Agricultural Science

for Secondary Schools in Guyana

Book One
Agricultural Science

for Secondary Schools in Guyana

Book 1

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Curricula must be flexible enough to respond to the existential needs of the children in a changing society. Textbooks which are aids in the delivery of those curricula must be revised and edited as often as the need arises to make them contemporary in information and presentation.

Because of these things one welcomes the revised editions of the secondary school textbooks.

We wish to commend all those persons responsible for this painstaking effort for having done a worthwhile job. The nation's children and their teachers will benefit significantly because of this effort.

May the industry of the editors be suitably rewarded by the wise use of the revised secondary school texts.

Dale Bisnauth
Minister of Education
This series of secondary textbooks has evolved from the first set of secondary textbooks which was planned for students in General Secondary Schools. An important modification is that the new secondary books have been designed for students exposed to all types of secondary education (General Secondary Schools, Community High Schools and the secondary divisions of Primary Schools).

The books have been prepared with the common curriculum in focus and will be found to be consistent with most of the concepts dealt with in the curriculum guides for these schools. It is hoped that the introduction of these books to the different levels of secondary education now evidenced in Guyana, will help to remove some of the disparities which exist in accessing suitable learning materials.

There was a deliberate attempt to involve the experiences of teachers of the existing Community High Schools, the secondary divisions of Primary Schools, the General Secondary Schools, teacher educators and university lecturers.
Introduction to Agriculture

In this chapter we are going to learn:

- how agriculture developed over the years
- ways in which agriculture is important to man and the country
- the areas of study that agriculture may be divided into.

The term ‘agriculture’ is derived from two Latin words: ager, meaning field, and cultura, meaning cultivation. Today, however, the term is more broadly defined as the production of plants and animals useful to man. It covers not only the cultivation of soil and the management of crops and livestock, but also the preparation of plants and animal products for use by man, and the distribution of these products by marketing.

History of Agriculture

The earliest man survived by hunting wild animals, fishing in lakes and rivers and gathering fruits and nuts from the forests. When man was no longer able to find enough food within his surroundings, he moved to new places in search of food. Gradually he learnt how to select and domesticate animals, till the soil and cultivate plants to satisfy his needs. Communities developed as he became more settled and organised in his ways of living.

The first settlements emerged along the banks of the Nile, Tigris and Euphrates rivers, where land was very fertile. Those early settlers used tools made of stone and other materials to prepare the soil for planting. They, however, continued to hunt for animals and to fish in the sea, rivers and lakes around them. They used the meat of those animals for food. The useful hides or skins were used for clothing and shelter.

Can you tell what other materials were used for making tools and weapons?

Settlements developed into communities and man began to spend time studying and observing his environment or surroundings. As the population increased the demand for more food also increased. That led to the selection of animals for rearing or domestication and crops for planting, through trial and error. As time passed, man developed improved breeds of livestock and new improved varieties of crops. He also improved the tools and the fertilizers and animal feed used for crops and livestock.

Similar developments have taken place in Guyana and the Caribbean. The earliest settlers (the
Amerindians) hunted, fished and planted simple crops. The establishment of plantation agriculture by the European settlers after 1621 changed the pattern of agriculture in Guyana. The Dutch confined their activities to the river banks. The British who assumed control of Guyana from 1796, kept the population on the narrow coastal strip.

The European settlers established plantations of tobacco, sugar cane, coffee and cotton. Along with these they introduced high technology like drainage and irrigation, machines and chemicals on their plantations. By 1880, the rice industry was introduced to Guyana and today it ranks second to sugar cane as a foreign exchange earning crop.

Around the year 1900, the management of livestock in Guyana was very poor. Horses and mules received some amount of attention, while cattle, sheep, goats and poultry were left to fend for themselves. Later, attempts were made to provide proper drainage for pastures and protection against unfavourable weather conditions. With the introduction of more efficient systems of management, the livestock industry in Guyana developed and production increased in cattle, poultry, sheep and goats.

List some promising livestock enterprises in Guyana.

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The importance of Agriculture

Some necessities of life are met through agriculture. In early times, agriculture performed the simple role of satisfying man's need for food, clothing and shelter. This still remains one of the most important roles of agriculture.

In modern society, however, these roles have expanded to include a number of other developments. Today, agriculture is considered very important because it also provides:

- a basis for research
- opportunities for the economic use of land
- raw materials for industry
The economic use of land is an important consideration to all farmers. Farmers use the land for cultivating crops, establishing pastures, erecting buildings for housing animals and for other related purposes. Land is also needed for the establishment of agro-industries. Agriculture is therefore responsible for bringing much idle land into good use.

Raw materials for industries are supplied by agriculture. Some are: sugar cane, hides of animals, fresh milk and paddy.

Fig. 1.2 Man's basic needs
- opportunities for aesthetic appreciation
- employment and revenue
- scope for recreational activities
- foreign exchange.

As a basis for research, work in agriculture has led to investigations into plant and animal life and the products obtained from these. The present use of suitable pesticides and better varieties of crops are some of the improvements which have resulted from years of research and experiment in agriculture.

Fig. 1.3 Raw materials for industry
Foreign exchange refers to the revenue obtained from the sale of products to overseas markets. This money helps to purchase those commodities which are essential to national development but which cannot be produced locally.

Aesthetic appreciation can be developed in agriculture, especially by the floriculturist. Ornamental and landscape plants enhance the environment and draw attention to the beauty in nature.

Employment and revenue are two areas of agriculture which provide great benefits to those involved. Through employment, persons earn a living. Moreover, revenue or national income obtained from agriculture helps in the development of other sectors of the economy.

Recreational activities can be enjoyed in the form of a simple agricultural venture. Rearing a few chickens in the back yard or fishing by the riverside provides great scope for relaxation from other work.

Branches of Agriculture

The main branches of agriculture are:

- Crop science
- Soil science
- Animal science
- Agricultural engineering
- Agricultural economics
- Agricultural Education
Crop science

Crop science deals with the production of plants which are of economic importance to human beings. It includes:

- crop protection, whereby the farmer protects his crops against pests and diseases to ensure high yields and good quality.
- crop improvement, which deals with the selection and breeding of new plant varieties.

Soil science

Soil science emphasises the need for maintaining a high level of fertility in the soil. It involves the study of:

- soil formation
- soil characteristics
- soil management.

Animal science

Animal science involves the study of producing livestock. Some important aspects are:

- selection of animals
- livestock management
- control of pests and diseases
- breeding of animals.

Agricultural engineering

Agricultural engineering involves the following:

- designing and constructing farm machines and farm buildings
- laying out drainage and irrigation systems
- maintaining farm machines and equipment.

Agricultural economics

Agricultural economics deals with the science of managing farm resources such as land, labour and capital, to achieve a desired level of production in agriculture. Important aspects of this branch are:

- farm management
- marketing of farm produce
- farm record keeping.

Agricultural education

Agricultural education includes training for farm occupations as well as for non-farming occupations. It involves:

- training and education of children in schools
- training of farmers by extension workers
- training and education of specialists in various fields of agriculture.
Careers in agriculture

Agricultural professions

This occupational grouping requires individuals, who through an extended period of specialized training beyond high school must acquire a B.Sc. degree in the field of agricultural science and those areas of instruction which support it.

The clusters of the profession are:

Education
- Agricultural extension workers
- Agricultural teachers
- Agricultural lecturers / professors

Communications
- Agricultural communication workers

Specialities in Agriculture
- Agronomists
- Agricultural economists
- Agricultural crop scientists
- Agricultural chemists
- Agricultural engineering
- Agricultural research careers

Conservation, forestry and related fields.
- Careers in forestry
- Careers in conservation
- Careers in soil conservation
- Careers in fish and wildlife

Food technology, animal dairy and poultry industry
- Dairy technologists
- Food technologists

Horticulture landscape architecture
- Horticulturists
- Landscape architecture

Veterinary medicine
- Veterinarian

Agronomist

The agronomist is trained in soil management and crop production. The basic qualification is a Bachelor of Science degree in Agriculture – B. Sc. (Agriculture).

Horticulturist

The horticulturist is trained in the production of vegetables, fruits and ornamentals. The basic qualification is B. Sc. (Agriculture).
Silviculturist

The silviculturist is trained in the planting and caring of forest trees. The basic qualification is a Diploma in Forestry or B. Sc. (Agriculture).

Plant breeder

The plant breeder is trained in crop improvement principles. Responsibilities include the production of new plant varieties. The basic qualification is B. Sc. (Biology) or B. Sc. (Agriculture).

Entomologist

The entomologist studies insects, particularly those which affect crop plants. He designs insect pest control programmes. The basic qualification is either B. Sc. (Agriculture) or B. Sc. (Biology).

Soil conservationist

Soil conservationist designs soil management programmes which include:

- control of soil erosion
- plans for irrigation and drainage layout, advises farmers how to carry out soil conservation practices. The basic qualification is B. Sc. (Agriculture).

Veterinary surgeon

The veterinary surgeon is concerned with the prevention and control of pest and disease conditions which affect animals. He is responsible for diagnosing the causes of abnormal conditions and death of animals and for the prevention of zoonotic diseases. The basic qualification is either a Doctor of Veterinary Medicine degree (D.V.M.) or a Bachelor of Veterinary Science degree (B.V. Sc.).

Livestock officer

The livestock officer prepares plans for improved production of livestock. He also keeps in contact with other agencies which relate to livestock so that important information can be transferred to farmers. He pays attention to things like:

- artificial insemination
- establishment and management of improved pastures
- nutrition programme for livestock
- preparation of project proposals for livestock production.

The livestock officer supervises the work of the Assistant Livestock Officer. He also works along with the farmers for the success of this programme. The basic qualification is B. Sc. (Agriculture).

Livestock assistant

The livestock assistant is in daily contact with the livestock farmers. He keeps them informed on desirable management techniques and arranges demonstration exercises for farmers. He also advises and assists livestock farmers to plan and execute programmes suitable for their farms and communities. The basic qualification is either a Diploma in Agriculture or a Diploma in Animal Health.

Extension officer

The extension officer collects and interprets information on agricultural research. He organises training programmes for farmers and other specialists in agriculture. He also informs the community about new trends in agriculture. The basic qualification is either a Diploma in Agriculture or B. Sc. Agriculture).
Agricultural economist

The agricultural economist prepares agricultural estimates of projects. He also analyses and approves loans for agricultural businesses and determines the economic feasibility of farm enterprises. The basic qualification is B. Sc. (Agriculture).

Agricultural science educator

The agricultural science educator assists students and members of the community to acquire knowledge and skills to operate as technicians in agriculture. He also prepares students for local and regional employment and counsels them on the careers in agriculture. Qualifications include formal training in agriculture and in teaching.

Agricultural engineer

The agricultural engineer deals with the structure and function of farm machines, designs of farm buildings and drainage and irrigation systems. Qualifications include a B. Sc. in Agriculture Engineering.

Occupations in agricultural production

The classification includes all occupations involved in production of food and fibre, plants and animals, either on a self-employed basis or as an employee, usually on a farm.

The farmer

The farmer is engaged in the production of crops and livestock. He also prepares his produce for the market. A farmer must have interest in his work so as to ensure maximum yields. Training in agriculture can be of help to the farmers.

