matter and nutrients for crop production.

- Nutrient Management: Integrated systems focus on efficient nutrient management to optimize crop and livestock productivity while minimizing environmental impacts. Nutrients from livestock manure are recycled back into the system through proper manure management practices. Manure can be applied to cropland as a natural fertilizer, taking into account nutrient content, crop nutrient requirements, and soil nutrient status. This helps maintain soil fertility, reduce the need for synthetic fertilizers, and minimize nutrient runoff or leaching.

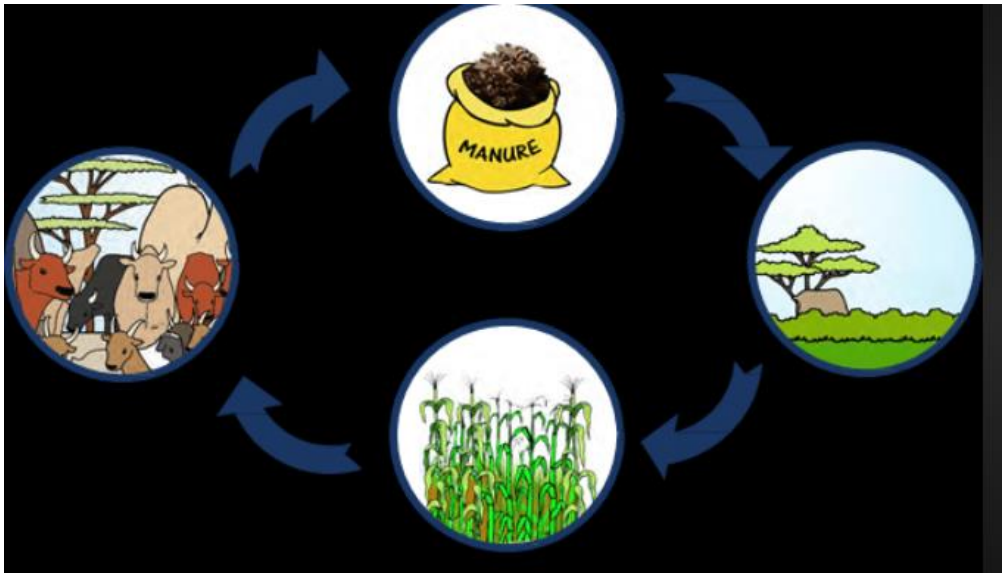


Figure 1: nutrient recycling in crop livestock system

e) Agro-forestry and soil fertility

Agro-forestry is a land-use management system that combines the cultivation of trees or shrubs with agricultural crops or livestock in a mutually beneficial manner. It is the practice of integrating trees or perennial plants with crops and livestock. It helps in soil conservation, provides shade and shelter to animals, and enhances biodiversity. Agro-forestry also offers additional income opportunities through the sale of timber, fruits, and medicinal plants.

Agro-forestry practices can have positive impacts on soil fertility through various mechanisms:

Nutrient Cycling: Trees in agro-forestry systems contribute to nutrient cycling by extracting nutrients from deep soil layers and redistributing them through leaf litter and root exudates. When the leaves fall and decompose, they release nutrients back into the soil, enriching its fertility.

- Organic Matter Accumulation: Agro-forestry systems often have higher levels of organic matter compared to conventional agricultural systems. The presence of trees contributes to the input of organic materials such as leaves, branches, and root exudates, which enhance soil organic matter content. Organic matter improves soil structure, water-holding capacity, nutrient retention, and microbial activity.
- Nitrogen Fixation: Some agro-forestry systems include nitrogen-fixing tree species, such as legumes. These trees have symbiotic relationships with nitrogen-fixing bacteria in their root nodules, enabling them to convert atmospheric nitrogen into a form that can be utilized by plants. This biological nitrogen fixation enriches the soil with available nitrogen, benefiting both the trees and associated crops or forage plants.
- Soil Erosion Control: Trees in agro forestry systems provide a protective canopy that reduces the impact of rainfall, minimizing soil erosion. They also help stabilize slopes and bind soil particles with their root systems, preventing soil erosion by wind or water.
- Microclimate Modification: The presence of trees in agro forestry systems creates a modified microclimate. Tree canopies provide shade, reducing temperature extremes and evaporation rates. This microclimate modification helps maintain soil moisture, which is beneficial for plant growth and nutrient availability.

- Biodiversity and Soil Health: Agro forestry systems promote biodiversity by providing diverse habitats for various organisms, including beneficial insects, earthworms, and microorganisms. Increased biodiversity enhances soil health by improving nutrient cycling, pest control, and disease suppression.
- Nutrient Partitioning: Agro forestry systems often exhibit spatial nutrient partitioning, where different plant species occupy different niches and utilize different nutrient resources. This reduces competition for nutrients among plants and increases overall nutrient use efficiency.

(https://www.youtube.com/watch?v=jLZ0KtNx354)



1.2. Determining chicken -fish integrated farming

Chicken-fish integrated farming, also known as poultry-aquaculture integration, is a form of livestock-crop integration in which chicken and fish production systems are combined within the same farm or production area. This integrated farming approach allows for the synergistic benefits of both poultry and aquaculture, optimizing resource utilization, and increasing overall productivity.

1.2.1 Pond-based system

In this system, fish ponds are integrated with chicken coops or poultry houses. The chicken manure and waste, along with any spilled feed, serve as a source of nutrients for the fish in the pond. The fish, in turn, help to maintain water quality by consuming excess organic matter and controlling algae growth. The chickens can also benefit from the insects and larvae that emerge from the pond, providing them with a natural source of protein.



Fig. 1: Pond-based system

1.2.2 Floating raft system

This system involves the use of floating rafts in fish ponds, where chicken coops or cages are placed on the rafts. The chicken waste falls directly into the water, providing nutrients for the fish. The fish feed on the organic matter and help to maintain water quality. This system can be particularly useful in areas with limited land availability, as it allows for the vertical utilization of space.

1.2.3 Sequential system

In this approach, the chicken and fish production systems are operated in a sequential manner. For example, chickens may be raised in poultry houses for a certain period, and then the chicken waste is used as fertilizer for the crops grown in the area. Once the chicken production cycle is complete, the ponds are stocked with fish, which utilize the nutrients from the previous poultry cycle. This sequential system maximizes the use of resources and provides a continuous production cycle.

Benefits of chicken-fish integrated farming include:

- **Efficient resource utilization**: Chicken waste is utilized as fish feed, reducing the need for synthetic feed and lowering production costs. The fish, in turn, help to maintain water quality and control pests in the chicken production area.
- **Diversification of income**: Integrated farming systems allow farmers to have multiple income streams from both poultry and fish production. This can help to stabilize farm income and reduce risks associated with market fluctuations.
- Environmental sustainability: By combining chicken and fish production, nutrient cycling is enhanced, minimizing nutrient runoff and reducing the environmental impact. Integrated farming reduces the need for chemical fertilizers and mitigates the potential negative effects of poultry waste on water bodies.

1.3. Selecting plant varieties

Selecting plant varieties is an essential aspect of crop production, as it directly affects the yield, quality, and adaptability of the crops to the growing conditions. When choosing plant varieties, several factors should be considered.

Climate suitability: Different plant varieties have specific temperature, moisture, and photoperiod requirements. It's important to select varieties that are well-suited to the local climate conditions, including average temperature, rainfall patterns, and length of growing season. Consider whether the variety is adapted to the specific agro-ecological zone in which you are farming.

Disease and pest resistance: Plant varieties differ in their resistance or tolerance to various diseases, pests, and insect infestations. Assess the prevalent diseases and pests in your area and select varieties that have a demonstrated resistance to those specific challenges. This can help reduce the need for chemical inputs and minimize crop losses.

Yield potential: The yield potential of a variety is an important consideration. Look for varieties that have a track record of high performance in terms of yield, while considering the specific conditions of your farm, such as soil fertility, irrigation availability, and management practices. It's also worth considering yield stability across different environmental conditions.

Quality attributes: Consider the quality characteristics of the crop, such as taste, texture, color, nutritional content, and post-harvest storage qualities. These attributes can vary between

varieties, and choosing varieties that meet consumer preferences and market demands can contribute to the success of your farming enterprise.

Growth habit and maturity: Plant varieties can have different growth habits, such as determinate or indeterminate for tomatoes or short-day or long-day types for onions. Consider the growth habit and maturity period of the varieties to ensure they align with your production system and market requirements. This includes factors such as plant height, branching, flowering time, and fruiting patterns.

Market demand: Understanding the market demand for specific crop varieties is crucial for commercial farmers. Consider market trends, consumer preferences, and the requirements of potential buyers or processors. This information can help guide your selection of varieties that are in high demand and have good market potential.

Farmer experience and knowledge: Consider your own experience and knowledge as a farmer. If you have successfully grown certain varieties in the past or have familiarity with specific varieties, it may be beneficial to continue using those varieties. However, it's also important to remain open to new varieties that offer improved characteristics or performance.

Seed availability and quality: Ensure that the selected varieties have reliable seed sources and are available in sufficient quantities. Check the reputation and reliability of seed suppliers to ensure you are obtaining high-quality seeds that are true to type and free from contaminants.

(https://www.youtube.com/watch?v=ndR1OXJJXKo)

1.4 . Identifying and maintaining budgetary constraints

Budgetary constraints can indeed be a significant factor when implementing integrated farming systems. Here are some budgetary considerations to keep in mind:

Initial Investment

Implementing an integrated farming system may require some initial investment for infrastructure development, such as constructing livestock shelters, establishing irrigation systems, or setting up fencing. The cost of acquiring livestock, purchasing seeds or seedlings, and acquiring necessary equipment should also be considered.

Operating Expenses

Integrated farming systems involve ongoing operating expenses, including feed for livestock, seeds, fertilizers, veterinary care, irrigation costs, and labor. It is important to estimate these expenses accurately and ensure that they fit within the available budget.

Resource Utilization

An integrated farming aim to optimize resource utilization, but it is essential to consider the costs associated with resource management. For example, the cost of sourcing organic inputs, managing and transporting manure or compost, or implementing water-saving techniques should be taken into account.

Market and Value Chain

Consider the market dynamics and value chain associated with the integrated farming system. Assess the potential income generation and profitability of the different components, such as crop sales, livestock products, or value-added products. Identify potential market channels and evaluate their associated costs, such as transportation or marketing expenses.

Risk Management

Budgetary constraints should also account for potential risks and uncertainties associated with integrated farming. These may include crop failure, disease outbreaks, extreme weather events, or market fluctuations. Allocating a portion of the budget for risk management strategies, such as insurance coverage or diversification of income sources, can help mitigate these risks.

