COMPETENCY: You should be able to have a good understanding of the sector and the opportunities in agriculture for a living in Uganda

Key words

i. Agriculture
ii. Nomadic
iii. Production
iv. Subsistence
v. Commercial
vi. Activities

By the end of this chapter , you should be able to

1. Understand the historical background of agriculture in terms of animal herding, the nomadic way of life, food gathering and hunting
2. Understand the value of agriculture to society and human being
3. Understand the value of the farm as a production unit
4. Understand the value of various farming systems and their socioeconomic impact in Uganda
5. Understand the importance of keeping records in agriculture
6. Understand the requirements of a career in agriculture and key principles of the labour act on the living conditions of the farm workers

Introduction

In this Chapter you are going to find out the opportunities and benefits of engaging in agricultural production activities. This will enable you to identify possible careers that will enable you produce enough food and have enough income to live a comfortable life.

Developing an interest in agriculture can lead to a fulfilling career. Think about the different activities in agriculture and select those that appeal to you. Engaging in any of these will lead you to discover the opportunities in Agriculture. What is the most common commodity people buy or sell in a market on a daily basis in your community? Have you ever imagined a day without food?

Historical background to agriculture in Uganda

People must have food to live and there are different ways of getting food. In Uganda, many years ago people used to get food through hunting and gathering. It became more and more difficult to get food which forced the people to domesticate crops and animals for a more reliable supply of food. Before 1900, shifting cultivation and nomadic paternalism were the main forms of agricultural production. They have long been replaced by commercial farming on large scale production using fertilizers, machination, agrochemicals and selling to the market beyond the local community.

Activity 1.1: Exploring agricultural activities in your community

You will need: note book, pen and observation list

In pairs

1. Develop an observation list of agricultural activities and products in the community
2. Make a plan of your movement in the community
3. Carry out the visit, observe, identify and record agricultural products produced in your community and suggest their uses.
4. Present your findings in class.
5. What do you say about the agricultural activities and products in your community?
6. Compare agriculture and nomadism by completing the table below

Table 1.1 Comparison of agriculture and nomadism

	What you know about it	Examples to show it	Definition
Agriculture			
Nomadism			

7. Extended work in groups "Identify the value of agriculture and the prospects for the future of agriculture in Uganda, regionally and globally
8. Extended work in groups "Investigate the evolution and progress in development of agriculture activities in their community and other regions in Uganda"

The value of agriculture to the community

Agriculture is the way of life for most people in Uganda. About 70% of the population is engaged in agriculture. It contributes about 25% to the national gross domestic product (GDP). Local agricultural production contributes 85% of the food consumed in Uganda.

Activity 1.2: Importance of agriculture to society

You will need: notebook and pen

a) Individually, write down the names and occupations of about five family members within their local area, indicating how; what they do for their income and livelihood directly or indirectly relates to agriculture

a)

b)

c)

Figure 1.2 Products from agriculture

b) Answer the following questions in your exercise book.

1. Study the photographs above and mention what you see
2. What role does agriculture play in relation to what is found in the photos
3. Why is agriculture a main way of life for about 70 percent of the people in Uganda?
4. List five benefits Ugandan get from Agriculture

c) In groups, collect pictures / labels /samples and make posters showing the food and other products people get from crops and animals

d) In pairs, can you unscramble these letters to find these crops and animals that you might get on farms in your community? Write your answer next to the box. There are other crops and animals you can find in the Uganda. How many others can you think of? Write their names and what it does for us as human beings?

sowc	
srohe	aet
scihkcne	fefoce
sfhi	nabana
ooesg	bacebga
ykonde	wappwa
igsp	hilci
	ctuelte
ehpes	
btarib	ganom
atog	ecir

Understanding farming systems in Uganda

Agriculture can be looked at as a production system where inputs are changed into products through a production process. The most important inputs are include natural sources like water sunshine and soil and manmade sources like seeds, animals, fertilizers, agro chemicals, labour and machinery. Some operations that are involved include ploughing, digging, sowing, irrigation, weeding, crop care or protection and harvesting. While the outputs from the systems include crops, wool, dairy, meat, hides, manure and poultry production. Therefore a farm is a system with inputs, processes and outputs. A farming system is everything that the farmer does in farming under the existing climatic, socio and economic conditions of an area.

A farming system is a way of organizing a farming enterprise. Systems vary widely depending on several factors.

Activity 1.3 The value of farming systems and their socioeconomic impact on Ugandans

You will need: note book and pen

a) 

b) 


c)


d)


e)


f)


g)

Figure 1.3 Different farming activities in Uganda

Table of a farming system approach

Inputs	**Processes**	**Outputs**
Pastures, dairy cows, water	Feeding	Milk

a) In groups answer the following questions in your exercise book.

1. Study the photographs above and mention what you see
2. What farming system is shown in each of the photography above
3. Of what value is each of the farming system above and the benefit to the people shown in the pictures

Individually learners will discover some animals. They will get to know what each animal eats; where they live and which product they give.

b) In groups, research on four different farming systems in Uganda including one of your community, noting and reporting to the class on the:

i. reasons for different systems in different regions

ii. the value of farming systems and the benefits to Ugandans

c.) In pairs or groups, draw a map of Uganda, research and indicate the areas of crop and animal production.

Importance of record keeping in agriculture

Record keeping is the act of writing down or documenting the activities you are involved in. In the past people used to keep all their information in the head. Today this has changed because the quantity of information that needs to be kept is big. So there are special record books or computer programmes that may be used. Keeping records helps effective running of farm activities. The activities include planning, budgeting, implementing and evaluation of farm activities.

Figure 1.4 Farm records office

Keeping records on the farm

Record keeping is an important aspect in all human activities. We all keep records of some kind as you do activities. This is because all of us need to keep track of what happened. Farm records are essential to good farm management. Planning decisions rely on information concerning expenditure, use of stock and productivity. Without records the farmers has to make decisions based on guesses. This makes farming activities to be risky. The exact records kept depend on the farming enterprise or activity.

CASE STUDY

Case study of Porena and Minu

Porena and Minu operated a small scale business which dealt in selling fruits of all varieties, such as pineapples, oranges, passion fruit, bananas, watermelons, grapes and many others. They received their supplies directly from the farmers. To ensure good operation of the business they tried very hard to keep good records. They maintained a supplies book where he recorded all the supplies from each supplier. In the supplier book they recorded the quantities supplied and the amount of money the supplies were worth. They also maintained a cash book where they recorded the cash sales. They also recorded any credit given to their customers on small pieces of paper. They also recorded all the business expenses in a hard cover book.

Porena and Minu was very happy with the record keeping but one day the pieces of paper on which they recorded the creditors disappeared and subsequently, they were not able to tell how much they owed their creditors. This had taken two seasons. Yet each season many people carried out business with them.

Porena and Minu found it difficult to recall the exact person who gave them credit and the total amount to pay from their head or memory. So they kept on wondering who to pay and how much to pay.

In 2018, the Uganda Revenue Authority (URA) staff visited Minu's and Porena's vegetable and fruit business and demanded to see their records. They had no clean book to presents. The data was difficult to understand as on some pages you could find phone numbers with names in the column of total amount. Minu and Porena were surprised to hear that vegetable and fruit sellers were required to maintain records for inspection by the Uganda Revenue Authority staff. The URA staff gave them one month to prepare the records. They did not know where to begin.

Activity1.4 Understanding the importance of record keeping in agriculture

You will need: note book, pen

a) Individually or as a group read the case study above.

What is it about? How effective in your opinion are Minu and Porena at record keeping? Identify the records that Minu and Porena should maintain to meet the requirements of the URA. If you were Minu and Porena, what methods could you employ to improve the system they have?

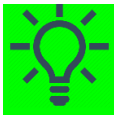
b) In groups, prepare and present a role play of a conversation between two farmers, one who recognizes the importance of keeping records and one who does not. Have a whole class discussion to consider who is likely to be more productive and why.

c) In pairs,

1. Identify and write the kind of information found in each of the types of record above

Type of record	**Information shown**
Production records	
Financial records	
Health records	
Breeding records	

2. Mention the importance of keeping each kind of information in the records above



Careers in agriculture

Most young people wonder about their future. They want to be successful in something they enjoy doing. They want to have enough income to live a comfortable life. To achieve this **it requires good planning and preparation**.

A career is an occupation undertaken for a significant period of a person's life and with opportunities for progress. It is the general direction of a person's life in terms of employment. A **Career** may be the sequence of jobs that a person holds to make a living. This may lead a person to have a good income and a better standard of living

Careers in agriculture are grouped into pathways. **A pathway** is a group of careers with similar education, training and interests. There are several career pathways in agriculture including animal, crop, nutrition, agribusiness, conservation and technical systems.

Since you will probably spend the greater part of your adult life working, you will need to familiarize yourself with all kinds of career possibilities in agriculture for you to realize where your interests lie so as to identify a career for better life.

Activity 1.5 Available career opportunities in agriculture

You will need: note book, pen,

a) In groups, investigate and prepare a presentation on the:

i. different agricultural careers and the appeal of each

ii. working conditions of farm workers in relation to the provision of basic necessities provided within the agricultural sector

b) Individually recall or go out in your community and identify;

i. One individual doing a career in agriculture

ii. Find out how he/she made it, the opportunities and challenges faced in doing that career.

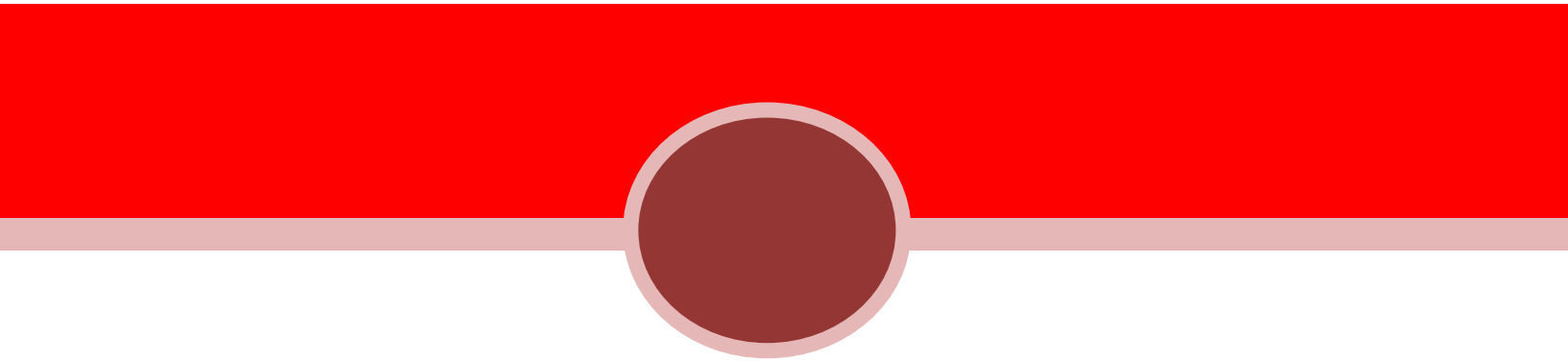
iii. Are there any other careers in agriculture? if so list them down

iv. Present your findings in class

ACTIVITY OF INTERGRATION

Context

Most young people wonder about their future. They want to be successful in something they enjoy doing like the great celeb you know in Uganda. They want to have enough income to live a comfortable life. They must have interest in those things that appeal to them. They look at opportunities and develop plans to achieve their desires. Agriculture has many such areas.



Support; *pictures of a goat farmer; cheese maker; pesticide applicator worker*

Task

Identify something in agriculture you want to be successful in and write down the opportunities and challenges involved.