The group of farmers include those involved in the following farm operations:

- Animal husbandman
- Animal producers
- Fruit growers
- Grain producers
- General farmers
- Poultry producers
- Poultry farm managers
- Truck farmers
- Part-time farmers
- Speciality farmers
- On farm employees
- Farm labourers

Occupations in agriculture business, industry and services.

The classification includes all occupations involved in buying agricultural produce, truckers of some farm commodities and most workers engaged in processing, packaging and selling farm products. Included in this group will be workers who perform services for farmers, sells to them or the public in activities where he needs agricultural training or experience. This grouping includes:
Processing and distributing
- Agricultural products
- Career opportunities in the meat industry, milk industry and crop industry.
- Florists

Distribution to farmers
- Farm equipment dealers
- Farm equipment industry workers
- Feed and farm supply Store

Farm services
- Agricultural business manager
- Farm mechanic

Agricultural services
- Conservation worker
- Landscapes and nurserymen

Agricultural technicians
- Agricultural laboratory technician
- Agricultural research technician
- Veterinary technician
- Communications technician

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Exercises
1. Say in your own words how ancient man lived.
2. Role-play: A day in the life of the farmer.
3. Match the occupation in group A with the appropriate duties in Group B.

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<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
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<tr>
<td>Agronomist</td>
<td>improves crop and produces new plant varieties</td>
</tr>
<tr>
<td>Entomologist</td>
<td>manages soil and crop production.</td>
</tr>
<tr>
<td>Horticulturist</td>
<td>studies insects and designs their control programme.</td>
</tr>
<tr>
<td>Plant breeder</td>
<td>produces vegetables, fruits and ornamentals.</td>
</tr>
<tr>
<td>Veterinary surgeon</td>
<td>is concerned with the control and prevention of pests and disease conditions which affect animals.</td>
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4. Copy the table below and complete it by filling in the blanks.

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<th>Raw materials</th>
<th>Manufactured products</th>
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<td>fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sugar cane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tobacco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cattle</td>
<td></td>
<td></td>
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<tr>
<td>swine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>timber</td>
<td></td>
<td></td>
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<tr>
<td>coconut</td>
<td></td>
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</tbody>
</table>

**Summary**

**WE HAVE LEARNT THAT**

- early man moved in search of food but when he began to produce food he was able to settle and develop communities with schools, churches, industries, etc.

- agriculture satisfies man's basic needs. It also provides materials and opportunities for other aspects of life that are important to man.

- in agriculture there are many areas of study. There are basic academic qualifications which persons must have if they want to be employed in the various branches of agriculture.
In this chapter we are going to learn:

- the origin of soils
- how the soil is formed
- the factors that cause weathering
- the composition of the soil
- the properties of the soil.

We may say also that the soil is the natural material in which land plants grow.

**Origin of soils**

Rocks are continuously disintegrating (breaking into smaller pieces) and decomposing (changing to substances) to form soil. Substances from rocks make up the mineral matter in the soil. Rocks are formed in three ways:

- When lava from volcanoes cools, it forms rocks. These are known as **igneous rocks** eg granite.

The soil is a natural renewable resource, that can be sustained by proper management. Most of man's needs come from the soil. It is therefore essential for agriculturists to understand the properties of the soil, so that they can protect, conserve and improve this most valuable resource.

The soil is the loose material on the earth's surface. It is made up of:

- mineral material which comes from weathered down rocks
- organic material which comes from the excreta and remains of living organism and decayed leaves of plants
- soil air
- soil water.

![Fig.2.1 Igneous rocks](image-url)
• Solid rocks deep under ground are under high pressures and temperatures. Over a period of time those rocks are changed to form **metamorphic rocks** eg. marble and slate.

**Fig 2.2 Metamorphic rocks**

• Moving water carries small pieces of rocks collected in quantities so large that the weight squeezes the pieces causing those at the bottom to stick together. These are known as **sedimentary rocks** eg. limestone.

**Fig 2.3 Sedimentary rocks**

---

**How the soil is formed**

The soil is formed by a process described as **weathering**. Weathering refers to the wearing away of rocks. This produces small fragments and particles which help to make up the soil. Factors which bring about weathering are:

• temperature
• water
• wind
• the roots of plants.

**Temperature**

The heating of rocks during hot days followed by cooling at nights causes rocks to expand and shrink. In the process of expanding and shrinking rocks crack and break into fragments and soil particles.

**Water**

Water running over a rock for a long time gradually wears away the rock. This happens in warm countries. In cold countries, water seeps into cracks and freezes. The ice formed in the cracks expands and puts a great pressure on the sides and this causes the rock to break and sometimes crumble.
Roots of plants

Plant roots grow and enter the crevices of rocks; and as they grow exert sufficient pressure to widen cracks and assist in further splitting up the rocks which eventually breaks up into smaller fragments and particles.

Wind

Strong winds blow small fragments and particles of soil from one place to another. The movement of these materials over the surface of a large rock gradually wears down the rock to form soil.

Animals

In making their burrows in the soil, animals bring up rocks to the soil surface where they weather to form soil. Water and air also get into the burrows and dissolve certain minerals in the surrounding rocks, causing them to crumble.
Man

Through his activities, man helps in the breaking up of rocks to form soil. The machines used for road building, land clearing and tilling, turn over rocks which are then reduced to fragments and finally soil particles.

![Image of a tractor plowing a field](image)

Fig. 2.7 The action of man

Composition of the soil

In adequately drained soil, liquid and gas occupy the pore spaces between soil particles. Soil is made up of 50% solid, 25% liquid and 25% gas.

Soil solids

The soil solids are made up of (i) inorganic (ii) organic matter. The inorganic matter makes up the mineral materials in the soil. These supply some nutrients to the plants. Some soil nutrients are

- Nitrogen - N
- Phosphorus - P
- Potassium - K
- Calcium - Ca
- Magnesium - Mg
- Manganese - Mn
- Sulphur - S

Soil water

Soil water is necessary for the movement of nutrients from the soil into the plants. The soil is the place from which the land plants obtain water.
Fig. 2.9 Water in the soil

Experiment to show that soil contains water
Heat some soil in a test tube. What do you observe?
Place a mirror over the test tube:
(a) what do you observe?
(b) use blue cobalt chloride paper and test for water. Remember water turns blue cobalt chloride paper pink.

Soil air
Soil air is necessary for the development of healthy roots and soil organisms.

Experiment to show that soil contains air
Use a drinking straw and blow some air into a jar of water. What do you see?
Now take a piece of dry soil and immerse it in water.

(a) What do you observe?
(b) Give reasons for your observation.

Fig.2.10 Air in the soil

Soil organisms

Have you ever dug up a section of your yard or your school farm? What did you find in the soil? Let's list some of the things you are likely to find in the soil.

- roots of plants
- earth worms
- insects such as ants and crickets.
- the larvae of some soil insects (worm-like creatures)
- centipedes and millipedes
- snails
- slugs.

Do you think these are the only living things in the soil? Oh no, in some places large animals such as rats and squirrels live in the soil.

In addition, very small organisms live in the soil. These are nematodes, bacteria, fungi and viruses.
Properties of the soil

Physical properties

Texture

Texture is the relative proportion of the different soil particles (sand, silt and clay) that make up the soil.

A clay soil is said to have a fine texture because of fineness of the particles, while a sandy soil is said to be coarse. The sand particles are gritty while the silt particles are smooth and powdery. The clay particles are plastic and very sticky when wet. The effects of soil texture on the properties of soil can be observed by comparing sandy soil with clay soils.

Fig. 2.12 Clay soil - fine texture

Clay soils retain water and plant nutrients. The particles are tightly held together. However, water is easily retained in clay soils thus they are easily waterlogged during the heavy rainy seasons.

Sandy soils are well drained since the particles are loosely held. These soils cannot retain much water; thus, they are poor in plant nutrients. Strong winds can easily blow sandy soil particles away. Sandy soils need organic matter, fertilizer and water regularly to maintain water and nutrients in the soil and promote plant growth.
Fig. 2.13 Sand soil - coarse texture

A sandy soil will feel gritty between the fingers, while a clay soil will feel smooth between the fingers. The following table shows some of the commonest soil types. Soils are classified according to the size of the soil particles (International system).

<table>
<thead>
<tr>
<th>Types</th>
<th>Size (mm)</th>
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<tbody>
<tr>
<td>Stone and gravel</td>
<td>more than 2.0</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>2.0 - 0.2</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.2 - 0.02</td>
</tr>
<tr>
<td>Silt</td>
<td>0.02 - 0.002</td>
</tr>
<tr>
<td>Clay</td>
<td>less than 0.002</td>
</tr>
</tbody>
</table>

STRUCTURE

The arrangements or cementing of the soil particles decides the soil structure. The structural units are usually of five basic shapes:

- **Platy** - units that are flat or platy. They are arranged in thin horizontal plates.

- **Blocky** - structural units which are blocky or many sided.

- **Crumb and granular** - Those which are more or less round and spherical or many sided. The units do not fit closely against adjoining units. This is the best condition for agricultural soil.
Soils with good crumb or granular structure are favourable agricultural soils. They are fertile, since the shape and size of the pore spaces are suitable for the retention of adequate air, water and plant nutrients.

**COLOUR**

Soils vary in colour. The common colours of soils are red, yellow, brown, grey and black. The brown, yellow and red indicate the iron compounds present. In well drained soils with iron the colour is red. In poorly drained soils with iron the colour is yellow or brown.

The dark coloured soils have organic matter. Black soils have a mixture of limestone and humus, while grey soil are most times waterlogged.

**Biological properties**

Soils house a complex mass of living plants and animals, from large macro-animals like rodents to tiny micro-organisms like bacteria. Each of these organisms has a specific task of converting organic matter to valuable plant nutrients and maintaining a soil structure suitable for plant growth.

**Exercises**

1. (a) Apart from the organisms listed in this chapter, name six other organisms which you may find in the soil.

(b) Draw the organisms you have listed in (a).

2. Collect samples of rocks and group them under the three types mentioned in this Chapter.

3. Grow two plants in separate pots. When they are about one foot tall, water one everyday, and stop watering the other.

(a) Note your observations for twenty-one (21) days.

   Remember, plants must be kept under same conditions, eg. in the sun or under a shade as you choose.

(b) Explain reason(s) for every difference between the two plants during the period of observation.
Summary

WE HAVE LEARNT THAT

- the soil is made up of mineral materials which come from weathered rocks; organic materials such as decayed plant and animal remains, also soil air and water.

- the factors which bring about weathering include temperature, water, wind, roots of plants, animals and man.

- the soil has physical, chemical and biological properties which aid healthy plant growth.
3 The distribution of crops and livestock

In this chapter we are going to learn about:

- how plants and animals provide man with food, clothing, shelter and other materials.
- how the distribution, growth and yields of plants and animals depend on social, biological and physical factors.
- the factors that affect the distribution of crops and livestock in Guyana and the Caribbean.

The distribution of crops

Factors affecting the location of crops

The cultivation of crops on an economic basis depends on various factors.

Some of these are:

- **Climate** - some crops require a cool climate for normal growth, while others grow well under warm climatic conditions e.g. most varieties of wheat thrive under temperate or cold conditions. Rice needs tropical or hot conditions.