Long-term Financial Planning

Integrated farming systems often require a long-term perspective, as they may take time to establish and optimize. It is essential to consider the long-term financial implications and develop a realistic financial plan that accounts for both the initial investment and ongoing operational expenses.

1.4.1. Maintaining budgetary constraints in integrated farming

Maintaining budgetary constraints in integrated farming requires a combination of effective financial management practices and strategic decision-making. Here are some steps you can take to maintain these constraints:

- Develop a Comprehensive Budget: Start by creating a detailed budget that includes all anticipated income and expenses for your integrated farming operation. Consider both upfront costs and ongoing operational expenses. Ensure that your budget is realistic and aligned with your production objectives.
- Monitor and Track Expenses: Regularly monitor and track your farm's expenses to stay within budgetary constraints. Keep records of all financial transactions and categorize them according to different expense categories. This will help you identify areas where costs can be reduced or optimized.
- Prioritize Essential Expenses: Identify the essential expenses that are critical for the efficient functioning of your integrated farm. Prioritize these expenses and allocate sufficient funds to cover them. Evaluate non-essential expenses and consider reducing or eliminating them if they are not crucial to the success of your operation.
- Optimize Resource Utilization: Seek ways to optimize the use of resources on your farm. This includes maximizing the use of organic fertilizers, minimizing waste, and implementing efficient water and energy management practices. By optimizing resource utilization, you can reduce the need for costly external inputs and improve cost-efficiency.
- Explore Cost-Saving Opportunities: Look for cost-saving opportunities within your integrated farming system. For example, consider bulk purchasing of inputs to take advantage of discounts, explore cooperative arrangements with other farmers to share resources and reduce costs, or implement integrated pest management practices to minimize the use of costly pesticides.
- Diversify Income Streams: Explore diversification opportunities to generate additional income streams for your farm. This can involve value-added processing of farm products, direct marketing to consumers, or exploring niche markets that offer higher prices. Diversifying income sources can help mitigate the impact of market price volatility and provide stability to your financial situation.
- Regular Financial Analysis: Conduct regular financial analysis to assess the performance of your integrated farm. Compare actual income and expenses against

your budgeted amounts. Analyze profitability by component or product to identify areas where costs can be reduced or revenues increased. Use this information to make informed decisions and adjust your production plans as needed.

- Risk Management: Implement risk management strategies to mitigate financial risks that could impact your integrated farming operation. This may involve obtaining appropriate insurance coverage, diversifying your product portfolio to reduce reliance on a single crop or livestock species, or staying informed about market trends and emerging risks that could affect your farm's financial stability.

1.4.2. Cost-benefit analysis

Cost-benefit analysis is a valuable tool for evaluating the financial feasibility and potential returns of integrated farming systems. Here are the steps involved in conducting a cost-benefit analysis:

Identify Costs

Start by identifying all the costs associated with implementing and operating the integrated farming system. This includes both initial investment costs (e.g., infrastructure development, equipment purchase, livestock acquisition) and ongoing operational costs (e.g., feed, seeds, fertilizers, labor, and veterinary care, marketing expenses).

Quantify Costs

Assign monetary values to each cost item identified in the previous step. This can involve researching market prices, obtaining quotes from suppliers, and estimating labor costs based on prevailing rates. Ensure that all relevant costs are included and accurately quantified.

Identify Benefits

Determine the potential benefits generated by the integrated farming system. These can include revenue from crop sales, livestock products, or value-added products. Consider other benefits such as cost savings through resource optimization, improved soil fertility, reduced dependency on external inputs, or enhanced ecosystem services (e.g., biodiversity conservation, carbon sequestration).

Quantify Benefits

Assign monetary values to the identified benefits. This can be based on market prices, projected yields, or other relevant indicators. For non-market benefits, such as environmental or social impacts, it may be necessary to use valuation techniques or consult expert opinions to estimate their monetary equivalents.

Timeline and Discounting

Determine the time frame over which costs and benefits will occur. Since costs and benefits may be spread over multiple years, it is important to account for the time value of money. Apply a discount rate to adjust future costs and benefits to their present value for a fair comparison.

Calculate Net Present Value (NPV)

Calculate the net present value by subtracting the total discounted costs from the total discounted benefits. A positive NPV indicates that the integrated farming system is financially viable, while a negative value suggests that the costs outweigh the benefits.

Sensitivity Analysis

Conduct a sensitivity analysis to assess the robustness of the results. Adjust key variables (e.g., yields, prices, costs) to see how changes in these factors impact the financial outcomes. This analysis helps identify critical factors and potential risks that may influence the profitability of the integrated farming system.

Interpretation and Decision Making

Evaluate the results of the cost-benefit analysis and consider other factors such as environmental sustainability, social impacts, or personal goals. Use the analysis as a basis for decision-making, considering whether the expected benefits justify the costs and align with the overall objectives of the integrated farming system.

It's important to note that conducting a cost-benefit analysis requires careful data collection, accurate estimation, and realistic assumptions. Seek assistance from agricultural experts, financial advisors, or agricultural extension services to ensure the analysis is comprehensive and accurate.

Self-Check 1.	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 point)

1. What is the main benefit of integrated farming systems?
   a) Increased food production and food security
   b) Conservation of natural resources
   c) Reduction of environmental risk
   d) Diversification of family food resources
2. Which of the following is an example of a livestock-crop integration technology?
   a) Integrated crop-livestock systems
   b) Conservation tillage
   c) Crop rotation
   d) Crop residue decomposition
3. How does proper management of crop residues contribute to soil health?
   a) Prevents moisture loss and reduces soil erosion
   b) Enhances nutrient cycling and soil fertility
   c) Suppresses weed growth and moderates soil temperature
   d) All of the above
4. What is one key consideration for dung and urine use in agricultural systems?
   a) Proper collection and storage
   b) Composting and anaerobic digestion
   c) Nutrient application and distribution
   d) All of the above

Test II: Short Answer Questions (15pts).

1. What are some positive impacts of agro forestry on soil fertility? (4pts)
2. What is chicken-fish integrated farming? (3pts)
3. What are the benefits of chicken-fish integrated farming? (4pts)

Note: Satisfactory rating - 15 points **Unsatisfactory - below 15 points**

You can ask you teacher for the copy of the correct answers.

LG #22	LO #2. Implement pasture and crop management program

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Implementing pasture and crop program
- Carrying out strategic grazing to reduce or eradicate areas of weed infestation, where planned.
- Determining pasture and crop management practices
- Introducing and implementing processes to minimize waste and soil degradation

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Implement pasture and crop program
- Carry out strategic grazing to reduce or eradicate areas of weed infestation, where planned.
- Determine Pasture and crop management practices
- Introduce and implement Processes to minimize waste and soil degradation

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below.
9. Read the information written in the information Sheets
10. Accomplish the Self-checks
11. Perform Operation Sheets
12. Do the “LAP test”

Information Sheet- 2

2.1. Implementing pasture and crop program

Developing a comprehensive pasture and crop program that incorporates various types of land and crops requires careful planning and consideration. Here are some steps to develop such a program:

2.1.1. Assessing the land resources

Assessing land resources for a pasture and crop program involves evaluating various factors to determine the suitability and potential productivity of the land for agricultural purposes. Here are some key considerations for assessing land resources:

- Soil Quality: Soil is a critical factor in agriculture. Assess the soil type, texture, fertility, drainage, and pH levels. Conduct soil tests to determine nutrient content and assess the need for soil amendments.
- Climate and Weather Patterns: Consider the local climate, including temperature, rainfall, and seasonal patterns. Different crops and pasture species have specific climate requirements, so ensure the land is suitable for the target crops or pasture.
- Water Availability**:** Assess the availability of water sources for irrigation, as well as natural rainfall patterns. Adequate water supply is crucial for successful pasture and crop production.
- Land Size and Configuration: Consider the size and shape of the land. Larger, contiguous parcels are often more efficient for agricultural operations and allow for better management practices.
- Access to Infrastructure: Evaluate the proximity and accessibility to roads, markets, storage facilities, and other necessary infrastructure. Easy access to these resources can impact the viability and profitability of the program.

- Topography and Slope: Evaluate the land's topography and slope. Steep slopes may be challenging for cultivation or grazing, while flat or gently sloping land is generally more suitable.
- Land History: Investigate the land's history, including previous land use, potential contamination, or soil degradation issues. This information helps identify any remediation needs or constraints.
- Legal and Regulatory Considerations: Understand the local zoning regulations, land-use restrictions, and environmental regulations that may affect agricultural activities. Ensure compliance with applicable laws.
- Biodiversity and Conservation: Assess the ecological value and biodiversity of the land. Identify any environmentally sensitive areas or protected habitats that may require special management considerations.
- Economic Viability: Consider the economic feasibility of the pasture and crop program. Evaluate the market demand for the selected crops or livestock and determine the potential profitability of the venture.

2.1.2. **Determining grazing and cropping objectives**

The primary objective of grazing is to efficiently utilize available forage resources and maximize the production of high-quality forage for livestock consumption. This involves managing grazing intensity, timing, and duration to promote adequate forage growth and regrowth. Grazing management aims to provide livestock with a nutritionally balanced diet throughout the grazing season. The objective is to meet the nutritional requirements of the animals, optimize weight gain or milk production, and ensure overall animal health and well-being. Emphasis is placed on maintaining or improving the quality of grazed forage. Proper grazing management practices, such as rotational grazing or strip grazing, can help prevent overgrazing and ensure that livestock have access to high-quality forage with desirable levels of protein, energy, and other essential nutrients.

Grazing objectives also include maintaining the health and persistence of pasture plants. Effective grazing management considers factors such as appropriate stocking rates, rest and recovery periods, and avoiding excessive grazing pressure to allow for plant regrowth and avoid overutilization of pasture species. The primary objective in cropping is to achieve high crop yields while maintaining crop quality. This involves selecting appropriate crop varieties, optimizing planting dates, managing nutrient availability, and implementing effective pest and disease control measures.

Crop management aims to ensure optimal nutrient availability to support crop growth and productivity. This includes soil testing, nutrient planning, and applying fertilizers or soil amendments based on crop nutrient requirements and soil test results. The objective is to prevent nutrient deficiencies or excesses that can impact crop yield and quality. Effective pest and disease management practices are crucial to minimize crop losses and maintain crop health. Objectives include early detection and monitoring, integrated pest management (IPM) strategies, and timely and targeted interventions to control pests and diseases while minimizing environmental impact.

