Animal Production

Level-IV

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Module Title: Developing Integrated Farm Production

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LG #29	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 *t*echnologies
- Carrying out production plan of integrated farm
- 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 outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify livestock-crop integration *t*echnologies
- Carry out production plan of integrated farm
- 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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”

8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, ask your trainer for further instructions or go back to "Operation sheets".

Information Sheet 1- Identifying livestock-crop integration technologies

1.1. Introduction

Integrated farming system represents an appropriate combination of farm enterprises *viz*. Cropping systems, horticulture, livestock, fishery, forestry, poultry and the means available to the farmers to raise them for profitability. It interacts adequately with environment without dislocating the ecological and socio-economic balance on one hand and attempt to meet the national goal on the other. The farming system in its real sense will help in different ways to lift the economy of agriculture and standard of living of the farmers of the country as a whole.

Definition:

Different scientists have defined an Integrated farming system (IFS) differently. However, many definitions, in general, convey the same meaning that it is strategy to achieve profitable and sustained agricultural production to meet the diversified needs of farming community through efficient use of farm resources without degrading the natural resource base and environmental quality. Relatively recent definitions include:

- Integrated farming system is a resource management strategy to achieve economic and sustained agricultural production to meet diverse requirements of farm livelihood while preserving resource base and maintaining a high level of environment quality.
- Integrated farming is a set of agro economic activities that are interrelated and interact with themselves in a particular agrarian setting. It is a mix of farm enterprises to which farm families allocate its resources in order to efficiently utilize the existing enterprises for increasing the productivity and profitability of the farm. These farm enterprises are crop, livestock, aquaculture, agro forestry and agri-horticulture.
- Integrated farming system is a mix of farm enterprises such as crop, livestock, aquaculture, agro forestry and fruit crops to which farm family allocates its resources in order to efficiently manage the existing environment for the attainment of the family goal..

- Integrated farming system represents an appropriate combination of farm enterprises (cropping systems horticulture, livestock, fishery, forestry, poultry) and the means available to the farmer to raise them for profitability. It interacts adequately with environment without dislocating the ecological and socioeconomic balance on one hand and attempts to meet the national goals on the other..
- Integrated farming system is a decision making unit comprising the farm household, cropping and livestock system that transform land, capital and labour into useful products that can be consumed or sold.

1.2. Principles

The key principles of integrated farming system are:

- *Cyclic.* The farming system is essentially cyclic (organic resources – livestock – land – crops). Therefore, management decisions related to one component may affect the others.
- *Rational.* Using crop residues more rationally is an important route out of poverty. For resource-poor farmers, the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production.
- *Ecologically sustainable.* Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

1.3. Benefits or advantages of integrated farming system

The advantages of IFS include:

- **Productivity**: IFS provides an opportunity to increase economic yield per unit area per unit time by virtue of intensification of crop and allied enterprises.
- **Profitability:** Use waste material of one component at the least cost. Thus reduction of cost of production and form the linkage of utilization of waste material and elimination of middleman interference in most inputs used. Working out net profit/ BC ratio is increased.

- **Potentiality or sustainability:** Organic supplementation through effective utilization of byproducts of linked component is done thus providing an opportunity to sustain the potentiality of production base for much longer periods.
- **Balanced food:** Components of varied nature are linked to produce different sources of nutrition.
- **Environmental safety:** In IFS waste materials are effectively recycled by linking appropriate components, thus minimize environment pollution.
- **Recycling:** Effective recycling of waste material (crop residues and livestock wastes) in IFS. Therefore, there is less reliance to outside inputs – fertilizers, agrochemicals, feeds, energy, etc.
- **Income rounds the year:** Due to interaction of enterprises with crops, eggs, milk, mushroom, honey, cocoons silkworm, it provides flow of money to the farmer round the year. There is higher net return to land and labour resources of the farming family.
- **Adoption of new technology:** Resourceful farmers (big farmer) fully utilize technology. IFS farmers, linkage of dairy/mushroom / sericulture / vegetable. Money flow round the year gives an inducement to the small/ original farmers to go for the adoption of technologies.
- **Saving energy:** To identify an alternative source to reduce our dependence on fossil energy source within short time. Effective recycling technique the organic wastes available in the system can be utilized to generate biogas. Energy crisis can be postponed to the later period.
- **Meeting fodder crisis:** Every piece of land area is effectively utilized. Plantation of perennial legume fodder trees on field borders and also fixing the atmospheric nitrogen. These practices will greatly relieve the problem of non – availability of quality fodder to the animal component linked.
- **Solving fuel and timber crisis:** Linking agro- forestry appropriately the production level of fuel and industrial wood can be enhanced without determining effect on crop. This will also greatly reduce deforestation, preserving our natural ecosystem.

- **Employment generation:** Combing crop with livestock enterprises would increase the labour requirement significantly and would help in reducing the problems of under employment to a great extent. IFS provide enough scope to employ family labour round the year.
- **Agro – industries:** When one of produce linked in IFS are increased to commercial level there is surplus value adoption leading to development of allied agro – industries.
- **Increasing input efficiency:** IFS provide good scope to use inputs in different component greater efficiency and benefit cost ratio

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1.4. Livestock-crop integration technologies

Some of the key aspects of crop-livestock integration, and the trade-offs to farmers they entail, are outlined below.

- **Manure:** manuring is viewed by many as the critical technological component driving agricultural intensification at its early stages. Animal manure makes nutrients more immediately accessible to crops than green manure or mulching, and allows the concentration of nutrients from more distant, rangeland sources on farmers' fields. Manure from livestock may contribute as much as 35 per cent of soil organic matter. There is some debate over the most efficient, traditional animal and manure management practice for maximising nutrient cycling - penning livestock on fields overnight where they deliver their manure directly to the soil or keeping animals in the farm compound overnight and collecting their droppings to transport to the field. The choice of method depends mainly on the attributes of the field and the endowments of the household.
- **Crop residue:** crop residues are used for a variety of purposes - one is as livestock feed; this constitutes another key link between cropping and animal keeping. The straw of cereals and grain legumes provides valuable feed after harvest.
- **Other fodder sources:** growing forage crops is costly and means sacrificing land otherwise put into food crops. As a result it is relatively uncommon in smallholder mixed farms in Africa. However pastures and fodder fields absorb more water that

row-crop fields and leguminous fodder plants also improve soil fertility, and schemes for the in situ conservation of sown legumes in fodder banks.. Leguminous trees (such as *Leucaena*) are sometimes planted as a source of fodder to bridge the dry season deficit. Fallow land is also sometimes used as temporary pasture. Again the trade-off for farmers is between open-grazing or cutting and carrying fodder for stall feeding (this obviously has heavy labour requirements). In peri-urban areas the use of agro industrial byproducts such as oilseed cakes as cattle feed is increasing.

- **Animal traction:** livestock in mixed farming systems offer the additional potential benefits of draught labour for cultivation, weeding, and transport.. It requires high initial capital investment and is most common in African farming systems where high value-added cash crops are grown.
- **Soil management and fertility:** soil is the basis of agricultural production. The conservation and improvement of this valuable resource must be among the highest priorities on any farm.

The availability of land and fertile soil is essential for healthy productive crops and livestock. Good quality soil also supports water management, reduces risk of nutrient run-off, acts as a carbon sink and promotes biodiversity.

Good soil husbandry includes the routine analysis, maintenance and improvement of physical, chemical and biological soil health. This helps ensure soils' long term fertility and builds organic matter, while reducing the risk of erosion, structural degradation, compaction and associated environmental concerns such as flooding and drought. Good soil husbandry increases yields and profitability.

- **Agro-forestry and soil fertility:** agro forestry can be defined as a dynamic, ecologically based natural resource management system that, through the integration of trees on farms and in agricultural landscapes or through the production of agricultural products in forests, diversifies and sustains production for increased economic, social and environmental benefits for land users.

The accruing agro forestry benefits (favorable microclimates, enhanced biodiversity, providing windbreaks, improved soil fertility, diversification of production, and reduced

nutrient runoff and erosion) are the elements that can be tagged without losing sight of the ultimate goal of combating climate change through mitigation and adaptation.

Concepts and principles of agro forestry: Agro forestry is distinguished from traditional forestry by having the additional aspect of a closely associated agricultural or forage crop. Agro forestry systems and practices vary with the needs of different farmers, and outcomes may also differ considerably, depending on the conditions under which agro forestry is practised. To be called agro forestry, a land-use practice must satisfy four key criteria—the *4 I's*:

- **Intentional.** Combinations of trees, crops and/or animals are intentionally designed and managed as a whole unit rather than as individual elements in order to yield multiple products and benefits;
- **Intensive.** Agro forestry practices are intensively managed to maintain their productive and protective functions. These practices often involve annual operations such as weeding, cultivation, pruning, pollarding and fertilization;
- **Interactive.** The biological and physical interactions between the tree, crop and animal components are actively manipulated to yield multiple products and benefits; and
- **Integrated.** The tree, crop and/or animal components are structurally and functionally combined into a single integrated management unit. Integration may be horizontal or vertical, and above or below ground, either sequentially or simultaneously.

The economic benefits: include the reduction of agricultural inputs, especially when using leguminous species which fix nitrogen to improve soil fertility. At the same time, this maintains or increases production and may diversify production in farming systems, for example, food, fodder, lumber, building materials and wood fuel.

The social benefits: include improvements to the health and nutrition of the rural poor. The on-farm production of several products, often collected from off-farm sources, can reduce the time and effort needed to obtain them, often lessening the burden on women or generating money if the products can be sold.

The environmental benefits; may include a range of environmental services such as improving soil fertility, minimising soil erosion, giving crops and livestock protection from the wind, restoring degraded lands, and water conservation. If properly designed and managed, agro forestry systems can also contribute to biodiversity conservation and climate change adaptation and mitigation. However, if not done properly, agro forestry can cause decreases in production because of competition among trees and crops.

Agro forestry systems and practices: Agro forestry has been practiced for a very long time in many parts of the world and varies from landscape to landscape, country to country and region to region, depending on human needs and capabilities and the prevailing environmental, cultural and socio-economic conditions.

Agro forestry systems can be classified on the basis of their dominant components into

- agrisilviculture,
- Silvo-pasture,
- Agro-silvo- pasture,
- Silvo-agriculture,
- Silvo-agro-pasture,
- pastoral silviculture,
- multipurpose and other systems, such as apiculture with trees, aqua-forestry, and mixed wood lots. The arrangement of the components can vary in space and time.

Agro forestry practices used worldwide include improved fallows (3–4 year fallow with nitrogen fixing trees/ shrubs), alley cropping (trees planted in alleys, with crops between the alleys), home gardens (multi-storey structures like gardens), growing multipurpose trees and shrubs in farmlands, boundary planting, farm woodlots, orchards and tree gardens, tree plantations, shelterbelts, windbreaks, conservation hedges, fodder banks, live fences, silvopasture systems, and apiculture with trees. Example is shown in Figure 1.

a. Windbreaks *b. Alley cropping* *c. Live fence* *d. Silvo pasture*

Figure 1. Some uses of agro forestry

Cropping pattern: the proportion of area under various crops at a point of time in a unit area or it indicates the yearly sequences and spatial arrangement of crops and fallow in an area.

Crop sequence and crop rotation are generally used synonymously.

Self-check 1	Written test

Directions: Answer all the questions listed below.