COMPETENCY: You should be able to use measurement tools; crop and animal tools, equipment, machines and implements properly and safely in agriculture activities to ensure safety on farm.

Key words	By the end of this chapter, you should be able to
vii. Tools viii. Equipment ix. Implement x. SI UNITS xi. Safety standards xii. Hazard xiii. Health standards xiv. First Aid xv. Husbandry practice	a) Identify tools used on the farm including garden tools, woodworking tools, metal tools, and the basic tools used for fencing, mechanics and farming activities b) Demonstrate skills of using farm tools and implements for better production c) Show skill in using common measurement tools for length, volume, time, and mass/weight d) Demonstrate basic occupational safety and health standards in agriculture e) Show skills in applying the steps in giving First Aid on the farm and during agricultural activities

[illegible] a suitable site for your selected crop to grow or livestock to rear, you need right tools to make work easy. There is need to prepare your planting site, restrain your animal, administer drugs, move materials from one site to another and many more practices. To do all this, you need to know the right tools, implements and equipment to use.

Figure 2.1 Common tools on the farm

Identifying tools used on the farm

What is the name of the picture in figure 2.1a and b? Where is it used in your community? Did you know the names of its parts? Now look at figure 2.1c, d, e, f and g. What does it do for farmers? You realize that tools can be grouped into categories based on the type of work they can be used for; these tools will include garden tools, woodworking tools, metal tools, and the basic tools used for fencing, mechanics and animal handling. A wrong tool for the wrong job does not only waste time but causes irreparable damage both to the tool and work being done.

Activity 2.1: Tools used on the farm

You will need a pen, note book and drawing pad.

a) In pairs,

i. Categorize different farm and measurement tools provided according to their uses in: the garden; the workshop; animal husbandry; crop husbandry and building.

ii. Discuss how each tool is used and prepare a report to present

b) In groups, pay a visit to the school workshop or nearby farm;

i. to identify common tool used

ii.list the functions of each tool

c) Extended work in groups

i. Investigate the reasons for using different tools, equipment and machines in agricultural activities.

ii. Identify career opportunities in manipulating these equipment and machines in agriculture

Conversion of units in agriculture

All of us use measurement in some form on a daily basis. Some activities and professions depend on having competent measurement skills. The builders, farmers, landscape gardeners, veterinarians, plant doctors, crop breeders, processors and retailers of agricultural products all need to calculate mass, length, time, area, volume and dilutions efficiently. A nursery bed operator, for example, may need to calculate the length of wood required tomake a seedbed box, the volume of soil to fill it and the amount needed to water seedlings there in. Our ability to accurately measure the length of wood will save money and energy of carrying timber you are not going to use. However the timber dealers use their own measurement and nursery bed operator applies a different unit.

With all of the different measuring systems in the world, converting units can come in handy. When you have two units, they must measure the same thing. For example, you when you have "convert 2 metres into centimetres," both metres and centimetres measure length. If your units measure two different things (like length and weight like 2 grammes and 2 metres), you cannot convert them. While those measuring the same things can be converted. For example if a bicycle is moving 10 Kilometres per hour, how many metres does it travel in one minute? Now you can practice conversion of units. Remember, you can only convert between two units that measure the same thing. In our example, we have units that measure length (kilometres and metres), and units that measure time (hours and minutes). Start with one pair and find the conversion between them. For example 1 kilometre =1000metres and I hour is 60 minutes. This is to say that the metric system, also called the decimal system, is designed for easy conversion. To convert from one metric unit to another, you only have to work with round numbers: 10, 100, 1000, and so on.

Activity 2.2: Conversion of units on farm tools and equipment

You will need a calculator or computer and conversion table

a) In pairs, converting different measurements in agriculture as required.

i. 6290 mm into cm, ii. 780cm to m iii. 53,000m into dm

iv. 40,000 dm into km v. 360 seconds into minutes vi. 180minutes to hours

vii. 2.3 km to m viii. 59 cm to m ix. 1hour and 10 minute to seconds

b) Individually practice converting different measurements in agriculture into the Standard Units (SI units)

i. A vegetable garden of 226cm by 64cm

ii. A path to the farm with 25tiles each 40cm wide

iii. A tractors ploughs an acre of land in 1 hour 20 minutes

v. Milking a cow in 4 minutes

vi. 600cm^3 of milk in a bottle of drinking water to litres

c) In groups

i. select a tool of your own choice to carry out the tasks assigned to you by the teacher from the following: -size of the flower bed; length of the science laboratory; weighing a bucket of beans; the amount of water in a watering can; the hole dug for planting a banana sucker or mango tree; period required to fill a 500ml bottle with water from a water source

ii. Describe the procedure you follow in carrying out the task to the class

iii. What did you learn from the task and presentations

Standard International Measurements

Many things in real life occur as quantities**.** Quantity is a property of materials that is measured [such as mass, length, time, volume, pressure]. The measurement is in units. A unit is a standard quantity against which a another quantity is measured [such as gram, metre, litre, second; and these are units of the above quantities] (10 minutes)

These are the Standard International (SI) Units. It was the in 1954; the 9th General Conference on Weights and Measures (**CGPM**) created the first version of the International System of Units. The base units that they used were the metre, kilogram, second, ampere and Kelvin. The seventh base unit, the mole, was added in 1971

Unit	**Symbol**	**Quantity**
metre	m	length
gram	g	mass
litre	l	volume
second	s	time
ampere	A	electric current
kelvin	K	temperature

Proper use of farm tools and equipment in carrying out farm practices

Farm tools are the equipment that are used in the processes of land preparation. For example the hand hoe, rake, slasher, axe and panga. While *farm equipment* is any kind of machinery used on a farm to help *with* farming. The best- known *example* is a tractor. There are also many other *farm implements. How do you use these farm tools and equipment? Tools and equipment are designed to perform a particular task on the farm. For instance a hoe is*

used to dig soil and a bucket or pail is used for milking cows. Therefore when choosing a tool make sure you use the right tool for the right job. Accompany this by keeping them rust free, free of slippery oils, have a budget for replacing broken and worn out tools.
Also when using your tools, equipment and machines:
• Have them organized in a pouch or store, tray, or other system, with each tool going in its own place. This way, you can easily see at a glance which one you might need for task you want to carry out.
• Wipe each tool clean after use
Further when storing tools, equipment and machines:
• Never throw tools or equipment into a tool box. Carefully place each tool or equipment into its proper place in the store or tray.
• Never leave tools or equipment lying about, especially on the floor.
• Record each tool when getting it from the store and on returning it. Report damaged, broken and lost tools as you returning from doing the task.
• Always put tools or equipment away at the end of the activity, even if you are working in a closed room. They must be maintained and kept safely.

Basic occupational safety, health standards and first aid during agricultural activities

Safety is the condition of being free of harm and danger. However on the farm you are using tools, equipment and machines. Some of these have cutting blades, sharp edges or piercing ends. These may cause harm or danger to the users. Therefore it is important to handle them carefully. You can do this by preventing accidents and having a productive working environment which are part of safety precautions on the farm.
When using tools, equipment and machines there are many possible hazards. Therefore a farmer must take precautions. In addition manufacturers provide information on safe use of tools and equipment. You must read, understand and practice safe use of tools and equipment. This does not prevent injuries can occur. Why do you think this happens?

As farmers we need to practice safety during agriculture activities. Routinely you need to follow good safety practices in the farm, laboratory, and daily activities. This will prepare you to practice safety during agricultural tasks and on the job as a good practicing farmer. This may require you to do some of the following:
-Under all circumstance wear protective gear.

-Ensure that you use tools and equipment when you are physically and emotionally sound.
-All your gears should be worn securely to avoid entanglements with tools and equipment you are using.
-cover sharp edges and piercing ends to avoid causing harm to yourself and others
-the right person should use the right tool, equipment and machine for the right job for example you can be a **Farm Equipment Mechanics and Service Technicians**

FARM EQUIPMENT MECHANIC AND SERVICE TECHNICIAN
a) Record details of repairs made and parts used.
b) Reassemble machines and equipment following repair, testing operation and making adjustments as necessary.
c) Maintain, repair, and overhaul farm machinery and vehicles, such as tractors, harvesters, and irrigation systems
d) Dismantle defective machines for repair, using hand tools.
e) Repair or replace defective parts, using hand tools, milling and woodworking machines, lathes, welding equipment, grinders, or saws
f) Using relevant information and individual judgment to determine whether events or processes comply with laws, regulations, or standards.
g)Install and repair agricultural irrigation, plumbing, and sprinkler systems
h) Calculate bills according to record of repairs made, labour time used, and parts used
i) Clean and lubricate parts
j) Fabricate new metal parts, using drill presses, engine lathes, and other

Accidents in our life

Accidents are caused by being careless. Accident can hurt you or cause injuries to us. Different accidents can lead to scratches, scrapes, damages, cuts and bruises. While fatal

accidents can result in broken limbs or loss of life. Injuries take time to heal or to get better and cost huge amounts of money. You need to avoid all this.
Accidents may happen anywhere and at any time. You should therefore be careful so as to avoid accidents happening. You can do this by being cautious and thinking critically before you do something. For that reason there are many safety rules and regulations that help farmers to prevent accidents. One of them is giving first aid.

First aid is the assistance given to any person who gets an accident and is suffering a sudden injury or illness with care to save life or promote recovery. First aid refers to the emergency or immediate care you should provide when a person is injured or ill until full medical treatment is available. The first step in any emergency is the recognition of the problem and providing help. Whether you are at home, work, or school, knows where the first aid kit is kept. After determining the problem, the next step in providing help is to determine the unresponsiveness of the injured or ill person. The best way to determine this is to tap the person and talk loudly to them: "Are you okay?" After determining unresponsiveness, yell for help. Then you pick the first aid box to get out what you can use to provide immediate care.

Activity 2.3 Administering first aid

a) In groups imagine a student in your class has got an accident while using farm tools.

i. Design a role play and act out how you can provide first aid to the injured.

ii. Make presentation to be displayed in your school to ensure safety on the farm

b) In groups, research on First Aid and the basic occupational safety and health standards in agriculture by listening to an invited speaker or using the internet or other resources. Present the group's messages about what all agriculture workers should know and be able to do with respect to paying attention to health and safety plus carrying out First Aid.

ACTIVITY OF INTERGRATION

a) **Context**

If you go out to the community, what do you see? You will see farmers, fields and farms. Oh! The list continues, and trees, hedges, birds, insects……It's a long list! Farms rear animals

like goats, poultry, sheep, cattle and pigs and can grow things such as maize, millet, banana, coffee, sorghum, tea, tobacco, cotton, sugarcanes, fruit and vegetables. They use tools, equipment and machines. The people wear things like gumboots, caps, gloves and overall coat.
Farms are wonderful places to visit. You may have been to a farm on a school visit in your primary school or on a trip with your parents. Some of you may even live on a farm. It is important to remember that farms are work places and so they might be dangerous objects and you need to take care.

b) Supports

Picture showing a farm with people wearing gum boots, a farm workshop for tools, garden tools, a tractor, farm house, crops and animals

c) Task

The senior 1 you have been asked to establish a small garden for growing vegetable to replace the flowerbeds in the school compound, using the information in this chapter to make a presentation on what you should do.

COMPETENCY: You should be able to understand how soil is formed from rocks through the process of weathering.