Cropping objectives also encompass maintaining or improving soil health and sustainability. This involves implementing practices that enhance soil organic matter, preserve soil structure, minimize erosion, and promote beneficial soil microbial activity. Conservation tillage, cover cropping, and crop rotation are some practices that contribute to sustainable soil management.

A key objective in cropping is to achieve profitability and economic viability. This includes optimizing input costs, maximizing crop yield and quality, minimizing production risks, and making informed decisions based on market conditions and price projections.

2.1.3. Identifying suitable pasture and crop species

Suitable pasture includes:

- All unimproved and improved rangelands used for grazing
- Temperate and tropical pastures
- Crop stubble
- Shrubs and trees

- Residues that may be used for stock feed

Suitable crops include:

- Agricultural broad acre crops (wheat and coarse grains)
- Grain legumes
- Oilseeds
- Sugar
- Intensive fruit and vegetable crops
- Field and tree crops
- Vines
- Hay crops

Temperate and tropical pastures species

a. Temperate pastures species

Temperate pastures are typically found in regions with moderate climates, characterized by distinct seasons and moderate rainfall. Here are some common temperate pasture species:

- **Kentucky Bluegrass (Poa pratensis):** Kentucky bluegrass is a popular cool-season grass used in temperate pastures. It has good palatability and provides nutritious forage for grazing livestock. It thrives in fertile, well-drained soils.
- **Orchardgrass (Dactylis glomerata):**Orchardgrass is a cool-season grass that is highly productive and palatable. It has good drought tolerance and performs well in a variety of soil types. Orchardgrass is commonly used for grazing or hay production.
- **Tall Fescue (Festuca arundinacea):** Tall fescue is a cool-season grass that is widely used in temperate regions. It is known for its persistence, tolerance to traffic, and ability to withstand harsh conditions. However, some varieties of tall fescue may contain an endophyte fungus that can cause health issues in livestock, so it's important to select endophyte-free or novel-endophyte varieties.
- **White Clover (Trifolium repens):** White clover is a cool-season legume commonly used in temperate pastures. It fixes nitrogen from the atmosphere, enriching the soil and

providing a valuable protein source for grazing animals. It is often included in pasture mixes with grasses.

- **Red Clover (Trifolium pratense):** Red clover is another cool-season legume that is widely used in temperate pastures. It has high protein content and good forage quality. Red clover is often used in rotational grazing systems and can be grazed or harvested for hay.

b. Tropical Pastures species

Tropical pastures are found in regions with warm climates, high rainfall, and often exhibit less distinct seasons. These pastures are usually comprised of warm-season grasses and legumes adapted to tropical conditions. Here are some common tropical pasture species:

- **Brachiaria (Brachiaria spp.):**Brachiaria grasses, such as Brachiariabrizantha and Brachiariadecumbens, are widely used in tropical pastures. They are highly productive, drought-tolerant, and have good forage quality. Brachiaria grasses are well-suited for grazing and can withstand heavy grazing pressure.
- **Napier Grass (Pennisetum purpureum):** Napier grass is a tall, perennial grass commonly used in tropical regions. It has high productivity, good palatability, and is often used for cut-and-carry systems or as a fodder crop for livestock.
- **Buffel Grass (Cenchrus ciliaris):** Buffel grass is a warm-season grass that thrives in tropical and subtropical regions. It has good drought tolerance, high biomass production, and is commonly used for grazing in areas with low rainfall.
- **Stylosanthes (Stylosanthes spp.):**Stylosanthes is a legume commonly used in tropical pastures. It has the ability to fix nitrogen, improving soil fertility and providing protein-rich forage for livestock. It is often used in mixed pastures with grasses.
- **Centro (Centrosema spp.):** Centro is a tropical legume that is well-adapted to acid soils. It has good drought tolerance and provides high-quality forage. Centro is commonly used in grazing systems and can be grown in combination with grasses.

These are just a few examples of temperate and tropical pasture species. There are several other grasses, legumes, and forage crops available that are suitable for specific climates and management practices.

2.1.4. Designing a rotational grazing system

Rotational grazing:

Rotational grazing is a management strategy that involves dividing a pasture or grazing area into smaller paddocks and systematically moving livestock between these paddocks. The livestock are rotated through the paddocks, allowing the grazed areas to rest and recover before being grazed again.

Rotational grazing ensures pasture re-growth and helps to maintain or improve the condition of the pasture. Graze any given paddock for a period of 1 to 2 weeks followed by a 4 to 8 week of rest period. This will result in optimum production of pasture and force a break the life cycle of most internal parasites that may be present. The grazing and resting periods should be flexible depending on weather conditions.

In addition to these, this strategy offers several benefits:

a) Improved Forage Quality: Rotational grazing allows for better forage utilization. Livestock are given access to fresh, high-quality vegetation in each paddock, resulting in improved nutrition and palatability. By allowing the grazed areas time to recover, the regrowth of forage is healthier and more productive.

b) Enhanced Pasture Productivity: Through rotational grazing, pastures can maintain higher forage production levels. The rest periods between grazing allow plants to replenish their energy reserves, promote root growth, and increase overall pasture productivity. This can lead to increased carrying capacity and stocking rates.

c) Weed and Pest Control: Rotational grazing can help manage weeds and control pests. By maintaining proper grazing intensity and timing, livestock can actively graze and suppress the growth of undesirable plant species. Additionally, the movement of livestock disrupts pest life cycles and reduces pest populations naturally.

d) Soil Health and Nutrient Cycling: Rotational grazing benefits soil health and nutrient cycling. Livestock distribute their manure more evenly across the pasture, promoting nutrient recycling and enhancing soil fertility. The rest periods also allow for better soil structure development and water infiltration, reducing erosion and improving overall soil health.

e) Biodiversity and Habitat Preservation: Properly managed rotational grazing can support biodiversity and habitat preservation. By implementing diverse plant species within the pasture system and providing rest periods, it allows wildlife and beneficial insects to thrive, contributing to a more balanced ecosystem.

f) Water Management: Rotational grazing can help manage water resources more effectively. By dividing the pasture into smaller paddocks, livestock have access to water points in each paddock, reducing the distance they need to travel for water. This can minimize soil compaction around water sources and improve water distribution across the pasture.

g) Animal Health and Performance: Rotational grazing can have positive impacts on animal health and performance. Access to fresh forage with higher nutritional content can improve weight gain, milk production, and overall animal health. Reduced parasite loads and lower exposure to disease from resting pastures can also benefit livestock health.

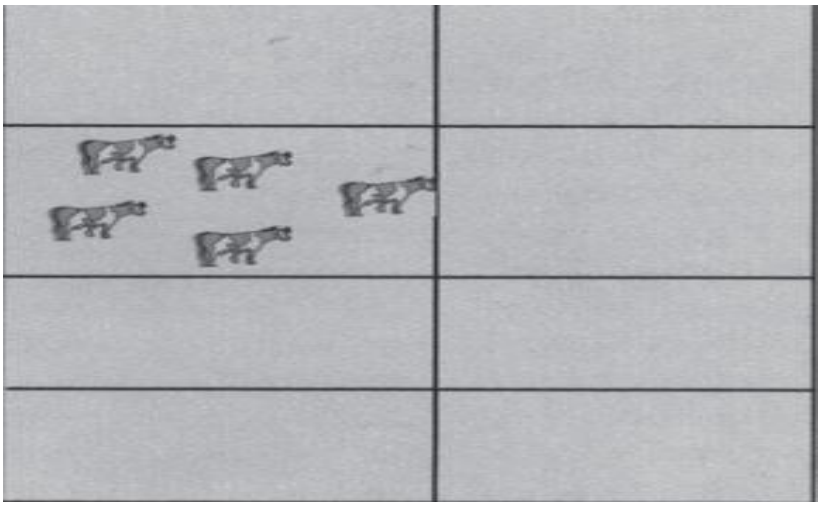


Figure 2: Intensive rotational grazing

To implement rotational grazing effectively, farmers need to consider factors such as pasture size, number of livestock, grazing duration, and rest periods. Monitoring forage growth, livestock behavior, and adjusting the rotation schedule accordingly is essential for optimal results.

Here's an example of a grazing schedule that incorporates rest and recovery periods for each paddock in a rotational grazing system:

Assumptions:

a. Four paddocks labeled A, B, C, and D.

b. Each paddock will be grazed for a specific number of days and then given a rest and recovery period.

c. The grazing period and rest period will vary depending on factors such as forage growth rate, stocking density, and desired residual forage height.

Example of Grazing Schedule:

Week 1:

- Paddock A: Livestock are introduced and allowed to graze for 5 days.
- Paddock B, C, D: These paddocks are rested and not grazed.

Week 2:

- Paddock B: Livestock are moved to Paddock B and allowed to graze for 5 days.
- Paddock A: Paddock A is rested and not grazed.
- Paddock C, D: These paddocks are still under rest.

Week 3:

- Paddock C: Livestock are moved to Paddock C and allowed to graze for 5 days.
- Paddock A, B: These paddocks are rested and not grazed.
- Paddock D: Paddock D continues to be under rest.

Week 4:

- Paddock D: Livestock are moved to Paddock D and allowed to graze for 5 days.
- Paddock A, B, C: These paddocks are now rested and not grazed.

Week 5 and onwards:

- The rotation continues following the same pattern, with each paddock being grazed for 5 days and then given a rest period while the livestock move to the next paddock in the sequence.

It's important to note that the duration of the grazing and rest periods can be adjusted based on factors like forage growth rate, stocking density, and desired residual forage height. Regular monitoring of forage growth and livestock performance can help inform adjustments to the grazing schedule to ensure optimal pasture health and livestock productivity.

Additionally, it's recommended to have flexibility in the schedule to account for variations in weather conditions, forage availability, and other factors that may require adjustments in the grazing plan.

2.1.5. Integrated crop production

Integration of livestock and cropping systems is essential for sustainable natural resource management and improved livestock productivity. Sustainable livestock and crop production in Ethiopia is dependent on dramatic changes in livestock management systems. The key components of these changes are a shift towards more intensive feeding systems, with more emphasis on cut and-carry feeding, and a gradual shift away from uncontrolled grazing, particularly on uplands and sloping areas. This may need to be combined with decreasing livestock populations in some areas perhaps associated with small-scale mechanization of cropping systems, which currently rely on animal draught power for cultivation. The use of woody leguminous species in

- agro-forestry
- Alley cropping or browse coppice systems are one of the key elements of sustainable agricultural systems in Ethiopia. Legumes are especially emphasized because of their multipurpose utility, and their dual roles in animal nutrition and the maintenance or improvement of soil fertility and hence crop production.