1. List the recent definitions of an Integrated farming system (5 points)
2. Describe the key principles of integrated farming system (6 points)
3. List the benefits or advantages of integrated farming system (14 points)
4. List some of the key aspects of crop-livestock integration, and the trade-offs to farmers they entail (6 points)

Note: Satisfactory rating - 31 points Unsatisfactory - below 31 points

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

Information Sheet 2- Carrying out production plan of integrated farm

2.1. Introduction

To maximize productivity, an integrated farm enterprise needs a sound production plan. However, effective planning is complex process that covers a wide variety
of activities to ensure that materials, equipment and human resources are available when and where they are needed. Production planning is like a road map. It helps to know where you are going and how long it will take you to get there.

Production planning covers all of the details surrounding how your farm operation will produce products for market. This can include considering the production capacity of your land, the varietals or breeds you select for your climate and production practices, the types of equipment, buildings and facilities you have or need, your production practices and more.

Advantages

Here are some advantages of an effective production plan and scheduling

- Reduced labour costs by eliminating wasted time and improving process flow
- Reduced inventory costs by decreasing the need for safety stock and excessive work in process inventory
- Optimized equipment usage and increased capacity
- Improved on time deliveries of products and services

2.2. Key factors of a production plan

Effective planning hinges on a sound understanding of the key activities that entrepreneurs and business managers should apply to the planning process. Here are five examples:

- **Forecast market expectations**: to plan effectively, you need to estimate potential sales with some reliability. Most business don't have fiem numbers on future sales. However, you can forecast sales based on historical information, market trends and/or established orders.

- **Inventory control**: Reliable inventory levels feeding the pipeline have to be established and a sound inventory system should be in place.
- **Availability of equipment and human resources**
- **Standardized steps and time**: typically, the most efficient means to determine your production steps is to map processes in the order that they happen and then incorporate the average time it took to complete the work.
- **Risk factors**: where risks are significant, you should conduct a failure modes and effects analysis(FMEA) and ensure that controls are put in place to eliminate or minimize them

Self-check 2	Written test

Directions*:* Answer all the questions listed below.

1. What are covered in the production planning (6 points?)

2. List the advantages of production plan (4 points)

3. Describe the five key factors of a production plan (10 points)

Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Information Sheet 3- Determining chicken-fish integrated farming

3.1. Introduction

Chicken raising for meat (broilers) or eggs (layers) can be integrated with fish culture to reduce costs on fertilizers and feeds in the fish culture and maximize benefits. Chicken can be raised over or adjacent to the ponds and the poultry excreta recycled to fertilize the fish pond.

Uses of integrated chicken- fish farming**:**

- Balanced diet
- Productivity improvement
- Higher living standards
- Increased employment opportunity
- Recycling of farm waste
- Higher income
- Increased land use

3.2. Chicken-fish integrated farming

3.2.1. Chicken raising

Integrating chicken with fish farming can be done in two ways. These are:

- Direct integration
- Indirect integration

- **Direct integration:** In this method, fish farming was done with chicken, poultry shed was built on top of the tank and hen waste automatically falls into the pond to fish as feed. Probably this is called double layer method. Fish in the lower layer, i.e, the upper layer of the water tank and chicken in the upper layer is the growing method.

Raising chickens over the pond has certain advantages::

- It maximizes the use of space,
- Saves labour In transporting manure to the ponds and

- the poultry house is more hygienic.

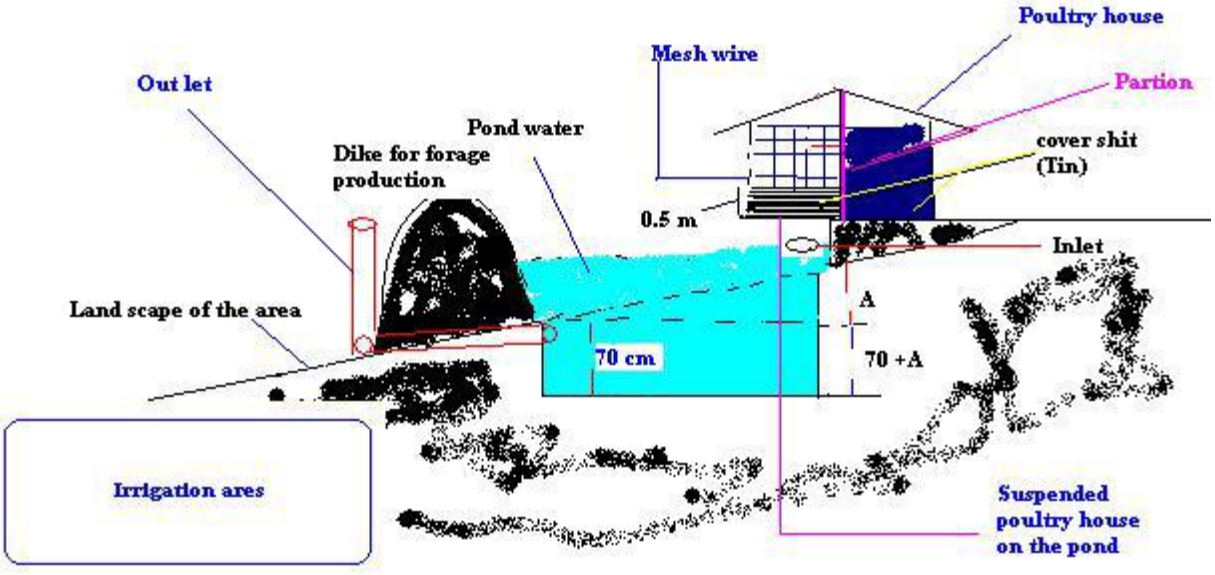

Figure 2.. Direct Integration of chicken with fish

- **Indirect integration**: In this system, chicken was reared in the pond bank, chicken shed was cleaned weekly once and the excreta were spread on top of the pond or keep as heap in every corner of the pond. This practice may be followed in the early morning.

In both this method of chicken reared with fish farming in integrating method.

No significant differences have been observed on the chickens' growth or egg laying when they are raised over the ponds or on land. In the case of the former, the pond embankment could still be utilized for raising vegetables

The following management practices in the handling of such integrated chicken with fish farming are very important.

- Chicken rearing methods.
- Chicken shed.
- Chicken species/breeds.
- chicken stocking (stocking density)
- Feed given to chickens.
- Egg laying chicken care.
- Disease management for chicken.

Chicken rearing methods

- **Chicken rearing in backyard**: Generally farmers rearing country chicken in their house in the backyard. While rearing lesser number of country chicken, birds sheltered night only and moving throughout the day in the garden of the house, backyard and fed kitchen waste, grains, worms, insects and locked only at night. In this method daily clean the chicken excreta and fed to the fishes in the fish pond or used as fertilizer after decomposition. In this method outcome of excreta was comparatively lesser than others
- **Rearing chicken in shed:** When the fish was reared with country chicken shed method is suitable one. On commercial cultivation of country chicken under shed method yield more profits than backyard rearing. In shed method unnecessary roaming can be avoided energy loss and supply of good quality feed on need basis will yield better and higher income. There are two types of shed rearing is there;

✓ **Cage system:** In this method, on top of the fish pond birds shed were lined

and arrange to fall the country chicken excreta into the pond and it was used as feed for fish. If poultry sheds were kept in pond bank and cultivated in cage system means every cage place the plate to collect the poultry droppings. This was used for fish feed

- ✓ **Deep litter method**: In this method chicken shed was kept on bank of fish pond or nearby place it can be reared. The cement floor of the shed was spread with rice husk, groundnut shell, coconut fiber were used as mulches it was maintained for the height up to a feet from the floor. The droppings were collected for every two months after decomposition it was used as feed for fish in a pond. Poultry manure contains 25.5% organics, 1.63% nitrogen, 1.54% phosphorus and 0.83% potassium

- **Chicken shed installation:** chicken, for good egg and meat production provide sufficient space, select right place, good air movement, light source, floor should not be moisturized and also it has to be cooler in summer and warm during winter

In direct integration method, the shed placed 1.2-1.5 m above from the pond upper layer. This kind of shed developed with low cost material with simplified one. One bird requires 1 to 2 square feet space in the shed. So integrated system provide space according to the number of birds reared

- **Chicken breeds:** these are exotic and/or cross hybrid breeds grown for meat and eggs.
- **Stocking up of chickens:** Eight week old chickens stocked into shed before releasing the fisher lings in fish pond (a month earlier). Before putting younger ones clean the shed. The chicken water and food container had sanitized with cleaning agent.

  For a hectare of farm 500-600 stocking density can be reared. Chicken which are stop laying the eggs in farm should be remove within 18 months. The droppings of birds contain 10% more protein and phosphorus nutrients are fed to fish which resulted higher production

  Giving fodder to chickens:

  For chickens reared in intensive system, should be given a balanced feed. According to their growth, three types of feeds can be given. These include: -

- Chick feed - 40-45 g / day up to 8 weeks
- Growing stage feed - 50-70 g / day up to 8 to 24 weeks.
- Egg laying stage feed - 80-120 g / day for 24 weeks aged birds

Birds fed mainly starch, fiber, protein, fat, minerals, vitamins and water.

Farmers can utilize the available raw materials in their area like grains, variety of cakes, bran varieties, fish pieces, vitamin and minerals are mixed and grind to make poultry feed. For chickens, both in the morning and evening feed had to be given. Such feed increased the growth of chickens and egg production. Ensure the supply of Clean, Cold water available to the birds

- **Caring of egg laying hens**: Calcium supplements should be added to the feeds for egg laying birds. Shells are mixed with feed it will supply calcium. Birds begin laying eggs first 24th week onwards. It lays up to 72 weeks (18 months). Birds lays 80 - 100 eggs in a year. Eighteen months old birds are removed from the farm and new growth birds to be stocked. In the corner of the shed keep straw in the pot to facilitate residing of hatching birds. It helps to relax hatching birds.
- **Disease management for birds:** For birds proper deworming and health care and proper treatment can help prevent the disease

3.2.2. Fish culture

- **Pond preparation**

For an example pond of 1 000 m², remove predatory and weed fish either by draining the pond or by applying approved chemicals.

Apply 25 kg lime to pond bottom if the pond is dry, or dissolve lime in water and spray solution if pond has water.

- **Stocking**

Stock 600-1 000 fingerlings of Tilapia, catfish, Chinese carps, silver carp , grass carp and common carp. Species stocking rate could be 40 percent surface feeders (silver carp), 20 percent rohu, 30 percent bottom feeders (common carp) and 10 percent grass carp.

- **Feeding**

No feeds need to be given, as the feed spilled by chicken (which could be as much as 10 percent) fall into ponds.

- **Fertilization**

No fertilizer is needed, except for excreta of chicken falling into ponds.

- Harvesting

*Harvesting of fish could start 6-7 months after stocking when some fish reach table size.

- **Oxygen depletion**

*When water becomes deep green due to plankton blooms, oxygen in the water may get depleted and fish may die. In such cases, put mats or plastic sheets below the poultry house to catch the chicken excreta and suspend nutrient inputs for 1 to 3 weeks. If possible, immediately irrigate the pond with freshwater.

Self-check 3	Written test

Directions: Answer all the questions listed below.

1. List the uses of integrated chicken- fish farming (7 points)
2. Mention the advantages of raising chickens over the pond (6 points)

Note: Satisfactory rating - 13 points Unsatisfactory - below 13 points

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

Information Sheet 4- Selecting plant varieties and livestock

4.1 Introduction

Farming enterprises include crops/cropping systems (Field, horticultural, plantation), cattle rearing, poultry, fish, piggery, sericulture, mushroom, bee keeping, agro forestry, biogas, vermi-compost etc. A combination of one or more enterprises with cropping when carefully chosen planned and executed, give greater returns than single enterprise especially for small and marginal farmers. Farm as a unit to be considered and planned for effective integration of the enterprises to be combined with crop production activities. In the IFS, it is always emphasized to combine cropping with other enterprises/activities.