Key words

a) **Soil**
b) **Rocks**
c) **Weathering**
d) **Nutrients**
e) **Soil fertility**
f) **Soil pH**
g) **Fertilizer**
h) **Soil texture**

By the end of this chapter, you should be able to

- Show skills in analyzing soil and identifying the different components
- Understand the different types of weathering processes and factors influencing soil formation
- Show skills in distinguishing between the different soil particles, soil textures, soil structure, soil profile horizons and types of soils as used for agricultural purposes
- Show skills in
- Understand the importance of plant nutrients and soil pH
- Demonstrate soil improvement practices and understand their effects on plant growth

In this chapter you will know more about soil. Soil is the upper layer of earth in which plants grow. This is the uppermost layer of the earth crust. It is a black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles. It is portion of the earth crust consisting of disintegrated rock and humus. Thus soil consists of a mixture of inorganic and organic particles in various proportions.

What is soil?

Soil is that material which nourishes and supports growing plants. These include rocks, water, organic matter and air
Because plants get support, nutrients and water from soil making an important area in agriculture. This material do provided human beings the ability to produce food through agriculture. It is also where man and other animals are held to carry out several activities that support life.

Components of soil

The four major ingredients of soil are minerals, organic matter, air and water. Mineral and organic matter is the solid particles in soil. While water and air fill up the spaces between the particles. In the soil you also find living organisms; some are very tinny to be seen with our naked eyes. While other organisms are big like moles, millipedes and centipedes.

Figure3. 1: Composition of Average Soil

Air 25%
Water 25%
Mineral Matter 45%
Organic Matter 5%

Draw circle showing those percentage composition of soil

3.1 a) Activity: Examining the composition of soil

- In your group get three different sample of soil from various places in your community (garden, near a kraal, from a swamp, from a forest/tree plantation, school compound, lake shore/river bank/dam/pond)
- Place a given amount in a jar/measuring cylinder with a lid
- Add some water so that the jar/measuring cylinder is three quarter full
- Put the lid/palm firmly and shake the jar/measuring cylinder
- Leave the jar/measuring cylinder and its content to settle for two day
- Repeat for all you samples collected
- Make your observation on how the particles settle
- Describe what you see in the jar/measuring cylinder

3.1 b) Activity: Investigating the main components of soil

In small groups carry out the following experiment

- Get two dry sample of soil from two areas (on top of a hill-A and in the valley-B) in or around the college. Label the soil samples A and B
- Get three dry 250ml conical flasks or 100ml measuring cylinders and label any two A and B respectively
- Stick on the side conical flask/measuring cylinder a strip of graph paper
- Put 70ml of dry soil sample A into the respective conical flask/measuring cylinder
- Put 70ml of dry soil sample b into the respective conical flask/measuring cylinder
- Measure 100ml of water and pour it into each conical flask/measuring cylinder containing the soil samples A and B
- Cover with your hand or cover and shake thoroughly for 2minutes. Repeat this for the other conical flask/measuring cylinder
- Allow the conical flask/measuring cylinder to stand for 10minutes.

1. Examine the results of your experiment after settling
2. Estimate the percentage of each type of soil particle using the formula

$$\text{Percentage of soil component} = \frac{\text{Height of the component}}{\text{total height of all solid matter + height of organic}}$$

NOTES: During the experiments at first you will be able to see bubbles come up in the cylinder as you pour the water. This means that soil contains air. The things that float on top of water in the cylinder are pieces of dead plants, dead insects, old rotten roots or leaves and small soil particles. While the heavy soil particles will sink by size. The bigger soil particles will sink to the bottom. The colour of the water in the cylinder will start as brown then clear after 7days. Humus make the soil look dark brown.

Soil formation

Soil is formed from a mixture of mineral particles, air, water, decaying plant and animal materials. The mineral particles come from rocks. The rocks are the solid material forming the earth crust. Thus the crust of the earth is made of solid rock. But deep inside the earth is very hot. When the rock inside is very hot it melts to form a liquid. The molten rock is called magma. Magma is a mixture of different minerals. When magma cools it forms new rocks. Thus the rocks are classified by the way they are formed. These rocks differ in their chemical composition and the way they were formed. These rocks are of three types: igneous, sedimentary and metamorphic rocks.

Activity 3. 2 Investigating the properties of rocks

- In your group look at three different rocks(metamorphic, igneous and sedimentary) given to you
- Write down a list of questions you will need to ask about these rocks (texture,colour, roughness, crystal, size, porous, hard by scratching)
- Use a hand lens to examine the rocks
- Describe what you see
- State four properties of these rocks

Weathering

Rocks do not stay the same forever. They get changed slowly and with time. **Weathering** is the breaking or splitting down of or rocks. It is the process by which rocks break down to form soil particle.

.

Types of weathering

Two important classifications of weathering processes exist – physical and chemical weathering; each sometimes involves a biological component.

a) Physical weathering

This involves the splitting of rocks into small particles without any change in chemical composition. The agents of physical weathering are:

i) Force of running water

When water is fast flowing in a river or stream, it carries along with it any small rocks, stones, boulder and other particles. As these materials move they knock each other and keep breaking. The small particles that break off, form part of soil.

ii) Glaciation

Rocks are split by the movement of huge blocks of ice ending up knocking each other and splitting into small particles

iii) Freezing of water

When rain water collects in cracks in rocks. When it becomes very cold, this water freezes and expands. This is due the anomalous behaviour of water. This forces the crack to widen, making the rock to break.

iv) Wind

When strong wind blows small particles they knock each other and split further into small particles.

v) Temperature

When temperatures are high the rocks expand and when it becomes cold they contract. The expansion and contraction of rocks is caused by heat from the sun rays and cooling in the evening cause rocks crack and split. These changes in temperature weaken the structure of rocks leading them to split into small particles

b) Chemical weathering

This involves a change in the chemical composition of the original rock. The processes involved are:

i) Solution

When water dissolves any soluble minerals found in rocks, this weakens the structure and changes the form of the resulting rock. Thus the rock will easily crumble.

ii) Hydrolysis

When weak acids react with minerals found in rocks they form new substances that dissolve out and this weaken the structure of rocks. Examples of weak acids are Sulphur dioxide and nitric acid.

iii) Oxidation

When oxygen from air reacts with minerals like Iron-and Aluminium-containing rocks new compounds are formed. These weaken the structure of rocks

iv) Carbonation

When carbon dioxide reacts with metals found in rocks to form carbonates, it weakens the structure of rocks.

c) Biological weathering

i) When heavy animals move over rocks will set up vibrations that weaken the structure of rocks.

ii) The activities of human beings like stone quarrying, construction, dynamiting and mineral extraction lead to rocks being broken into small particles

iii) When plants and animals die they decompose/decay into organic matter and humus. These are components of soil and contain plant nutrients.

iv) The activities of burrowing animals like moles and squirrel mix rock particles with organic matter

v) The activities of animals with sharp hooves on rock surfaces will cause crumbling of rocks.

vi) When the roots of plants or mosses will create humid condition to speed up chemical weathering. Also if the grow in cracks will expand in size and widen them leading to splitting of rocks.

Factors influencing soil formation

Weathering is the process whereby rocks are split into smaller and smaller particles. This is the kick start of soil formation.

1. Parent material

This the material from which soil develops. These materials include rocks, stones, in some places peat, and specific minerals. Peat is the decaying plant matter found in a very wet place.

2. Climate

The action of wind, temperature and rainfall of an area affects the weathering process and the movement of rock particle.

Strong winds can move large quantities of particles from one area to another

Heavy rainfall around streams and rivers fill up or swells up then carry particles to far away distance.

Activity 3.3 Micro organism decomposing of plant remains

- Gather fresh plant material and cow dung
- Dig a trench or hole
- Put the fresh material and cover it with cow dung in the hole
- Check on the material after 7days
- Find out what is happening on the materials
- Find out whether there are any living organisms feeding on the materials
- Describe what happened to the material?

3. Living organisms

First the dead plants and animal remains are acted on by microorganisms. They decompose the materials. Decomposition or decay is the process by which plant and animal materials are broken down to form part of soil. The part of soil formed from these materials is known as organic matter or humus. These bacteria and other living organisms in the soil break all organic materials into smaller particles as they feed.

4. Topography

Topography is the nature of the land surface. The slope of the land clearly affects the distribution of soil. Land that slopes will have faster water runoff and dry out more quickly. Water running down the hills picks up soil particles and carries them off. So you find that the hill tops have little amount of soil. While the low laying and valleys receive most of the soil particles carried by erosion. Thus have huge amounts of soil and nutrients.

5. Time

The weathering process is only the beginning of the long journey to form soil. Soil is known to takes many years to mature. It involves distribution of particles, movement of the rock particles, the addition of organic matter and the continuing action of soil organisms, rainfall, winds and plant roots gradually form the soil we see after many years. So the age of a soil or how long it has been forming, determines the nature of the soil in an area.

Soil profile

The soil profile is defined as a vertical section of the soil from the ground surface downwards to where the soil meets the underlying rock. The soil profile can be as little as 10 cm thick in immature soils and as deep as several metres in tropical areas where the climate is conducive to rapid alteration of the underlying rock to form soil. In temperate areas, the soil profile is often around a metre deep and in arid areas somewhat shallower than this.

This is the vertical cross-section through the soil showing different horizontal layers soil. The horizontal layers are called horizons. Each horizon differ in colour, depth, texture and structure

Activity 3.4 Determining soil profile

- Observe the different layers of a soil profile
- Select an area in the compound
- Dig up a pit of about 2metres deep or visit a dug pit latrine site
- Was the person paid for digging it? Find out how much was paid for each metre deep?
- How many layers are seen?
- Observe the layers or colour of soil as you dig deeper
- Draw the layers you see
- Study and mention the characteristics of the layers
- Compare your drawing with the sketch below. What differences do you see?
- **How does a soil profile determine the type of crop to be planted in garden?**

At the top in a soil profile you find the most useful part of soil and three other horizons.

Horizon A

This is also called the Top soil. It is covered by a layer of rotting organic matter. Its soils are friable and have a good crumb structure. Air and water can move freely which enable many soil organisms and plant roots to live. Most of the plant nutrients occur in this layer.

Horizon B

This layer known as sub soil has the soil particles closely packed together and there is less movement of air and water. It is red brown in colour. This is an indication of the accumulation of iron. However you also find there silica and calcium often present in large quantities.

Horizon C

This a layer made up rocks slowly disintegrating or weathering. It has coarse rocks, stones and with no or few plant root. It is also called the stony or weathering region.

Horizon D

This is the soil rock at the bottom of the soil profile. It is also called the Bed rock. It may collect underground water forming ponds on top of this rock. It is likely to undergo weathering and in very dry areas some plant roots may penetrate all the other layers to search for water here.

Activity 3.5 Investigating the things that makes up soil

In pairs you will need measuring cylinder, dry soil different layers of dug pit, water, and stop clock

- Get a transparent 250ml measuring cylinder
- Get dry soil from your compound gardens
- Pour 100ml of dry soil into the measuring cylinder
- Add 100ml of water to the cylinder with dry soil
- Record what you see when you have poured all water
- Cover the mouth of the cylinder and shake. Allow the water mix up with water
- Allow the contents of the cylinder to settle for 15minutes. What do you see?
- Are there materials that sink or float?
- What is the colour of the water?
- Draw the final result and label the components in the cylinder of the activity after 7days.