Forage integration strategies

Forage integration strategies involve incorporating forage crops and vegetation into livestock production systems to enhance animal nutrition, reduce feed costs, and improve overall sustainability. Here are a few common forage integration strategies:

a) Backyard forage production

Backyard forage production is based on small plots and hedges of productive forage and browse planted within house compounds and around their boundaries. This is the most important initial strategy since it is developed in the farmer's household, and is very convenient for intensive feeding of dairy animals or fattening of meat animals. The higher fertility level typically found in and around house compounds also helps with the successful establishment of backyard forage.

This strategy has a major impact in exposing farmers to the management and productivity of new species and also provides a seed bank to help establish new plantings for other forage strategies. Woody leguminous browse species are particularly suited to this strategy because of their multipurpose benefits and rapid growth rates.

- Tall growing tropical grasses are also suited to backyard forage development.
- Tree legume hedges have been the most widely adopted backyard forage strategy and need to be used as an incentive for broad-scale forage development based on contour forage strip and under sowing strategies.
- This strategy introduces the concept of supplementing crop by-products and poor-quality roughages with high quality forage in a location, which facilitates close attention to management
- Backyard forage provides significant quantities of both forage and fuel wood where they can be conveniently used.
- Other benefits include shelter, increased privacy, wood products construction and implements and bee products.
- Backyard forage can be cut and carried to tethered or housed animals, or cut and conserved for dry season use in mixes with crop residues and natural pasture hay or roughages.



Figure 3: Backyard forage production

b) Under sowing and inter planting

Under sowing and inter planting is the establishment of forage species in an annual crop or perennial plantation. This strategy provides the most convenient approach to rapidly increasing on-farm forage supplies and should have a major impact in the short to medium term. The use of legumes in this system will contribute to the improved fertility and structure of cropping soils.

Under sowing works best with sprawling, low growing annual legumes but can also work well with climbing legumes.

The strategy is particularly suited to the production of tall growing cereals such as maize, sorghum or millet but also works with other cropping systems. Under sowing with legumes produces large quantities of high-quality forage for utilization by either post-harvest grazing or cut and carry systems.

The under sown forage:

- protects the soil from erosive rains,
- can contribute nitrogen for the food crop, and
- Balances the forage value of crop residues such as stover and straw to increase its intake and utilization.

The strategy works well with sprawling and climbing legumes but is also effective with other forage legumes and dual-purpose legumes such as cow pea. Tree crops and some vegetables can

also be under sown or inter planted with leguminous forages. The establishment of annual or perennial legumes under tree crops is a reliable strategy. It is particularly appropriate to the more intensive horticultural and forestry systems where the under sown legume is intensively managed with cut and carried systems for livestock feed. The strategy primarily involves lower altitude systems where fruit, coffee, coconuts, enset or chats are grown.

Where crop weeding practices are very thorough, forages should be under sown at the time of final weeding. This avoids any risk of the under sown legume competing seriously with the cereal crop but often means that the legumes have insufficient time to produce ripe seed prior to crop harvest.

In areas of poorer weeding practices, under sowing should coincide with an earlier weeding. In this way sufficient legumes survive any subsequent weeding to provide an adequate seeding capacity prior to crop harvest. Early maturing cereals generally favor better forage production because they compete with the under sown forage legume for a shorter period of the growing season.

The competitive balance between crop and under sown or intercropped forage legume is very sensitive to sowing time. This will vary with soil and crop type, season, and management practices, and is best determined using on-farm demonstrations.

Integrating leguminous forages with cereal crops

Integrating leguminous forages with cereal grains is a beneficial practice known as intercropping or companion cropping. This approach offers several advantages, including enhanced soil fertility, improved nutrient cycling, weed suppression, and increased overall productivity.

Here's how you can integrate leguminous forages with cereal grains:

Selection of Suitable Leguminous Forages

Choose leguminous forages that are compatible with the cereal grain crop and can thrive in the same growing conditions. Common leguminous forages used in intercropping include clovers, vetches, alfalfa, and peas.

Determining the Intercropping Pattern:

Decide on the intercropping pattern based on the growth habits, competitive abilities, and compatibility of the selected leguminous forages and cereal grains. Options include row intercropping (alternating rows of legumes and grains) or mixed intercropping (sowing legumes and grains together in the same row).

Seed Rate and Planting Arrangement

Adjust the seed rate and planting arrangement to ensure an appropriate balance between leguminous forages and cereal grains. Consider the relative competitiveness and growth rates of the two crops to avoid one species overpowering the other.

Nutrient Fixation and Cycling

Leguminous forages have the unique ability to fix atmospheric nitrogen through symbiotic nitrogen fixation with rhizobia bacteria in their root nodules.This nitrogen fixation process provides a natural source of nitrogen for both the legumes and the associated cereal grain crop.

After the leguminous forages are incorporated into the soil, the fixed nitrogen becomes available for subsequent crops, improving overall soil fertility.

Weed Suppression

Leguminous forages can act as effective weed suppressors due to their competitive growth and shading capabilities. The dense growth of legumes helps to smother weeds, reducing competition for resources such as light, water, and nutrients.

Biomass Production and Forage Quality:

Leguminous forages can provide additional biomass and forage that can be used for livestock feed or as a green manure. Harvest leguminous forage at the appropriate growth stage to ensure optimum quality and maximize nutrient content.

Crop Rotation and Pest Management

Incorporate intercropping with leguminous forages and cereal grains into a diversified crop rotation system. Crop rotation helps break pest and disease cycles, reduces pest pressure, and promotes overall soil health.



Figure 4: Desmodium Integration with sorghum

c) Contour forage strips

Contour forage strips are an integration strategy that involves establishing strips of forage crops along the contours of the land. This technique is particularly useful in sloping or hilly areas to prevent soil erosion and improve water management. Here's how contour forage strips can be implemented:

Terrain Assessment

Assess the topography of the land to identify the contours. Contours are lines that connect points of equal elevation. This can be done using topographic maps, GPS technology, or simple visual observation.

Planning Strip Placement

Determine the spacing and width of the contour forage strips based on the slope and erosion risk of the area. Steeper slopes may require closer spacing and wider strips to effectively control water flow and prevent runoff. The strips should be positioned perpendicular to the contour lines.

Selecting Forage Crops

Choose appropriate forage crops that are well-suited to your region, soil type, and management goals. Some common options for contour forage strips include grasses like fescue, ryegrass, or switch grass, or leguminous forages like clover or alfalfa. Consider the forage's ability to

establish and persist on sloping terrain, as well as its erosion control and nutrient cycling capabilities.

Establishing the Strips

Prepare the soil in the designated contour strips by loosening it and removing any existing vegetation. Sow the selected forage seeds or establish vegetative cuttings in the strips. Ensure proper seed-to-soil contact and provide adequate moisture for germination and establishment. Depending on the forage crop chosen, seeding methods such as broadcasting or drilling can be employed.

Strip Maintenance: Once established, manage the contour forage strips appropriately. This may involve regular mowing or grazing to maintain the desired height and prevent the forage from shading out the cash or cereal crops in the adjacent areas. Implementing rotational grazing or periodic cutting can help balance forage production and erosion control.

Integration with Cash Crops

The contour forage strips can be integrated with cash crops such as cereals or vegetables. The strips act as natural buffers, reducing the impact of water flow and controlling erosion between the rows of cash crops. This integration helps protect the cash crops from soil erosion and nutrient loss while providing additional benefits like weed suppression and improved water management.

Benefits and Functions

Contour forage strips provide several benefits in agricultural systems. They help control soil erosion by reducing water runoff and capturing sediment. The forage plants' extensive root systems enhance soil stability and improve water infiltration. Additionally, contour forage strips can serve as living barriers, slowing down water movement and promoting sediment deposition.



Figure 5: contour strip forage grase

d) Over sowing common grazing areas

Over-sowing is the simplest of the forage development strategies and can be undertaken at very low cost depending on the seeding rates used. It involves broadcasting or sowing improved forage species into common grazing lands, native pastures and degraded areas without any cultivation or other inputs. From grass species Rhodes grass is the most promising species for this strategy. Moreover, Vetch and Desmodium are also promising species for these strategies.



Figure 6*:* Pasture with Sativa oversown

g) Stock exclusion areas or forage banks

Stock exclusion areas are an important means of protecting degraded areas, key watersheds, and common land. They also provide an opportunity to develop forage banks for use during droughts

or periods of seasonal forage shortage. Stock exclusion areas are particularly important for the conservation of highlands but are only accepted by farmers where they see sufficient profits to organize grazing management groups to control stock exclusion areas The introduction of browse species, productive legumes and improved grasses can rapidly increase the productivity of exclusion areas.



Figure 7: Ovvesowing in stock exclusion area

2.1.6. Implement soil and nutrient management practices

Soil and nutrient management are essential components of successful pasture and crop programs. Proper management practices help maintain soil fertility, optimize nutrient availability, and ensure sustainable productivity. Regular soil testing is crucial to assess the nutrient status and pH of the soil. It provides essential information about nutrient deficiencies or imbalances, allowing for targeted fertilization and soil amendment strategies. Soil testing should be conducted before each cropping season or as recommended by local agricultural extension services.

To maintain high forage yields adequate soil pH is necessary for microbial activity. Microbes fix nitrogen in legume nodules and decompose soil organic matter to recycle nutrients in the soil system. At a soil pH above 5.5 the solubility of toxic aluminum and manganese is kept low, helping maintain good root health in plants sensitive to these elements**.**

Agricultural lime will increase soil pH and provides calcium (Ca) and magnesium (Mg). Plants need Ca for forming cell membranes and translocating carbohydrates and Mg for photosynthesis, since each molecule of chlorophyll has a molecule of Mg at its center. Also many of the enzymes of carbohydrate metabolism require Mg as an activator.

Grasses fertilized with nitrogen grow well as long as the pH is above 5.5. When grasses are grown with legumes the optimum pH will be determined by the legume's requirement. Alfalfa needs a soil pH of 6.5 or greater while birds foot trefoil (Lotus corniculatus L.) and clover (Trifolium spp. L.) need a pH of 6.0-6.2 or greater. Clovers may not respond to soil pH greater than 5.5 when available soil phosphorus is high. Many forage species have ecotypes that are resistant to low soil pH.

Develop a nutrient management plan based on soil test results, crop nutrient requirements, and yield goals. This plan should outline the appropriate types and amounts of fertilizers to apply. Utilize both organic (e.g., compost, manure) and inorganic fertilizers (e.g., nitrogen, phosphorus, potassium) to meet crop nutrient demands. Apply fertilizers at the right time and in the right manner to minimize nutrient losses and optimize plant uptake.