4.2. Determinants plant/crop-livestock integrated farming systems

The key categories of determinants influencing plant/crop-livestock integrated farming system are as follows:

- **Natural resources and climate:** The interaction of natural resources, climate and population determines the physical basis for farming systems. The increased variability of climate, and thus agricultural productivity, substantially increases the risk faced by farmers, with the concomitant reduction in investment and input use. Certain soil and water regimes are suitable only for given type of crops. Similarly, some of the physical and geographical features e.g. drainage characteristics, elevations and slopes as well as climatic factors e.g. total rainfall and its distribution, minimum and maximum temperature, humidity and intensity of sun light etc. are other factors which have to be taken in to considerations while making decision with respect to selection of enterprise for a farming systems.
- **Science and technology:** Investment in agricultural science and technology has expanded rapidly during the last four decades. During this period, major technical and institutional reforms occurred, which shaped the pattern of technology development and dissemination.

The research driven growth in developing countries has been green revolution, where it achieved considerable achievement in the field of food grain production and for this the policy and other aspects supported the farming system for such achievement. Research has been focused principally upon intensifying crop and livestock production. There has been for less research on integrated technologies for diversifying the livelihoods of small farmers in developing countries and increasing the sustainability of land use.

Despite these weaknesses, the natural and global research agenda is gradually moving from a focus on individual crop performance to a growing acceptance of the importance of increased system productivity. There has been emphasis in recent agriculture of targeting technologies towards women farmers and poorer households.

- **Trade liberalization and market development:** Markets have a critical role to play in agricultural development as they form the linkages between farm, rural and urban economics upon which the development processes depend. As a result of the reduction of impediments to international trade and investment, the process of trade liberalization is already generating changes in the structure of production at all levels-including small holder-farming systems in many developing countries. Not only the market development is accelerating, but patterns of production and natural resources usage are also changing profoundly in response to market forces.

The availability of new production, post harvest and transport technologies will also change demand patterns due to delivery of new products or established products in new forms to markets, where they have been previously unattainable.

- **Policies, institutions and public goods:** The development of dynamic farming systems requires a conducive policy environment. Moreover, the establishment of the farm-rural-urban linkages requires effective demand. Policy makers have increasingly shifted their attention to the potential to increase the efficiency of service delivery through the restructuring of institutions. The production incentives have dramatic effect on farming systems. Policies on land ownership, water management and taxation reform etc have a great bearing on types of farming system in a region or area.

- **Information and human capital:** The evolution of farming systems based upon increasing specialization (e.g. large scale broiler units) or integrated intensification (e.g. rice-fish-ducks) has required extra knowledge on the part of farm operators. The need for better information and enhanced human capital has also increased, as production systems have become more integrated with regional, national and international market systems.

Lack of education, information and training is frequently a key limiting factor to smallholder development. Many observers anticipated an information revolution i.e. bridge gap of knowledge between scientists and farmers will be very key factor for agricultural growth of these small farmers. Whilst in the past many development efforts failed women-because planners had a poor understanding of the role women play in farming and household food security-greater efforts are being m a d e to take account of their actual situations. It is increasingly recognized and acknowledged by development workers that the empowerment of women is the key to raising levels of child and family nutrition, improving the production and distribution of food and agricultural products, and enhancing the living conditions of rural populations. It has been concluded that, if women in Africa received the same amount of education as men, farm yield would rise by between 7 and 22% .

Similarly, better access to credit, land and extension services would enable women to make an even greater contribution to eliminating rural hunger and poverty. As gender bias is progressively eliminated during coming years - often in the face of severe cultural and religious barriers productivity within many farming systems will be transformed.

- **Indigenous technological knowledge (ITK) :** Indigenous technical knowledge is the knowledge that people in a given community has developed over times, and continues to develop. It is based on experience, often tested over long period of use, adapted to local culture and environment, dynamic and changing, and lays emphasis on minimizing risks rather than maximizing profits. The ITK covers a wide spectrum soil water and nutrient management; pasture and fodder management; crop cultivation; plant protection; farm equipment, farm power, post-harvest preservation

and management; agro-forestry; bio- diversity conservation and also exploitation; animal rearing and health care; animal products preservation and management; fisheries and fish preservation; and ethnic foods and homestead management. Thus, the ITK of a farmer has a great influence in managing the farm and farming system.

4.3. Criteria for crop-livestock enterprise selection

The basic points that are to be considered while choosing appropriate crop-livestock enterprise in IFS are:

- Soil and climatic features of an area/locality.
- Social status of the family and social customs prevailing in the locality.
- Economical condition of the farmer (Return/income from the existing farming system).
- Resource availability at farm and present level of utilization of resources.
- Economics of proposed IFS and credit facilities.
- Farmer's managerial skill.
- Household demand.
- Institutional infrastructure and technological knowhow.
- Market facilities

Priority should be given to improve the present status of different components of the existing farming system, should have better compatibility with prevalent farming system, nil to very less dependence of input from outside, high risk bearing and capable to generate more per day income and employment. In addition to this technological knowhow related to the enterprise(s) should locally be available and particularly no wastage of products and by products due to integration of enterprises.

Self-check 4	Written test

Directions: Answer all the questions listed below.

1. Explain the key categories of determinants influencing plant/crop-livestock integrated farming system (12 points)

2. List the basic points that are to be considered while choosing appropriate crop-livestock enterprise in IFS (9 points)

Note: Satisfactory rating - 21 points Unsatisfactory - below 21 points

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

Information Sheet 5- Identifying and maintaining budgetary constraints

5.1. Introduction

The main purpose of identifying budgetary constraints is to

- consider alternative courses of work,
- counter measures and proper strategies for better management

5.2. Budgetary constraints

In many developing countries, budgetary constraints are often very serious. The common phenomenon/reason is:

- an absolute insufficiency of funds.
- the uncertainty of the forthcoming funds even when the budget has been approved.

It is not unusual that field workers start work, sign agreements, promise subsides to the farmers in order to complete a seasonal task, yet they have to wait embarrassingly to get the needed funds. It is also not uncommon that funds allocated to integrated farm work are diverted for unrelated fields.

These constraints can both discouraging and damaging. Planners, therefore, should identify them with other problems during the planning stage and make every effort to ensure necessary budgeting and proper flow and use of funds.

Management alternatives should be studied and prepared during the planning stage in order to:

- provide alternative budgetary sources
- keep plans flexible to cope with unforeseeable changes

5.3. Strategies for financial control

It is not unusual that a project or program stops short of completion because of over spending or because the original budget is insufficient to cover increased costs.

Although outside factors such as inflation, devaluation, or increases in minimum wages are difficult to control, the planner should prepare strategies to deal with these situations, should they occur. Some of the strategies you will use for controlling budget constraints are:

- Include an inflation factor in the cost estimates
- Set up contingency funds in the project for unforeseeable future expenditure expenses
- Exercise strict control of expenditures
- Order or purchase equipment, vehicles or materials promptly as soon as the funds are approved
- Endeavour to reduce costs through improved work efficiency and other means
- Try alternative technology through research or field experiments to achieve the same or better results at less expenses

Self-check 5	Written test

Directions: Answer all the questions listed below.

1. List the main purpose of identifying budgetary constraints (2 points)

2. Why management alternatives should be studied and prepared during the planning stage? (2 points)

3. List some of the strategies you will use for controlling budget constraints (6 points)

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

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

LG #30	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
- Determining fertiliser applications and rates
- Introducing and implementing processes to minimise waste and soil degradation

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:

- Implement pasture and crop program
- Carry out strategic grazing
- Determine fertiliser applications and rates
- Introduce and implement processes to minimise waste and soil degradation

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1-Implementing pasture and crop program

1.1. Introduction

Pasture is land used for grazing. Pasture lands in the narrow sense are enclosed tracts of farmland, grazed by domestic livestock, such as horses, cattle, sheep, or swine. The vegetation of tended pasture, forage, consists mainly of grasses, with an interspersion of legume and other forbs-non-grass herbaceous plants-. Pasture is typically grazed throughout the summer, in contrast to meadow which is ungrazed or used for grazing only after being mown to make hay for animal fodder. Pasture in a wider sense additionally includes rangelands, other unclosed pastoral systems, and land types used by wild animals for grazing or browsing.

Pasture lands in the narrow sense are distinguish from range lands by being managed through more intensive agricultural practices of seeding, irrigation and the use of fertilizer, while rangelands grow primarily native vegetation, managed with extensive practices like controlled burning and regulated intensity of grazing

1.2. Factors influencing pasture management

Important factors which influence pasture management are:

- Soil type,
- minimum annual temperature, and
- rainfall

1.3. Types of pasture

Pasture habitats are listed below.

- **Grassland**

Grasslands are areas where the vegetation is dominated by grasses and can also be found along with variable proportions of legumes, like clover, and other herbs. Grasslands occur naturally on all continents except Antarctica and are found in most eco-regions of the Earth. Furthermore, grasslands are one of the largest biome on earth and dominate the landscape worldwide. There are different types of grasslands:

natural grasslands, semi-natural grasslands, and agricultural grasslands. They cover 31–43% of the Earth's land area.

Grasslands cover around 3.5 billion hectares globally, representing 26–40 percent of Earth's total terrestrial area

- **Heath land**

A heath is a shrub land habitat found mainly on free-draining infertile, acidic soils and characterized by open, low-growing woody vegetation. Moorland is generally related to high ground heaths with especially in Great Britain—a cooler and damper climate.

Heaths are widespread worldwide but are fast disappearing and considered a rare habitat in Europe. They form extensive and highly diverse communities across Australia in humid and sub-humid areas where fire regimes with recurring burning are required for the maintenance of the heath lands. Even more diverse though less widespread heath communities occur in Southern Africa. Extensive heath communities can also be found in the California chaparral, New Caledonia, central Chile, and along the shores of the Mediterranean Sea. In addition to these extensive heath areas, the vegetation type is also found in scattered locations across all continents, except Antarctica

- **Machair**

A machair : sometimes machar in English is a fertile low-lying grassy plain found on part of the northwest coastlines of Ireland and Scotland.

- **Maquis**

Maquis is a scrubland biome in the Mediterranean region, typically consisting of densely growing evergreen shrubs

- **Moorland**

Moorland or moor is a type of habitat found in upland areas in temperate grassland , savannas, and scrublands and montane grasslands and scrublands biomes, characterized by low-growing vegetation on acidic soils. Moorland, nowadays, generally means uncultivated hill land, but also includes low-lying wetlands . It is closely related to heath, although experts disagree on what precisely distinguishes these types of vegetation.

Generally, moor refers to highland and high rainfall zones whereas heath refers to lowland zones which are more likely to be the result of human activity. Moorland habitats mostly occur in tropical Africa, northern and western Europe, and neo-tropical South America. Most of the world's moorlands are very diverse ecosystems. In the extensive moorlands of the tropics, biodiversity can be extremely high. Moorland also bears a relationship to tundra (where the subsoil is permafrost or permanently frozen soil), appearing as the tundra and the natural tree zone. The boundary between tundra and moorland constantly shifts with climatic change.

- **Porter-(landform)**

A potrero is a long mesa that at one end slopes upward to higher terrain. This landform commonly occurs on the flanks of a mountain, as part of a dissected plateau.

