Agricultural Science

Year 1

SECTION

2

AGRICULTURAL MACHINERY

NEW DAWN IN AGRICULTURE

Agriculture Machinery

Introduction

Before we move on to new lessons, it is important to recognise that understanding and identifying the uses of simple farm tools, equipment, implements, and machines in agriculture is essential and cannot be overlooked. It is necessary to be able to identify these tools and use them effectively to produce vegetable crops and ornamental plants. This section will guide you in understanding the various uses of these implements and machines at different stages of farming, from soil preparation to planting and harvesting. Additionally, it will help you classify and operate the various types of machinery used in crop production in Ghana. The study of simple farm tools, equipment, implements, and machines is closely connected to agricultural engineering, a specialised branch of agricultural science.

At the end of this section, you will be able to:

- Identify the functions of agricultural tools and implements used in crop production in Ghana.
- Classify and operate different types of equipment and machinery used in crop production in Ghana.

Key Ideas

- **Farm tools:** These are items or implements that are used in crops and livestock production.
- **Farm equipment:** Any kind of machinery used on the farm to help in farming.
- **Farm implements:** These are tools required to carry out agricultural practices. They are usually attached to farm machines.
- **Farm machines** are mechanical structures and devices used in farming.
- **Backyard farming:** A type of farming practice in which a farmer carries out it close to his or her residence. It is normally done on a small scale and sometimes in the form of a garden.
- **Garden:** A piece of land or ground close to a house in which vegetables, flowers, grasses, and shrubs may be grown.

Identification and the uses or functions of some common farm tools and equipment for crop production

Farm tools and equipment play an essential role in crop production, aiding farmers in carrying out various tasks efficiently and effectively. From soil preparation to planting, maintenance, and harvesting, the right tools can make a significant difference in the overall success of farming activities. Understanding the different tools available and their functions allows farmers to optimise their work, ensuring better productivity and sustainability in their agricultural practices. This section will explore some of the most common tools and equipment used in crop production and their specific roles in supporting farming processes.

Simple Farm Tools and Equipment and Their Uses

Simple farm tools are simple handy tools constructed by the farmer or craft men and women used to carry out some basic farming operations. These tools are normally used in the garden or used for backyard farming. They include the following:

1. **Hand fork:** A hand fork is a small, hand-held gardening tool used for loosening hard soil, lifting, turning, and mixing compost with the soil. They are also used for removing weeds in seedling trays and plots and lifting and transplanting plants and seedlings. Their use also aerates the soil.

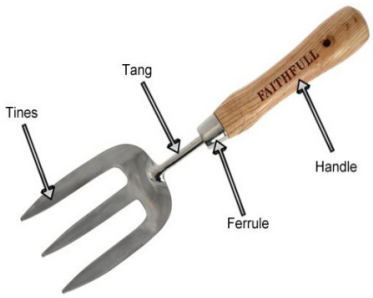

Fig. 2.1: Diagram of a hand fork

2. **Hand trowel:** Hand trowels are used for loosening the soil around plants. It has parts like the shovel.

Fig. 2.2: Picture of hand trowel

3. **Hand cultivator:** This is a simple garden instrument used for tilling garden plots and removing weeds.

Fig. 2.3: Picture of hand cultivator

4. **Hoe:** The hoe is made up of a flat metal blade and handle, which can be made of either wood or metal. The hoe is used for removing weeds, loosening, and levelling soil. It is also used for digging furrows for planting and making mounds.

Fig. 2.4: Diagram of a hoe

5. **Knife:** It is a universal tool for cutting. Some are single-edged, while others are double-edged. It is a hook-shaped tool consisting of a curved blade made of high-carbon steel and manganese steel, attached to a wooden or plastic handle.
6. **Machetes/Bolos**: These are large cutting tools usually used for clearing vegetation, cutting tall weeds and grasses, and chopping branches of trees.

Fig. 2.5: Diagram of machetes/bolos

7. **Mattock/Pick-mattock:** The mattock has **two main parts**: the head, which is the metal part, and the handle, which can be made of either wood or fibreglass.

Fig. 2.6: Picture of a mattock head of a mattock

The head of the mattock is made up of:

- The large horizontal blade is called the "adze" and is used for digging the earth. The blade of the adze is slightly curved, which gives it the correct angle when striking the earth to penetrate further.
- The eye of a mattock head is the hole in the centre through which the handle is fitted.
- The vertical part at the back of the head can be either the pick or the axe, depending on the type of mattock. It is used for uprooting stumps or cutting the roots of trees when digging the soil.

8. **Sickle** is a well-known and ancient hand-held agricultural instrument. It has a curved blade that is used for cutting weeds and harvesting cereals such as rice.