Maintain and enhance soil organic matter content through practices like crop residue incorporation, cover cropping, and organic amendments. Organic matter improves soil structure, water-holding capacity, and nutrient retention. It also supports beneficial microbial activity and overall soil health. Implement crop rotation and diversification to break pest and disease cycles, optimize nutrient utilization, and improve soil health. Rotating between different crop families helps manage nutrient demands and reduces depletion of specific nutrients. Including leguminous crops in the rotation can contribute to nitrogen fixation and reduce reliance on synthetic fertilizers.

Minimize soil disturbance through conservation tillage practices such as no-till or reduced tillage. These practices help preserve soil structure, organic matter, and microbial communities. Implement erosion control measures like contour farming, terracing, or planting windbreaks to prevent soil erosion and nutrient loss.

Efficient water management is critical for optimizing nutrient availability and crop growth. Implement irrigation practices that match crop water requirements while avoiding over-irrigation, which can lead to nutrient leaching. Employ water conservation techniques such as mulching, precision irrigation, or soil moisture monitoring to optimize water use efficiency.

Adopt an Integrated Pest Management approach to manage pests and diseases while minimizing the use of pesticides. IPM strategies include cultural practices, biological control, crop rotation, and resistant crop varieties. Reducing pest pressure helps maintain crop health and nutrient uptake.

Regularly monitor crop growth, nutrient deficiencies, and pest or disease outbreaks. Keep records of soil test results, fertilizer applications, crop yields, and management practices. These records provide valuable information for future decision-making, allowing for adjustments and improvements in the soil and nutrient management program.

Stay updated on the latest research and best practices in soil and nutrient management. Seek guidance from agricultural extension services, agronomists, or soil scientists who can provide tailored recommendations based on local conditions, crop types, and specific challenges.

2.1.7. Consider residue and by-product utilization

Residue and by-product utilization in pasture and crop programs can be an effective way to improve soil health, nutrient cycling, and overall sustainability. Here are some approaches for utilizing residue and by-products:

Crop Residue Management: Incorporate crop residues (such as stalks, stems, leaves, and stubble) back into the soil following harvest. This practice helps to increase organic matter content, improve soil structure, and enhance nutrient cycling. Residue incorporation can be achieved through methods like tillage, mulching, or no-till practices, depending on the specific crop and management system.

Cover Crops: Planting cover crops during fallow periods or after cash crop harvest can utilize and protect the soil while providing additional benefits. Cover crops, such as legumes, grasses, or brassicas, capture residual nutrients, prevent soil erosion, suppress weeds, and improve soil

structure. After cover crop growth, they can be terminated and left as a mulch or incorporated into the soil, enhancing organic matter and nutrient availability.

Green Manure: Some crops, especially legumes, can be grown specifically as green manure. These crops are intentionally grown to be incorporated into the soil while still green and actively growing. Green manure crops contribute organic matter, fix nitrogen, and improve soil structure. They are usually tilled or mowed and left as a mulch or incorporated into the soil before planting the subsequent cash crop.

Composting: Residues and by-products, such as crop residues, manure, or food waste, can be composted to create nutrient-rich organic matter. Composting involves the controlled decomposition of organic materials through microbial activity. The resulting compost can be applied to fields as a soil amendment, improving soil structure, nutrient content, and water-holding capacity. Composting also helps to reduce waste and minimize environmental impact.

Biomass Energy Production: In some cases, crop residues or by-products can be utilized for energy production. Biomass energy systems, such as anaerobic digesters or biomass boilers, can convert agricultural residues into heat, electricity, or biofuels. This can provide an additional revenue stream while reducing waste and reliance on fossil fuels.

Livestock Feed: Crop residues, such as corn stalks or wheat straw, can be used as livestock feed, particularly for ruminant animals. Proper processing, such as grinding or chopping, may be necessary to improve digestibility. By feeding crop residues to livestock, the nutrients are recycled through manure, which can then be utilized as a nutrient source for crops.

By-Product Utilization: By-products generated from agricultural or food processing operations, such as bran, spent grains, or pomace, can be utilized as feed ingredients or soil amendments. These by-products often contain valuable nutrients that can be recycled back into the agricultural system, reducing waste and improving resource efficiency.

2.2. Carrying out strategic grazing to reduce or eradicate areas of weed infestation, where planned

Implementing strategic grazing can be an effective approach to reduce or eradicate areas of weed infestation. Here's how you can utilize strategic grazing as a weed management tool:

Targeted Grazing

Identify areas with weed infestations that are suitable for targeted grazing. Targeted grazing involves using livestock, such as goats, sheep, or cattle, to selectively graze and control specific weed species.



Figure 8: Targeted grazing by goat

Grazing Timing

Time the grazing to coincide with the growth stage of the target weed species. Ideally, graze the weeds when they are in the vegetative growth stage before they produce seeds.

Grazing Intensity and Duration

Adjust the stocking density and duration of grazing based on the weed species, its growth habit, and the desired level of control. Intense and concentrated grazing can help weaken and suppress weed populations more effectively.

Rotation and Rest

Implement rotational grazing to allow for adequate rest and recovery of grazed areas.

Rotating livestock to different grazing areas prevents overgrazing and promotes desirable vegetation growth while minimizing weed resurgence.

Grazing Management Plan

Develop a grazing management plan that outlines the target weed species, grazing strategies, and monitoring protocols.

Regularly assess the effectiveness of the grazing approach and make necessary adjustments to achieve desired weed control outcomes.

Integration with Other Weed Control Methods

Combine targeted grazing with other weed control methods, such as mechanical removal, herbicide application (if permitted and deemed necessary), or manual hand-weeding. Integrating multiple strategies can enhance weed management effectiveness and reduce the reliance on any single method.

Livestock Selection and Training

Select livestock species and breeds that have a preference for grazing the target weed species.
Train livestock to recognize and selectively graze the weeds while avoiding desired plants or sensitive areas.

Monitoring and Evaluation

Regularly monitor the grazed areas to assess the effectiveness of weed control. Monitor weed regrowth, plant diversity, and overall vegetation health to evaluate the impact of strategic grazing.

Collaboration and Expert Support:

Collaborate with local agricultural experts, extension services, or experienced grazers who have knowledge and expertise in targeted grazing for weed management. Seek guidance and support to develop and implement an effective strategic grazing plan.

2.3. Determining and applying Pasture and crop management practices appropriate to crop/pasture type

Ethiopia has a diverse range of forage species that are well-adapted to its varied agroecological zones. Here are some common forage species available in Ethiopia: Napier Grass (Pennisetum

purpureum): Napier grass is a widely cultivated forage crop in Ethiopia. It has high biomass production and is commonly used for cut-and-carry systems or as a fodder source for livestock.



Rhodes Grass (Chloris gayana): Rhodes grass is a warm-season perennial grass that performs well in areas with moderate to high rainfall. It is valued for its high forage yield, good nutritive value, and tolerance to grazing.



African Star Grass (Cynodonnlemfuensis): African star grass is a perennial, warm-season grass that is well-suited to tropical and subtropical regions of Ethiopia. It can tolerate drought and provides good quality forage for both grazing and hay production.

Desho Grass (Pennisetum pedicellatum): Desho grass is a native grass species found in Ethiopia. It is well-adapted to dryland conditions and has good drought tolerance. Desho grass can be utilized for both grazing and hay production.



Figure 9: Dessho grass

Lucerne/Alfalfa (Medicago sativa): Lucerne or alfalfa is a legume forage crop that is cultivated in Ethiopia. It has high protein content and is suitable for hay production and as a component of livestock diets.



Figure 10: Alfalfa

Lablab (Lablab purpureus): Lablab is a legume forage crop that is commonly grown in Ethiopia. It is valued for its high protein content and is used for grazing, hay production, or as a green manure crop.



Vetches (Vicia species): Various vetch species, such as common vetch (Vicia sativa) or hairy vetch (Vicia villosa), are grown in Ethiopia. Vetches are leguminous crops that improve soil fertility and provide nutritious forage for livestock.



Figure 11: Vicia sativa

Cowpea (Vigna unguiculata): Cowpea is a versatile legume crop that can be used both as a grain and forage crop. It is well-suited to Ethiopia's diverse agroecological zones and can be grazed or harvested for hay or silage.



Management activities for legume forages and grass forages

Here are some general management activities for legume forages and grass forages separately:

Legume Forages:

- Prepare a well-prepared seedbed by removing weeds and loosening the soil.
- Inoculate legume seeds with the appropriate rhizobia bacteria to enhance nitrogen fixation.
- Sow seeds at the recommended depth and seeding rate.

Provide adequate moisture during establishment to ensure good seed germination and establishment.

Fertility Management:

Conduct soil testing to assess nutrient levels and apply fertilizers or soil amendments accordingly.

Legume forages have high nitrogen-fixing capabilities, but they still require other essential nutrients such as phosphorus (P) and potassium (K).

Monitor the legume stand for nutrient deficiencies and address them through appropriate fertilization practices.

Weed Control

Implement weed control measures before planting to reduce weed competition during establishment.

Use cultural practices such as mowing, hand weeding, or intercropping with companion crops to suppress weeds.

If necessary, use herbicides labeled for legume forages, following label instructions and considering timing applications based on weed growth stages.

Grazing or Harvest Management

Monitor the legume forage growth stage to determine the optimal time for grazing or harvest.

Legume forages are typically grazed or harvested at the early flowering stage when the plants have reached their maximum nutritive value.

Avoid overgrazing to maintain a healthy legume stand and allow for regrowth.

Pest and Disease Management

Regularly scout for pests such as aphids, armyworms, or leafhoppers. Implement integrated pest management strategies, including biological control and targeted insecticide applications if necessary.

Manage diseases such as powdery mildew, rust, or root rots through proper sanitation, crop rotation, disease-resistant varieties, and, if needed, fungicide applications.

Grass Forages

Prepare a well-prepared seedbed by removing weeds and loosening the soil.

Sow grass seeds at the recommended depth and seeding rate.

Provide adequate moisture during establishment to ensure good seed germination and establishment.

Fertility Management

Conduct soil testing to assess nutrient levels and apply fertilizers or soil amendments accordingly.

Grass forages generally require balanced nutrient levels, including nitrogen (N), phosphorus (P), and potassium (K).

Monitor the grass stand for nutrient deficiencies and address them through appropriate fertilization practices.

Weed Control

Implement weed control measures before planting to reduce weed competition during establishment.

Use cultural practices such as mowing, regular cutting, or intercropping with companion crops to suppress weeds.

If necessary, use herbicides labeled for grass forages, following label instructions and considering timing applications based on weed growth stages.

Grazing or Harvest Management

Monitor the grass forage growth stage to determine the optimal time for grazing or harvest.