A loan word from the Spanish language, potrero is in current use in the southwestern United States, where it is sometimes translated as "tongue of land" and "enclosed piece of pasture land". In the Spanish language, however, the "tongue of land" sense is archaic.

In Spanish, the usual sense of *potrero* now refers to any land (such as a ranch, open range, or community pasture) where such horses are kept.

Historically, these potreros were used as winter pasture for livestock (horses, sheep, and cattle) that were driven to and from lush summer pastures in the high grass valleys (*valles*) of the Valles Caldera. Today, these potreros are used in this manner by a large herd of elk. These *potreros* are natural enclosures, with only one principal exit: the narrow connection to higher land.

In Spain a *potrero* is common land in poor condition

- **Prairie**

Prairies are ecosystems considered part of the temperate grasslands, savannas, and scrublands biome by ecologists, based on similar temperate climates, moderate rainfall, and a composition of grasses, herbs, and shrubs, rather than trees, as the dominant type. The term encompasses the area referred to as the Interior lowlands of Canada,

the United States, and Mexico, which includes all of the Great Plains as well as the wetter, hillier land to the east.

- **Rangeland**

Rangelands are grasslands, scrublands, woodlands, wetlands, and deserts that are grazed by domestic livestock or wild animals. Types of rangelands include tall grass and short grass prairies, desert grass lands and scrublands, woodlands, savannas, chaparrals, steppes, and tundras. Rangelands do not include forests lacking grazable understory vegetation, barren desert, farmland, or land covered by solid rock, concrete and/or glaciers.

Rangelands are distinguished from pasture lands because they grow primarily native vegetation, rather than plants established by humans. Rangelands are also managed principally with practices such as managed livestock grazing and prescribed fire rather than more intensive agricultural practices of seeding, irrigation, and the use of fertilizers.

Grazing is an important use of rangelands but the term *rangeland* is not synonymous with *grazing land*. Livestock grazing can be used to manage rangelands by harvesting forage to produce livestock, changing plant composition, or reducing fuel loads.

Fire is also an important regulator of range vegetation, whether set by humans or resulting from lightning. Fires tend to reduce the abundance of woody plants and promote herbaceous plants including grasses, forbs, and grass-like plants. The suppression or reduction of periodic wildfires from desert shrub lands, savannas, or woodlands frequently invites the dominance of trees and shrubs to the near exclusion of grasses and forbs.

- **Rough pasture**

Rough pasture is non-intensive grazing pasture, commonly found on poor soils, especially in hilly areas, throughout the world.

- **Savanna**

A savanna or savannah is a mixed woodland-grassland ecosystem characterized by the trees being sufficiently widely spaced so that the canopy does not close. The open

canopy allows sufficient light to reach the ground to support an unbroken herbaceous layer consisting primarily of grasses.

Savannas maintain an open canopy despite a high tree density. It is often believed that savannas feature widely spaced, scattered trees. However, in many savannas, tree densities are higher and trees are more regularly spaced than in forests.

Savannas are also characterized by seasonal water availability, with the majority of rainfall confined to one season; they are associated with several types of biomes, and are frequently in a transitional zone between forest and desert or grassland. Savanna covers approximately 20% of the Earth's land area.

- **Steppe**

In physical geography a steppe is an eco-region characterized by grassland plains without trees apart from those near rivers and lakes. Steppe biomes may include the montane grasslands and scrublands biome in the temprate grasslands, savannas and shrublands biome

The prairie of North America (especially the short grass and mixed prairie) is an example of a steppe, though it is not usually called such. A steppe may be semi-arid or covered with grass or with shrubs or with both, depending on the season and latitude. The term "steppe climate" denotes the climate encountered in regions too dry to support a forest but not dry enough to be a desert. Steppe soils are typically of the chernozem type.

Steppes are usually characterized by a semi-arid or continental climate. Extremes can be recorded in the summer of up to 45 °C (115 °F) and in winter, −55 °C (−65 °F). Besides this major seasonal difference, fluctuations between day and night are also very great. In both the highlands of Mongolia and northern Nevada, 30 °C (85 °F) can be reached during the day with sub-freezing readings at night.

Mid-latitude steppes feature hot summers and cold winters, averaging 250–510 mm (10–20 in) of precipitation per year. Precipitation level alone does not define a steppe climate; potential evapo-transpiration also plays a role in the trees origin.

- **Wood pasture**

Silvopasture (*silva* is forest in Latin) is the practice of integrating trees, forage, and the grazing of domesticated animals in a mutually beneficial way. It utilizes the principles of managed grazing, and it is one of several distinct forms of agro forestry.

Properly-managed silvopasture can increase overall productivity and long-term income due to the simultaneous production of tree crops, forage, and livestock, and can provide environmental benefits such as carbon sequestration. Silvopasture is one of the oldest known forms of agriculture, and has been practiced in many parts of the world for centuries. Silvopasture is not the same as unmanaged grazing in woodlands, which has many known negative environmental consequences.

- **Veld**

Veld is a type of wide open rural landscape in Southern Africa. Particularly, it is a flat area covered in grass or low scrub, especially in the countries of South Africa, Lesotho, Eswatini, Zimbabwe and Botswana. A certain sub-tropical woodland eco-region of Southern Africa has been officially defined as the Bush veld by the World Wide Fund for Nature.[1] Trees are not abundant—frost, fire and grazing animals allow grass to grow but prevent the buildup of dense foliage.

1.4. Pasture species and varieties

Pasture species and varieties listed below are categorized as:

- Temperate or tropical grasses
- Temperate or tropical legume
- Native pasture
- Pasture herb
- Forage shrub

Self-check 1	Written test

Directions: Answer all the questions listed below.

1. Define pasture? (2 points)
2. List the important factors which influence pasture management (5 points)
3. Explain types of pasture (10 points)

Note: Satisfactory rating - 17 points Unsatisfactory - below 17 points

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

Information Sheet 2- Carrying out strategic grazing

2.1. Introduction

Native pastures can be managed through a number of grazing strategies including:

- Continuous grazing and set stocking
- Rotational grazing
- Cell grazing
- Time control grazing
- Spell grazing

2.2. Continuous grazing

Continuous grazing is a management system where livestock run in a paddock continuously over time with no, or only infrequent, spells from grazing. Continuous set stocking refers to the situation where livestock numbers in a paddock vary little from month to month, or from year to year.

The main benefits of continuous grazing are that it is simple to apply, requires minimal labour and can deliver good production and land condition outcomes if managed well. Disadvantages of set stocked continuous grazing are that pasture utilization may be above or below the optimal level at any one time. There is also the potential for overgrazing with livestock habitually revisiting preferred areas.

For good production and land class outcomes, set stocked continuous grazing systems should be conservatively stocked to minimise the decline of preferred native pasture species and land types. Risks to land condition and production can be minimized in a continuous grazing system by:

- Preparing a forage budget and adjusting stocking rate accordingly.
- Spelling the paddock during the growing season once every 3-4 years to allow full pasture recovery.
- Rotational burning to minimise patch grazing.

2.3. Rotational grazing, cell grazing and time control grazing

Rotational grazing involves moving livestock through a series of paddocks so when they have finished grazing the last paddock in the series, the first paddock has recovered to allow the rotation to recommence. Rotations are often organized around the plant growth cycles and aim to optimize pasture utilization.

Cell grazing and time control grazing are similar to rotational grazing, but are more intensive and involve more paddocks or 'cells'. In time control grazing, paddock moves are determined by plant growth - the faster the growth, the more moves and vice versa.

The main benefits of rotational grazing stem from a focus on plant growth phase. Plants are grazed in their vegetative state for relatively short periods, compared with continuous grazing, which reduces the tendency for preferred species to be grazed out. Grazing is then followed by a rest period, which allows perennials to replenish their root reserves and better withstand dry periods, benefiting both soil structure and land condition.

A well designed rotational grazing system can also prevent uneven grazing across the paddock.

Rotational grazing does, however require increased infrastructure and labour and may not be practical when plants are not growing, sheep and cattle are lambing and / or calving. The reduced opportunity to selectively graze in a rotational grazing program can also lead to a decline in per head animal production due to livestock being forced to graze less nutritious plant species.

2.4. Spell grazing

Spell grazing involves locking up pastures at critical times in their growth cycle to allow plants to replenish root reserves and set seed. This reduces the risk of over grazing and encourages pasture plant recruitment through seed set.

An example of spell grazing is wet season spell grazing in northern cattle production systems which involves destocking paddocks during the wet season to allow plant recovery and new native pasture plant recruitment through seed set.

Spell grazing can cause possible overgrazing if livestock are bought together at higher than optimal stocking rates while other paddocks are being spelled.

2.5. Successful grazing systems

Regardless of the strategy used, a successful system will:

- Manage pasture utilization effectively (carrying capacity and timing of spelling).
- Reduce uneven grazing that is either wasteful or harmful.
- Match stocking rate to the diet quality required by the animal production targets.
- Rotational grazing systems can help control weeds because livestock are less selective in small areas and more likely to eat weeds before they reach a seeding stage. Mowing before weeds flower could reduce weed competition as well, but at higher costs in terms of equipment, fuel, and labor. Letting different livestock species (sheep, goat, and horses) graze the same land may help with weed control.

Self-check 2	Written test

Directions: Answer all the questions listed below.

1. List the grazing strategies (5 points)
2. Define continuous grazing? (4 points)
3. How risks to land condition and production can be minimized in a continuous grazing system (3 points)
4. Define spell grazing(2 points)

Note: Satisfactory rating - 14 points Unsatisfactory - below 14 points

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

Information Sheet 3- Determining fertiliser applications and rates

3.1. Introduction

An irrigated pasture requires frequent fertilization for top production. The type of fertilizer applied on the pasture can be natural fertilizer and/or chemical fertilizer.

Fertilization is carried out mainly for two reasons:

a) to amend (overcome) nutrient deficiencies

b) to replace (replenish) nutrients removed by harvesting

3.2. Fertilizer Selection

Levels of nutrients used will depend on

- soil type,
- species used,
- level of production required, and
- Production system (cut-and-carry systems require greater maintenance inputs than grazing systems).

In the spring, drag pastures to spread any manure left by grazing animals. Animals avoid grazing areas fouled by fresh manure for about three weeks. By dragging the pasture, you not only avoid having ungrazed, fouled areas, but also more efficiently distribute the nutrient value of the manure.

The three primary plant nutrients contained in commercial fertilizer are (**N**) nitrogen, (**P**) phosphorus and (**K**) potassium. These nutrients are represented by the three numbers on every fertilizer bag. A fertilizer labeled “32-10-10” indicates that:

32% of the contents is nitrogen (N)

10% of the contents is available phosphorus (P_2O_5)

10% of the contents is soluble potassium (K_2O)

(The other 48% is inert filler)

Example: Suppose the soil test recommended that you apply 100 lbs of nitrogen per acre. Using the 32-10-10 fertilizer, you would need to apply 312 pounds per acre. (100 lbs of nitrogen divided by 32% (.32) = 312 lbs of fertilizer.

Self-check 3	Written test

Directions: Answer all the questions listed below.

1. Why you apply fertilizer? (4 points)
2. What are the level of nutrients depend (4 points)
3. List the three primary plant nutrients contained in commercial fertilizer (3 points)

Note: Satisfactory rating - 11 points Unsatisfactory - below 11 points

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

Information Sheet 4- Introducing and implementing processes to minimise waste and soil degradation

4.1. Introduction

An agricultural waste management system (AWMS) is a planned system in which all necessary components are installed and managed to control and use by-products of agricultural production in a manner that sustains or enhances the quality of air, water, soil, plant, animal, and energy resources.