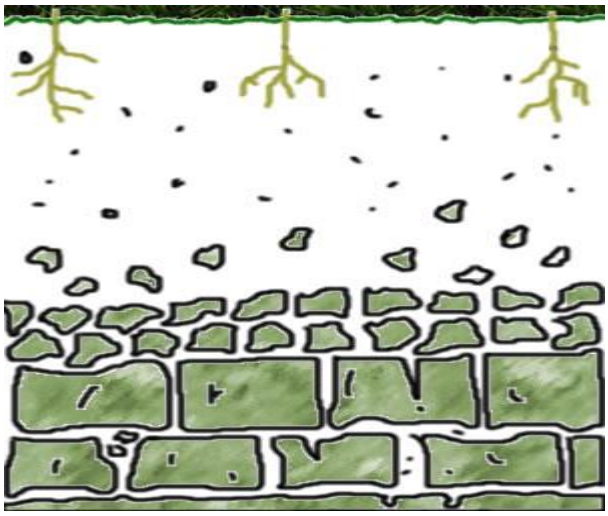


Figure 3.2 **Sketch of** ***the locations of soil horizons***

Importance of the soil profile

A soil with a thick top soil is more fertile and its productivity is good. Yet an area with a thin top soil layer will not have much fertility and will not produce large crops. Therefore farmers need to use practices that keep the top soil from being lost.
A soil profile will determine which crops or vegetation to grow normally in area. Crops with long roots will need deep soil with a sizeable thickness of top soil. This is because deep soils have more nutrients and water to support plant life or thick and vigorous healthy looking vegetation.
While young soils or heavily eroded areas will have thin layers of each of the first three horizons and will be less fertile soils. This renders such places to naturally support few plants or little pale vegetation.

Soil sampling

Soil sampling is the practice of collecting samples of soil from a given area for detailed study in the soil laboratory. Soil samples are used to determine whether soils are acidic or alkaline; have enough and balanced plant nutrient levels. This information is then be used to make and suggest recommendations on fertiliser, lime or phosphate applications for optimal plant production.
Procedure of soil sampling
1. The first step in taking a soil sample is to remove the top surface (1 to 3 cm) of the area to be sampled as this part usually contains and a relatively high content of plant and animal residues (debris) in different stages of decomposition. These do not form part of soil and will most likely introduce error.
2. The second step involves taking what is known as top soil. Top soil is that part of soil that is up to 30cm deep from the top surface. A tool widely used for soil sampling is an auger (see pictures), which works in an analogous manner to a cork screw. It is inserted into the soil by applying a downward force while rotating it, and fills as it goes deeper into the soil. Once filled at the correct depth, the auger is then removed and the top soil placed into a clean, dry container marked “top soil”. If no auger is available, a simple spade will do just as well.
3. The third part of soil sampling involves taking a sub soil, which is a further 30cm deeper into the soil. In other words, a depth of up to 60cm of soil is taken from the same sampling spot. The sub soil is then placed into another container marked “sub soil”.
4. The fourth and final step is to ensure that both the top and sub soils are representative of the whole area that is being sampled by repeating the three steps above several times at other randomly chosen spots (the more replicate samples collected the higher the likelihood that the area will be well represented). The top soils should then be well mixed together to form a composite top soil. The same must be done for the sub soils. The two composite samples must never be mixed together to form a unit sample, but, from each composite, a laboratory sample weighing about 1,5kg must be obtained. The two

laboratory samples (labelled “top soil” and “sub soil” in their respective clean, dry containers) are then sent in for analyses.

Figure 3.3 **Soil auger for soil sampling**

A good sample is obtained by:
(a) first removing the top surface of soil (1 – 3cm)
(b) taking the top soil, which is located up to 30cm into the soil from the top surface using a soil auger or spade
(c) taking the sub soil, which is a further 30cm deeper into the soil,
(d) repeating the three steps above at other randomly chosen spots to ensure that the samples will be representative of the whole area,
(e) mixing all the top soils together to form a composite top soil, and doing the same for the sub soils, then packing it a well labelled container
(f) and finally obtaining a laboratory sample of about 1,5kilogrammes of each composite sample.

There two main methods of soil sampling employed are: Transverse and Zig zag. After soil sampling then you can study more about soil to determine the physical and chemical properties.

Physical properties of soil

Farmers need to know the physical properties of soil. These include size, colour and shape. These soil characteristics of depend on the parent material, amount of organic matter available and weathering process that were in action. Thus the type of soil particles determines the physical nature and characteristics of the soil in a given area.

Activity 3.6: Mechanical analysis of soil particles

Either Part 1: Using a sieve mesh

- Get a set of sieves of different diameter sizes of their holes
- Get a dry amount of garden soil from your area
- Place sieve of the smallest diameter in the holder

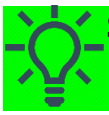
- Place a collecting tray below the sieve holder
- Place 200gms of dried soil in the sieve
- Collect the soil particles that fall through the first sieve to obtain the first fraction
- Repeat the process above with a new sieve of a bigger diameter until all sieves are done

The soil that is collected one by one in order of increasing diameter size will be helping you to separate the soil particles into fractions of the similar size.
The percentage of the whole soil sample (200gm) that each fraction will be representing will be calculated by weight/mass or volume.

Or Part 2: Using a measuring cylinder

- Get a three 250 ml measuring cylinder which are clean and dry
- Measure about 50gm of dried soil
- Place the measured dried soil in the measuring cylinder
- Using another cylinder get 100ml of water
- Pour the measured volume of water into the cylinder with soil
- With one hand in gloves put over the mouth of the cylinder shake it vigorously for 3-5 minutes
- Allow the cylinder to stand for 20 minutes, 60 minutes, 120 minutes, 240 minutes and 7days.
- Record what you see each of the times above
- Draw what you see in the measuring cylinder after shaking up with the dry soil and allowing it to stand for 120 minutes and for 7 days.
- Do you notice any difference?
- What does tell you about soil?

NOTE: Mechanical analysis is a process of separating soil particles according to their size. In the case of a measuring cylinder the particle will settle in order of their size, the heaviest first.. Thus big stones or coarse particles will be found at the bottom of the cylinder. Organic matter or plant and animal remains will float on top. The volume of each fraction can be read off the scale of the cylinder. Sometimes it is called soil sedimentation.



Soil texture

Soil texture is the size distribution of different particle that make up soil. It is the proportion of clay, silt and sand in a given sample. Soil texture determines the size of the spaces between the particles. These spaces between the particles are occupied by air or water you find in the soil. In turn this will influence the living organisms that can be found and the movement of water through the soil particles.

For instance the large particles of sand do not fit closely together. Thus they have large air spaces between them and water easily passes through these sand particles. Consequently sand soils cannot hold water for a long time.
While clay particles are very small and this allows them to stick together very closely. Hence these particles have no or little air spaces between them and water does not easily pass through. Consequently clay soil particles hold water for long and are known to be poorly drained.

Soil structure

Soil structure is the way soil particles are arranged together to form an aggregate or lump. It is the way the soil particles stick together and hold our plants.

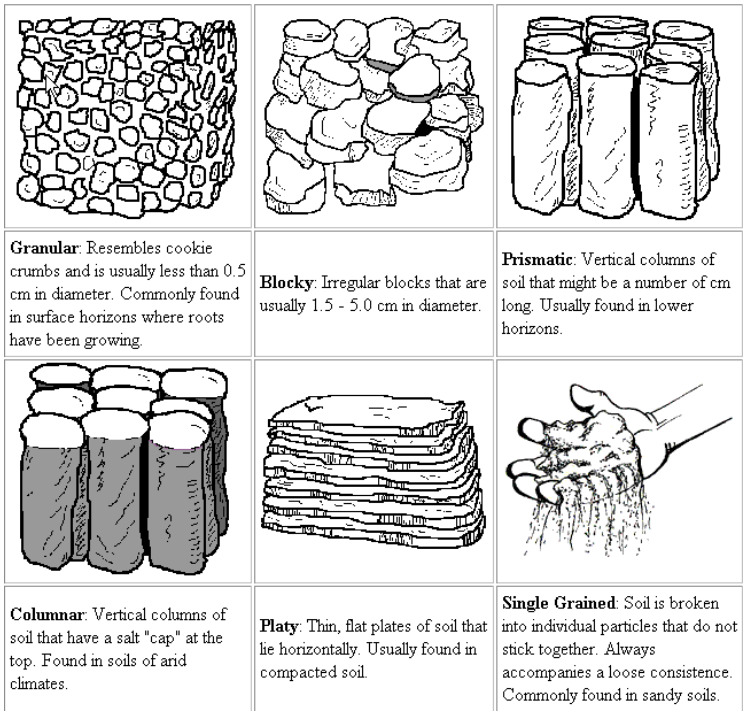


Figure3.4 Examples of soil structures

In summary there are five types of soil structure namely:

- Crumb or granular : is the porous granules with high amounts of organic matter, subject to wide and rapid changes
- Platy/plate-like: arranged as horizontal plates and found in virgin lands
- Blocky: are irregularly six faced cubes or rectangles found in the sub soil
- Prismatic: are pillar like aggregates with a prism shape found in the subsoil
- Columnar : are round pillar like aggregates found in the subsoil

Importance of soil texture and structure

For plants to grow successfully they require air and water. Soil texture and soil structure play a role in determining how much space is available for air and water to occupy. The best soil for crop production is loam soil which has a balanced amount of sand, silt and clay particles. These loam soils have a good soil texture and soil structure. This gives loam soils the following advantages for plant growth:

1. Loam soil is porous. It has enough space between the particles to allow water pass through easily and at the same time holding sufficient amounts for plant use. Yet clay soils with only very fine and small particles gets waterlogged during a rainy season as the space between clay particles get filled with water. Clay soils are not porous. There is no air because the particles get closely packed together. While sandy soils are very porous, this allows water and nutrients to be washed away easily. Sandy soils also dry out quickly on exposure to drought or heat.
2. A good soil texture and soil structure allows good circulation of air in and around the soil particles. This is essential in plant growth and existence soil organism. They will be supplied with oxygen to carry out their life processes.
3. It allows plant roots to grow and extend to greater heights in the soil profile without much obstruction or barriers
4. The soil temperature will be controlled as warm air will carry away heat from the soil particle
5. Good soil texture and soil structure provides soils that are easy to cultivate or plough using a tractor. They easily break up.

Activity3.7a Experiment to show the relative porosity of soils

You will need 6 measuring cylinders (50 or 100 ml), 4 funnels, beakers or conical flasks, pestle, mortar, filter papers/cotton wool, water, retort stand, weighing balance, a graph paper and a stop clock

- In pairs get dry samples of clay, silt, sand and loam soils then grind it into powder
- Set up four measuring cylinders with a funnel and a filter paper as shown below

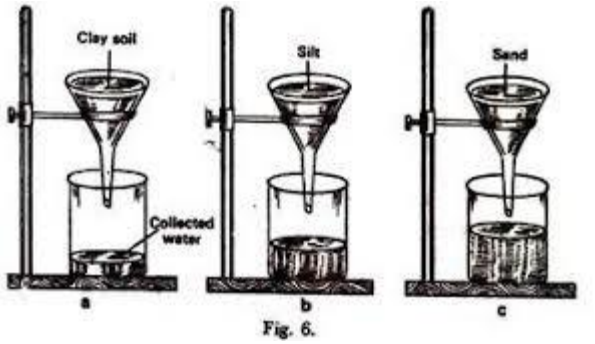


Fig. 6.