Grass forages are typically grazed or harvested at the vegetative stage when they have the highest nutritive value.

Avoid excessive grazing or cutting that may weaken the grass stand and hinder regrowth.

Pest and Disease Management

Regularly scout for pests such as grasshoppers, armyworms, or fungal diseases. Implement integrated pest management strategies, including biological control and targeted insecticide or fungicide applications if necessary.

Manage diseases such as rust, leaf spots, or smuts through proper sanitation, disease-resistant varieties, and, if needed, fungicide applications.

Self-Check- 2	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 points)

1. When assessing land resources for a pasture and crop program, what is one key consideration?

a) Market demand for crops
b) Proximity to storage facilities
c) Soil pH levels
d) Availability of irrigation systems

2. What is the primary objective of grazing management?

a) Maximizing crop yields
b) Minimizing soil erosion
c) Ensuring animal health and well-being
d) Promoting biodiversity and conservation

3. Which of the following is a suitable temperate pasture species?

a) Brachiariabrizantha
b) Napier grass
c) White clover
d) Buffel grass

4. What is a benefit of rotational grazing?

a) Reduced forage quality
b) Increased soil erosion
c) Improved livestock nutrition
d) Higher weed competition

Test II: Short Answer Questions (11pts)

1. What is the purpose of regular soil testing in soil and nutrient management? (3pts)
2. What are the benefits of maintaining adequate soil pH for microbial activity? (3pts)
3. How can residue and by-products be utilized in pasture and crop programs? (3pts)
4. How can strategic grazing be used to manage weed infestations? (2pts)

Note: Satisfactory rating - 15 points **Unsatisfactory - below 15 points**

You can ask you teacher for the copy of the correct answers.

Operation Sheet -1

2.1. Implementing crop and pasture management program

A. Materials tools and equipment

- Seeds
- Fertilizers and Soil Amendments
- Pesticides
- Livestock Fencing
- Livestock Supplies
- Tractor
- Tillage Equipment
- Planting Equipment
- Sprayers
- Irrigation Equipment
- Harvesting Equipment
- Livestock Handling Equipment:
- PPE
- Soil Testing Kits:
- Moisture Meters
- Weather Monitoring Devices
- Measuring tool

B. Procedure

a. Prepare Materials tools and equipment
b. Determine your specific goals for the program
c. Set measurable objectives that align with your goal
d. Evaluate the characteristics of your land, such as soil type, topography, and drainage.
e. Assess the availability of water sources, irrigation systems, and equipment.
f. Consider the size and layout of your fields or pastures.
g. Conduct soil tests to assess nutrient levels, pH, and organic matter content.
h. Develop a soil fertility plan to address the specific needs of your crops and pastures
i. Select crops and forages that align with your goals.
j. Prepare the land by removing weeds, rocks, and debris.
k. Monitor nutrient levels and adjust fertilizer applications as needed.
l. Implement integrated weed and pest management strategies.
m. Implement efficient irrigation systems and practices to optimize water use

n. Assess the outcomes of your management program against your goals and objectives.
o. Keep records of yields, costs, and other relevant data.

LAP test-1	

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given the necessary templates, tools, and materials, you are required to perform the following tasks within 12 hours. Each student is expected to complete the project.

Task 1: Implement crop and pasture management program

LG#23	LO#3. Monitor crop/pasture growth and fodder production

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Determining longer term trends in weed, pest and disease incidence
- Monitoring soil structure and erosion
- Checking and scheduling irrigation and drainage systems
- Monitoring grazing management
- Monitoring crop/pasture maturity and harvesting

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Determine longer term trends in weed, pest and disease incidence
- Monitor soil structure and erosion
- Check and schedule irrigation and drainage systems
- Monitor grazing management
- Monitor crop/pasture maturity and harvest

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet-3

3.1. Determining longer term trends in weed, pest and disease incidence

Determining longer-term trends in weed, pest, and disease incidence for crop/pasture growth and fodder production involves a systematic analysis of relevant data and factors. Here's a step by-step approach.

a. Data Collection

Gather historical data on weed, pest, and disease incidence, crop/pasture growth, and fodder production. Collect information from agricultural records, research studies, field surveys, and reports from agricultural agencies or extension services. Ensure that the data covers a sufficiently long period to capture trends.

b. Data Analysis

Analyze the collected data to identify patterns and trends. Use statistical methods to examine changes in weed, pest, and disease incidence over time. Calculate annual or seasonal averages and evaluate their variations. Similarly, analyze crop/pasture growth and fodder production data to identify any long-term trends.

c. Correlation Analysis

Assess the relationship between weed, pest, and disease incidence and crop/pasture growth, as well as fodder production. Look for correlations between the occurrence of specific weeds, pests, or diseases and changes in crop yields or pasture productivity. Statistical techniques such as correlation analysis can help determine the strength and significance of these relationships.

d. Environmental Factors

Consider environmental factors that may influence weed, pest, and disease incidence. These can include

- Climate variables (temperature, rainfall, etc.)
- Soil conditions, agricultural practices, and surrounding land use. Analyze how changes in these factors over time may have impacted weed, pest, and disease dynamics and subsequently affected crop/pasture growth and fodder production.

e. Long-term Changes: Identify any long-term changes in weed, pest, and disease incidence. Look for consistent trends such as increasing or decreasing occurrences of specific pests or diseases over the years. Assess whether these changes align with known factors such as:

- Climate change
- Changes in land management practices, or the introduction of new crop varieties

f. Future Projections

Consider using predictive models or scenario analysis to project future trends in weed, pest, and disease incidence for crop/pasture growth and fodder production. Incorporate anticipated changes in environmental factors, land management practices, and climate conditions. These projections can assist in planning and implementing appropriate management strategies

3.2. Monitoring soil structure and erosion

Monitoring soil structure and erosion is essential for sustainable land management. Here are some methods and techniques to monitor crop/pasture growth and fodder production as well as soil structure and erosion:

Visual Observation

Regular Field Inspections: Conduct regular visits to the fields or pastures to visually assess the soil structure, erosion, and signs of compaction. Crop/Pasture Health Check: Observe the overall health, vigor, and growth of crops or pasture vegetation, which can indicate soil quality and erosion issues. Soil Sampling and Analysis:

Soil Sampling

Collect soil samples from various locations within the field or pasture to assess soil structure, nutrient content, pH levels, and organic matter. Soil Texture Analysis: Determine soil texture (proportions of sand, silt, and clay) to evaluate soil structure and its susceptibility to erosion. Soil Erosion Potential: Use erosion prediction models or tools to estimate soil erosion rates and identify areas prone to erosion. Soil Moisture Monitoring:

Soil Moisture Sensors

Install soil moisture sensors at different depths to monitor soil moisture levels over time. This helps to assess water availability, infiltration rates, and potential erosion risks.

Erosion Control Practices

Contour Farming: Implement contour farming techniques, such as cultivating along the contour lines, to reduce water runoff and minimize erosion. Terracing: Construct terraces on sloping fields to slow down water flow and prevent soil erosion. Cover Crops: Plant cover crops during fallow periods to protect the soil surface, enhance organic matter content, and reduce erosion.

Remote Sensing and GIS

Satellite Imagery: Utilize satellite imagery to analyze vegetation indices, such as NDVI (Normalized Difference Vegetation Index), to monitor crop/pasture growth and identify areas with potential erosion or stress. Geographic Information Systems (GIS): Use GIS tools to map and analyze erosion-prone areas, monitor changes over time, and plan erosion control measures.

Rainfall and Runoff Monitoring

Rain Gauges: Install rain gauges to measure precipitation levels and evaluate the relationship between rainfall intensity and soil erosion. Runoff Monitoring: Measure and monitor runoff from fields or pastures, especially during heavy rainfall events, to assess erosion risks. Conservation Practices Assessment: Soil Conservation Surveys: Conduct surveys to evaluate the effectiveness of implemented soil conservation practices, such as erosion control structures or conservation tillage methods.

Monitoring Soil Health in Your Grazing System
(https://www.youtube.com/watch?v=WGJknH1a9xA)



Soil erosion monitoring

3.3. Checking and scheduling Irrigation and drainage systems

Irrigation and drainage systems play a crucial role in integrated farm production systems, as they ensure optimal water management for crops and prevent water logging or excess moisture in the soil. Here are some steps to check and schedule irrigation and drainage systems:

a. Assess soil moisture

Regularly monitor the soil moisture levels in your fields using soil moisture sensors or manual methods like the feel and appearance of the soil. This will help determine when irrigation is required and prevent overwatering or under watering.

b. Determine irrigation needs

Consider the water requirements of different crops and their growth stages. Factors such as weather conditions, evapotranspiration rates, and soil type will also influence irrigation needs.

c. Evaluate irrigation system efficiency

Check the efficiency of your irrigation system to ensure water is distributed evenly and effectively. Inspect sprinklers, drip lines, or other irrigation components for any leaks, clogs, or damage that may affect water distribution. Make necessary repairs or adjustments as needed.

d. Schedule irrigation

Create an irrigation schedule based on crop water requirements and the capacity of your irrigation system. Consider factors such as:

- the time of day
- Weather conditions and soil moisture levels.

Avoid irrigating during the hottest part of the day to minimize water loss due to evaporation.

e. Implement water-saving techniques

Incorporate water-saving techniques into your irrigation practices. These may include using drip irrigation or micro-sprinklers for targeted watering, employing mulching to reduce evaporation, and adopting precision irrigation technologies that adjust water application based on real-time data.

f. Monitor and adjust drainage systems

Ensure proper drainage in your fields to prevent water logging and excess moisture. Regularly inspect drains, ditches, or other drainage infrastructure to identify any blockages or inefficiencies. Clear away debris and maintain proper slope and gradient to facilitate water flow away from the fields.

g. Consider automated systems

Explore the use of automated irrigation and drainage systems that can be controlled remotely or through sensors. These systems can help optimize water management by adjusting irrigation and drainage based on real-time data, weather conditions, and plant needs.

h. Keep records and analyze data

Maintain records of irrigation schedules, water usage, and crop performance. Analyze the data over time to identify trends, improve efficiency, and make informed decisions regarding irrigation and drainage management.

Remember, the specific requirements for irrigation and drainage systems may vary depending on your location, climate, soil type, and crops grown.