Owners of any kind of livestock know that animals can affect neighbors. Some fairly general complaints livestock owners receive are concerning dust, flies, and odors.

Dust can be reduced in corrals by periodic wetting. If your pasture is producing dust, it needs serious attention.

Flies hatch from maggots that grow in warm, wet manure. The most unpleasant odors also come from wet manure.

4.2. Waste management functions

An AWMS consists of six basic functions (Fig.3):

- **Production:** Production is the function of the amount and nature of agricultural waste generated by an agricultural enterprise.
- **Collection:** Collection refers to the initial capture and gathering of the waste from the point of origin or deposition to a collection point.
- **Transfer:** Transfer refers to the movement and transportation of the waste throughout the system.
- **Storage:** Storage is the temporary containment of the waste.
- **Treatment:** Treatment is any function designed to reduce the pollution potential or modify the physical characteristics of the waste, such as moisture and TS content, to acilitate more efficient and effective handling.
- **Utilization:** Utilization includes reusing and/or recycling of waste products.

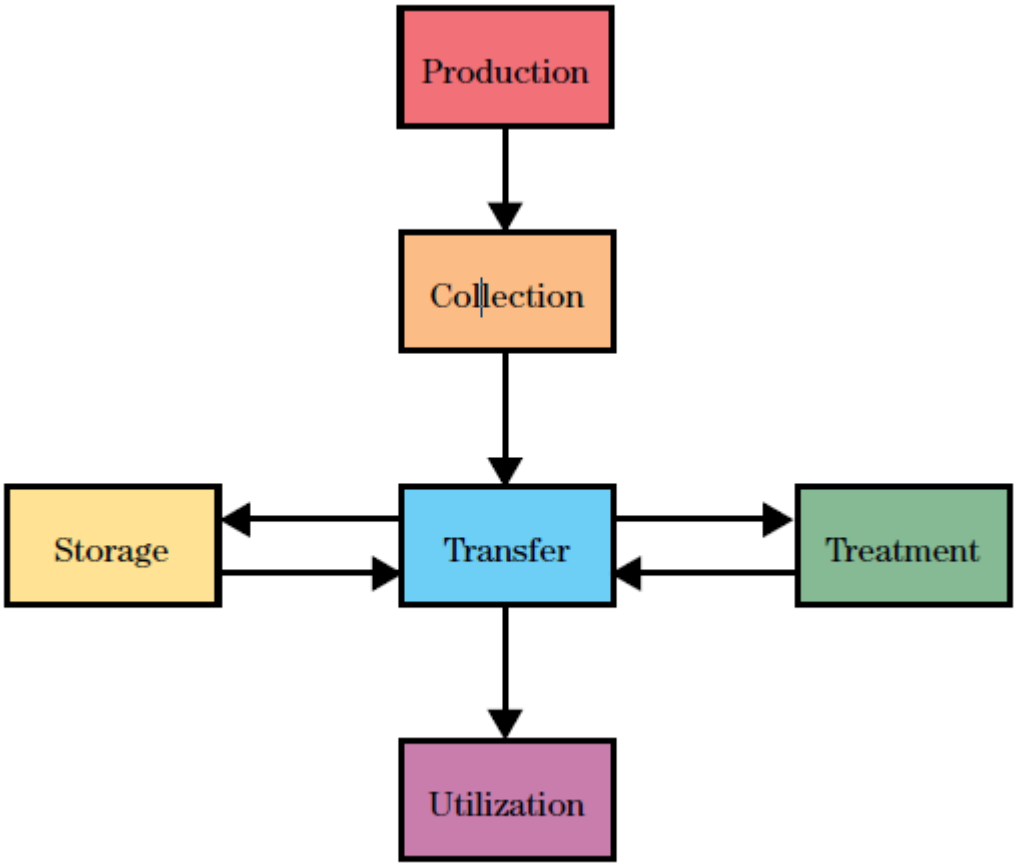

Figure 3. Waste management functions

Some possible solutions:

- Feed dealers have mineral supplements that stop flies from growing in manure.
- Drag manure to spread it over the field and dry it out.
- Divert runoff water away from corrals.

Save the trees! Trees and shrubs are an asset in most pasture settings. They work like an evaporative cooler in the summer and are a windbreak in cold weather. They also increase the value of your property. If animals are peeling bark or otherwise damaging trees, consider protecting the trees with a fence.

Stream stewardship - Trees and shrubs protect stream banks and enhance wildlife habitat. If they are removed, the stream is likely to cut into the stream bank on your property. People downstream then have to deal with the sediment that used to be your

land. Sediment kills fish and fills canals, lakes and ponds. Having a pasture on a stream can be an advantage, however it carries increased responsibility.

Fencing livestock off the stream bank allows willows and trees to grow and protect the soil. You don't have to find another way to water the stock if you utilize proper fencing. Make a small stream access area with panels or fence. The access should be small enough to keep animals from wading into the stream. Putting gravel in the access area will provide a firm base to keep animals from disturbing the stream soil.

Don't make me drink It! Take a hard look at the lay of your land. When it storms, where does the water go? It is not good stream stewardship to let your runoff carry manure with it because most streams are somebody's drinking water source. Even people using well water know that often their water source is the ground water from pastures.

Spread manure on land that is away from the stream, and manage irrigation water. When grass is well managed, it cleans and filters water and uses the nutrients in the manure for growth. If you have a well-managed pasture, you can actually improve the quality of water for everyone.

Self-check 4	Written test

Directions: Answer all the questions listed below.

1. What is an agricultural waste management system (AWMS)? (2 points)
2. Discuss the six waste management functions (12 points)

Note: Satisfactory rating - 14 points Unsatisfactory - below 14 points

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

LG #31	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 changes to control measures
- Monitoring soil structure and erosion
- Determining changes to cultural practices, grazing management and drainage
- Checking, scheduling and maintaining irrigation and drainage systems.
- Monitoring grazing management
- Monitoring crop/pasture maturity and undertaking 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 changes to control measures
- Monitor soil structure and erosion
- Determine changes to cultural practices, grazing management and drainage
- Check, schedule and maintain irrigation and drainage systems.
- Monitor grazing management
- Monitor crop/pasture maturity and undertake harvesting

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished

answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Determining trends in weed, pest and disease incidence

Pasture weed are plants that are growing where they are not wanted and can interfere with forage production. Weeds that infest pasture lands include trees and brush (woody plants), broadleaf plants (usually herbaceous), and undesirable grasses.

Herbaceous, woody and grassy weeds which are either unpalatable or even poisonous can pose big problems to cattlemen. Undesirable plants can frequently overrun an area so that the value of the land for grazing can be completely destroyed. There needs to mechanisms for weed control which have to be implemented on a regular basis.

The most effective, efficient and cheapest form of weed control is to follow a regular programme of fertilization and judicious grazing management practices. Chemicals or other mechanical eradication methods may be needed for the more aggressive weeds. Weeds are difficult to identify or classify as a valuable crop plant in one area can be a weed in another area.

Pasture and forage crops in the tropics are attacked by a wide spectrum of fungi, bacteria, viruses and nematodes. Diseases of this nature will become a more severe problem when exotic species are introduced which are much less resistant to local diseases than the local less productive species.

As many insect pests cause damage through which secondary infections such as fungi or viruses can enter, the most useful control is to control the insects which can be done with insecticides. Rotations are a useful method of control for forage crops grown in single or two species stands.

Pests such as rats and rabbits are known to have a very detrimental effect on germinating seedlings of tree legume species and are regarded by farmers as primary cause of failure of projects introducing such tree species into an area.

Self-check 1	Written test

Directions: Answer all the questions listed below.

1. Define pasture weed? (3 points)
2. List weeds that infest pasture (3 points)
3. List pasture pests (3 points)
4. List pasture diseases (4 points)

Note: Satisfactory rating – 13 points Unsatisfactory - below 13 points

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

Information Sheet 2- Monitoring changes to control measures

Crop pest, weed, and disease management practice standard

- The producer must use management practices to prevent crop pests, weeds, and diseases including but not limited to:
  - ✓ Crop rotation and soil and crop nutrient management practices.
  - ✓ Sanitation measures to remove disease vectors, weed seeds, and habitat for pest organisms; and
  - ✓ Cultural practices that enhance crop health, regard to suitability to site-specific conditions and resistance to prevalent pests, weeds, and diseases.
- Pest problems may be controlled through mechanical or physical methods including but not limited to:
  - ✓ Augmentation or introduction of predators or parasites of the pest species;
  - ✓ Development of habitat for natural enemies of pests;
  - ✓ Non-synthetic controls such as lures, traps, and repellents.
- Weed problems may be controlled through:
  - ✓ Mulching with fully biodegradable materials;
  - ✓ Mowing;
- Livestock grazing;
- Hand weeding and mechanical cultivation;
- Flame, heat, or electrical means; or
- Plastic or other synthetic mulches: Provided that, they are removed from the field at the end of the growing or harvest season.
- Disease problems may be controlled through:
  - ✓ Management practices which suppress the spread of disease organisms; or
  - ✓ Application of non-synthetic biological, botanical, or mineral inputs.

Self-check 2	Written test

Directions: Answer all the questions listed below.

1. List the management practices to prevent weed, pest and disease (12 points)
2. How the weed problem is controlled? (4 points)

Note: Satisfactory rating - 16 points Unsatisfactory - below 16 points

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

Information Sheet 3- Monitoring soil structure and erosion

3.1. Introduction

Soil structure is defined as the arrangement of solid parts of the soil and the pore space between them. It is the result of the geologic parent material, soil processes, environmental conditions under which the soil formed, clay and organic materials present, and soil mgt.(e.g. tillage)

From agricultural perspective, soil has good structure when it is aggregated and has low density and high porosity. A well- structured soil encourages biological activity and allows roots to penetrate.

Soil aggregates are ‘clumps’ of soil particles that are held together by clay, organic matter (such as roots), organic compounds (from bacteria and fungi), and fungal hyphae. The space, or pores, within and b/n soil aggregates are essential for air and water storage and flow, root passage, and microbial life. b/se aggregates vary in size, they create spaces of many d/t sizes in the soil.

Grazing affects soil structure, as livestock hooves can reduce aggregates and severely compact wet soils. Soil compaction reduces eater infiltration and the amount of air (oxygen) available to the plant roots and soil organisms. As available water and air decrease, plant production declines. Some plant species cannot survive in compacted soil, and the loss of desirable grass and legume species allows weeds and less desirable species to increase. Heavy, prolonged livestock traffic can result in bare soil areas. The damage caused by grazing animal can take years to correct.

Organic matter promotes soil structure, this improving water infiltration and availability. Thus, pastures perform best when rapidly growing perennial plants supply organic matter to the soil. A vigorous, healthy plant community also reduces the potential for weed invasion and soil erosion.

3.2. Soil and pasture management

Farm practices should maximize soil health and minimise:

- soil compaction,
- soil erosion,
- soil contamination and
- emissions of greenhouse gases.

Good soil management practices will also:

- Give unrestricted pasture root development, leading to good plant growth and vigour, less drought stress and better clover-N fixation
- Lessen the period of soil saturation and associated slow pasture growth and cow foot problems
- Improve seed germination, emergence and vigour when regrassing or cropping
- Reduce the risk of weed infestation
- Minimise topsoil loss through erosion and runoff, and reduce fertiliser requirements
- Minimise the need for remedial sub soiling or artificial drainage.

To manage soils appropriately, it is useful to know:

- The soil types on the farm
- What the properties of the soils are
- Appropriate management strategies for these soil types.