Figure3.5 Relative porosity experimental set up

- Weigh 50 gm of dry soil particle from each sample
- Put the 4 soil samples in the funnels of equal size. The end of the funnel is blocked with cotton wool or a filter paper.
- Measure 50 mls of water; four times each in its own beaker/conical flask
- Start the stop clock as you pour the volume of water on the funnel filled with the first sample. Record the time the first drop of water comes out and the volume collected after 10 seconds, 20 seconds, 30 seconds, 60 seconds, 90 seconds, 120 seconds, 180 seconds, 240 seconds and 360 seconds. Repeat the above task for the remaining funnels
- Plot a graph of volume collected against time
- Display the graph in a learning station or classroom notice board/wall
- Describe what you learn from this experiment

Activity3.7b Investigating the water-holding capacity of different soils

You will need dry samples of clay soil and sandy soil, two funnels, three measuring cylinders of100 mls each, a beaker of 250mls to hold water, stop clock and filter paper or cotton wool.

Set up two measuring cylinders with a funnel and filter paper or cotton wool inside the funnel.

- Place 25 gm of dry soil into funnel with filter paper or cotton wool. Label the first one A (with sandy soil) and B (with clay soil)
- Pour 100ml of water over each sample as you start the stop clock
- Record the time when the first drop appear
- Record the volume of water collected every after 5minutes until all water has drained through. Calculate how much water has been retained by the soil
- Work out how much water would be retained by 100gm of soil. This is the water holding capacity of that soil.
- Draw the experimental setup on a large sheet of paper. Display your work in one corner of the class

Soil types

Figure3.6 The different soil particle sizes

At the start of this chapter you came to learn that soil is made up of mineral matter, organic matter, living organisms, water and air. Also you were given the different soil particles sizes and how the particles arrange themselves into soil aggregates or lumps. This means that the soil one finds in one area cannot be exactly the same.

There are three basic types of soil: sand, silt and clay. But, most soils are composed of a combination of the different types. How they mix will determine the texture of the soil, or, in other words, how the soil looks and feels

You can identify the different soil types using colour. For instance soils containing much iron will appear red/ brown or yellow. While fertile loam soils are dark in colour because of the amount of humus content they carry. There are other ways you can use to determine the soil type. These are examination of the soil profile, chemical analysis, mechanical analysis/soil sedimentation and estimation of humus content.

Soil type	Properties	Challenges
Loam soil	Well drained; friable; fertile; has a good proportion of sand, clay and silt; easy to work; forms crumb structure	
Silty soil	Has fine particles large than clay, fairly draining	
Clay soil	Has very tiny particles of soil, compacted, little air space and holds water for long time thus poorly drained; becomes hard like a stone in dry season	Can be water logged, difficult to cultivate, require lime to flocculate
Sandy soil	Has big and coarse particles, well drained and cannot hold water	Has less ability to hold water for crops,

Table 3.1 Soil types

Plant nutrients

These are the chemical elements that are necessary for plant growth. These chemical elements are divided into two major categories. These are the: macro nutrients and micro elements

1. Macro Nutrients: are the chemical elements that are needed in large quantities by plants and are necessary for plant growth. Table below lists the major nutrients needed by plants

Element	**Uses**	**Symptoms of deficiency**
Carbon (C)		No growth
Hydrogen (H)		No growth
Oxygen (O)		No growth
Nitrogen (N)	Chlorophyll formation, vegetative growth, protein formation	Stunted growth(short but aged), yellowing of leaves
Phosphorous (P)	Root formation and development, quick maturity	Poor root system, no tubers, leaves are grey or purple
Potassium (K)	Formation of proteins and carbohydrates	Browning of leaf edges
Calcium (Ca)		Young leaves die-back at the tips and margins
Magnesium (Mg)		Leaves curl upwards
Sulphur (S)		Delay in flowering and fruiting

Table 3.2 Example of Macro nutrients and their deficiency symptoms

2. Micro nutrients

These are the chemical element or substance required in small or trace amounts for the normal growth and development of plants. There are about seven nutrients essential to plant growth and health that are only needed in very small quantities. Though these are present in only small quantities, they are all necessary:

- Boron is involved in carbohydrate transport in plants
- Chlorine plays a role in photosynthesis.
- Copper is a component of some enzymes.
- Iron is essential for chlorophyll synthesis.
- Manganese activates some important enzymes involved in chlorophyll formation.
- Molybdenum is essential to plant health. Molybdenum is used by plants to reduce nitrates into usable forms.
- Zinc participates in chlorophyll formation, and also activates many enzymes.

Element	**Symptoms of deficiency**
Iron (Fe)	Yellowing of leaves
Manganese (Mn)	Leaves have spots
Zinc (Zn)	Leaves are mottled or thickened, low starch formation and seed formation
Copper (Cu)	Leaves are pale green, low nitrogen fixation
Boron (B)	Growing points of shoot and root die off, poor cell division
Chlorine (Cl)	
Cobalt (Co)	
Molybdenum (Mo)	Leaf curling

Table 3.3 Example of Micro nutrients and their deficiency symptoms

Soil acidity or alkalinity and soil pH

Soil pH is a way of expressing the acidity and alkalinity of soil. This measure of the acidity or alkalinity of soil solution or soil water employs the use of a pH scale. This scale measures the number of ions in a solution. Hydrogen exists in the soil or solutions as an electrically charged particle called hydrogen ions (H^+). The positive sign shows that the ion is positively charged. Therefore soil pH is the measure of the concentration of hydrogen ions in the soil.

When there are many hydrogen ions in then the soil is acidic. If the soil is too acidic, some nutrients such as phosphorus will not be available. This is very common in poorly drained soils. Therefore only a few crops like tea may be supported. While too alkaline soils will not have iron and potassium available to plants. Soil alkalinity or salinity is a condition that

results from the accumulation of soluble salts in soil. the most extensive occurrences are in arid regions, where they usually are found in low-lying areas where evaporation concentrates the salts received from more elevated locations in surface water, ground water, or irrigation water. Since low-lying areas are most easily cultivated and irrigated, they have the greatest agricultural value. The degree of alkalinity of a soil is conveniently expressed in terms of pH values.

The pH scale is divided into 14 divisions or pH units numbered from 1 to 14. Soils with a pH of 7 are neutral. Soils with pH values below 7 are acid or "sour" and soils with pH values above 7 are alkaline or "sweet". A pH of 9 is ten times more alkaline than a pH of 8 and a pH of 10 is ten times more alkaline than a pH of 9. Thus, a soil with a pH of 10 is 100 times more alkaline than a soil with a pH of 8. The pH value of most soils falls in the range between 4 and 8. Most crop plants grow and produce best on slightly acid or neutral soils. There are exceptions, however, such as some berries which do best on strongly acid soils. Saline conditions are caused by high concentrations of the following ions: sodium, calcium, magnesium, chloride and carbonates. Alkali conditions are caused primarily by a high concentration of sodium carbonate. This reduces uptake of calcium, breakdown the soil structure and makes soil particles to hold strongly plant nutrients.

Activity3.8 Determining soil pH

You will need dry samples of soil from different locations (garden of crop, anthill, freshly burnt bush area, along the road), universal indicator, litmus paper, Munsel chart, soil test kit, water, test tubes, measuring cylinder(25 mls or 50mls), pipette or dropper

- In pairs or individually collect the dry soil sample and label it
- Put about 5 mls of the dry soil particles into a test tube
- Add about 10mls of water to each test tube containing the soil samples
- Shake the mixture while covering completely the mouth of the test tube for 5 minutes and allow it to stand for 5 minutes or 10 minutes
- Add 3 drops of universal indicator to the solution in the test tube; above the settled soil particles
- Observe the colour and compare it with the standard range of colours, matched to the pH values.
- What do you say about each soil sample?

pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Colour	RED		ORANGE		YELLOW		GREEN			BLUE		PURPLE-VIOLET		
strength	Strong ACIDS				Weak		Neu-tral	Weak		ALKALIS			Strong	

Figure3.7 Munsell colour chart

Fertilizer

Fertilizers are any substance used to provide plant nutrients. This is because crops use nutrients to grow and bear fruits. Good crop yield will require adequate supply of nutrients.

Fertilizers may occur as dry or liquid form. The dry fertilizers are packed in bags or containers as pellets or granules. While liquid fertilizers are normally materials that have been dissolved in water at certain concentration. However there are two major forms of fertilizers namely organic (manure) and inorganic fertlizers

Organic fertilizers

These are plant and animal residues which the farmer can use to maintain soil fertility. There are four forms of organic fertilizers. These are four major types of organic fertilizers :compost manure, farm yard manure, green manure and mulch.

1. **Compost manure**

This is the crop residues, weeds, kitchen or household wastes and animal remains that has been rotted and decomposed as material to supply plant nutrients. This type of manure is normally got from decaying household waste like food peelings, slashed grass, leaves of trees, kitchen plant or animal remains, ash from cooking stove and rubbish from compound. All these are put in compost pits or piles to rot.
After 14 days, you have to turn the heap. After another 14 days, turn the heap again for 2 more rounds and then it is ready for use.

Figure3.8 Procedure for making compost manure

Picture of compost pit *picture of stack of compost*

- *Get stones and bamboo/elephant grass as foundation layer*
- *Have chopped material followed by a layer of cowdung/farm yard manure and last layer of very soft plant material. Bacterial activity will produce heat. If you check using a stick and the temperature is normal then the material is ready.*

Activity3.9 Making compost manure

a) *Traditional method*

- *Choose a site near your crop garden for making compost*
- *Get the materials, tools and equipment (hoes, shovel, spade, rake, wheel burrow, panga, tape measure and ruler*
- *Clear away the vegetation*
- *Measure a 1m x1 m area*
- *Dig two or more hole of 1mx 1 m and 1metre apart. Each hole/pit should 1m deep*
- *Begin by putting your household wastes, dry grass, weeds, banana peelings and wastes into the first hole*
- *Remove big braches, plastic materials, glass or metallic objects*
- *When the materials are 25cm high add some soil or dung/FYM*
- *Put another layer of material to 50cm high then add some ash and dung/FYM.*
- *Sprinkle some water because wet things rot faster*
- *Allow this material to rot for 2 weeks and transfer it to the second pit. This will make the material on top to be placed at the bottom and have even rotting*
- *Erect a shade over your pit to prevent rain and excess heat*
- *After 8weeks the material should be ready*
- *Start preparing compost in March for use in May*
- *Suggest your own method of making compost manure*

b) **Innovative way of making compost manure**

❖ Get the materials like cow dung/ poultry droppings, green plant materials, dry plant material and water

- ❖ Clear the ground where you are going to make your compost from
- ❖ Chop the green plant materials and dry plant materials in the ration 2:3
- ❖ First put three buckets of dry plant material spread in a diameter of I metre then sprinkle a bucket of water
- ❖ This is followed by two buckets of green plant material and I bucket of cow dung
- ❖ Repeat the same above two steps 6 times, to complete making a heap and cover it.
- ❖ Temperature will increase to 55^0 - 70^0C
- ❖ You need to turn 8times the material and every time squeeze the material to do a moisture test. If there is low moisture add green plant material and high moisture content add dry plant material.

2. **Farm yard manure**

This is the straw, food remains and animal beddings mixed with urine and faeces allowed to rot and decompose to be used as fertilizers. It is a mixture of rotten beddings and animal wastes. It normally made by people who keep animals and put dry grass on the floor or ground where animals are kept. The grass materials absorb the urine and feaces. After sometime these animal beddings are collected with the food remains and are put in a heap to be allowed to rot and decompose.

The composition and quality of Farm Yard Manure (FYM) varies or depends on:

-the type of animal kept: poultry, pigs goats, sheep usually produce FYM which is high in nutrients than horses and cattle.