Fig. 2.7: Diagram of a sickle

9. **Scythe:** In agriculture, the scythe is a versatile hand-held implement for mowing cereals and other herbaceous plants. It has a curved and sharp blade.

Fig. 2.8: Picture of a scythe

10. **Spade and Shovel**: The spade has a flatter, shallower face for digging, piercing, or cutting. Spades have smaller, narrow blades that enable greater precision and control when cutting through the soil. A spade is used primarily for cutting soil and digging holes, while a shovel is used for moving materials such as soil, sand, and gravel. Shovels typically have larger blades compared to spades. This allows for greater capacity when scooping and lifting materials. There are different types of shovels for specific functions, for example, round digger shovel, post-hole shovel, and trench shovel.

    The head of a shovel or spade consists of the blade and a socket. The blade (sometimes called a scoop) holds the material being moved while the socket fits over the hand-held

shaft. At the end of the blade is the cutting edge, which does the work of cutting through soil, clay, snow, and any other material.

Fig. 2.9: A diagram of a spade. Heads of spade and shovel (middle)

11. **Rake:** A rake is like a broom but made with metal. It consists of a long wooden handle and a serrated wooden or metal part planted at the other end of the handle. Rakes are made today of different materials and can be wood, metal, or plastic, and can be long or short, depending on purpose. It is a tool used for gathering trash, hay, gravel, stones, and foreign materials from lawns, fields, and seed beds.

Fig. 2.10: Diagram of rake

12. **Spading forks/pitchforks/foot forks:** These are multi-purpose agricultural tools. They have a handle and sharp points or tines. The handle is made of hardwood oak or beech, with a total length of 150 cm. They are used for digging out roots, loosening soil, and turning materials in a compost heap.

Fig. 2.11: Spading forks/pitchforks/foot forks

13. **Grab hoe:** A grab hoe helps to break hard topsoil. It is also used to crush hard soil smoothly.

Fig. 2.12: Grab hoe

14. **Cultipacker:** This is an equipment used for crushing soil clods. It can be used to eliminate cracks, press small stones, and remove air pockets to form a smooth, firm seedbed.

Fig. 2.13: Cultipacker

15. **Pruning shears or pruning scissors:** They are sharp, heavy-duty scissors that have one or two blades and are used for cutting plant stems and branches. The single-blade types are for floricultural and vine pruning. The double blade is for orchard pruning.

Fig. 2.14: Pruning shears

16. **Secateurs:** These are meant for cutting branches, deshooting, cutting of scion sticks, disbudding, defoliating stems, and topping off of small trees. They are also useful in pruning off pencil-thick branches and making cuttings for propagation.

Fig. 2.15: Secateurs

17. **Grass shear**: Grass shears in various types are used for the maintenance of lawns, i.e., trimming and side dressing of lawns. The important parts are cutting blades made of high-carbon steel or alloy steel. The blades are sharpened at the cutting edges.

Fig. 2.16: Grass shears

18. **Hedge shear**: It is used for trimming, pruning, and cutting hedges and shrubs into the desired shape. It consists of two blades with tangs. The blades vary from 15–30 cm in length and are 0.8 cm thick.

Fig. 2.17: Hedge shears

19. **Manual sprinkler:** This is a simple hand-held watering can for watering plants.

Fig. 2.18: Manual sprinkler

20. **Wheelbarrow:** This tool consists of a container mounted on a single wheel with two handles for controlling movement. A wheelbarrow is used for moving lightweight items such as fertilisers, manures, plants, seeds, and waste materials.

Fig. 2.19: Picture of a wheelbarrow

21. **Axe:** Consists of a metal part (head) and a handle that can be made of different materials, usually wood. It is used for cutting or splitting wood and big branches of trees.

Fig. 2.20: Picture of an axe

Implements

These are meant as appendages (attached) to machines for mechanised machinery and add more value to that piece of machinery. Implements, when added, allow the machine to be used for different purposes. The machinery would pull or push the implements to perform their designated role. Nowadays, tractors are used extensively, though there are places where, by necessity, oxen or manual methods have to be used. Examples of implements are:

1. **A cultivator:** A cultivator is used to stir and loosen the soil, breaking the clods and destroying the weeds. It performs intermediary ploughing and harrowing. It also maintains a good tilth, adequate aeration, and prevents run-off and evaporation. Cultivators may be shovel, disc, and blade types. Tine and spike cultivators are used to tilt the soil**.** They are used for removing weeds and for pulverising and stirring the soil before planting. The use of this implement allows for easier water percolation and aeration of soil.