Pastures should also be managed to maintain a healthy sward that will maximize productivity while minimising soil damage through compaction and erosion.

3.3. Compaction and pugging

Grazing practices by livestock can cause soil compaction due to stocking pressure and machinery traffic, especially on wet soils.

At moderate moisture levels, compaction of soils (compression of large pores) can occur even though this is often not visible. At high moisture levels, the hoof penetrates the soil more easily. The longer the soil remains wet, the deeper the penetration of the hoof, until deformation, called pugging, occurs. Compaction may also occur at deeper levels beneath the pugged zone.

When pugging is severe, the topsoil becomes a slurry, and pasture is also damaged. Production declines after pugging due to the following:

- Compaction of surface soil leading to poor infiltration and water logging. If a soil is partially pugged early in the winter then water will tend to remain on the paddock surface for longer. As a result, the soil will remain softer and wetter and the hooves of grazing animals will cause ongoing damage during subsequent grazings
- Crushing and bruising of leaves and stems, damage to roots and burial of plants in the mud make the pasture unpalatable and irretrievable to stock. Utilization can be reduced by 20 to 40%
- Poor clover growth and nitrogen fixation (research indicates there can be a 60% drop with moderate treading and an 80% drop after severe pugging).This may last for months.

These effects create a direct reduction in subsequent pasture yield. As well as the damage to existing pasture and suppression of N-fixation, future pasture growth is limited by compaction due to physical resistance within the soil and anaerobic conditions that restrict root growth. Pasture production on damaged paddocks can be depressed by 20 to 80% for 4 to 8 months, depending on the soil type.

Even with minimal pasture depression, the cost of lost feed is significant. On a typical Southland farm growing 12000 kg DM/ha, a 10% reduction over the whole farm represents 1200 kg DM/ha, which would be equivalent to $288/ha of lost production assuming a conversion rate of 60gMS/kg DM and a payout of $4/kg MS. As damage occurs mainly in winter and early spring, the impact on feed management may be even more severe. The importance of increasing feed supply on highly stocked farms is well known. Reducing pugging may be the cheapest means of increasing feed supply on some South Island farms.

Other consequences of pugging include the following:

- Weed invasion
- A need to regrass poorly performing paddocks

- More tractor passes required for seedbed preparation and sowing and greater fertiliser requirements. On severely compacted soils tillage costs are up to 340% higher and fertiliser costs (to ensure crop growth) are up to 280% higher
- Delays in sowing and harvest, and poor crop performance, with an increased susceptibility to root diseases and pest attack. On severely compacted soils, crop yields and pasture quality can be up to 45% lower
- Increased irrigation requirements
- Increased runoff and soil loss with overland flow of sediment, P and faecal material to waterways
- Increased release of greenhouse gases from compacted, waterlogged soils.

Compaction forces arise from wheels, plough soles, disc edges, rotary blades and livestock hooves. Cattle can do 3-4 times more damage to soils than sheep. On a grazed dairy farm, it is the management of heavy weight cattle in winter, spring and under irrigation that presents challenges.

Signs that compaction may be limiting pasture growth include greater fertiliser requirements to get the same pasture response, and poor pasture growth despite adequate soil test levels.

Figure 4. Compacted soil

Figure 5. Surface pugging

Self-check 3	Written test

Directions: Answer all the questions listed below.

1. Define soil structure (2 points)
2. List good soil management practices (6 points)
3. What you should know to manage soil appropriately (6 points)
4. Why production declines after pugging (6 points)

Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Information Sheet 4- Determining changes to cultural practices, grazing management and drainage

4.1. **Introduction**

Soil erosion usually occurs when vegetative cover is removed and soil is left unprotected during the winter months. Soil erosion in pastures is usually the result of poor grazing management. Over stocking a pasture and allowing livestock to graze forage down to bare ground is probably the single fastest way to destroy the pasture and soil resource. Livestock can be very disruptive to soil in other ways as well.

If animals are allowed to graze during periods of irrigation of heavy rainfall they can compact the soil and destroy plant cover. Livestock trails can also cause the soil to erode specially on steeper slopes where runoff water finds its way into the ruts that are formed by the animals. Areas along water courses such as stream banks are particularly susceptible to erosion caused by livestock, especially if alternate watering facilities are not adequate, Riparian areas are also prone to overuse by livestock seeking shade and riparian growth to browse on. If livestock are not well distributed over the pasture the likelihood of overgrazing and potential for soil erosion becomes greater. Other areas that have the potential for erosion include paddocks, access roads, parking areas and adjacent fields where runoff from these unprotected surfaces is increased and concentrated.

Houses, barns and other buildings and impervious surfaces also increases and can concentrate runoff increasing the hazard for erosion. Drainage control provisions should be included in all existing and future development plans for buildings, roads and other development. These provisions should indicate how increased runoff will be controlled so that soil erosion does not occur.

Some riparian areas may need to be fenced out and any existing erosion should be treated so that it does not get worse. Eroded areas small in size can be regarded, seeded and deferred from livestock. Additional treatment may be necessary if the erosion is in the form or gullies and or exists on steep slopes.

Selecting and maintaining a planned grazing system that meets the conditions of the site and the rancher's objectives is one of the best ways to manage the soil, and all related natural resources that may be impacted by the grazing of livestock. Existing surface drainage and storm water runoff patterns is a site condition often neglected in the planning stages of pasture development. Intermittent drainage swales, low spots, roads, livestock trails, impervious surfaces such as roof tops or pavement and other areas that might increase, divert and/or concentrate runoff should be evaluated and addressed to prevent future drainage and erosion problems and damage to pasture areas.

4.2. Limiting pugging damage

The incidence of pugging damage is related to factors such as rainfall, soil properties, stocking rates/ grazing intensity, and duration of grazing on wet soils.

Some degree of pugging damage will occur on any soil when grazing animals are left in the paddock in wet conditions. However, different soils can tolerate varying intensities of grazing before becoming damaged.

The way a soil reacts to the application of pressure depends on the texture of the soil, how wet it is, and the shape of the contact area.

Heavy, poor draining soils are particularly susceptible to pugging damage because they remain wet for a long time after rainfall. Where there is naturally compact subsoil that is slow to drain, the problem can be even worse (e.g. with silt or silt loams (Yellow Grey Earths)).

4.3. Winter grazing management

Winter grazing strategies to protect against pugging include the following:

- Build pasture cover leading into the wet season. Increased pasture cover, will protect against pugging, recognizing that some pasture wastage may occur
- Make use of the differences in soil type, drainage, land slope and aspect using the 'strengths' of different soils on the farm at different times of the year. For

example, use drier north and west slopes more in winter and less in summer to best utilize pasture growth and minimise soil damage. Plan to graze the wetter paddocks before the wettest part of the season, and again as soils dry out to reduce the number of times they are grazed in wet conditions

- Use a slow round, otherwise if the herd returns regularly, each time the pugging will be worse. If each paddock is subject to only a few grazings in the wet season, they suffer less overall damage. Also, the protective pasture cover will have regrown to its optimum height
- Shift stock off before soils get too wet in a rainfall event – play it safe and move them early
- Avoid grazing soils recently irrigated with effluent, preferably defer effluent irrigation until drier soil conditions occur

4.4. Drainage

Installing and maintaining efficient drainage systems in susceptible paddocks will ensure that the paddocks remain wet for the shortest possible time following heavy rain. Improved drainage will reduce, but not eliminate the risk of treading damage. Even well-drained paddocks will pug during heavy rain events.

Where flat land is wet because of surface runoff from springs or hills, open or pipe drains can be used to intercept this runoff. This avoids the need for more drainage on the flat land below the hill or spring. All open drains should be fenced from stock to improve water quality and reduce drain maintenance.

Not all areas on the farm need to be drained, and drainage is not always cost-effective when ongoing drain maintenance is considered. Springs, seeps and swampy gullies perform valuable environmental services when fenced, as they filter runoff, reduce flood flows, and reduce dissolved nitrogen levels in water before it flows to streams.

One solution to poor drainage on flat land is mole drains. Flat land is usually poorly drained because surface water cannot move down through the soil, and is often made worse by a high winter water table.

Mole drains will last longer if they:

- Are in soils with a clay content greater than 20%
- Have been pulled in late spring or summer when soil temperatures are above 12ºC, the soil is moist but drying out, and the pasture is short. When a ‘worm’ can just be formed by rolling the soil to 3 mm thickness and 50 mm length, conditions are suitable for moling (refer to Figure 2.3-1). Conditions that are too wet for cultivating or sub soiling may still be suitable for moling
- Are not subject to surface pugging. Pugging destroys the soil structure and prevents water from moving through the soil profile. Overcoming serious pugging demands re moling
- Have good outlets so that water does not lie around in the mole drain.

Self-check 4	Written test

Directions: Answer all the questions listed below.

1. List the causes of soil erosion (4 points)
2. List the factors for the incidence of pugging damage (5 points)
3. List the winter grazing strategies used to protect against pugging (5 points)

Note: Satisfactory rating - 14 points Unsatisfactory - below 14 points

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

Information Sheet 5- Checking, scheduling and maintaining irrigation and drainage systems

Determining when to irrigate In all but the sandy textured soils, you can do a rough check on soil moisture by using the soil ball method. Dig a small hole and remove a handful of soil from a section 6" to 12" deep. Squeeze the soil into a ball. If, when you open your hand and bounce the ball (in the palm of your hand), the soil remains in a stable shape, your soil has more than 50% of its available water holding capacity. If it crumbles, it needs irrigation.

Am I applying too much water? Using too much water washes away plant nutrients. When this happens grasses appear yellow. Growth of aquatic weeds, such as sedge or rushes, is also indicators of too much water.

What if I'm short on water? If your grass is going dry and dormant between irrigation turns in the hottest part of the summer, it is time to sacrifice some pasture. Let some land dry up in July and August, the grass will green up again in the fall. In the meantime, keep your most productive areas green and unstressed by focusing your irrigation here. You will get more production from a smaller area of unstressed grass than a larger area of grass going in and out of dormancy.

How long should I irrigate? While this depends on the irrigation supply rate, in general, irrigate sandy soils for short periods (2-3 hours) and clay soils for longer periods (9-12 hours). Before considering rain as a replacement for an irrigation turn, use a shove to see how deep it has penetrated into the soil. Not often does a rain storm provide enough water to fill the rooting zone

The basic objective of irrigation scheduling is to minimize water stress of the plant, that of over irrigation, and under irrigation. The manager aims to manipulate the biological process of cell elongation and cell reproduction for improved plant yield and maximum use of available effluent.

In optimizing plant cell reproduction and growth (cell expansion), the ability to monitor the soil moisture content is the principal facet of developing good water management programs. A tendency to over or under-irrigate results due to the absence of information

about the soil moisture status down the soil profile. The result of over irrigation is poor utilization of natural rainfall because of high surface run off, and production problems associated with excessively wet soil such as water logging, leaching of nutrients, increased incidence of plant disease and reduced daily water use. The reduced daily water use of plants increases the area of irrigated land required to dispose of a given volume of water increasing the capital cost of land based waste water disposal systems. The need to determine the moisture status of the soil is a critical factor influencing plant production. Correct irrigation scheduling can control the soil moisture status reducing through-drainage and maintaining optimum levels of soil water for maximum plant growth. To implement a reliable and accurate irrigation scheduling regime regular, objective soil moisture readings are essential.