-the age of the animal:

-the diet of the animal

-the type of bedding used

-the time given for rotting and decomposition

3. **Green manure**

This is growing crops which are cut or ploughed into the soil just before flowering to provide soil nutrients. Any fast growing green crops are used in making green manure. The most effective green manure crops are legumes. This family of plants has nodules on their roots in which the *Rhizobia* bacterium lives. These bacteria have the ability to fix nitrogen of the air into the soil. They use nitrogen gas for their own chemical processes but as a result convert it into nitrates. Legumes such as cowpeas, beans, soya, peas, and groundnuts or Lablab, Sesbania, Mucuna and Caliandria are used.

4. **Plant Mulch**

This is the dry plant material or dry grass applied to the surface of the soil then allowed to rot and decompose to provide nutrients.

5. **Biological tea**

This is where plant material is exposed to a way of extracting nutrients then the liquid is applied to growing crops. There are two kinds namely compost and manure.

Preparing biological tea

- *Get a drum, bag/sack, wood ash, sticks and vegetative/plant material*
- *Put the wood ash and plant material into the bag. The bag should be half full*
- *Put the stick through the bag near the mouth or tie it with ropes*
- *Place the drum under a shade to protect it from sunshine and rain*
- *Hang the bag in the drum filled with water to three quarter volume*
- *Allow the bag to hang in the drum for 3 or 4 weeks*
- *Remove the bag from the drum*

The remaining liquid is liquid plant tea

The process is the same only that you use animal manure instead of plant material

Figure3.9 Picture of a drum with a bag hanged in with cross bar

Inorganic fertilizer

These are chemical or rock material specifically prepared and manufactured for agricultural use. Their compositions are known and are used in small quantities to provide plant nutrients.

Inorganic fertilizer refers to manmade or chemical fertilizers or soil amendments. Soil rarely contains all the nutrients needed to support optimal plant growth. Organic or inorganic fertilizers must be added to improve soil quality. Inorganic fertilizers are quick-release formulas that make the necessary nutrients almost instantly available to the plants. Inorganic fertilizers enrich the soil with specific nutrients which may be lacking. There are two ways of categorizing the inorganic fertilizers as shown below:

1. **Straight fertilizers**

These contain only one nutrient element. For example Nitrogen (N), Phosphate (P) or Potassium (K) and Sulphate (S). These can include Urea (46-0-0), Ammonium nitrate (34-0-0), Calcium Ammonium Nitrate - (CAN), Single Super Phosphate-(SSP), Rock phosphate is an inorganic fertilizer type that provides phosphorus to the soil. Sodium nitrates are also referred to as chilates or Chilean nitrate. These fertilizers contain amounts of nitrogen of up to 16 percent. These fertilizers make nitrogen, the most important component in plant growth, immediately available to plants. Sodium nitrates are considered a valuable source of nitrogen and are commonly added to the soil as a top and side dressing, especially when fertilizing younger plants and garden vegetables. Sodium nitrate fertilizers are especially useful in acidic soil.

2. **Compound fertilizers**

These contain at least two or more fertilizing agents or nutrient elements. For example DAP, NPK- 25:5:5, Sulphate of potash is the inorganic fertilizer which supplies the third-most needed nutrient, potassium, to the soil

Those who sell fertilizers must be able to tell you the amount of each nutrient in the fertilizer. For example single superphosphate contains 20 percent P_2O_5 and about 11.9 percent S. There buy the right fertilizer to give you the nutrients needed. Calculate the amount of fertilizer to give the amount of nutrient.

While NPK -10:10:20 means that this fertilizer contains 10kg of Nitrogen (N), 10 kg of Phosphorous (P) and 20kg of Potassium per 100kg bag or for every 100kg. Therefore a bag of 50kg will have 5 of nitrogen, 5 of phosphate and 10 of potassium

While with 2:1:1 (24) this number in brackets indicates that 24percent of the material in the bag is the fertilizer elements and 76 percent is the carrier material. So you can compute the amount of in 50kg bag as 24%. This will be only 12kg of the fertilizer elements. Hence 2/4 x 12=6kg is nitrogen, 1/4x12 =3kg of phosphate and 1/4x12 =3kg of potassium.

Methods of applying fertilizer

Fertilizers must be placed where the plants can get it. In the soil proper placement means that the fertilizer is close enough for roots to get it but not so close to damage the plant roots or leaves. This makes the times suitable for applying fertilizers namely:

1-Pre planting/before planting (broadcasting-scattered on the soil surface)

2-At planting (drill-put in the planting hole, band-put in rows along the holes)

3-Post planting (applied when the plant is growing through top or side dressing –placed 15cm from the root area of the plant, ring placement –fertilizer is applied in a ring around

the plant and spraying on the soil surface or leaves of the growing plants(in case of copper or zinc deficiency)

However the methods of applying fertilizers include:

a) **Broadcasting:** this where the fertilizer material is scattered or spread all over the garden or soil surface. This can be done at the same time or during planting

b) **Ring method:** this where the fertilizer material is applied in circle of radius 60-90cm around the plant.

c) **Drill method**: this where the fertilizer material is applied in the planting hole before the planting material has been put.

d) **Spraying:** this where the fertilizer material is made into a solution and applied in form of sprays on the plant or garden

e) **Top dressing**: this where the fertilizer material is applied over the ground where the crop is growing. Here it is expected that rainfall or dew will dissolve the fertilizer material and it will get soaked into the soil.

f) **Side dressing**: this where the fertilizer material is applied along the sides of the rows of growing crops. This is about 15-30cm away from the root zone

Factors to consider when applying fertilizers

The information needed to determine fertilizer requirement by the farmer are:

i-which nutrient or nutrients are deficient or missing in the soil and the degree of deficiency. There is some confusion over where to apply fertilizers. Some feel that they should be put at the same rate in all their land. Some feel that they should be put more heavily in the poor soils so that they could make crops grown their yield better. Other feel be put on best soils. The last thinking is the most appropriate. This is because such soil receives and holds water, have good amount of organic matter and are mostly silt loam soils. Sandy soils do not hold much water and quickly gets warm. While clay soils holds much more water but much of it is not available to crops. This makes it to hold the fertilizer nutrients as well. So you need to apply lime to it so that you flocculate it.

ii-methods of application where phosphorous is most effective when drilled with or near the seeds. It takes time to dissolve. Placing a band of phosphate fertilizer near developing roots of annual crops is the most effective way.

However do not broadcast phosphates in pastures or forages as it will delay response owing to its slow movement into the root zones. While nitrogen fertilizers can be broadcasted as it quickly dissolve in water, move readily in moist soil and can be leached to deeper layers where it will not be available to crops. So placement with or very near the seed is not necessary. Therefore apply nitrogen fertilizers by broadcast, side band, top dressing or row.

iii-the estimated response of the crop to a given level of fertilizer application. Crops respond differently to the same amount of fertilizer. The most accurate way to determine crop response is by a soil test. However presence of weeds in the garden will lower the yield potential of the crop. These weeds will compete for nitrogen fertilizer that is applied. This will make the crop respond poorly. Also delayed planting will decrease crop response to fertilizers. While crops with high yield potential generally respond better to higher nitrogen fertilizer application.

iv-the assessment of economic returns from the use of fertilizer. In some instances the cost of fertilizer cannot be recovered from the profit gained by the sale of the crop products. So it does not make sense to apply the fertilizers. For example crops grown in an area which has been under fallow will often require little or no additional nitrogen. Whereas non legume crops can give profitable returns if you apply 250kg of nitrogen fertilizers per acre. This is because there are three main source of nitrogen to non legume crops namely that stored in the soil particles, that released from soil organic matter or crop residues and manure , then through application of nitrogen fertilizers.

v-Type of fertilizer. Plants need a large amount of the major nutrients and very small amount of trace elements. Therefore chemical analysis of the soil will tell you whether there are too much or too little nutrients. This information will help to tell the type of fertilizer to apply. Very often the soil cannot provide enough nutrients as plants are harvested and carried away with plenty of nutrients. When this happens then nutrients must be provided by buying and applying the right type of fertilizers. Buy the right fertilizer to give the nutrient needed or lacking in the soil.

vi -Amount of fertilizer. Those who sell or use fertilizers must be able to tell you the amount of each nutrient found in a given fertilizer. For example single super phosphate (SSP) contains 20 % P_2O_5. While triple superphosphate contains 43% P_2O_5. So you will need twice as much single super phosphate (SSP) as you can get from a given amount of triple superphosphate to give the same quantity of P_2O_5. Further you will need 65 gm of SSP per plant

Figure3.10 Bag of fertilizers with its analysis

Safety, health and environmental protection measures when handling fertilizers

Ministry of Agriculture Animal Industry and Fisheries (MAAIF) have a brochure on the safe use of fertilizers. It highlights and provides advice on all health, safety and environmental issues that arise when using fertilizers on the farm or in our gardens. The issues include

- ❖ Personal safety when handling fertilizer products
- ❖ Good housekeeping practices for indoor or inside and outdoor storage
- ❖ The need for security when storing fertilizers following the following things:

-do not store fertilizers where there is public access
-do not leave fertilizers or unused fertilizer in the field/garden overnight
-do not store fertilizers near to, or visible from the children and public roads or highway
-do not buy ammonium nitrate fertilizer without the proper certificate. It is an offence
-do purchase fertilizer from approved supplier and outlet
-do retain and file in your records all fertilizer delivery notes or purchase receipts
-do store all your agrochemicals including fertilizers under key and lock building
-do make regular checks on stocks
- do report any stock discrepancy or loss of fertilizer material to the police

- ❖ How to minimize environmental impact during storage and use
- ❖ The importance of following instructions, reading of product labels and manufacturers safety information
- ❖ The proper care required along the whole fertilizer value chain right from product development, purchase and handling of raw materials, the process of manufacturing, packaging, storage and transportation right up to the end delivery, application, use and disposal of unwanted materials on the farm
- ❖ wear protective gear including gloves, gumboots, mouth and nose
- ❖ wash thoroughly your body after handling fertilizer
- ❖ clean the applicators and other equipment

Activity3.10 Identifying inorganic fertilizers

Individually or in pair you should identify inorganic fertilizers

You are provided with sample of fertilizers A, B and C. Study them carefully when wearing the protective gears and answer the questions below.

1. List down three observable characteristics of fertilizers.

Fertilizer A	Fertilizer B	Fertilizer C

2. What are the four characteristics of a good fertilizer?
3. Enumerate five advantages and disadvantages of artificial fertilizers
4. Extended work in groups:

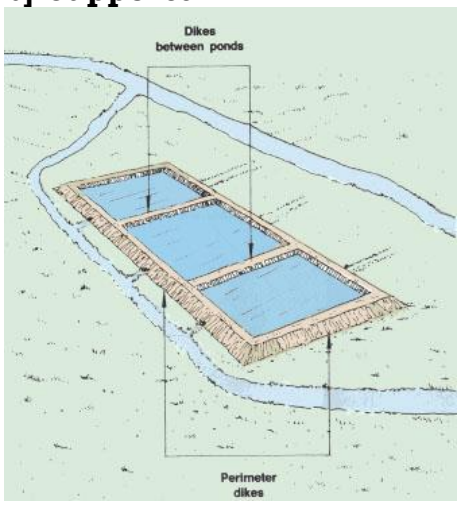
“Carry out integrated soil fertility management in order and demonstrate how it caters for environmental protection”

Activity of Integration

a) Context

Ministry of Agriculture Animal Industry and Fisheries developed the Kumi wetlands fish farming project is seeking to promote the conservation and sustainable utilization of wetlands and wetland resources in Kumi District while at the same time improving nutritional intake and widening the income base of the rural communities. The major activities include developing training on soil for fish pond construction and management. But the soils used to construct ponds in wetlands are not firm and they allow water to seep across the pond banks and through the bottom. Therefore, the lime applied is continuously lost through seepage and more lime is continuously required to keep the acid levels low.

b] Supports



c] Task

Make a presentation to members of one community in Kumi about how they should go about pond construction in the wet land available to them to start reaping from fish farming

COMPETENCY: You should be able to select a suitable vegetable for a locality and to carry out all the processes required in order to grow and market the vegetable.