Scheduling Irrigation and drainage systems **(https**://www.youtube.com/watch?v=kRBrQk67Sv0)

3.4. Monitoring grazing management

Monitoring grazing management in integrated farm production systems is essential for maintaining healthy pastures, optimizing livestock performance, and ensuring sustainable land use. Here are some key aspects to consider when monitoring grazing management:

- **Grazing intensity**: Assess the intensity and duration of grazing in different areas of your pasture. Monitor the stocking rate (number of animals per unit area) and grazing duration to ensure they align with the carrying capacity of the land. Avoid overgrazing, which can lead to pasture degradation, and underutilization, which can result in excessive forage growth.
- **Rotational grazing:** Implement a rotational grazing system where animals are moved between different grazing areas or paddocks. Monitor the length of grazing and rest periods for each paddock to allow for adequate forage regrowth. Adjust the rotation schedule based on the growth rate of the pasture and the nutritional needs of the livestock.
- **Grazing behavior**: Observe the behavior of livestock while grazing. Monitor the distribution of animals within the pasture to ensure even utilization of forage. Uneven grazing can create patches of overgrazed or underutilized areas. Encourage animals to graze uniformly by providing adequate water sources, salt/mineral stations, and shade/shelter in different areas of the pasture.
- **Forage availability**: Regularly assess the availability and quality of forage in the pasture. Monitor the height and density of the vegetation to ensure it meets the nutritional requirements of the livestock. Consider using tools such as:
    - ✓ Pasture measurement techniques (e.g., plate meter, rising plate meter) or remote sensing technologies to estimate forage biomass and plan grazing accordingly.
- **Soil health**: Monitor the impact of grazing on soil health parameters. Assess indicators such as soil compaction, organic matter content, nutrient levels, and erosion. Overgrazing can lead to soil degradation, while well-managed grazing can improve soil fertility and structure. Conduct periodic soil tests to track changes and adjust grazing practices accordingly.
- **Water availability**: Ensure adequate water sources are available throughout the pasture to meet the hydration needs of the livestock. Monitor water quality and cleanliness regularly to prevent contamination and maintain animal health.

- **Animal health and performance**: Monitor the health and performance of the livestock, including weight gain, body condition score, and overall health indicators. Regularly assess the presence of parasites and address any health issues promptly.
- **Record keeping**: It will help track trends, identify areas for improvement, and make informed decisions regarding grazing strategies. Maintain records of grazing management activities, including:
  - ✓ Grazing dates
  - ✓ rotation schedules
  - ✓ Forage assessments and livestock performance
- **Adaptive management**: Continuously evaluate and adapt your grazing management practices based on the monitoring data and observations. Implement changes as needed to optimize pasture utilization, livestock performance, and environmental sustainability.

3.5. Monitoring crop/pasture maturity and harvesting

Regular monitoring, accurate maturity assessment, and timely harvesting are critical for optimizing crop and pasture production. By employing a combination of visual observation, sampling, remote sensing, and utilizing appropriate tools, you can make informed decisions and achieve efficient and successful harvests.

3.5.1. Monitoring crop/pasture maturity

Monitoring crop and pasture maturity is crucial for integrated farm production systems to optimize yield, plan harvest or grazing schedules, and make informed management decisions. Here are some methods and considerations for monitoring crop and pasture maturity:

- Visual observation: Regularly inspect the crops or pastures to assess their growth stage and maturity. Familiarize yourself with the specific characteristics of each crop or pasture species and learn to identify the visual signs of maturity such as color changes, seed head formation, or leaf senescence.
- Growth stage guides: These guides provide detailed descriptions and visual cues for each growth stage, helping you determine the maturity level accurately.

- Phenology models: Phenology models use temperature, day length, and other environmental factors to predict the growth stages of crops or pastures. By inputting weather data into these models, you can estimate the maturity stage and plan your operations accordingly.
- Crop/pasture sampling: Periodically collect plant samples for further analysis. For crops, you can collect grain or fruit samples and assess their moisture content, hardness, or color. In pastures, collect herbage samples to measure dry matter content, fiber levels, or crude protein content. These measurements can provide insights into the maturity and nutritional quality of the crops or pastures.
- Remote sensing: Utilize satellite imagery or aerial drones equipped with multispectral or hyper spectral sensors to monitor crop or pasture health and maturity. These technologies can detect plant reflectance patterns that indicate maturity levels, stress, or nutrient deficiencies.
- Biomass monitoring: Measure the biomass or forage mass of the crops or pastures regularly. This can be done by using specialized equipment such as pasture meters or by harvesting a known area and weighing the biomass. Monitoring biomass can give you an idea of the growth and maturity trends over time.
- Growing degree days (GDD): GDD is a measure of heat accumulation over time. By tracking the cumulative GDD for a specific crop or pasture, you can estimate its growth stage and predict maturity levels
- Crop/pasture maps: Create field maps indicating different crop or pasture zones based on their maturity levels. This allows you to implement targeted management practices, such as selective harvesting or grazing, based on the maturity variations within your fields.

3.5.2. Undertaking crop/pasture harvesting

Harvesting crops and pastures in an integrated farm production system requires careful planning and implementation to ensure optimal yield, quality, and efficiency. Here are some steps to undertake crop and pasture harvesting in such a system:

a. Determine harvest time

Identify the appropriate time to harvest based on the maturity stage of the crop or pasture. Consider factors such as visual indicators, growth stage guides, phenology models, biomass measurements, or other relevant monitoring methods discussed earlier.

b. Harvesting equipment and resources

Ensure you have the necessary harvesting equipment and resources available. This may include machinery such as combines, forage harvesters, mowers, balers, or specialized equipment for specific crops. Ensure the equipment is well-maintained and in good working condition.

c. Harvest planning

Develop a harvest plan that outlines the sequence of fields or areas to be harvested, considering factors such as crop rotation, crop maturity variations, or pasture management zones. Take into account logistical considerations like proximity to storage facilities, access to roads, and labor availability.

d. Quality assessment: Before harvesting, assess the quality of the crop or pasture. For crops, check for moisture content, disease or pest infestations, and overall crop health. In pastures, evaluate the forage quality, nutritional content, and weed presence. Adjust the harvest plan accordingly to prioritize high-quality areas for harvesting.

e. Harvesting techniques

Employ appropriate harvesting techniques based on the crop or pasture type. For example, for grain crops use combine harvesters with proper header attachments for efficient threshing and separation. For forage crops or pastures, use mowers and forage harvesters to cut and collect the biomass.

f. Storage and preservation

After harvesting, promptly store the harvested material in suitable storage facilities or preservation methods. For grain crops, use grain bins or silos to protect against moisture and

pests. For forage crops, consider ensiling (making silage) or drying methods such as haymaking to preserve the nutritional quality.

g. Post-harvest management

Implement post-harvest practices such as cleaning, sorting, and grading the harvested material to ensure high-quality produce. Remove any damaged or inferior crops or pasture components to maintain product integrity.

h. Documentation and evaluation

Keep records of the harvested yields, quality assessments, and any observations made during the process. This information is valuable for future planning, yield analysis, and decision-making.

i. Field Maintenance and regeneration

After harvesting, implement appropriate field maintenance and regeneration practices. This may include soil testing, nutrient replenishment, cover cropping, or reseeding pastures to prepare for the next crop cycle or grazing season.

j. Continuous improvement

Regularly evaluate your harvesting practices, learn from the outcomes, and seek opportunities for improvement. This may involve adjusting harvest timing, optimizing equipment use, or adopting new technologies and techniques to enhance productivity and sustainability

Self-check-3

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Part I. Choice the correct answer (2 pts each)

1. What is the first step in determining longer-term trends in weed, pest, and disease incidence?

a) Data analysis

b) Correlation analysis

c) Environmental factors assessment

d) Data collection

2. Which technique can be used to assess soil texture and evaluate soil structure susceptibility to erosion?

a) Contour farming

b) Satellite imagery

c) Soil sampling

d) Rain gauges

3. What is an important factor to consider when scheduling irrigation?

a) The time of day

b) The color of the crops

c) The number of pests in the field

d) The availability of pesticides

4. What is a key factor to consider when assessing grazing behavior in livestock?

a) Soil compaction levels

b) Forage availability

c) Water quality

d) Animal weight gain

5. What is an important consideration when determining the appropriate time for crop or pasture harvesting?

a) Soil pH levels

b) Availability of storage facilities

c) Crop maturity stage

d) Labor availability

Part II. Short answers

1. Write at list 4 methods that used to monitor crop/pasture growth and fodder (4 pts)

2**.** List at least 6 aspects to consider when monitoring grazing management (6 pts)

Note: Satisfactory rating - 10 points **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Operation sheet-3

3. 1. Monitor crop/pasture growth and fodder production

A. Materials, tools and equipments

- Field notebooks or data sheets
- Marking flags or stakes
- Plant identification guides
- Maps or aerial imagery of the fields
- Weather monitoring equipment
- Measuring tape or ruler
- Quadrants or frames
- Soil sampling tools (augers, soil probes)
- Pruning shears or scissors
- Digital or analog cameras
- GPS device or smart phone with GPS
- Remote sensing tools
- Light meters or spectrometers
- Plant canopy analyzers
- Weighing scales or balances

A. Procedure

a. Prepare materials, tools and equipments
b. Set monitoring goals
c. Select the site you want to monitor
d. Select monitoring techniques
e. Monitor the site you select
f. Record data

g. Analysis Data
h. Interpret data
i. Making decision
j. Set regular monitoring schedule

LAP test-3

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3** hour. From each student the task is expected to do it.