- **Soil** - some plants can tolerate dry sandy soils, e.g. pine apples and peanuts, while others require wet and/or swampy areas, e.g. rice.

- **Methods of cultivation** - crops like rice and sugar cane are suited to plantation farming. They do not need the individual care and attention as some crops demand. Eschallot and celery for example require very intensive care.

- **Labour and machinery** - labour-intensive crops must be grown in areas which are relatively densely populated so that there is easy access to skilled and unskilled labour to meet crop requirements. Level to slightly sloping areas are preferable farm sites where machinery can be used to do farm operations.

- **Transportation** - when there is great distance between farm sites and consumption sites, the transportation costs cause the market price of the produce to increase. If storage facilities are inadequate or lacking during transportation, there can be great loss of produce due to spoilage.

- **Topography** - sloping terrains are chosen for cultivating crops such as fodder grass, coffee and some other orchard crops. Can you give reasons for this choice? Level lands facilitate mechanical operations, flood-irrigation and ease of transportation. List crops which will benefit from these services.

Crops grown in Guyana

Crops are plants grown for economic purposes. List some of these crops which are grown locally.
The Guyana Forestry Commission has started work on silviculture. In 1990 nurseries were established at Weruni Creek (Region 10), Yarrowkabra, Hauraruni, Kairuni, Long Creek, (Region 4), Moraballi Reserve and 5-7 Miles Bartica, (Region 7). The Pinus caribea (needle and thread) seedlings have been produced and their growth monitored. Viability tests, soil suitability tests and other tests are some of the operations done at the nurseries. Generally, seedlings of valuable timber would be produced for reforestation.

Crops grown in Guyana vary in their distribution throughout the administrative regions. However factors which influence the intensive cultivation of some crops in a particular region are mainly those which pertain to soil types and human factors already discussed.

### Local distribution of crops

Distribution of crops as it relates to production in the ten administrative regions is shown in Table 3.2

- Corn, starchy foods, dried pulses and vegetables have been produced in each administrative region. Production of rice, sugar cane and beverage crops has not been so widely distributed throughout the regions.
- Generally, food crop production is distributed continuously along the low coastal plain area. There has been a sparse distribution of these food crops in the white sand and clay area, the interior savannah area and the forested highland area. These are the four natural regions of Guyana. The map of Guyana showing the ten administrative regions and the crop producing areas, indicates the location of the main crop production sites.
- The low coastal plain stretches from the coastal areas of Region 1 to Region 6. This narrow strip of land ranges in width from 14.5 km (9 miles)
to 64.4 km (40 miles) from the sea coast inwards. The terrain is generally level varying in altitude from 9.6 m below sea level to 200 m above sea level.

(a) Corn plant

(b) Coffee branch

(c) Cocoa plant

(d) Tomato plant

The average annual rainfall in Regions 4, 5 and 6 varies from 150 cm to 200 cm. Regions 1, 2 and 3 are wetter with rainfall ranging from 200 cm to 250 cm. The soil type basically consists of an association of deep grey poorly drained clayey and silty soils with low humic content. Pegasse and coastal marine sand reef can be found in isolated areas along the coastal plain.

With the exception of oil palm, all the food crops listed in Table 3.2 are produced on the low coastal plain. Crops occupying the largest area are rice, (64.7% of total harvested area), sugar cane (34% of the total harvested area) and forage crops (1% of the total harvested area).

Fig 3.1 Crops grown in Guyana
Sugar cane was recorded as the highest producing crop in 1989. This crop is cultivated widely in Regions 3, 4, 5 and 6 with Region 6 recording the highest production for that year. Rice and sugar cane have always been and still are large scale, intensively cultivated crops.

Factors which support this type of large scale production of paddy and sugar cane are associated with the terrain and the soil type. These factors allow for the following:

- the use of machines for field operations
- the construction of access roads and drainage and irrigation systems
- other works of infrastructure.

Fig. 3.2 Crop producing areas in Guyana

<table>
<thead>
<tr>
<th>Key to crop production areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. North-West.</td>
</tr>
<tr>
<td>B. Waini</td>
</tr>
<tr>
<td>C. Potaro</td>
</tr>
<tr>
<td>D. Coastal</td>
</tr>
<tr>
<td>E. Socodyka-Linden</td>
</tr>
<tr>
<td>F. Namim-Mara - Mahaicony</td>
</tr>
<tr>
<td>G. Upper Mazaruni</td>
</tr>
<tr>
<td>H. Central Mazaruni</td>
</tr>
<tr>
<td>I. Aliki-Makouria - Kumukari</td>
</tr>
<tr>
<td>J. Intermediate Savannah</td>
</tr>
<tr>
<td>K. North Rupununi Savannah</td>
</tr>
<tr>
<td>L. Kunuku-Kuyuwini</td>
</tr>
</tbody>
</table>

Fig. 3.3 A sugar cane plant
Table 3.2  Distribution of crops in the administrative regions of Guyana

<table>
<thead>
<tr>
<th>Region #</th>
<th>Location</th>
<th>Crops grown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Barima/Waini</td>
<td>Citrus, pear, coconut</td>
</tr>
<tr>
<td>2</td>
<td>Pomeroon/Supenaam</td>
<td>Rice, coconut, coffee</td>
</tr>
<tr>
<td>3</td>
<td>Essequibo Islands /West Demerara</td>
<td>Rice, sugarcane, coconut</td>
</tr>
<tr>
<td>4</td>
<td>Demerara/Mahaica</td>
<td>Rice, sugar cane, coconut</td>
</tr>
<tr>
<td>5</td>
<td>West Berbice/Mahaica</td>
<td>Sugar cane, rice</td>
</tr>
<tr>
<td>6</td>
<td>East Berbice/Corentyne</td>
<td>Sugar cane, rice</td>
</tr>
<tr>
<td>7</td>
<td>Cuyuni/Mazaruni</td>
<td>Corn, starchy food,</td>
</tr>
<tr>
<td>8</td>
<td>Potaro/Siparuni</td>
<td>Corn, starchy food, rice,</td>
</tr>
<tr>
<td>9</td>
<td>Upper Takutu/Upper Essequibo</td>
<td>Peanuts, cashew nuts, rice</td>
</tr>
<tr>
<td>10</td>
<td>Upper Demerara/Berbice</td>
<td>Citrus, soya bean, peanut</td>
</tr>
</tbody>
</table>

Although the average annual rainfall is in excess of the general crop requirement, soil water control is very critical for these crops. The need for control exists because there is an uneven distribution of rainfall throughout the year. The poorly drained clayey soil is suitable for rice production since the crop requires soils with high water holding capacity. When crops which require well-drained soils are grown in these areas, there is need for much land preparation to improve soil structure, and beds and ridges must be made.

Coconut crops thrive on the coastal marine sand reefs, sandy loams, silty loam and the deep alluvial loams found along creeks and river banks in Regions 2, 3, 4, 5 and 6.

Rice, sugar cane and coconut are labour intensive crops. The dense population in these administrative regions makes access to manual labour easy. Both skilled and unskilled labour are available. The opportunity for the development of modern technology in crop production is better on the coastal plain than in any other area in Guyana. One disadvantage of operating on the coastal area, however, is the difficulty experienced in acquiring new farm lands of desirable sizes and at reasonable prices.
Apart from the low coastal plain, crop production occurs in the white sands and clay areas in Regions 2, 10 and 6, south of the low coastal plain. The natural vegetation consists of Wallaba forests, seasonal rain forest, equatorial rain forest and the intermediate savannahs. Crops are produced in the Aliki-Makouria-Kurupukari region. The main crops of Region 10 are peanuts and starchy food crops. Oil palm is also cultivated there. This region has recorded the highest production of peanuts 0.96 tonnes (58.9% of total peanut production in Guyana). The light textured sandy soil allows peanut pegs to penetrate easily so that development would proceed underground. Apart from the difficulty of peg penetration, harvesting is also difficult when the crop is planted in heavy clayey soils. In this case, soil particles stick on to the nuts and may stain them.
crops. In these interior locations and in some of the coastal communities, the starchy food crop group is considered a staple diet. This fact is supported by its production in every region of Guyana. In the densely populated regions, larger areas have been cultivated, resulting in relatively larger quantities being produced.

The terrain is undulating with gently rolling grasslands in the north, becoming more hilly in the south. The altitude ranges from 200 m to 800 m in the Kanuku Mountains. The soil type varies, having brown, red and yellow deep moderately drained clay and loamy soils.

Crop producing areas in the forested highland regions are the North Pakaraima region, the Upper Mazaruni and Central Mazaruni regions. Arakaka, Port Kaituma, Morawhanna, Mabaruma, Wauna and Moruca - Kenebana areas in the North West district. These areas are located in Regions 1, 7 and 8. Varying quantities of corn, starchy food crops such as cassava, dried pulses like peanuts, fruits, vegetable and hill rice are produced in these areas. Peanut, coconuts and citrus are major products of these areas. In addition, hill rice is produced in Regions 6 and 9. Forest covered hill and mountainous terrain, along with small scattered communities, contribute to the subsistence level of crop production in these areas.

Fig. 3.5 A pea nut plant

The terrain in this area ranges from gently sloping to sloping white sand plateaux and terraces. There are areas of excessively drained white sandy soil, as well as areas of poorly to moderately drained, grey, mottled, silty and clayey soils. Annual rainfall in this area is higher than on the coastal plain.

Region 9 is located in the interior savannah region. The Pakaraima and the Kanuku-Kuyuwini have been the main crop producing areas. Dried pulses, starchy food crops and corn are the main...
Distribution of crops in the Caribbean

Crop producing territories in the Caribbean region consist of mainland territories, islands of the Greater Antilles and islands of the Lesser Antilles.

Crops produced in the Caribbean region include food crops, fibre crops, tobacco and timber. The food crops of economic importance are as follows:

- plantation crops - sugar cane, rice, coconuts
- starchy food crops - arrowroot ground provision

![Map showing the Caribbean area](https://via.placeholder.com/150)

Fig. 3.6 Map showing the Caribbean area

Identify the following:

(i) Belize on the mainland of Central America.
(ii) Guyana to the north of South America.
(iii) Trinidad and Tobago.
(iv) Islands of the Greater Antilles.
(v) Islands of the Lesser Antilles which range from Anguilla in the south.

- beverage crops - coffee, cocoa
- fruits - banana, citrus, pineapple
- spices - nutmeg, pimento, bay-leaf, vanilla, ginger, turmeric
- forage crops - antelope grass, pangola grass, kudzu

Cotton and sisal are the fibre crops produced. The cotton industry produces cotton threads and fabric used for clothing. Sisal fibre is made into parcel twine and strong ropes.
Mahogany and pine are the main forest tree crops produced in Belize. Forestry on Crown lands in Belize is carefully controlled and areas from which trees have been felled are quickly re-afforested.

With regards to spice production, Guadeloupe produces vanilla, Dominica produces bay-leaves, Grenada and St Vincent produce nutmeg. Jamaica, an island of the Greater Antilles, produces pimento and ginger.