Key words

1. Seedbed
2. Nursery
3. Harden off
4. Mulching
5. Transplanting
6. Seedlings
7. Thinning
8. Weeding
9. Pest
10. Pathogens
11. Pricking out
12. Staking
13. Pruning
14. Nutrient

By the end of this chapter, you should be able to:

- Know a range of vegetables grown locally and understand their values in both nutritional and financial terms
- Understand how to select an appropriate vegetable for growing locally
- Establish a nursery, apply good practice of vegetable growing
- Show skills in preparing bi pesticides and plant derivatives
- Handle vegetables during and after harvest in order to maintain quality
- Market vegetables effectively
- Follow food safety guidelines for harvested fresh vegetables

❖

Introduction

In Uganda most people grow crops for food and market in their gardens or farms. Producing crops when, where and how we want them requires a lot of skill. We need to know how they grow and what makes them grow better. The most important requirements are good variety, good soil management and proper agronomic practices for good crop yield.

Most people grow crops like vegetables, fruits, grains and root crops for food and income. Growing vegetables using appropriate methods and tools can lead to sustainable community welfare. Vegetable are crops that take short period to grow and can be grown in several climatic conditions. They can be classified into root, leafy, fruit, and flower and bulb vegetables depending mainly on their parts eaten.

Value of vegetables

A vegetable is an edible part of plants rich in vitamins and minerals. Vegetables are eaten as part of a balanced diet. Some vegetable grow on their own while others are grown by human beings in their home stead. Even those growing on their own can be planted to ensure regular supply and big quantity.

Activity 4.1 Vegetables and their value in my community

a) In groups answer the following questions

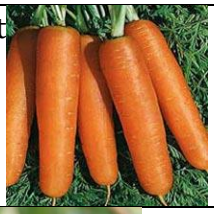
i) What vegetables are found in your community?

ii) Which parts of these vegetables are commonly eaten?

iii) Vegetables are grouped as shown in the table below. Complete the blank columns in your exercise books

Table 3.1 Categories of vegetables

Group	Names of the Example	Other examples in my community
Leafy 		

Fruit 		
Root 		
 Bulb		
Legumes 		
 Flower		

iv) Why are vegetables important in your diet?

b) Think-pair-share, to identify the common vegetables in your locality and discuss the value of vegetables in the diet and as a commodity, presenting conclusions in drawings and/or a written report.

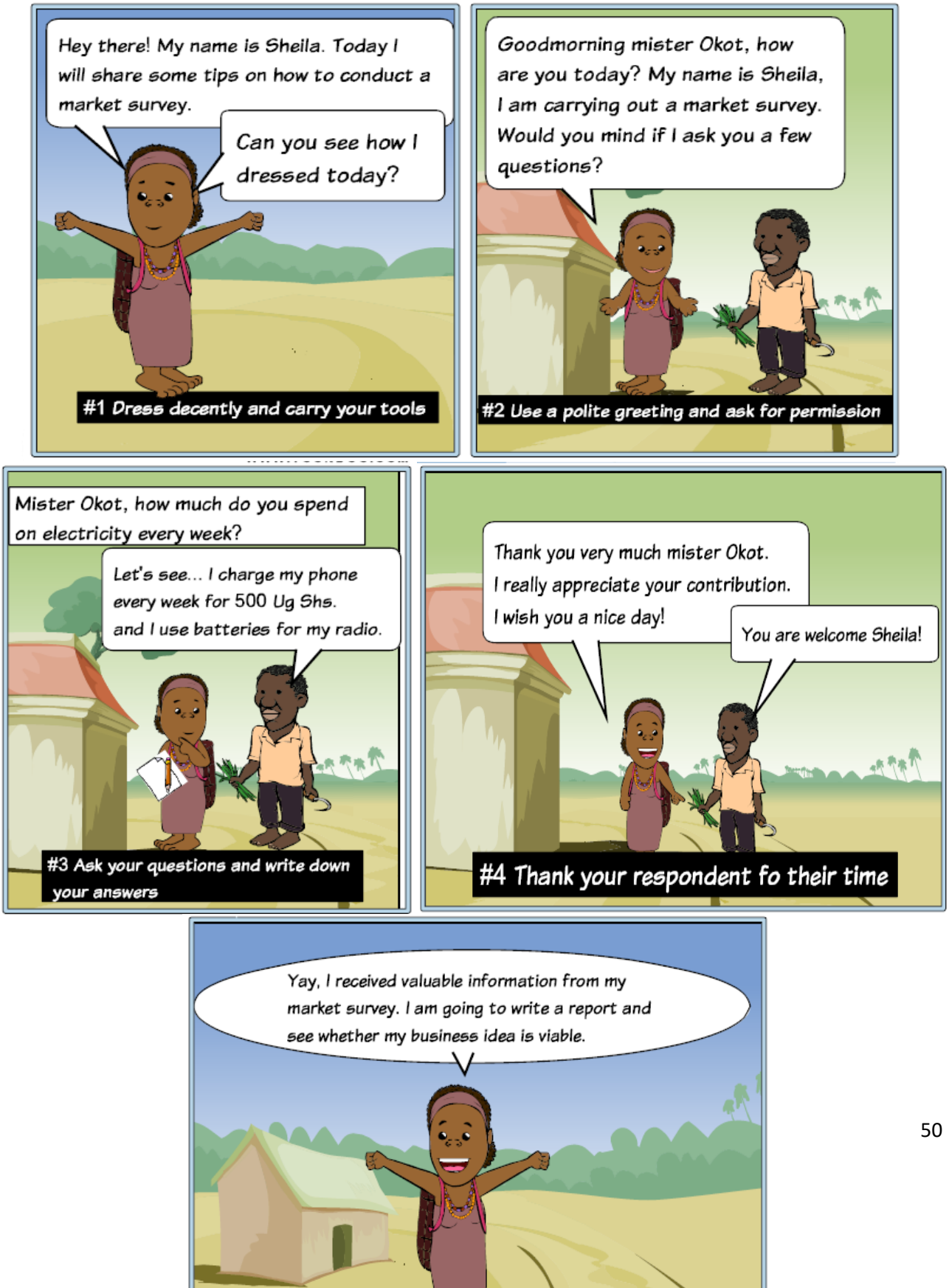
Activity 4.2 Selecting a vegetable to grow

Selecting a vegetable to grow is an important step to consider because you cannot grow all at once. How do you select one to grow? Your choice may depend whether you want to eat the vegetables or sell. Vegetable from home gardens can be eaten or sold in the market. By selling vegetables you can earn money. Before you choose which vegetable you are going to grow, you need to find out what vegetables are grown locally and most preferred in the area.

1. In class, discuss and write the questions that will guide you to find out the locally available vegetables in your community

2. In groups, go out in your community and find out the locally available vegetables using a survey tool you made.

A market survey of Sheila



Establish a nursery bed

Vegetables are planted differently. Some are planted first in a nursery bed and others are sown directly in the garden.
A vegetable nursery is a place or an establishment for raising or handling of young vegetable seedlings until they are ready for more permanent planting.

Vegetable nursery bed making like any other activity involves money coming in and money getting out of one's hands. Therefore it is important to know the costs incurred in making your nursery bed. Things budgeted for include, tool, labour and construction material

The reasons for growing vegetables in a nursery bed are to:
1) Look after these 'young' seedlings with care
2) Provide favourable germination and growth conditions
3) Control weeds, pests and diseases
4) Have uniform vegetable crop
5) Have a good start for higher yields
6) Have a shorter growing season
7) Accurately predict the harvest date.

Activity 4.3 How to establish a vegetable nursery bed

You will need; soil, garden tools, notebook, pen, protective gear

a) As a class, develop and document a budget for constructing a nursery bed, buying materials, establishing a nursery bed and raising vegetable seedlings
b) In groups, select one vegetable of choice and establish a fixed or portable a nursery following the given practices;
1. Select the type of nursery to use
2. Selecting a site for a nursery bed
3. Budgeting materials for making a nursery
4. Preparing a good soil for the nursery bed
5. Sterilizing soil for a nursery seedbed
6. Level the soil and make furrows
7. Sowing seeds in a seedbed
8. Constructing a nursery bed
9. Pricking
10. Weeding
11. Fertilizer application (organic and inorganic)
12. Pest control

13. Disease control
14. Hardening off

Growing vegetables in the garden

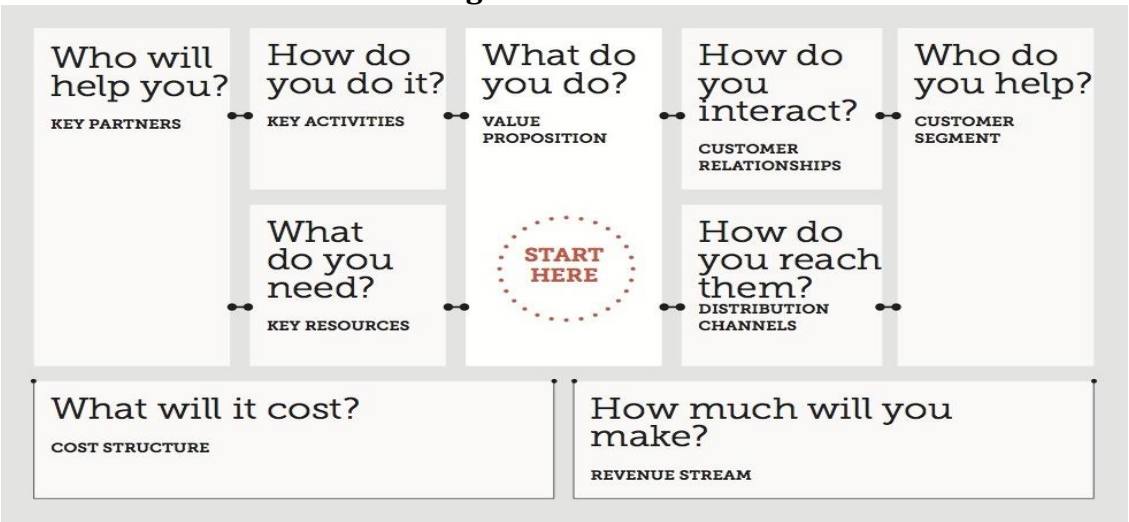
When vegetable seedlings are ready for transplanting, they are taken to the main garden. This will involve planting, proper spacing, fertilizer addition, pest and disease control. Pesticides are substances that are used to control insects and disease causing organisms that damage vegetables. . Unfortunately many farmers do not have enough money to buy them. Over time farmers have found organic pesticides suitable for small holder use. These are found in native and exotic plants. **Pesticides** that naturally control caterpillars include neem oil and bacterial sprays. Neem tree seeds are naturally insecticidal, and proprietary neem-based pesticides are formulated using extracts from the seeds. Bacterial sprays contain bacteria that attack the pest but aren't harmful to humans.
Some of these plants are just grown side by side with the crops. They usually send off a bad smell to drive away the insects or disease causing organisms.