Task-1. Under take Monitoring crop/pasture growth and fodder production

LG#24	LO#4. Review production level

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Evaluating pasture and crop yields
- Evaluating grazing and cropping programs
- Undertaking and documenting evaluation of production performance

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Evaluate pasture and crop yields
- Evaluate grazing and cropping programs
- Undertaking and documenting evaluation of production performance

Learning Instructions

13. Read the specific objectives of this Learning Guide.
14. Follow the instructions described below.
15. Read the information written in the information Sheets
16. Accomplish the Self-checks
17. Perform Operation Sheets
1. Do the “LAP test”

Information sheet- 4

4.1. Evaluating pasture and crop yields

Evaluating pasture and crop yields in integrated farm production systems involve assessing the productivity of both the cultivated crops and the pasture for livestock grazing. Here are the steps and considerations for conducting such evaluations:

a. Define evaluation objectives

Determine the specific goals of your evaluation. Are you interested in comparing yields between different crop varieties, assessing the impact of management practices, or evaluating the overall productivity of the integrated system?

b. Identify evaluation parameters

Select the key parameters you will measure to evaluate yields. For crops, common parameters include biomass, grain yield, plant height, or specific crop characteristics. For pastures, parameters may include biomass production, forage quality, or animal stocking rates.

c. Select sampling methods

Determine appropriate sampling methods to collect representative data. For crops, you can establish random or systematic sampling points within the field, collecting plants or harvest samples at each location. For pastures, use methods such as quadrat sampling or cutting transects to estimate biomass and species composition.

d. Conduct measurements and data collection

Implement your selected sampling methods to measure the identified parameters. Use appropriate tools and equipment such as weighing scales, plant clippers, or biomass harvesters to collect accurate data. Ensure that samples are properly labeled and recorded.

e. Analyze data

Calculate the crop and pasture yields based on the collected measurements. Calculate averages and variations within different treatment groups or management practices. Use statistical analysis to identify significant differences and trends in yield performance.

f. Consider integration effects

Assess the overall productivity of the integrated farm production system by analyzing the combined yields of crops and pastures. Evaluate the synergistic or complementary effects between the two components and how they contribute to the overall production.

g. Compare with benchmarks or standards

Compare your results with established benchmarks or standards for similar crop or pasture systems. This will help you assess the performance of your integrated system and identify areas for improvement.

h. Interpretation and decision-making

Interpret the results in the context of your evaluation objectives. Identify factors influencing yield variations and consider potential management adjustments to optimize productivity. Use the findings to make informed decisions regarding crop rotation, grazing management, fertilization, or other practices.

i. Continual monitoring and evaluation

Implement regular monitoring and evaluation to track changes in yields over time. This will help you identify long-term trends, evaluate the effectiveness of management interventions, and make necessary adjustments to optimize the integrated system's productivity

(Evaluating pasture and crop yields**:** https://www.youtube.com/watch?v=ngitCAdj6UE)

4.2. Evaluating grazing and cropping programs

Evaluating the grazing and cropping programs within an integrated farm production system involves assessing the performance and efficiency of both components. Here are the steps and considerations for conducting such evaluations:

Define evaluation objectives

Determine the specific goals of your evaluation. Are you interested in optimizing livestock production, maximizing crop yields, improving resource utilization, or achieving a balance between grazing and cropping activities?

Identify evaluation parameters

Select the key parameters to measure and evaluate the performance of the grazing and cropping programs. For grazing, parameters may include stocking rates, forage availability, animal weight gains, or forage quality. For cropping, parameters may include crop yields, input requirements, weed or pest control effectiveness, or soil health indicators.

Data collection for grazing program evaluation

Stocking rates: Determine the number of animals and the area available for grazing to calculate stocking rates. Forage availability: Use methods such as clipping or quadrat sampling to estimate the amount of available forage. Animal weight gains: Monitor and record the weight gains of animals over a specific period. Forage quality: Collect forage samples for laboratory analysis to assess nutrient content, digestibility, or energy value.

Data collection for cropping program evaluation:

Crop yields: Measure and record the yields of different crops within the system. Input requirements: Record the type and quantity of inputs (e.g., fertilizers, pesticides) used for crop production. Weed and pest control: Assess the effectiveness of weed and pest management practices through visual observations or weed counts.Soil health indicators: Conduct soil tests to evaluate soil fertility, nutrient levels, organic matter content, or soil structure.

Analyze data

Calculate and analyze the collected data to evaluate the performance of the grazing and cropping programs. Compare the results against predetermined benchmarks, previous years' data, or local standards. Use statistical analysis to identify significant differences or trends.

Assess integration and synergy

Evaluate how the grazing and cropping programs interact within the integrated system. Assess if the integration leads to improved productivity, resource utilization, or ecosystem services. Consider how the two components can complement each other in terms of nutrient cycling, pest control, or soil health.

Economic evaluation: Consider the economic aspects of the integrated system by analyzing the costs and returns associated with both the grazing and cropping programs. Calculate the

profitability of each component and assess the overall economic viability of the integrated system.

Interpretation and decision-making

Interpret the results in the context of your evaluation objectives. Identify strengths and weaknesses, potential bottlenecks, or areas for improvement within the grazing and cropping programs. Use the findings to make informed decisions regarding grazing management, crop selection, rotation strategies, or input optimization.

Continual monitoring and evaluation

Implement regular monitoring and evaluation to track changes in the grazing and cropping programs over time. This will help you identify long-term trends, evaluate the effectiveness of management interventions, and make necessary adjustments to optimize the integrated system's performance.

4.3. Undertaking and documenting evaluation of production performance

Undertaking and documenting the evaluation of production performance in integrated farm production systems involves a systematic approach to collect data, analyze results, and document findings. Here are the steps and considerations for conducting and documenting such evaluations:

Define evaluation objectives

Clearly define the objectives of your evaluation. Determine what specific aspects of production performance you want to assess, such as crop yields, livestock productivity, resource utilization, or overall system efficiency.

Identify evaluation parameters

Select the key parameters and indicators that align with your evaluation objectives. These parameters may include crop yields, animal weight gains, forage availability, input use, labor efficiency, economic returns, or environmental sustainability indicators.

Data collection methods

Determine the appropriate data collection methods to obtain relevant information. Consider both quantitative data (e.g., yields, weights, input quantities) and qualitative data (e.g., farmer perceptions, management practices). Data can be collected by the following methods:

- Field measurements: Collect data on crop yields, animal weight gains, forage availability, or other relevant parameters using appropriate measurement techniques and tools.
- Recordkeeping: Document essential information related to inputs used, labor inputs, animal management practices, pest and disease control measures, and other relevant activities.
- Surveys and interviews: Conduct surveys or interviews with farmers, workers, or experts to gather qualitative insights, perceptions, and feedback on production performance.
- Laboratory analysis: Send plant or soil samples to a laboratory for analysis of nutrient content, forage quality, or soil health indicators.

Data analysis and interpretation

Analyze the collected data using appropriate statistical methods, calculations, or comparisons. Interpret the results in the context of your evaluation objectives. Identify trends, patterns, strengths, weaknesses, and areas for improvement within the integrated farm production system.

Documentation of findings

Prepare a report: Summarize the evaluation process, objectives, methods, and key findings in a comprehensive report. Include data tables and figures: Present the collected data in tables, graphs, or charts to visually represent the findings. Interpretation and conclusions: Provide an interpretation of the results, discussing the implications for production performance, management practices, and future decision-making.

Communication and dissemination

Share the evaluation findings with relevant stakeholders, including farmers, agricultural advisors, researchers, or policymakers. Present the results in meetings, workshops, or conferences. Publish the findings in scientific journals or extension bulletins to contribute to the knowledge and understanding of integrated farm production systems.

Continuous monitoring and evaluation

Integrate the evaluation process into regular monitoring activities to track changes and progress over time. This will help identify long-term trends, evaluate the effectiveness of management interventions, and support adaptive management practices.

Self-check-4

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Part I. Choice the correct answer (2 pts each)

1. Which of the following parameters is commonly used to evaluate crop yields in integrated farm production systems?

A) Animal stocking rates

B) Forage quality

C) Biomass production

D) Plant height

2. Which parameter is commonly used to assess the effectiveness of weed and pest control in a cropping program within an integrated farm production system?

A) Forage availability

B) Animal weight gains

C) Stocking rates

D) Weed counts

3. Which of the following data collection methods is commonly used to gather qualitative insights and feedback on production performance in integrated farm production systems?

A) Field measurements

B) Recordkeeping

C) Surveys and interviews

D) Laboratory analysis

Part II. Short answers

1. Write at least 5 steps and considerations for conducting pasture and crop yields evaluation (**5pts**)

2. Write at least 5 steps and considerations for conducting grazing and cropping programs evaluation (**5pts**)

Note: Satisfactory rating - 8 points **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Operation sheet-4

4.1. Review production level of livestock and crop integrated farm production systems

A. Materials, tools and equipments

- Farm records and documents
- Spreadsheet software
- Farm management software
- Measuring tools (measuring tapes, rulers, measuring wheels)
- Field notebooks
- GPS devices
- Soil sampling equipment (soil augers, soil probes, soil corers)
- Plant sampling equipment (pruners, shears, sampling bags)
- Sample containers
- Computers and printers
- Presentation tools (Microsoft PowerPoint, Google Slides)
- Safety equipment (gloves, safety glasses, boots)
- Camera or smart phone
- Weather monitoring tools (thermometers, rain gauges, weather stations)

B. Procedure

a. Prepare materials, tools and equipments
b. Identify the review objectives
c. Gather production data for both livestock and crop
d. Organize and analyze data

e. Evaluate crop production
f. Evaluate livestock production
g. Assess resource utilization
h. Cost analysis
i. Identify strengths and weaknesses
j. Develop recommendations
k. Implement improvements and monitor progress

LAP test-4	

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3** hour. From each student the task is expected to do it.

Task-1. Conduct review production level of livestock and crop integrated farm production systems

Reference

Books

Anderson, L., & Garcia, M. (2021). Soil Health Management for Integrated Farming Systems. Journal of Soil Science, 42(3), 234-249. doi:10.xxxx/jss.2021.42.3.234

Johnson, R., & Smith, A. (2020). Sustainable Pasture Management: Strategies for Productive and Resilient Grazing Systems. Journal of Sustainable Agriculture, 18(2), 120-135. doi:10.xxxx/jsa.2020.18.2.120

Nair, P. K. R. (2018). Agro forestry: Principles and Practice (3rd ed.). Dordrecht, Netherlands: Springer

S.R. Reddy and G.H. Sankara Reddy .2015. Principles of Agronomy.

Web address

https://www.youtube.com/watch?v=tIqvxD7ao74 (Accessed on 24/9/2023)
https://www.youtube.com/watch?v=jLZ0KtNx354(Accessed on 24/9/2023)
https://www.youtube.com/watch?v=tIqvxD7ao74 (accessed on 24/9/2023)
https://www.youtube.com/watch?v=jLZ0KtNx354(accessed on 24/9/2023)
https://www.youtube.com/watch?v=WGJknH1a9xA (Accessed on 28/09/2023)
(https://www.youtube.com/watch?v=kRBrQk67Sv0) (Accessed on 28/09/2023)
(https://www.youtube.com/watch?v=ngitCAdj6UE) (Accessed on 28/09/2023)

Experts who developed the learning guide

No	Name	Qualification	Educational background	Institution	Phone number	E-mail
3	Yaekob Bonke	MSc	Animal production	Wolaita Sodo ATVET	0932060350	jackmanbonke@gmail.com
1	Kinfu Guta	MSc	Animal production	Alage college	0925238394	kinfuguta@gmail.com
2	Tilahun Mengistu	MSc	Animal production	Agarfa ATVT	0921356009	Tilahunmengistu100@gmail.com
4	Obsa Diriba	MSc	Animal production	Gewane ATVET	0920022972	Obsa9072@gmail.com
5	Gutu Hailu	BSc	Animal science	Mizan ATVET	0966195271	gutuhailu2020@gmail.com