Altitude declines as one moves towards the sea coast which ranges from 0 m to 200 m. Average annual rainfall in the forested highland is 200 cm to 250 cm and above, much higher than that on the coastal plain which averages 150 cm to 200 cm. Coastal soils originated from volcanic ashes or alluvial deposits, but a wide variety of soil types exists in the highland regions. Population density is highest in the urban and sub-urban areas.

Favourable conditions for the commercial production of sugar-cane, rice and coconuts exist on the coastal plains of the Caribbean territories. Coffee and nutmeg are produced in the forested highland areas, while cocoa seedlings are propagated on banana plantations. These seedlings benefit from the valuable shade offered by the banana leaves. In contrast to coffee plants, cocoa plants grow well on the lower elevations in the environment of the tropical evergreen rain forests.

**The distribution of livestock**

Livestock are domestic animals that are reared to produce food and other materials which are of use to man. Some livestock are also used as draught animals and others for sport. The chief kinds of livestock raised throughout the world are cattle, pigs, poultry, sheep, goats, and horses. Donkeys, rabbits, fish and bees are reared on a smaller scale.

**Factors affecting the distribution of livestock**

There are several factors which in combination influence both the distribution and production of livestock all over the world.
The factors include the following:
- climate
- availability of land
- soil type
- breed of the animal
- husbandry practices
- availability of feed
- technology
- transportation
- social and economic life of the people
- availability of money
- market conditions
- policy of government

Apart from influencing the classes of livestock raised by different countries, these factors influence their distribution, number, production capabilities and quality of the produce given by each class of livestock.

Climatic conditions include the effects of temperature, rainfall, humidity and winds. These conditions determine to a very large extent the breed of livestock raised by farmers in tropical and temperate regions, since some breeds are more adaptable to extremes of climate. Some cattle for instance perform better in tropical conditions than they do in temperate conditions. The zebu is a breed of cattle that is more adaptable to tropical conditions, whereas the Holstein performs better in temperate conditions.

Climatic conditions do not only affect the breed of the livestock raised but also the vegetation such as the grass used by the cattle and sheep as feed. The great cattle producing regions of the world are found in areas with temperatures that are conducive to their growth and with vast expanse of relatively flat lands that allow for good pastures for grazing.

These areas include:
- India which has by far a greater number of cattle than any other country. Hindus by custom, however, do not eat beef, since the cow is sacred to them. India, therefore, is not important for beef nor beef products.
- The vast plains of western Europe, including England, Holland, Switzerland and Northern France.
- The North Central and Western plains of the United States of America and Canada.
- The lowlands of South America, including the great plains of Brazil and Argentina.

Sheep on the other hand are in large numbers in countries such as Australia, New Zealand, Argentina, and Chile. The importance of cattle and sheep in the economies of all the countries mentioned is as a result of the availability of extensive pastures, coupled with the availability of finance, improved technology and farming systems and markets.

**Factors affecting livestock rearing in Guyana and the Caribbean**

In Guyana and the Caribbean, livestock farming is still basically under-developed. Although there is much land available for both cattle and sheep farming, there are other factors which have adverse effects on production. These factors include poorly drained soils, rainfall patterns, high temperature, the low production ability of local breeds, husbandry practices, transportation and technology used due to lack of financial support. In the
Caribbean Region, livestock farming is primarily in the hands of small rural farmers. The system of farming is basically subsistence in nature and production is primarily for local consumption.

In some countries in the region, there are some positive efforts to improve stock by introducing hybrids obtained from Europe and the United States of America and also by improving the husbandry practices and level of technology utilised by farmers. In Guyana, hybrids of cattle, pigs, sheep and poultry have been introduced in the livestock industry and were also used to upgrade indigenous stocks. Jamaica has developed several breeds of beef, dairy and dual purpose types of cattle, which include the Jamaica Red, Jamaica Hope, Jamaica Black and Jamaica Brahman. Barbados, on the other hand, has developed the Barbados Black Belly breed of sheep which is noted for reproducing twins. This breed has adapted well to conditions in the Caribbean Region.

**Livestock reared in Guyana**

Livestock reared in Guyana are cattle, poultry, pigs, sheep, goats, fish, bees and rabbits. With the exception of cattle, all the classes of livestock are reared primarily in the communities along the coast and the banks of our main rivers.

Cattle are reared in large numbers on the Intermediate and Rupununi Savannahs. They are the most important class of livestock reared in most of the Administrative Regions of Guyana. Table 3.3 shows the distribution of cattle in all the Administrative Regions of Guyana for the year 1988.

Although most of the cattle are reared by small farmers, there are several farms owned by individual farmers and public enterprises that have stocks ranging from several hundreds to thousands of heads of cattle. The Livestock Industries Development Company (LIDCO) has several ranches in different parts of the country.
Table 3.3  Distribution of cattle locally

<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
<th>No. of Cattle (approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Barima/Waini</td>
<td>2,000</td>
</tr>
<tr>
<td>2</td>
<td>Pomeroon/Supernaam</td>
<td>9,000</td>
</tr>
<tr>
<td>3</td>
<td>West Demerara/Essequibo Islands</td>
<td>15,000</td>
</tr>
<tr>
<td>4</td>
<td>Demerara/Mahaica</td>
<td>24,000</td>
</tr>
<tr>
<td>5</td>
<td>West Berbice/Mahaica</td>
<td>45,000</td>
</tr>
<tr>
<td>6</td>
<td>East Berbice/Corentyne</td>
<td>100,000</td>
</tr>
<tr>
<td>7</td>
<td>Cuyuni/Mazaruni</td>
<td>500</td>
</tr>
<tr>
<td>8</td>
<td>Potaro/Siparuni</td>
<td>1,000</td>
</tr>
<tr>
<td>9</td>
<td>Upper Takutu/Upper Essequibo</td>
<td>10,000</td>
</tr>
<tr>
<td>10</td>
<td>Upper Demerara/Berbice</td>
<td>5,000</td>
</tr>
</tbody>
</table>

These ranches include:

- Kabawer Ranch, located between Berbice and Abary Rivers, with more than 7,000 heads of cattle.

- Mara Ranch, located on the Berbice river, with more than 900 heads of cattle.

- Ebini ranch, located on the Berbice River, with more than 4,000 heads of cattle.

- Moblissa Ranch, located on the East Bank of Demerara River, with more than 900 heads of cattle.

- Dadanawa Ranch located in the Rupununi area with more than 20,000 heads of cattle.
The Guyana Sugar Corporation operates two ranches on the coast. One ranch is located at Liliendaal on the East Coast of Demerara, and the other is located at Versailles on the West Bank of the Demerara River. Both of these ranches are stocked with the Holstein breed of cattle, and have some of the most modern equipment used in dairy cattle production.

POULTRY

Poultry can be considered the next most important class of livestock reared in Guyana. Poultry includes chickens, ducks and turkeys. Although all of these are produced by almost every household in the rural communities, chickens are reared on a larger scale than any other kind of poultry used in commercial production.

The creole breed of chickens are the most commonly reared by subsistence farmers. However, several improved breeds are now commercially reared for broiler and egg production. The most popular hybrids are the White Vantress Cross for meat and the White Leghorn for eggs.

Some areas in which intensive production of the broiler type and egg type chickens are most popular, include the East Bank of the Demerara River, the East Coast Demerara and the West Coast Demerara.

SHEEP AND GOATS

Sheep and goats are reared mainly in areas such as the East Coast of Demerara, the West Coast of Berbice, the Corentyne Coast, Essequibo Islands, North Rupununi and North Pakaraimas. Sheep farming on the Coastland is often affected by Foot rot. Foot rot is a disease affecting the hoof. It is most prevalent in areas that are poorly drained. Farmers have been constructing pens with raised floors as one remedy to the problem.
SWINE

Pig farming is mainly for pork but some ham and bacon are produced. The largest producers are found on the East Coast and East Bank of the Demerara River and the West Coast of Berbice.

FISH

Fish is an important part of the food of people on the coast as well as in the hinterland of Guyana. Apart from being relatively cheap, it is a good source of protein. Fish is caught by several methods. These include:-

- fishing with small boats using the seine along the coast.
- fishing by trawling in the Atlantic Ocean for both fish and shrimp.
- casting nets in trenches and canals.
- poisoning rivers, creeks, lakes and ponds with certain leaves and roots.
- shooting, chopping and spearing with arrows, cutlasses and spears.

Fish farming is not a common practice among farmers. Fish farming involves the creating of conditions for fish to multiply and grow in ponds and trenches. The most common fish reared is the tilapia. At Onverwagt on the West Coast of Berbice, huge ponds were dug for the purpose of rearing fish. The Guyana sugar Corporation produces an abundance of fish in ponds located at Blairmont and Bath Settlement on the West Coast of Berbice.
BEE KEEPING AND RABBIT REARING

Bee keeping and Rabbit rearing are the most uncommon of the stock farming activities generally practised in Guyana. These activities are usually carried on by persons who have a special interest in either kind of livestock.

Beekeeping is the more lucrative of the two activities and honey is produced by some farmers. Areas in which bee-keeping is most prevalent include the Pomeroon River, Canals Polder on the West Bank Demerara, Mocha on the East Bank of Demerara, the West Berbice area and Mahaicony on the West Coast Berbice. In these areas there is an abundance of vegetation which provides adequate forage for the bees.

Rabbit farming is not popular since rabbits are generally regarded as pets. Rabbits, however, require much care and attention and are very much susceptible to the extremes of our weather patterns. The breed most popular to us in Guyana and the Caribbean is the New Zealand White.
Exercises

1. On a map of the world, mark all of the areas mentioned which are noted for cattle and sheep production.

2. Complete the table given, with reference to Guyana.

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Purpose Reared</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pig</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bees</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Draw a map of Guyana and insert the following cattle producing areas.
   - Mbolissa ranch
   - Kabawer ranch
   - Liliendaal dairy complex
   - Ebini ranch
   - Mara Ranch
   - Versailles dairy complex

4. Say why rice is not cultivated in Regions 1, 7, and 10.

5. Name two crops which belong to each of the following groups:
   - beverage crops, dried pulses, oil crops, cereal grains.

6. With the aid of a Caribbean atlas, complete the table below for every country within the Caribbean Region.

   Territory -

<table>
<thead>
<tr>
<th>Crops grown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average annual rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
Summary

WE HAVE LEARNT THAT

• there are six main factors which the farmer must consider when he is deciding what crop to produce or livestock to rear.
• agricultural activities in Guyana are carried out mainly along the coastal plain where most of our population is found.
• agricultural production goes on in the hinterland and deep riverain areas but on a smaller scale.
• the major crops in Guyana are sugar, rice, coconuts and vegetables and the major livestock are cattle, sheep and goats, pigs and poultry.
• fish farming and bee keeping are also activities which a few individuals engage in.
4 Farming systems

In this chapter we will learn about:

- the various practices employed in the management of crops and livestock from early times to present day
- how land is used in agriculture
- land suitable for agriculture
- manual and/or skilled labour
- financial resources available for capital and recurrent expenditure
- market for the produce
- rainfall, temperature and sunlight
- customs of the community
- the level of technology available.

Farming systems can be classified in two main ways. They are unsettled farming and settled farming.