Activity 4.4 Managing vegetables in the garden

You will need; garden, garden tools, pesticides and a market

a) In groups,draw a vegetable business model below. Complete it with informations required as you provide answers to the 9 questions in the model

Table 3.2 Business model for vegetables



b) In groups, learners grow, care or and manage vegetables through to maturity

c) In groups as a project, prepare bio pesticides and plant derivatives from locally available materials like tephrosia, Black Jack, neem tree, tick berry leaves, hot pepper/chili, pawpaw leaves and seeds and research the uses of each. Apply as appropriate to growing vegetables

Watering

Seedlings in a nursery bed need water. Water is important because it helps in dissolving nutrients in the soil.

Pricking

When your seedlings have germinated find out if they are overcrowded. Some seedlings will need to be removed from the seedbed to another one. This will avoid overcrowding and will create spaces for the seedlings to grow well.

The removed seedlings can be replanted in anew seedbed, fed to livestock or used to make compost manure. The process of separating and removing seedlings in the nursery bed is called pricking out.

Pricking out is best done when seedlings and their roots are still small.

Weeding

Many times you find unwanted plants in your nursery bed. These unwanted planted are called weeds. Removing weeds from seedlings and the soil around young seedlings is important. If weeds are not removed and controlled, they will compete with the seedlings for nutrients, water, and growing space. Weeds also can bring disease causing organisms and pests. So keep checking your seedlings to see if weeding is required.

Controlling pest in vegetables

Figure 3.2 Caterpillars on some vegetable leaves

Caterpillars can be a major pest of fall **vegetables**, particularly cabbage, pumpkins, kale, collards, broccoli, and cauliflower.

If you can find and remove caterpillars and eggs from your plants, you can stay a step ahead of these pesky pests.

Caterpillars are the larval stage of butterflies and moths. After mating, butterflies and moths lay eggs on their host plant, often on the underside of the leaves. If you check your plants daily, you can often spot a caterpillar or pest infestation before it gets out of control.

As soon as you see one caterpillar or pest, check the plant for more and for tiny eggs, which may be laid singly or in clusters. Remove all the caterpillars or pests you see, dropping them into a bucket of soapy water if you're too squeamish to squash them. Crush all the eggs or pick off the whole leaf and destroy it if the plant has plenty to spare. Repeat the process daily.

Vegetable pests can be insects, birds, snails or animals. Pests will spoil your vegetables if you do not keep them away. Keeping pests away from your crops is called pest control.

Controlling diseases in a nursery bed

Figure 3.3 Diseased tomato fruit and leaves

You frequently see diseases affecting your vegetables. They make the vegetable curled, dry up or start to rot. Probably you might have seen these signs on vegetables in previous seasons; these are the symptoms of diseases that attack vegetables. The diseases are caused by organisms are called **pathogens**. Examples of pathogens include bacteria, fungi, viruses and nematodes. These pathogens make your vegetables to rot, wilt, get deformed or die. Sometimes leading to death and total loss of the crop.

Control measures of pests and disease in vegetable

You can control pests and diseases using the following methods

Table 3.3: Examples of the control measures

Method of control	Description	Examples
-Cultural	Using ordinary agronomic practices to prevent pests and diseases	Crop rotation, early planting, disease free planting materials, quarantine, field hygiene
-Mechanical	Using equipment tools and machines to control pests and diseases	Net, Hand hoe
-Biological	Using other living plants and animals to control pests	*Tagetes minuta, Ladybird beetle, wasps,*
-Chemical	Using chemicals or manufactured inorganic materials to control pests	Fungicides, pesticides
-Plant derived pesticides or Organic pesticides	Using a collection of materials extracted from plants or animals to control pests	Red pepper, tobacco, wood ash, *Tithonia spp*, Botanical tea

Pesticides

Pesticides are substances that are used to control insects and disease causing organisms that damage vegetables. Many pesticides are poisonous to man. Therefore all safety measures must be followed strictly when using them. Pesticides are chemicals which are used to prevent damage by insects and other destructive organisms

Over time farmers have discovered that a number of native and exotic plants do have substances in their leaves, roots, wood or fruits and seeds that can be used to protect their crops from being eaten or destroyed. **Pesticides** that naturally control caterpillars include neem oil and sprays. Neem tree seeds are naturally insecticidal, and neem-based pesticides are formulated using extracts from the seeds. Many neem products are concentrates, and you must dilute the product before using it. For example, one commonly used neem oil product must be diluted at a rate of 2 tablespoons per 15 litres of water. Bacterial sprays contain bacteria that attack the pest but are not harmful to human beings.

Most important we can make pesticides from these plants and they are called **plant derived pesticides.** Examples of plants used are Neem tree (*Azadirachta indica*) and Chili (*Capsicum frutescens*) whose seeds and leaves.

Harvest handling in vegetable

The term harvesting is the process of gathering ripe crops. When vegetables reach maturity they are picked from the garden.
Vegetables show different signs or conditions when they are mature. To harvest depends on which vegetable you have grown. Pre harvest preparation should include lining up sufficient labor, supplies (containers and packaging items), cleaning the grading/ packing shed, and determining if all equipment is operable. Once the produce reaches harvest maturity, delays for any reason can result into loss in quality and nutritive value.

Post harvest handling

Postharvest handling includes all steps involved in moving a commodity from the producer to the consumer including harvesting, handling, cooling, curing, ripening, packaging, storing, shipping, wholesaling, retailing, and any other procedure that the product is subjected too. Because vegetables can change hands so many times along the value chain, therefore a high level of management is necessary to ensure that quality is maintained.

Figure 3.4 Mature tomatoes ready for harvest

Activity 4.5 Harvesting of vegetables

1. In pairs, identify how different vegetables appear when they are ready for harvest
2. In groups, explain the harvesting procedure you will use on the vegetable you are growing

Marketing of vegetables

Have you ever gone to buy vegetables and you did not find any? What did you do? You had little choice. It could have been possible that you had your meals without vegetables. Although the reason for vegetable shortage may not be obvious, several things could have happened. The absence of vegetables is due to many things other than production
Among these is transporting the vegetables to the right place, in the right form and at the right time.
This is marketing! **Marketing is the process of getting goods and services that consumers want to them in the forms that they want.** It links the farmers with the people who use the farm products and services. This will involve the movement of food, fibre, shelter materials and services from the producer to the consumer.

Figure 3.5 Vegetable stall in the market

Activity 4.6 Finding out about the vegetable market

a) In pairs discuss the possible reasons why you may not find vegetables to buy when you need them. Suggest ways you can do to have vegetables whenever you need them
b) In groups, develop and apply a marketing strategy for your vegetables
c) In pairs, research and brainstorm on the food safety guidelines for harvested fresh vegetables and design a set of criteria to explain the guidelines to the community

Delivering vegetables to the market

Once right decisions are made the farmer will proceed to deliver vegetables to the consumers.

Figure 3.6 Vegetable stall on the road side shade

Activity 4.7

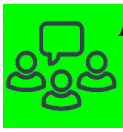
In groups

i. Study the picture above and identify the different vegetables being sold
ii. Suggest materials where vegetables are kept before sale
iii. In case you are among the vendors how different could you increase the life of vegetables in your stall
iv. Present your work for a gallery walk by the class

Packaging of vegetables

Good postharvest handling should be accompanied with good cold chain management in keeping your vegetables fresh and wholesome. Temperature control is particularly important in governing the postharvest quality of fresh produce like vegetables. But what do you see in the vegetable value chain. There is temperature abuse, poor handling and improper packaging which often generates up to 30 % wastage in the vegetable supply. This wastage constitutes to a substantial loss of valuable food resources and can be a threat to farmers' income and Uganda's food security. What should be done? You need to change what you experience with our vegetables in the market. Vegetables like tomatoes, onions, Irish potatoes, chillies, green pepper, egg plants, red pepper, okra, nakati, cabbage, pumpkin, cucumber, peas, French beans, cowpeas, groundnuts, cauliflower, lettuce or Sukuma wiki are packed in baskets, sacks, gunny bags, plastic buckets, 3-Ply or 5-Ply

wooden boxes with ventilation holes depending upon the capacity. The capacity of box varies from 5kilogrammes to 10 kilogrammes. For the sacks it is difficult to tell the weight.



Activity 4.8 Packaging of vegetables

In groups

i. Draw a packing flow activity chart for vegetables. Display it in the class
ii. Design a package for your vegetable.
iii. What will it contain to be able to attract the attention of buyers
iv. Suggest how you could attract more people to know and buy your vegetable and present it to the class
v. From the work of others what do you learn that you have included or not included and why

Activity of Integration
a) Context

In your community it is reported that there is a pest attack of army worm (black caterpillars). It is destroying farmer's crops. The army worm eats all green parts of vegetable and other plants. You may help your community growing vegetables to face this problem happening

b) **Support**

Figure 3.9 Mulched vegetable gardens

c) **Task**

- Prepare a presentation you will use to inform the vegetable farmers on how to supply safe and healthy vegetables to the market after controlling weeds, pests and pathogens

ANNEX 1

Common vegetables in Uganda

Scientific name	**Common name**	**Part used**
VEGETABLES		
Amaranthus dubius	Amaranthus spinach	Leaves
Phaseolus lunatus	Lima beans	Seed
Phaseolus vulgaris	French beans	Leaves and seed
Amaranthus lybridus	Amaranthus spinach	Leaves
Vigna unguiculata	Cow peas	Leaves
Gynandropsis gynandra	African spinderherb	Leaves
Lagenovia siceraria	Calabash gourd	Leaves
Solanum gito	Bitter berries	Leaves
Solanum nigrum	katunkuma	Leaves
Cucurbita maxima	Pumpkin	Leaves and fruit
Zingiiber officinalis	Ginger	Stem
Capsisum frutescens	Chillis	Fruit
Solanum indicum	Bitter berries	Fruit
Vigna unquiculata	Cow peas	Fruit
Colocasia schimperi	Cocoyam	Leaves

Oxytenanthera abyssinica	Bamboo shoots	Stem
Amaranthus lividus	*Ebugga*	Leaves
Gynandropsis (Cloeme) gynandra	Ejjobyo	Leaves
Solanum indicum	*Katukuma*	Fruits
Solanum gilo	Entula	Fruits
Solanum aethiopicum	Nakati	Leaves

ANNEX 2 Business model

<table>
<tr><td rowspan="2">Partners</td><td>Activities to be done</td><td rowspan="2">Kind of vegetable or its product needed in the market</td><td>The kind of relations you will have with customers</td><td rowspan="2">Who are different customers you can sell</td></tr>
<tr><td>Materials and external resources needed</td><td>How best you make the customers get/sell your vegetable as and when they need</td></tr>
<tr><td colspan="2">How much money is ivolved in growing and managing a vegetable</td><td colspan="3">What amounts of money will your vegetable garden bring</td></tr>
</table>

Context

Balances are commonplace in markets. They are used to weigh fruit and vegetables from as little as 100 g to more than 5 kilos. Many types exist, some using weights and others where there is only 1 pan. The customers look at the position on which a balance are put and wonders what is going on in this vegetable market. Is their accuracy acceptable? Are they being used accurately by the sellers?

Support; *pictures*

Task

How would promote vegetable market standard in this community? Write a message for sellers to convince buyers that use of balances is the way to go.

Glossary and index

Agriculture *is growing of crops and rearing animals to produce food, fibre and fuel for human beings*
Botanical name *is the scientific name indicating both the genus name and species name*
Combustion *burning*
Cotyledons *structure found in inside a seed which stores food for the young embryo*
Embryo *a very young, new organism which has developed from a zygote*
Fertile *able to grow crops well*
Prepare *getting ready*
Planning *making an outline of what you want to do*
Nutrients *plant food in the growing medium like soil or water*
Soil *is the natural material on the earth surface in which plants grow*
Weeds *unwanted plants growing in a garden*