There are numerous ways to measure soil moisture, and the technique you choose will depend on factors such as the question you are asking and the resources available. Some techniques, like Time-Domain Reflectometery (TDR), allow for in situ soil moisture measurements and are relatively fast, while others, like gravimetric techniques, are more time consuming and destructive, requiring the removal and destruction of soil samples to determine soil moisture content.

Self-check 5	Written test

Directions: Answer all the questions listed below.

1. When do you irrigate your pasture? (4 points)
2. What will be the color of the grass if you irrigate too much water? (2 points)
3. How long do you irrigate sandy and clay soil? (4 points)

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

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

Information Sheet 6- Monitoring grazing management

3.1. Introduction

Grazing management is the manipulation of grazing animals to accomplish desired results in terms of animal, plant, land, or economic responses.

Aims

- To provide a supply of nutritious herbage over the growing season at a low cost.
- To avoid wasting herbage and inefficient utilization by the animal.
- To maintain the productive capacity of the sward

Distributional control aims to reduce animal movements and thus avoid destruction of the range by excessive grazing and trampling. The following methods can be employed to achieve uniform distribution of animals.

- Fair distribution of watering areas.
- Development of boreholes (wells) at several sites in the range.
- Use of fences to help control animal movements.
- Provision of salts (mineral licks) at different sites.
- Employing controlled grazing system (described under grazing systems) appropriate for the more
- intensively managed rangelands (ranches).

3.2. Natural laws of grazing management

The four natural laws of grazing management are:

- Keep down the shoot, kill the root.
- Nature does not like bare spots
- Bare soils decrease moisture availability.
- If given a chance, nature would like to bring back best-adapted plants.

3.3. Basic principles of controlled grazing for natural pastures

- Provide rest or recovery period between grazing cycles.

- ✓ During recovery, plants build up nutrient reserves that ensure continued vigor.
- ✓ There is a need to take care of palatable species by controlling scrub and brush growth to avoid competition.

- Avoid heavy defoliation of key species during their active growing period.
  - ✓ Plants use up to ¾ of root food reserve (when rate of carbohydrate production is greater than the rate of demand) to produce new vegetative growth until the plant nears flowering.
  - ✓ Heavy defoliation during active growth will result in the valuable perennials to be replaced first by increasers, then by invaders and finally by bare ground.

As a precaution, stocking rate should be highly reduced or grazing totally stopped when no more than 50% of the weight of herbage has been consumed.

3.4. Grazing systems

The objectives of proper grazing systems are to:

- maintain a favorable balance between herbage species;
- maintain high production of good quality forage for the longest possible period;
- achieve efficient utilization of the forage produced; and
- achieve high rates of animal production.

The types of grazing systems include:

Continuous grazing is an extensive system of grazing in which animals remain on the same pasture area for prolonged periods. Continuous grazing is a normal practice on rangelands and tropical savannahs where, in most cases, the low carrying capacity of the grazing resource may not allow employment of other intensive systems of grazing.

In continuous grazing systems, pasture areas are generally under grazed during the rainy season and overgrazed during the dry season, with a consequent deterioration of the sward. A low stocking rate should be maintained to maintain the grazing system. Major disadvantages of the system include a build up of tick and nematode infestation and a lack of grazing distribution.

Rotational grazing is an intensive system of grassland management practiced on improved permanent or lay pastures. The grazing area is subdivided into a number of paddocks, usually at least six, and the animals are moved systematically from one to another of these in rotation. Each paddock is grazed for a period of 3–7 days, the length of the grazing period depending on stocking rate (often high, up to 25 cow equivalents/ha) and herbage growth rate.

The aim of this system is to use the pasture when it is young and highly nutritious and then to allow an adequate recovery period (See Figure 6).

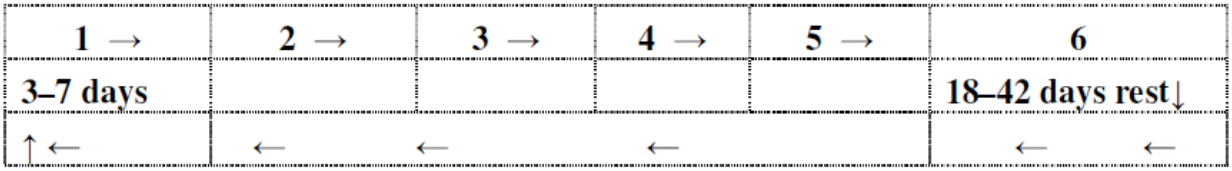

Figure 6. An alfalfa pasture divided into 6 paddocks.

Strip grazing is a more intensive method of rotational grazing based on the use of electric fence, which is moved forward once or twice a day.

Advantage

- Selective grazing is minimized, resulting in more uniform consumption.

Applicability

- Highly productive and nutritious pasture.
- High-producing animals.

Deferred grazing is the setting aside of certain pasture paddocks for use at a later stage, e.g., standing hay.

Advantages

- Enhanced plant vigor.
  - ✓ Improved self-regeneration from fallen seed.

Soiling or zero grazing is the feeding of cut crops to housed stock.

Advantages

- Efficient herbage utilization.
  - ✓ No loss due to trampling.

- ✓ Uniform herbage intake.
- ✓ Control of bloat by wilting lush pasture

Disadvantages

- High cost for labor or machinery.
- Bedding required for housed stock.
- Manure disposal is laborious.

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Self-check 6	Written test

Directions: Answer all the questions listed below.

1. What is mean grazing management (2 points?)
2. Explain the types of grazing systems (10 points)

Note: Satisfactory rating - 12 points Unsatisfactory - below 12 points

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

Information Sheet 7- Monitoring crop and pasture maturity and undertaking harvesting

The stage of maturity at the time of cutting is one of the most important factors affecting forage quality. Forage yields accumulate rapidly from vegetative to early flowering in legumes and until dough stage in grasses. While yields will continue to increase in later stages, they often increase more slowly due to the loss of leaves from the plants lower stems. In the vegetative stages, the proportion of leaves is equal to or greater than that of stems. However, during flowering the proportion of stems exceeds that of leaves. Forage quality is highest when legumes and grasses are in the vegetative (immature) stage. Forage is said to have a high nutritive value when they have protein, digestible carbohydrates, mineral and vitamin contents, low fiber content, and if they are readily eaten digested by animals. The proportion of leaves drops as the plant mature. Any reduction in leaf proportion relatively to stems decreases forage quality, since leaves are more nutritious than stems.

Scheduling the harvest based on stage of plant development is, therefore, the most reliable way to obtain the desired yield and quality. However, recommended harvest schedules vary with the goals of the enterprise. If the enterprises are seeking high forage quality, they should cut legumes at the bud stage &grasses at the bloom stage. However, if the high nutrient yield per unit area of land is the goal, legumes should be harvested at early flowering.

Harvest the plant at the optimum stage of maturity to maximize nutrient yield per unit of land. Most forage should be cut just after reaching an early bloom stage of maturity.

Self-check 7	Written test

Directions: Answer all the questions listed below.

1. Mention the factor affecting forage quality (2 points)
2. Mention the stage at which legume and grasses yield accumulate rapidly (4 points)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

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

LG #32	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:

- Monitoring and evaluating pasture and crop yields
- Evaluating and documenting grazing and cropping programs
- Undertaking and documenting evaluation of production performance
- Evaluating advantages and disadvantages of integrated livestock-crop
- Maintaining physical and financial records of production

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:

- Monitor and evaluate pasture and crop yields
- Evaluate and document grazing and cropping programs
- Undertake and document evaluation of production performance
- Evaluate advantages and disadvantages of integrated livestock-crop
- Maintain physical and financial records of production

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Monitoring and evaluating pasture and crop yields

1.1. Introduction

Understanding level of yield in your pastures is the key to, making good day- to -day grazing decisions. This information sheet covers the methods for estimating forage production.

Estimating pasture yield will help you make grazing management decisions. Estimating forage yield can help you answer the following questions:

- How large should be paddock be in order to meet my production goals and optimize uniform grazing to a predetermined height
- When should I move the livestock to the next paddock?
- Is there enough forage in the next paddock to support the current group of animals and meet my production goals?
- Am I leaving enough residual?
- Is there regrowth rate adequate so that livestock can return to this paddock at the planned time?

As you move through the grazing season, monitor pastures growth and utilization. Monitoring enable you to fine tune paddock size, animal numbers, and grazing periods. Observe utilization daily in the current paddock, and monitor in the last two paddocks and the next two or three paddocks. Periodically estimate the total forage in all paddocks.

4.5. Methods of estimating pasture and crop production yield

The methods of estimating pasture and crop yield are:

- Direct methods
- Indirect methods

Fresh forage must be converted to a dry matter (DM) basis for most comparisons. You base your calculation on oven dried forage.

4.5.1. Direct methods

Clipping, drying and weighing samples are the most commonly used direct method of estimating forage production**.**

Although hand clipping is precise, it is time consuming which makes routine use impractical. The most practical use of hand clipping is for calibrating the indirect methods discussed below.

- Collecting samples-
- Calculating forage DM per acre

4.5.2. Indirect methods

There are several indirect methods of estimating forage production. in each case, forage DM weigh is estimated from measurements taken in standing forage. These are:

- Pasture sticks(rulers) measure forage canopy height
- Rising plate and falling plate meters measure compressed forage height.

Pasture sticks

Keep in mind the estimate is only as good as the sample. If the forage stand and the topography are uniform, a minimum of one sample per acre is recommended. Take more measurements for fields with variable soils, topography, or forage stands.

Figure 7. Ruler used to measure height.

The steps in pasture sticks method are:

Step 1—Use the ruler to measure forage height (Figure 1). With most forages, plant height taller than 18-24 inches is really better suited to hay than to grazing. This is particularly true with endophyte-infected tall fescue, because toxins increase with stem growth and seed head development. See Sampling Tall Fescue Endophyte in Pasture or Hay Stands (PPA-30) for more information on dealing with infected tall fescue.

Height is not a measure, but rather an average, of the tallest plants. Spread your hand and lower it onto the canopy. The average height is measured at the point where you feel very modest resistance from the plant canopy. In Figure 1, the height is 7 inches. Record the height for each sample location in the pasture and then calculate the average height for the pasture.

Step 2—Stand density is the amount of the ground surface covered with standing forage. Your goal is to place the pasture into one of three density categories (less than 75%, 75 to 90%, or more than 90%).

Visually estimates stand density by looking directly down at each location where you have just measured canopy height. Do not include ground residue, only plant material tall enough for the livestock to consume. Stand density measurements using the grazing stick are most accurate when canopy height is approximately 8 inches.

Record the density reading for each location, and then calculate the average stand density for the pasture. The density yield table (Table 1) can now be used to estimate forage yield per acre-inch. The table is more accurate with denser stands.

Table 1. Estimated dry matter yield per acre inch based on density and forage type.

	Density		
	<75%	75-90%	>90%
Forage	**Dry Matter Yield (lb)**		
Tall fescue or orchardgrass	50-150	150-200	200-300
KY Bluegrass	50-100	100-175	175-250
Cool-season grass (clover)	50-125	125-200	200-275
Bermudagrass	100-200	200-300	300-400
Alfalfa	75-150	150-225	225-300
Red clover	75-125	125-175	175-250

Step 3—determine the dry matter (DM) yield per acre-inch using the density measured in Step 2. For example, if you are measuring a tall fescue pasture and you estimate that the available forage covers 85% of the ground area, this pasture would be assigned to the middle density category of 75 to 90% cover.