Unsettled farming

When the farmer roams from place to place looking for pastures (grasslands) for his cattle, sheep, goats or horses to graze he is practising what is called nomadic herding. This is a type of unsettled farming. It is done in dry regions where the farmer takes advantage of the growth of grasses and other plants that grow with the occasional rain. This is a primitive way of rearing livestock.

Fig.4.1 Nomadic herding

Do we have nomadic herding in our country? Let's name some areas where nomadic herding is done.

When a farmer occupies a piece of land for a period of time and cultivates crops on it, and when the yield of crops declines, he moves to another piece of land to grow his crops, this is called shifting cultivation, and is another example of unsettled farming.
**Shifting cultivation**

In shifting cultivation the farmer clears a piece of land of its natural vegetation (forested trees and bushes) by cutting and burning. He then plants his crops. After two or three planting seasons, when soil nutrients are exhausted and crop yields decline, he leaves that piece of land and clears another piece of land to make a new farm. The land is not ploughed but is worked with simple tools like hoes, cutlasses and forks.

**STAGES IN SHIFTING CULTIVATION**

(a) Rain forest

(b) The trees and bushes have been cut but the land has not been burnt

(c) After burning

(d) Farmer sowing seeds on the partly cleared land

(e) The effects of slashing and burning and cultivating for a few seasons (soil erosion)

Fig. 4.2
This system of cultivation needs plenty of land. If enough land is available the same farmer may never return to that piece of land. But if land is limited and population increases it becomes necessary to settle and seek ownership of the land.

Shifting cultivation is still practised in the riverain and some hinterland areas in Guyana and in many undeveloped countries.

ADVANTAGES OF SHIFTING CULTIVATION
- It can be practised when population is sparse and there is plenty of land.
- It helps to check some insects and diseases.
- Inputs like fertilizers, and heavy machinery are not required.
- It is cheaper for the subsistence farmer.

DISADVANTAGES OF SHIFTING CULTIVATION
- It cannot be practised if there is increased population and scarcity of land in an area.
- Organic matter is lost when bushes are burnt.
- Erosion of soil by wind, water and animals results when the soil is exposed.
- Loss of mineral salts by run off or leaching.
- Poor yields of crops after two or three seasons because manures or fertilizers are not added to the soil.
- Danger of damage to neighbouring farms by fire.

Bush falling
It involves growing crops on a piece of land until its nutrients are exhausted. Then the land is allowed to go back to bush for six to twelve years before it is used again. Meanwhile the farmer clears other areas in succession to make new farms. This practice is also referred to as 'Land Rotation'.

Settled farming
When the farmer occupies a plot of land all the time and grows crops and/or rears livestock on it, that type of farming is termed settled farming.

Sometimes we classify farms according to the commodities produced on them. Can you name some farm commodities? Now, based on the commodities you have named, we can have a crop farm, a livestock farm or a mixed farm.

Farming systems can also be classified according to the level of production. If a farmer cultivates his land with minimum inputs to produce barely enough to maintain himself and his family
this type of farming is termed subsistence farming. Farms which occupy large areas of land, with high inputs and only one main cultivated crop are termed plantations. That is also described as commercialised farming.

In extensive farming:

- the land used for cultivation is large.
- the crops are grown mainly depending on rainfall.
- a wider spacing is given between individual plants.
- inputs like fertilizers, labour and machinery are kept to a minimum.
- needs little management.
- the yields are low to moderate and often uncertain.
- the farmer depends on total yield from a large area, rather than high yield from a small area.

For example, in the case of rearing cattle extensively, few animals occupy areas of poor grazing lands, no housing is provided, they are allowed to roam on grassland where they take care of themselves. The farmer herds or collects his animals whenever he needs them.

Other terms which are used to describe farming systems are intensive farming and extensive farming. In intensive farming one aims to get a large profit from a small area, and cropping or livestock production almost without interval of rest to the land.

In this method:

- the land is cultivated to perfection
- crops are planted at closer spacing
- manual labour being largely employed for digging, weeding and inter-cultivation
- large amount of manures or fertilizers are applied to the crops.

Now, let's name some crops which could be grown under the intensive system. What livestock could be reared under the intensive system?
Now give one example of an extensive farm in your
Region.
Name the commodity or commodities produced on
the farm.

**Mono-cropping**

This is the practice of growing exclusively one type
of annual crop and harvesting it before planting
another crop on the same piece of land.

**Monoculture**

Mono-culture is the practice of growing the same
crop on the same piece of land season after season.

It is practised only when the crop is in high
demand, and the farmer gets a good price for his
produce. The system needs high capital inputs
(machinery, chemicals) and the application of
science and technology to maintain high production
levels. Sugar cane and rice are local examples.

**Mixed cropping**

This is the practice of growing more than one type
of crop on a piece of land at the same time and
intermingled (haphazard manner, no row
arrangement), banana, dasheen and yam can be
grown in this way. Mechanization and specializa-
tion cannot be fully employed here. While long
term crops are growing, short term crops are
harvested.

Give two advantages and two disadvantages of this
type of farming system.

**Crop rotation**

Crop rotation is a system of growing botanically
different types of crops on the same land in
successive years in a definite sequence for a
considerable period of time (3-5 years). Each crop
included in the rotation has different effects on soil
and man. Examples of a rotation pattern is cereal
followed by a legume crop then a vegetable fruit or
leafy crop and finally a root crop.

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal crop</td>
<td>Restores soil structure</td>
</tr>
<tr>
<td>Leguminous crop</td>
<td>Replenishes nitrogen in the soil</td>
</tr>
<tr>
<td>Fruit or leafy crop</td>
<td>Utilises nitrogen restored</td>
</tr>
<tr>
<td>Root crop</td>
<td>Clear the land of weeds while harvesting</td>
</tr>
</tbody>
</table>

Fig 4.6  Mixed cropping yam, dasheen and banana

![Crop rotation diagram]

Fig 4.7  Crop rotation
ADVANTAGES OF CROP ROTATION

This practice:
- prevents a build up in population of insects and diseases (soil borne) peculiar to that crop.
- since each crop in the rotation has a different type of root system (deep feeding and surface feeding) nutrients at different layers in the soil are used.
- legumes help to replenish nitrogen in the soil by fixing the nitrogen from the air by specific bacteria found in root nodules of legumes in the soil.

Mixed farming

This is the practice of cultivating crops and rearing livestock on the farm at the same time. The livestock are confined to an area to protect the crops.

The bedding, dung, urine and washings from livestock houses are used to maintain soil fertility. The farmer and his family are able to have a balanced diet since he has a greater variety of produce. He is also able to operate very economically; being able to feed his animals with his farm crops, especially at times when such crops are attracting low prices in the market. He also utilises the coarse bye-products on the farm to feed his livestock.

Mixed farming requires a great deal of knowledge and skill on the part of the farmer. It however, leads to high total production and helps to reduce adverse effects of the failure of any single farm enterprise.

Livestock farming

Livestock are animals which are reared for food and other purposes. Let us list some ways in which we use animals. Animals can be used for:-

- food
- transportation
- power (plough)
- protection
- recreation
- fuel (biogas)
- jewellery
- decoration
- fibre

Livestock farming system refers to all the practices associated with rearing livestock which include cattle, sheep, goat, rabbit, pig and poultry.

A farmer who operates a dairy farm tries to employ a system which supports the efficient production of milk. The pig farmer, the poultry farmer and bccf farmer will also attempt to do likewise for their respective enterprises.

Livestock farming system like crop farming system can be described as nomadic (unsettled) herding and settled farming depending on how the farmer controls his herd. We have looked at nomadic herding at the beginning of this chapter.
Cattle ranching

Cattle ranching is a development of nomadic herding. It is a form of settled farming, and a system where cattle are reared on large grassland. The land is used all the time for grazing, so adequate attention must be given to the grass and fertility of land. Provision must be made to maintain a continuous water supply for the stock and introduce and maintain better quality breeds on the ranch. Cattle ranching involves large scale operations, where one farmer may

- control herds grazing on vast areas
- manage large number of beef and milch cows
- sell his produce to a large commercial market.

Now name some cattle ranches you know. What is the major produce from each ranch you have named?

Exercises

1. Explain in your own words what is a
   (i) crop farm?
   (ii) livestock farm?
   (iii) mixed farm?

2. (i) Name two farms you know.
   (ii) Do you consider these large scale or small scale farms?

3. (i) Name three areas in your country where shifting cultivation is practised.
   (ii) Name the crops grown under this system.

4. In the columns provided, list the characteristics of herding and cattle ranching.

<table>
<thead>
<tr>
<th>Nomadic herding</th>
<th>Cattle ranching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary

WE HAVE LEARNT THAT

• shifting cultivation involves moving from one plot of land as production reduces, to an unused plot of land.
• bush fallowing is an improved form of shifting cultivation.
• nomadic herding involves moving herds from place to place for pasture.
• mono-culture is where one crop is grown on a plantation for a number of years e.g. sugar cane and rice.
• in mixed cropping a number of crops are grown on the same plot of land at the same time e.g. plantain, cassava and sweet potato.
• crop rotation is the growing of unrelated crops one after the other on the same plot of land for a specific period.
• in mixed farming livestock and crops are produced on a farm during the same period.
• in cattle ranching animals are managed on one expanse of land all the time.
5

Flowering plants

In this chapter will learn about:

- the parts of roots, stems, leaves, flowers, fruits and seeds.
- the primary and secondary functions of roots, stems and leaves.
- modification of roots and stems to perform secondary functions.
- differing shapes of leaf blades.
- pollination and fertilization.
- different types of fruits.

Flowering plants are the highest forms in the plant kingdom. They have well developed roots, stems, leaves, flowers and fruits. All our crops and timber trees are members of this group. The main classes in this group are **monocotyledons** and **dicotyledons**. They differ externally in the following features.

**Monocotyledons**

- Seeds have one cotyledon or seed leaf.
- Petals are arranged in groups of threes or multiples of threes and pale in colour.
- Leaves have veins running parallel to one another.
- Most of them have fibrous root system.
- Stigma are feathery.

**Dicotyledons**

- Seeds have two cotyledons or seed leaves.
- Petals are arranged mostly in groups of four or five and brightly coloured.
- Leaf veins are arranged in a branched network.
- Most of them have tap root system.
- Stigma are sticky.

**Root system**

**Tap root**

The radicle grows to form the primary root. If the primary root continues to grow it is called the **tap root**. The tap root produces lateral branches which are known as **secondary** roots, and these in turn produce **tertiary** roots. The older and longer roots are situated away from the root tip while the younger and shorter ones are closer to it. The tap root is normally found in dicotyledons. This goes **deep** into the soil and is therefore described as ‘deep feeding’ e.g. mango, citrus, guava, ochro, tomatoes, coffee.

![root system diagram](image)

(a) Tap root.
**Fibrous root**

If the primary root develops into a cluster of roots which are approximately of equal length and thickness with no main root, fibrous roots are formed. These roots do not go as deep as the tap root and are therefore described as a 'surface feeding'. The fibrous root is characteristic of monocotyledons e.g. grasses, onion, palms.

**Adventitious roots**

Roots sometimes develop from the nodes of stems as in sugar cane and bamboo, from branches trailing on the ground as in grasses or from leaves as in 'leaf of life'. Roots such as these, which grow from any part of the plant other than the primary root are called adventitious roots.