Fig. 2.21: Pictures of cultivators

2. **Plough:** A plough is one of the most ancient agricultural implements whose function is to till the soil and prepare it for sowing. Ploughs are normally pulled by tractors. Some types of plough are:
   a. **Mould-board plough:** This is a tractor-operated implement with 1–3 ploughs, whose digging and cutting parts are made from high-carbon steel or low-alloy steel. The ploughs cut, crumble, and invert the soil. The plough leaves a level soil surface and is used where flood irrigation is important.

Fig. 2.22: Mould-board plough

b. **Disc plough:** It consists of moving circular steel discs of varying diameters and thickness. Discs cut, turn, and break furrow slices. These can work well in sticky soil as well as in very hard and dry soil. It is heavy and leaves the soil rough and cloddy.

Fig. 2.22: Disc plough

c. **Sub-soil single-arm plough (Patashi plough):** This plough is ideal for heavy soils. It features a single adjustable arm with shears at the base, designed to break through the hardpan that develops beneath the soil surface. By improving drainage in waterlogged soils, it enhances soil quality and productivity. The plough can penetrate up to 50 cm deep into the ground and is best suited for creating a trench that is 5–7 cm wide.

Fig. 2.23: Sub-soil single-arm plough

3. **Harrow**: These are usually used after disc ploughing for the preparation of finer soil by breaking clods, cutting weeds, and pulverising the soil surface during field preparation. The harrow may be disc, spike, spring, or blade types and used in multiples.

Fig. 2.24: Harrower

4. **Subsoiler:** This tractor-mounted equipment is used to break up and loosen the soil during deep tillage. It is used to improve the growth of crops in areas where soil compaction is a problem.

Fig. 2.25: Subsoiler

5. **Irrigation sprinkler or water sprinkler:** An irrigation sprinkler is used to irrigate crops in a field. It helps to irrigate large areas and maintain the optimum level of humidity.

Fig. 2.26: Sprinkler

6. **Seed planter:** This is an implement used for calibrated sowing of seeds at equal distance and at the proper depth.

Fig. 2.27: Seed planters in different angles

Machinery

Farm machinery refers to a set of mechanised equipment that can run on electricity, diesel, petrol, or hydraulic power. Most farm machinery is still operated by humans, but there is a gradual introduction of machinery that is smart and can run according to a computer-controlled program. This can include an entire system like a combine harvester, which integrates multiple machines (such as cutting, threshing, and separating components) to streamline the harvesting process. Machinery is more complex, as it involves the coordination of multiple machines, often requiring sophisticated control systems to optimize performance and efficiency in agricultural production.

Examples of Machines

1. **Tractor:** Probably the most widely used and most important machine on a farm. It is used for pulling or pushing agricultural equipment in order to till, plough, harrow, or plant. A tractor is a vehicle specifically designed to deliver a high tractive force at slow speeds for the purposes of hauling a trailer or machinery used in agriculture or construction.

Fig. 2.28: Picture of a tractor

Fig. 2.29: Parts of a tractor

2. **Harvester:** They are used to harvest larger areas of crops quickly and efficiently.

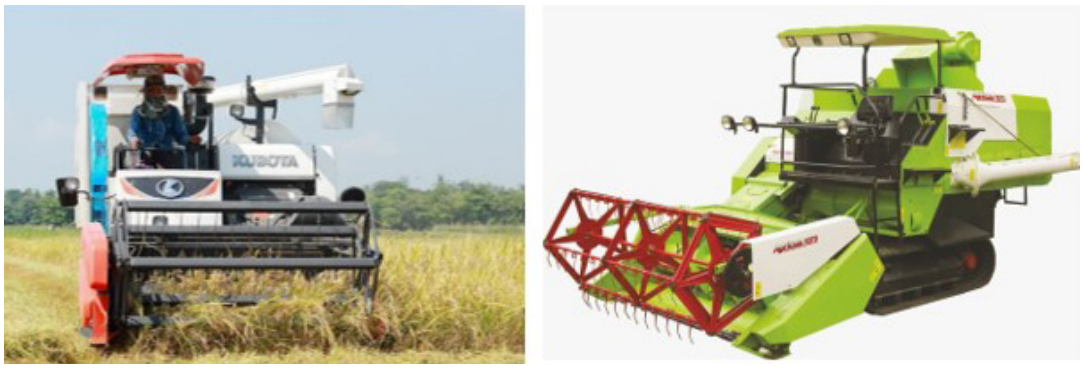

Fig. 2.29: Harvester (left), Harvester on a farm (right)

3. **Knapsack Sprayer:** This machine can be manually, electrically, or petrol-driven. It is used to apply wettable, emulsifiable, and water-soluble pesticides and liquid fertilisers to plants.

Fig. 2.30: Knapsack Sprayer (left), Man manually using a knapsack sprayer on a farm (right)

Activity 2.1

Follow the following tasks to complete the activity.