According to Table 1, this density rating would be between 150 and 200 lb of DM per acre-inch. Based on your assessment of the stand, assign a yield. The thicker the stand, the closer the yield will be to the upper end of the range. Since 85% is in the upper end of this density category, 200 lb of DM per acre-inch would be a good estimate. If the average stand height is 8 inches and you want to maintain 3 inches of stubble after grazing, available forage equals:
5 inches x 200 lb/acre-inch = 1,000 lb DM/acre.

Step 4a—Calibration (quick estimate): A periodic check of your measurements can help you be consistent in using the grazing stick. Harvest 1 square foot of forage (cut at soil level), weigh it in grams, and multiply it by 20. This calculation will give an estimate of lb per acre assuming the forage is 20% DM. While this method is useful for a quick check, the DM content of forage does vary throughout the year, so the yield estimate will be more accurate if the sample is actually dried.

Step 4b—Calibration (better estimate):

- Harvest 1 square foot of forage (cut at soil level) and chop the forage into 1- to 2-inch lengths.
- Weigh the forage (in grams) then place it on a microwave-safe dish. Place the dish in a microwave oven along with a cup of water, which helps reduce the risk of burning the forage.
- Heat on high for two minutes.
- Weigh the forage.
- If the forage is not dry, place it back in the oven and heat it for 30 seconds more.
- Repeat steps D and E until the weight does not change. If the forage is charred, use the last weight.
- Multiply the dry weight in grams by 100 for an estimate of dry matter yield in lb per acre.

Self-check 1	Written test

Directions: Answer all the questions listed below.

1. What are the questions answered through estimating pasture and crop yield?(5 points)
2. What are the methods used for estimating pasture and crop yield (4 points)
3. List the steps in pasture sticks (5 points)

Note: Satisfactory rating - 14 points Unsatisfactory - below 14 points

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

Information Sheet 2- Evaluating and documenting grazing and cropping programs

2.1. Introduction

A grazing strategy is a plan for accomplishing a set of objectives based on comprehensive knowledge of available resources and the production and marketing environment. .Management can be greatly simplified when grazing strategies are based on clearly stated and prioritized resource management and livestock production objective (Figure6), decisions on when and how to use plant resources have profound effects on the success of grazing strategies. Plant resources can be used for livestock production or wildlife cover and ecosystem functions such as hydrologic condition and site stability.

2.2. Best management practices

Decisions on when and where to graze plant resources should be on clearly defined animal production and resource management objectives (figure 6). Production objectives for growing livestock should be defined in terms of target weight at a future date that reflects future ownership and production plans. Target cow condition scores at selected point during the annual reproductive schedule should be based on knowledge of seasonal patterns of nutritive value of available forage resources

Figure 8. Grazing strategies

Self-check 2	Written test

Directions: Answer all the questions listed below.

1. What are the bases for accomplishment of grazing strategies? (6 points)
2. What are the basis for decisions on when and where to graze plant resources? (4 points)

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

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

Information Sheet 3- Undertaking and documenting evaluation of production performance

3.1. Important socio-economic factors in integrated fish farming

The essence of integrated system is productivity of fish as to meet the challenges of food shortage and reducing the unemployment rate.

Socioeconomic conditions should be considered when developing integrated fish-farming systems. The development of a diversified economy depends on the harmonious interactions between socio-economic conditions, agricultural productions and regional environmental conditions.

In any part of the country the type and level of integration depends on:

- the prevalent environmental conditions,
- social norms,
- cultural values and
- religious factors.

3, 2. Systems of integrated fish farming

The common types of integration that are being practiced in are as follows:

3.2.1. Fish cum poultry farming

Birds raised for egg (layers) or the one that are raised for meat (broilers) can be integrated with fish farming. This will reduce the cost of inputs, such as fertilizer and feed, so as to maximize profits.

3.2.2. Fish cum pig farming

The pig is a highly prolific animal and its combination with fish not only increase economic efficiency, but also increase its ecological efficacy as wastes, residues, and left over from kitchen, aquatic plants are often used as pig food. The excreta in turn are used as organic manure in fish ponds.

3.2.3. Fish cum crop production

This is the cultivation of agricultural crops (e.g. vegetables and arable like maize, rice etc) and aquatic plants (like water spinach, water chestnut etc. with fish farming. This is widely practiced among the farmer in the rural areas, at subsistence level. The vegetables, like water leaf and spinach among others are planted on the dykes, while in the case of rice; it is planted right inside the pond. The crops derive water and nutrients from the fish ponds while the crops serves as food, especially for herbivorous fish. Besides, periphytons on the crop may enhance yield of cultured fish species.

3.3. Economic benefit of integrated fish farming

The economic benefit of integrated fish farming cannot be over-emphasized since the integration is varied and diversified in nature. It is one of the most viable, reliable and profitable of any farming enterprise. It contributes immensely to the economic empowerment of many families especially in the rural communities. It enables the farmer to be productive all the year round and fully maximize its production. Its contribution in the enhancement of food security and self sufficiency is below:

- Food security
- Self sufficiency
- Regular source of income

3.4. Ecological importance of integrated fish farming

Sustainable agriculture depends upon eco-friendly culture system for its survival. One of the appealing features of integrated farming is that it leads us to view farms in terms of interdependent components. Integrated farms are comprised of different ecosystems that can be described, modeled, analyzed and compared; they are guided by principles, and the parts that make them up and the way these parts are related . In any integrated system, the interrelationships are many; crop byproducts are fed to animals, while fish and animal manures are returned to the crops and fish in the ponds. The fish may feed on insects and weed in the rice field planted inside the pond and this in turn can

increase the available nutrients to the crop. The ecological efficiency of an integrated fish farm is very paramount to the success of the entire farming enterprise,

Self-check 3	Written test

Directions: Answer all the questions listed below.

1. What are the factors for the type and level of integration (4 points)
2. List the economic benefit of integrated fish farming (6points)

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

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

Information Sheet 4- Evaluating advantages and disadvantages of integrated livestock-crop

4.1. Introduction

The advantages and disadvantages of integrated crop-livestock farming systems depend very much on:

- the local environmental,
- socioeconomic and cultural context, and
- on the perception of stakeholders.

4.2. Advantages and disadvantages of integrated livestock-crop

Advantages and disadvantages of crop-animal systems compared to specialized crop and specialized livestock production systems: are given below

Advantages

- Greater buffer against market price fluctuations
- Greater buffer against climate fluctuations
- Greater nutrient recycling due to more direct soil-crop-animal manure relations
- More diversified income sources
- More consistent labor demand
- Better weed and disease control
- Alternative use for low-quality roughage
- Greater sources of security and savings
- Greater investment options
- Greater social functions

Disadvantages

- Greater requirement of expertise (double expertise needed)
- Greater investment in diverse equipment
- Less opportunity for benefiting from economies of scale

Self-check 4	Written test

Directions: Answer all the questions listed below.

1. List the advantages of integrated livestock-crop farming system (10 points)
2. List the disadvantages of integrated livestock-crop farming system (3points)

Note: Satisfactory rating - 13 points Unsatisfactory - below 13 points

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

Information Sheet 5- Maintaining physical and financial records of production

5.1. Record keeping

You can improve your grazing system with good records of pasture yield, grazing days, and other data because they allow you to evaluate past efforts. If you keep good records and compare yield estimates with data from actual grazing days, you will be able to more closely calculate the actual yield for your farm and your conditions.

Grain producers determine the number of inputs to use based on the yield they will gain from each one. Because inputs and the resulting yield are easily measured, grain production systems can be quickly refined and improved. Good pasture records are slightly more difficult to collect, but they can also contribute to rapid improvement of pasture systems. One objective of pasture improvement is to increase yield, but changes in pasture management may also target herbage quality, yield distribution, or persistence. Pasture improvement may result in improved gains, increased carrying capacity, or reduced need for supplementation during summer months.

Records help a manager:

- place a value on improvements and
- make decisions on where to spend limited resources to maximize the benefits.

These improvements are not necessarily obvious unless producers keep good records and study them.

All your record information should be entered in a timely manner and regularly reviewed. It should include:

- record year,
- paddock identification,
- paddock size,
- monthly rainfall,
- date and amounts of fertilizer,
- seed and pesticide inputs, and
- the most recent soil test data.

In addition, each time a paddock is grazed, record the number and average size of animals, dates in and out, pasture height at the beginning and end of grazing, and yield estimate and stand density at the start of grazing.

5.2. Using records for planning

Records must be studied. Some people diligently keep records and file them at the end of the season. It will take some work to compile records into a form that you can use efficiently, but this effort is worthwhile. If you are going to keep records, commit yourself to using them.

Here are a few questions that might be answered by studying your pasture records:

- How much did legumes increase animal grazing days per acre during the summer?
- How much did fertilizer improve animal grazing days per acre?
- Which pastures and forages performed best in a dry year?
- How severe is the summer slump? Do you need to increase production during this period?
- Are your pastures improving or declining? Do you need to increase or decrease stock density to improve your pastures?
- Did your stockpile run out before spring growth began?
- How many more acres of stockpile do you need to support the herd?
- Can you fill gaps in forage production by grazing crop residues?
- Did your pasture management improvements result in reduced costs, increased carrying capacity, or better gains?

Physical and financial records of pasture include:

- seed and fertilizer rates and costs,
- number of paddock operations and fuel costs,
- types of chemicals, rates and costs of applications for weed,
- pest and disease control,
- amount of irrigation water applied and application costs,

- weather conditions during growth,
- purchased labor,
- contracting and share-farming.

Self-check 5	Written test

Directions: Answer all the questions listed below.

1. What are included in the record information of pasture (7 points?)
2. List the questions that might be answered by studying your pasture records (9 points)
3. list the physical and financial records of pasture production (12 points)

Note: Satisfactory rating - 28 points Unsatisfactory - below 28 points

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

Operation Sheet – Determining pasture yield using rising plate meter

Objectives: to determining pasture yield using rising plate meter

Procedure:

1. Walk through the paddock in a W pattern.
2. At a fixed interval—20 to 35 foots steps— collect a hand clipping to ground level in an area of 3 feet by the shear width.
3. Insert clippings in individual bags and label the bags according to the order in which they were collected.
4. Push down the rising plate meter and record the accumulative pasture number.
5. Repeat steps 2 to 4 throughout the W pattern. If paddock is small, at least 15 samples are needed.
6. Weigh each bag. This is the bag wet weight (Bag Ww).
7. Randomly select three bags.
8. Weigh selected bags. This is the wet weight (Sub Ww).
9. Dry selected bags.
10. Weigh selected bags. This is the dry weight (Sub Wd).
11. Calculate percent DM content (%DM) of selected bags: Sub Wd ÷ Sub Ww x 100
12. Calculate average %DM.
13. Obtain bag DM for each bag: Bag DM = Bag Ww x average %DM
14. Calculate the clipped area: Shear width (ft) x 3 feet ÷ 43,560
15. Calculate pounds of DM per acre (DM/A): Bag DM ÷ clipped area

LAP TEST	Performance Test

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3** hours. The project is expected from each student to do it.

Task: Determine pasture yield using rising plate meter

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The trainers who developed this learning guide

S.NO	Name	Qualification	Educational background	Institution	Region	Phone Number	E-mail
1	Abera Shiferaw	B	Animal production and health	Holeta PTC	Oromia	0911556155	aberashiferaw2014@gmail.com
3	Temesgen Roro	A	Animal Production	Holeta PTC	Oromia	0917657496	temesgenroro@gmail.com
5	Ayele Mengsha	A	Animal Nutrition	Holeta PTC	Oromia	0911802467	ayelemengesha@ymail.com
6	Wondiye Hateu	B	Animal Production	Holeta PTC	Oromia	0925255341	harme2013@gmail.com