**Regions of a root**

A typical root has four regions from the tip upward. The tip of the root is very tender and pointed and is protected by a cone-shaped covering of dead cells called the root cap. This protects the tender apex of the root as it makes its way through the soil. It is usually absent in aquatic plants. Above the root cap, the cells in the root tip undergo repeated division. This is the region of cell division. Some of the newly formed cells contribute to the formation of the root cap, others, to the formation of the upper regions of the root.

Just above the region of cell division is the region of elongation. The cells in this region increase and expand rapidly and are responsible for growth in length of the root. Above this region is

Fig 5.1 Types of roots system

Fig 5.2 Regions of a root
the region of absorption. The outer cell layer of this region bears numerous fine hair-like outgrowths called root hairs. These increase the surface for absorption. They also penetrate the soil and absorb soil water and dissolved mineral salts from it. Beyond the absorbing region is the region which conducts water upwards to the stem. This region is also called the branching region.

Functions of the root

PRIMARY FUNCTIONS OF THE ROOT

- Roots anchor the plant firmly in the soil.
- Root hairs absorb water and dissolved mineral salts from the soil.
- Roots transport water and dissolved mineral salts to the stem and leaves from the soil.

SECONDARY FUNCTIONS OF THE ROOTS

- Roots also carry on specialised functions and they adapt themselves accordingly to the need of the plant.
- In some plants the tap root is swollen as a result of food stored in it e.g. radish, carrot, beet.

- In some plants, the roots are modified for climbing. These plants produce sticky roots from their nodes, by means of which such plants attach themselves to their support and climb them e.g. black pepper, betel.

In some plants growing in mud or water e.g. white mangrove, the roots are modified for breathing. They send out roots through the mud or water, into the air. These roots are very spongy and take in air for respiration of the root system.

Fig. 5.3 Special types of roots
The stem

The stem usually grows upwards towards sunlight. It may consist of a main shoot and many side branches or a single main stem as in palms. Each shoot has two chief parts, stems and leaves. Stems when young are normally green in colour. The leaves are attached to slightly swollen parts on the stem called nodes, and the space between two nodes is called an internode. The stem ends in a condensed structure called the terminal bud. The terminal bud is protected by young over-lapping leaves. When the stem or the branch ends in a vegetative bud, it continues to grow upwards or sideways. If however, it ends in a flower bud the growth ceases. The angle between the leaf and the stem is called the axil of the leaf. An axillary bud, is usually seen in the axil of a leaf. It may develop into side branches similar to the main axis or produce floral branches or individual flowers.

In many plants the vegetative axillary buds may remain dormant. If the terminal bud should become damaged or killed, one or two of the axillary buds will take over the main growth of the shoot. In some plants, however, the axillary buds grow even while the terminal bud is growing. This happens in tomato plants where many of the laterals grow and deprive the main stem of nutrients. The fruits that develop from the plant will be more but smaller in size, therefore, the laterals have to be removed to encourage the main stem to produce large fruits. In some plants like coffee, black pepper and citrus, it is desirable that the trees do not grow too tall, a situation which would adversely affect harvesting of the fruits. In such cases, at some point below the terminal bud, the tip of the main shoot is removed to

(a) Dicot

Fig.5.4 Shoot system of a dicot and a monocot plant

(b) Monocot
encourage the growth of the axillary buds in a horizontal, rather than a vertical direction.

- Stems that are green carry on photosynthesis as leaves do.

(b) Bougainvillea (thorn climber)

(a) Passion fruit (tendril)
(c) Ginger (rhizome)
(d) Bean (twinner)

Fig.5.5 Modification of stems

**PRIMARY FUNCTIONS OF THE STEM**

- It gives attachment and support for leaves, flowers and fruits.
- It holds the leaves in a suitable position for them to obtain sunlight and air for photosynthesis.
- It holds the flowers above the ground in assisting pollination by insects or wind.
- It conducts water and dissolved mineral salts from the soil through roots to the leaves, and substances like sugars from the leaves to other parts of the plant, particularly to storage organs and growing regions.

**SECONDARY FUNCTIONS OF THE STEM**

- In some plants like sugar cane, Irish potato and ginger, the stem stores food which is used in the future by the plant or by man for vegetative propagation.
- In some plants the branches are modified into tendrils and used for climbing e.g. passion fruit.
- In some plants the stems are modified into thorns and used for climbing e.g. bougainvillea
- Stems in some plants form tight coils round the support and climb up (twinners) e.g. beans.
The Leaf

A leaf is a green expanded structure attached to the stem at the node, usually by means of a stalk called the petiole. The part of the petiole attached to the stem is called the leaf base. In monocotyledons the petiole is lacking and the leaf base is expanded into a sheath which partially or wholly clasps the stem e.g. grass. The broad flat portion is the lamina or leaf blade. The tip of the leaf is known as the apex and the edge of the lamina is known as the margin. The continuation of the petiole through the leaf blade forms the mid rib which produces lateral veins, which in their turn give rise to veinlets.

Shapes of the leaf blade

1. **Linear** – the leaf blade is long and narrow e.g. grass.
2. **Ovate** – broad base, suddenly tapering to a point at the tip e.g. hibiscus, carambola.

(a) Ovate

(b) Linear

3. **Oblong** – the blade is uniformly broad throughout e.g. banyan.
4. **Elliptic** – somewhat broad in the middle, tapering both towards the apex and base e.g. mango, guava.

(c) Oblong

(d) Elliptic

Fig. 5.6 Parts of a leaf

Fig. 5.7 Shape of leaf blades
5. **Reniform** – a hollow base and rounded at the apex e.g. Centella.

6. **Cordate** – when the blade is heart shaped e.g. seaside grape.

In the **compound** leaf, the incision of the leaf-blade goes down to the midrib or to the petiole and the leaf is divided into a number of segments called **leaflets**. The leaflets of compound leaves may be arranged in several ways:

**Pinnately compound leaf** – leaflets are arranged oppositely or alternatively on the main stalk. If the leaflets end in pairs it is called **paripinnately** compound leaf e.g. tamarind. If the leaflets end in a single leaflet it is called **Imparipinnately** compound leaf e.g rose, carambola.

**SIMPLE AND COMPOUND LEAVES**

**Simple** leaves are those which have a single leaf blade. In simple leaves the leaf blade may be **entire** or **lobed**. If the lobes are arranged on either side of the mid rib, it is **pinnately** lobed e.g. breadfruit. If the lamina is partly divided up into lobes and the division does not reach right down to the mid rib, it is described as **palmately** lobed e.g. papaw, cassava, ochro.

![Image of simple leaves](image)

**Fig 5.6 Simple leaves**

(a) Palmitately lobed

(b) Entire

(c) Pinnately lobed

(b) Imparipinnately compound

(a) Paripinnately compound
**Palmately compound leaf** – is one in which the main stalk bears a number of leaflets spread like the fingers of the palm e.g. rubber, silk cotton.

![Palmately compound](image)

(c) Palmately compound

**Trifoliate compound leaf** – the leaf possesses only three leaflets, one at the top and two below e.g. bean, soya bean.

![Trifoliate compound](image)

(d) Trifoliate compound

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**Venation**

- **Reticulate venation**
- **Parallel venation**

![Venation](image)

**Fig. 5.11 Types of venation**

The arrangement of the veins and veinlets in the leaf-blade is known as venation. There are two types of venation, **Reticulate** where the veinlets are irregularly distributed forming a network e.g. guava, coffee and citrus and **Parallel**, when they run parallel to each other e.g. maize, banana, coconut. The former is characteristic of dicotyledons and the latter of monocotyledons.

---

**PRIMARY FUNCTIONS OF LEAVES**

- Manufacture of food materials by chlorophyll in the presence of sunlight, carbon dioxide and water.
- Interchange of gases (carbon dioxide and oxygen) between the atmosphere and the plant.
- Evaporation of excess water through the leaf.

---

**SECONDARY FUNCTIONS**

- Storage of food and water e.g. scale leaves of onions.
- Leaves produce buds on them and can be used for vegetative propagation e.g. leaf of life.
The flower

Flowers are the main reproductive organs of the flowering plants. They arise singly or in clusters from the stem. The stalk that bears the flower is called the pedicel and the one that bears the inflorescence (cluster of flowers) is called the peduncle. The flower stalk arises from the stem and ends in a fleshy expanded area, the receptacle.

A typical flower consists of four types of floral leaves arranged in four different rings on the receptacle. They are:

- calyx
- corolla
- stamens
- pistil

The third ring consists of the stamens which form the male part of the flower. Each stamen possesses a stalk called the filament and at the end of the filament is the anther which contains the pollen grains. The pollen grain contains the male cell. The fourth ring forms the pistil which forms the female part of the flower. The pistil consists of the ovary, style and stigma. The ovary is made up of one or more floral leaves called carpels. The carpels enclose the ovules. Extending from the ovary is a style which ends in an expanded area, the stigma, which receives the pollen grains during pollination.

The outermost ring is called the calyx and consists of leaf-like structures called sepals usually green in colour and serves to protect the inner parts of the flower during bud stage. Internal to the calyx is a ring called corolla consisting mostly of brightly coloured petals which serve to attract insects to the flowers to assist in pollination.

Fig 5.10 Parts of a flower
Pollination and fertilization

As the flowers open they are ready for the transfer of pollen grains from the anther to the stigma of the flower. In fertilization the male nucleus unites with the egg to produce the embryo.

![Diagram of a flower](image)

Fig.5.11 The pistil (longitudinal section)

Fruit

A fruit is a fertilized ovary containing the fully developed ovules, the seeds. After fertilization the ovary develops into a fruit. The fertilized egg cell or ovum grows and gives rise to the embryo and the ovule forms the seed. The wall of the ovary forms the pericarp. There are some fruits that develop without fertilization, so they produce no true seeds e.g. banana, pineapple and some citrus fruits. Fruits may be classified into dry or fleshy fruits according to the nature of the pericarp.

Dry fruits

The pericarp of dry fruits are hard and dry. They may be one seeded, indeliscent (non-splitting) fruits or dry many seeded dehiscent (splitting) fruits. Indeliscent fruits consist of

- **Achene** – a small seed surrounded by a dry non-splitting pericarp. The pericarp and seed coat are free e.g. carrot, sunflower.

![Achene](image)

- **Cypsela** – resembles the achene but the pericarp bears hairs to aid in dispersal e.g. silk cotton.

![Cypsela](image)

- **Nut** – a one seeded fruit, in which the pericarp is hard and forms a shell e.g. cashew-nut.

![Cashew nut](image)
- *Caryopsis* - a one seeded fruit in which the pericarp and seed coat are fused e.g. paddy, maize.

![Caryopsis](image)

(d) Caryopsis (paddy)

Fig. 5.12 Dry indehiscent fruit

In **dry dehiscent** fruits, the pericarp splits open to set the seeds free. They are classified according to the number of splits which occur in the pericarp. The main types of dry dehiscent fruits are:

- **Follicle** - a dry fruit formed from one carpel which has one or more seeds and splits on one side only e.g. Calotropis.

![Follicle](image)

(a) Follicle

- **Legume** - a dry fruit formed from one carpel but splits longitudinally along both dorsal and ventral lines e.g. beans, peanut.