1. Head to the school garden or any nearby farm or agricultural workshop where you can observe the available simple farm tools, implements, and machinery.
2. Walk around and take notes on each tool you find, paying attention to how it looks and what it might be used for.
3. Identify at least five (5) different tools and write a brief description of their uses or functions. Make sure to include how they could be helpful in various stages of farming, such as soil preparation, planting, or harvesting.

Activity 2.2

Case Study

You are part of a small farming community in one of the regions in Ghana. The farmers in your community rely on traditional methods of farming, using basic tools like hoes, cutlasses, and watering cans. However, they have been facing challenges with soil fertility and crop production, especially after the last rainy season, which was not as fruitful as expected. To improve the situation, a local agricultural officer has introduced new modern farming tools and equipment, such as power tillers, seed planters, and irrigation systems.

Your community is eager to adopt these new tools but is unsure how to use them effectively. You and a group of fellow young people are asked to help the farmers learn about these new tools by identifying them, understanding their uses, and spreading the knowledge throughout the community.

Questions:

1. How would you go about identifying and learning the uses of these modern farming tools introduced to your community?
2. After watching videos or reading about these tools online, how would you explain their benefits to the farmers in a way they would easily understand?
3. What safety measures would you suggest the farmers follow when using these new tools to prevent accidents or injuries?
4. How can the introduction of these new tools help improve crop production and overall farming efficiency in your community?

Classification of Farm Equipment, Implements, and Machines

There is a wide range of agricultural equipment currently used in farming. In general, these implements can be divided into five main categories based on their functions. These five categories are briefly described below.

1. **Soil cultivation implements:** These are used for ploughing the soil and preparing it for cultivation. Some examples of soil cultivation equipment include tillers, disc harrows, and moldboard ploughs.
2. **Planting machines:** These are used for planting seeds and saplings after the soil has been prepared.
3. **Irrigation machinery:** These are used for watering crops on large farms. They usually include central pivot irrigation systems and pump units.
4. **Harvesting equipment:** These are used to gather crops once they have reached maturity. Examples of harvesting equipment are diggers, pickers, and trailers.
5. **Miscellaneous agricultural equipment:** These are used for carrying out supplementary activities such as haymaking, shredding, and loading on a tractor.

Activity 2.3

1

a. Work in a group of five to explore different types of farm machinery used in crop production. Browse the internet and find information about the following classes of farm machinery:

- Land Tillers
- Planters
- Harvesters

b. Once you have found relevant information, write down the names of specific machines under each class. For example, under "Land Tillers," you might find machines such as rotary tillers or power tillers. Ensure that you also note how each machine is used in crop production.

c. After gathering your information, create a short presentation (digitally or manually) and share your findings with the class and teacher for review.

Activity 2.4

Follow the following instructions to complete the activity.

1. Visit a farm or research simulated demonstrations of farm machinery used in crop production.
2. Take notes on what you observe, focusing on how each machine works and its role in the farming process. Pay attention to any demonstrations of land tillers, planters, and harvesters, noting how these machines make farming easier and more efficient.
3. Once the visit or research is complete, write a report of at least 200 words. In your report, describe each type of machinery you observed and how it is used on the farm. Include the benefits of using these machines in terms of increasing productivity and reducing labour.

REVIEW QUESTIONS

1. A friend has asked for your help because a ditch running through their land has become blocked, preventing the water from flowing. Upon visiting the site, you noticed that the ditch is overgrown with branches from trees and bushes, some of which are covered in thorns. Dead branches have also fallen into the ditch, causing a buildup of mud behind them. Which tools would you take with you to help clear the ditch? Are there any other items you would consider bringing along?
2. Farm machinery is designed to accelerate farming processes and reduce the manual labour that was previously required. Classify these machines into five (5) categories based on their specific uses.

ANSWERS TO REVIEW QUESTIONS

1. The following tools are likely to be the most helpful in resolving the problem: a spade, machete, shovel, secateurs, rake, and axe. Other things to be carried along may include hand gloves, overall protective clothing, a Wellington boot, and a wheelbarrow.
2. The five (5) categories of the machines are:
    - **Soil cultivation implements:** These are used for ploughing the soil and preparing it for cultivation. They include tillers, disc harrows, and moldboard ploughs.
    - **Planting machines:** These are used for planting seeds and saplings after the soil has been prepared. These include seed drills and broadcast planters.
    - **Irrigation machinery:** These are used for watering crops on large farms. They usually include sprinkler systems and pump units.
    - **Harvesting equipment:** These are used to gather crops once they have reached maturity. They include combine harvesters, pickers, and trailers.
    - **Miscellaneous agricultural equipment:** These are used for carrying out supplementary activities such as hay-making, shredding, and loading on a tractor.

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Acknowledgements

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