![Legume](image)

(d) Legume

- **Capsule** - a dry fruit with many carpels joined together and usually splitting longitudinally along three or more lines e.g. cotton.

![Capsule](image)

(c) Capsule

- **Schizocarp** - a dry many seeded fruit, which when mature splits up into a number of indehiscent one seeded parts e.g. castor, coriander, desmodium.

![Schizocarp](image)

(b) Schizocarp

Fig. 5.13 Dry dehiscent fruit

**Fleshy fruits**

Fleshy fruits are juicy, succulent and non splitting.

- **Drupe** - pericarp is made up of three layers, an outer thin **epicarp**, a middle fleshy **mesocarp** and an inner hard **endocarp** e.g. mango. Coconut is also a drupe but it has a fibrous mesocarp.

![Drupe](image)

(a) Fleshy drupe (mango)  (b) Fibrous drupe (coconut)
- **Berry** – the whole of the pericarp is soft and many seeds are embedded in it. There is no stony endocarp as in a drupe e.g. tomatoes, grapes, guava.

- **Hesperidium** – the epicarp and mesocarp are fused together to form a separable skin of the fruit. Thin endocarp projects inwards to form distinct chambers. A number of fleshy hairs grow into the chamber as extension of the thin endocarp e.g. orange, lemon.

---

**Seed**

A seed is a fully developed fertilized ovule. A typical seed consists of a seed coat enclosing and protecting the embryo. The seed coat consists of two layers, the outer thick one, the **testa** and the inner membranous one, the **tegmen**. A scar known as the **hilum** is found on one part of the seed and is the point of attachment of the seed to the fruit. Just above the hilum is a minute pore, the **micropyle**. Water and air enter the seed through this opening during germination.

---

**Fig. 5.15 Dicot (cowpea)**

(a) Entire seed
(b) Longitudinal section

---

A seed with one cotyledon is monocotyledonous and a seed with two cotyledons is dicotyledonous. In most seeds the cotyledons are swollen with stored food for the growing radicle and plumule during germination. However, in some seeds the cotyledons appear as thin membranous structures, whereas in some others the food is stored in the endosperm.

---

**Fig. 5.16 Monocot (maize)**

(a) Entire seed
(b) Longitudinal section
Exercises

1. Flowering plants can be divided into two main groups.
   (a) Name the two groups.
   (b) From your surrounding identify three plants in each group.

2. (a) Give two examples where food is stored in the stem.
   (b) State one commercial use of each example.

3. Select four different shapes of leaves from your garden, draw and label the part of the leaf and name the shapes.

4. (a) How would you differentiate between a simple and a compound leaf.
   (b) What do you understand by the term venation?

5. Discuss three functions of leaves.

6. Draw and label the structure of a named monocotyledonous flower.

7. (a) Name the parts of the flower which forms the fruit.
   (b) What is a fleshy fruit? Give two examples of drupe.

8. (a) Draw and label the structure of a named monocotyledonous seed.
   (b) Where is the food stored in a monocotyledonous seed and what is its use?

Summary

WE HAVE LEARNT THAT

- all of our crops and timber trees belong to the group called flowering plants, and are divided into two main classes namely, monocotyledons and dicotyledons.
- there are many external differences between the two main classes of flowering plants.
- every part of a flowering plant carries out specific functions. In some cases plant parts are changed or modified to carry out special functions.
Farm tools and equipment

This chapter looks at
- simple tools and equipment needed on a crop farm. These will include both manually and mechanically operated implements and cover activities ranging from land clearing to harvesting.

Farm tools and equipment are implements which are designed to allow farm operations to be done easier. Many of them also help farmers to do a better job in shorter time. In this way, the use of farm tools and equipment results in getting farm operations done efficiently. Consider a situation in which a farmer has to get a day’s work done without the use of farm tools and equipment. This is likely to be a very tiresome experience and one from which he will suffer great inconvenience.

The types of tools and equipment needed on a farm are determined by the work to be done. Because many jobs on a crop farm are different from those on a livestock farm. Some tools and equipment needed by the crop farmer will be different from those needed by the livestock farmer.

How many of these did you list? Can you add anything to this list?

Tools can be operated manually, by draught animals, and mechanically.

Manually operated tools and equipment

Many farmers who operate small holdings or farms use manually operated tools and equipment.

Tools used for land clearing

Manually operated tools and equipment used in land clearing include:

- axe  
- cutlass  
- digging mattock  
- crowbar  
- rope  
- saw

The **axe** consists of an edged head (sharp cutting edge) fixed to a cylindrical wooden handle about 90 cm long. The cutting edge lies parallel to the handle. It is used for felling trees and for chopping up tree trunks, branches and large roots.
The **cutlass** has a long flat metal blade about 90 cm long and 6 cm wide. One edge of the blade is fastened to two pieces of wood about 8 cm long by nails or screws. The wooden handle gives a smooth grip. It also absorbs sweat and prevents the tool from slipping out of hand. The cutlass is used for slashing shrubs, weeding and carving points at the bottom end of the pegs and poles. When weeding is done the cutlass is used together with a **hook-stick**.

The **digging mattock** has a cylindrical wooden handle about 90cm long attached to the middle of a blade made of a thick block of iron about 40cm long. One end of the blade is long and conical while the other end is flat, broad and sharp. The mattock is used for digging and uprooting small stumps.

The **crowbar** is an iron rod about 90-120cm long and pointed at one end. The other end is blunt and may be straight or bent slightly. By inserting the pointed end into the soil and pushing the other end downwards the load (stone or large roots) can be gradually moved. The crowbar can also be used for digging holes for planting seeds.

The **fibre rope** about 4-5cm in thickness is tied about half way up the trunk of large trees as they are being felled (cut). The other end of the rope is pulled in the direction in which the tree should fall.

The **hand saw** consists essentially of a thin, flat, long blade of tempered steel with a continuous series of sharp toothed edge on one side of the blade. The blade is fixed to a wooden handle and worked by hand by pushing backwards and forwards. The saw is used for cutting wood.

**Tools used for land preparation**

Land preparation begins after the land has been cleared. It includes all the practices which the farmer carries out in preparation for sowing or planting his crop.

Tools used for land preparation are selected according to the type of soil the farmer has to deal
with. Soils are classified as 'heavy' as in the case of clay or 'light' as in the case of sandy soil.

Hand tools used for land preparation include the following:

- large garden fork
- shovel
- spade
- hoe
- pick-axe
- rake
- measuring tape
- pegs
- garden line
- wheel barrow
- axe

The **large garden fork** has four metal prongs or tines attached to the shoulder of the fork. A long wooden shaft attaches the shoulder of the fork to its handle. The fork is used to dig up soil as deep as about 18 cm. This is done by plunging the fork into the soil and by placing one foot on the shoulder, pushing downwards. When the soil is lifted it is usually turned over so that the top soil is buried and the sub-soil is exposed to air and sunlight. This operation is called ploughing/forking.

The **shovel** has a curved rectangular metal blade which is attached to a long wooden handle. The lower edge or the nose is kept sharp for cutting through the soil during drain construction. Shovels are also used for digging holes to plant orchard crops and for canal or pond construction.

The **spade** is similar in structure to the shovel. The blade is wider and flattened instead of curved. It is used to lift soil particles, pen-manure and other objects into wheel barrows or from place to place. Spades are also used for digging.
The hoe has a flat triangular metal blade which is fixed to a long wooden handle. It is used for deep cultivation on light soils. Hoes are also used for making ridges, weeding, tilling the soil after planting and moulding up.

The pick-axe has a long, curved, narrow metal blade. A short wooden handle is attached to the centre of this blade. One end of the blade is pointed while the other end is flattened and sharp. The pick axe is used to break up hard soil surface. It is suitable for working on stony soil.

The rake has a narrow rectangular metal blade into which ten to twelve short prongs are fitted. This blade is attached to a long wooden handle. The rake is used for levelling soil surface which already has a fine tilth. It can be used to break up large soil clods on light soils and to gather up leaves and other objects on the seed bed. When seeds have been broadcast, a rake can be used to cover them with soil particles.

The measuring tape is used for taking detailed measurements on the plot. Many tapes give measurements in both imperial units and metric.

Pegs are usually wooden sticks which are about 45 cm long. These sticks are sturdy and pointed at one end to allow for easy penetration into the soil. Pegs are used to mark distances on the plot after they have been measured.

The garden line commonly used is the polythene twine. The material is durable so it can be used for a long time. It is used to set up a straight line from one peg to another. Garden lines are very useful in drain construction and for planting in straight rows.

The wheelbarrow is a lever which is used to transport pen-manure and other bulky articles from one point to another on the plot.

The watering can has a tank to which two handles and a spout are attached. The spout has a perforated rose which allows water to be sprinkled out of it. The watering can is used to sprinkle water over seed beds and small plants especially during dry weather conditions. This can is sometimes used to apply soil insecticides on to seed beds before planting is done.

The cutlass dealt with as a land clearing implement is used also for land preparation. In this case it is used for breaking large soil clods, loosening soil particles and digging holes in the soil for planting.

**Nursery management and planting tools**

Some plants like cabbage produce seeds which are so small that they cannot be planted directly into the garden bed or field. These seeds must be sown in nursery beds or seed boxes under special care and conditions. When the seedlings have reached the stage for transplanting (usually 3-4 weeks in the case of vegetable crops), when they have adequately grown they are transplanted in the field.

In addition plants which are propagated from vegetative methods like budding and grafting must also be started in the nursery.

Among the tools and equipment used for the management of nurseries and for planting are the following:

- hand trowel
- budding knife
- hand fork
- row marker
- soil sieve
- dibber
- seed box
- budding tape
- press board
- labels (tags)
The **hand trowel** has a short wooden handle and a small metal blade which is curved into a scoop. A trowel is used for making small holes on seedbeds and for lifting seedlings to be transplanted. Removing seedlings from seed-boxes or seedbeds in this way helps to reduce damage to the tender roots. The scoop-shaped blade makes it easier to carry the seedling with a ball of soil particles around the roots.

The **hand fork** is a small tool which usually has a wooden handle and four small metal prongs. It is used to crush soil clods on seed beds, break surface crust and loosen soil particles around seedlings which are to be transplanted.

**Soil sieves** are shallow metal pans which are circular in shape. The bottoms of these pans are made of metal mesh material which allow soil particles of a particular diameter to pass through. Each sieve allows a different size of soil particles to pass through. In preparing seed boxes soil particles are usually sieved so that tiny seeds are given a suitable environment which will help them to germinate.

**Seed boxes** are small, shallow wooden boxes which can be about 35 cm long, 25 cm wide and 7 cm deep. The bottoms of these boxes have narrow slits or small circular holes to allow excess soil water to escape from them. Seed boxes are usually filled with potting soil which tiny seeds need for proper germination. Potting soil also allows for the healthy growth of seedlings. Seedlings can also be grown in nursery trays, pots, baskets, small black perforated plastic bags or on well-prepared seedbeds.

The **press-board** is a flat piece of board to which a handle has been fixed on one of the broad sides. It is used to gently press soil particles down soon after the seed box has been filled with potting soil. This helps to settle soil particles so that the tiny seeds will not sink to a lower position in the box after they have been sown. It is difficult for seedlings to emerge above the soil surface if seeds are too deep in the soil.

**Tags** are useful in identifying seed-boxes and seed beds after they have been planted. The name of the crop or the variety as well as the date of planting can be written on tags.

The **dibber** has a wooden handle and a metal point. It is used to make holes in the field for planting larger seeds and for covering planted seeds with soil particles.

The **row-marker** looks like a wooden rake. The short prongs are evenly spaced at about 5 cm to 8 cm apart. Row markers are used on seed beds. They help to make drills which have the same depth and are evenly spaced.

The **budding knife** is a small knife which has a very sharp metal blade. This blade is used to remove buds from bud wood which is selected for propagation, and to make necessary cuts such as
inverted T on the bark of the root stock. The handle has a flattened end which is used to lift the cut bark on the root stock so that the bud can be fitted into it.

The budding tape is used to tightly wrap the bud after it has been fitted to the root stock during budding.

Shade materials include branches of the coconut palm or other palm trees, coloured fibre glass or dark plastic. These materials are usually mounted on wooden frames to protect seedlings from damage caused by heavy rainfall and the strong rays of the sun. Seed-boxes can be placed under a nursery shed which is covered with similar materials.

Tools and equipment used for supplying water to the soil, are buckets, watering cans, hose and motorised sprinkler system hoses. They are used to sprinkle water around the root zone of crops. Sprinkling the water reduces surface crusting of soil particles. This soil condition prevents air and water from entering freely into the soil so water runs off instead.

The removal of excess soil water from the field is referred to as drainage. The wooden box-koker is an important equipment which allows farmers to regulate the inflow and outflow of water on and off the field. Shovels and spades are also very useful in this operation.

Tools used for irrigation and drainage

![Diagram of irrigation tools](image)

Fig 6.4 Tools used for irrigation

Tools used for plant protection

![Diagram of plant protection tools](image)

Fig 6.5 Tools and equipment used for plant protection
On small farms, the tools and equipment shown in Fig. 6.5 are commonly used when protecting crops from harmful organisms.

The **hand sprayer** has a small tank into which about one litre of liquid pesticide can be filled. When the plunger is pushed downward in the metal casing, the pressure on the liquid in the tank increases and forces the liquid out in mist form. The hand sprayer is used to apply small droplets of liquid pesticide onto the leaf surfaces of plants on a small plot.

The **knapsack sprayer** has a larger tank which can hold up to about 20 litres of liquid pesticide. The sprayer is carried on the farmer’s back. The pump increases the pressure on the liquid when the handle is operated. The size of droplets can be controlled by adjusting the spray nozzle. Knapsack sprayers are used on larger plots with numerous plants.

The **hand duster** is used to apply pesticides in dust or powder form to leaf surfaces. A respirator should be worn when using this equipment.

The **soil injector** is used to apply pesticides to the soil before planting is done. The pesticide can be injected below the surface level of the soil so that soil pests at that depth can be controlled.

The **respirator** is a light plastic covering which is worn over the nostrils and the mouth so as to prevent foreign matter from entering them. Behind the perforations is a filter which traps foreign matter as air is breathed into the body. The filter should be changed every time the farmer uses the respirator.

**Protective clothing** includes a pair of long rubber boots, a pair of long sturdy gloves, a pair of eye shield or goggles, an overall or clothing with long pants and long sleeved shirts, along with a hat or cap for every operator. It is important for farmers to protect all exposed areas of their skin during pest control activities. Pesticides are poisonous and many of them can enter the body through the skin.

### Tools used for inter-crop tillage

The main tools used for inter-crop tillage are the **hoe** and the **cutlass**. They are used mainly for removing weeds, loosening soil particles around plants and for pulling soil particles around every plant.

### Tools used for fertilizer application

Tools and equipment needed for this operation depend on the way the fertiliser is applied. For applying fertiliser in the granular form, a pair of strong rubber gloves; a plastic bucket, a hand trowel, a small hoe, a shovel or a cutlass will be needed. The last item listed is needed to make furrows in which to place fertilisers and for covering after placement with soil particles. The knapsack sprayer can be used if liquid application of fertiliser has to be made.

### Tools used for pruning

**Pruning knife**

**Frame saw**

**Garden shears**

**Secateurs**

**Fig 6.6 Tools and equipment used for pruning**

The **garden shears** resemble a pair of large scissors. They are used to cut off unwanted shoots from shrubs, especially those used as hedges.

**Secateurs** look like shears but the blades are curved. They are used to remove excess shoots and diseased parts of plants. Stem cuttings can also be taken with the secateurs.
The **pruning knife** can be used for removing unwanted parts of plants as well.

The **frame saw** has a long narrow metal blade which is about 1 m to 1.5 m long. It is used to remove woody branches from orchard crops or ornamental plants. The cut can be made as closely as possible to the stem and no untidy and jogged edges will be left on the trees.

**Tools used for harvesting**

The **sickle** is a curved metal blade which has a serrated cutting edge on the inner side. A short wooden handle is attached to this blade. The sickle is used to harvest crops of the grass family. Rice and fodder grasses are the common crops harvested with the sickle. When a sickle is firmly attached to one end of a long pole, it can be used to harvest coconuts.

**Knives** are useful in harvesting many vegetable crops as well as bananas, pineapples and other crops produced.

The **scythe** has a long curved metal blade which is attached to a long handle. On the handle are two short hand grips which are held by the operator. The scythe can be used to harvest fodder grasses and cereals such as rice. A wire cradle can be attached to catch cereals as they are cut. The scythe has to be used on flat, level land because it cuts close to the ground level. A skilled operator can harvest much faster with a scythe than with a cutlass or sickle.

The **goulet** has a flat metal blade which has a sharpened edge and an angle cut into it. Attached to this blade is a wooden handle. Goulets are used to harvest orchard crops grown on tall trees.

**Garden forks** and **cutlasses** are also very useful tools for harvesting root crops and other crops.

**Animal drawn tools and equipment**

Animal drawn tools and equipment have been found useful to farmers who do much work on small farms. Draught animals can be easily gotten and trained to work. They are also cheaper to maintain than motors which require expensive fuel.

Tool bars which are about 1.3 metres wide, have been designed to carry different types of tools and equipment. Simple ploughs, ridgers, cultivators, harrows, seed hoppers, fertiliser applicators, sprayers and carts can be bolted onto the tool bar which would be hitched to the yoke of the draught animals. In this way tools and equipment are drawn by animals. The commonly used animals are the oxen. Horses and donkeys, mules and buffaloes are also used as draught animals. However if work is not done regularly these animals can become difficult to control.

The **mouldboard plough** has a single mould board which turns over the soil which has been sliced by the share. The farmer directs the plough by holding on to the handles while the animals pull the
equipment. The **ridger** is used to make ridges and furrows.

(a) Oxen yoked together

(b) An animal drawn cultivator

**Fig.6.8** Animal drawn equipment

The **seed drill** is used to plant seeds at even distances apart in the field. Planting is done in rows. The hopper contains the seeds. As the oxen pull this equipment the plate below the hopper allows the seeds to pass through the seed tube and fall into the furrow which has been opened by the furrow opener. The furrow covering device pushes soil particles over the seeds. The soil is rolled over the roller which presses soil particles closer to the seeds. In this way seeds absorb moisture from the soil particles which touch them.

(c) Mouldboard plough

- Handle for operator
- Mouldboard
- Ploughshare
- Wheel
- Hitch (point of attachment to work animal)

(d) Ridger

The **cultivator** is made up of rigid tines which are bolted onto the tool bar. As the equipment is moved through the soil, soil particles are stirred up and weeds are removed.

**Carts** of various sizes can be bolted on to the tool bar to carry large and heavy objects from place to place. Some objects to be transported may include livestock feed, crop and animal produce for the market and pen-manure for seed-bed preparation.

**Punts** are flat bottomed metal boats which are popularly used to transport sugar-cane from the fields to the factory. These boats can be drawn by
draught animals. In Guyana, mules, yoked oxen and buffalos have been used to pull punts. Recently yoked oxen have been useful in transporting long lines of punts when the dams are too muddy for tractors. Rice farmers in rice producing areas have been considering the use of punts to transport paddy.

**Mechanically operated tools and equipment**

Many crop farm operations can be done by tools and equipment which are operated by a motor. The farm tractor is commonly used to carry most of these equipment. Sometimes the tractor supplies the equipment with power so that they can work.

**rubber-wheeled tractor** and the **track-wheeled or crawler tractor**. There is the less popular **hand-guided tractor** which is operated by a motor also. This can be useful in the smaller vegetable commercial farms since it may be fitted with equipment for ploughing, rotovating, harrowing, planting, spraying and lawn mowing.

**Fig.6.9 Types of farm tractors**

The popular types of farm tractors are the
Tools used for land preparation

An equipment commonly used for land clearing is the bulldozer. It is used to fell and stumps out trees on sparsely forested land.

The front end loader can be used to clear away heaps of branches. The bulldozer should not be used for this purpose since it removes the valuable top soil as well. Large logs can be removed by hauling with the tractor.

The tractor with a plough drawn behind it, is used for ploughing fields. The plough has metal blades which slice the soil and turn it over. This causes the top soil to be buried and the sub-soil to be exposed to air and sunlight. Two types of ploughs are the disc plough and the mould board plough.

Disc ploughs have strong circular blades. They are made to work on heavy clayey soils and rough stony soils; while the mould board plough is made to work on light soils.

Harrow are equipment which are suitable for breaking up large soil clods into smaller ones. They are also carried behind tractors. Harrowing is done after ploughing. Harrows may be disc harrows or tined harrows.

Riders are used to prepare the harrowed field into ridges and furrows. Riders may have mould board blades or disc blades. The rotovator is designed to plough and chip the soil at the same time. It is used on light soils to prepare seedbeds.

The drain digger can be used to make drains
of different sizes. They can make drains in the field and around the field. Draglines are used to make canals and dams, ponds and embankments.

**Tools used for nursery work**

The rotovator is the mechanical equipment used on large crop farms to make seed beds. This equipment has a long horizontal shaft on which cutting blades are fixed. These blades turn up the soil and chip it at the same time.

**Tools used for irrigation and drainage**

The overhead sprinkler is one of the equipment used on large farms to irrigate small crops. Water is pumped from wells through pipelines and is sprinkled on the soil surface. Each sprinkler can water a distance of ten metres on each side, so pipelines on the field must be laid about ten metres apart. Drainage pumps are needed to remove large quantities of excess soil water from the soil surface. This is very important on flooded fields.

**Tools used for plant protection**

![A crop sprayer](image)

Fig. 6.12 A crop sprayer

Crop sprayers are used to apply chemical substances in liquid form to the field. These chemicals include weedicide, insecticide, fungicide and fertilisers. Crop sprayers can be mounted behind tractors. The liquid chemical has to be pumped into the large tank. This chemical flows through the horizontal pipe below and is discharged through the many nozzles positioned on it.

**Crop harvesters**

![A combine harvester](image)

Fig. 6.13 A combine harvester
There are many types of crop harvesters. The corn harvester, the sugar-cane harvester and the combine grain harvester will be described here.

The **corn harvester** gathers and breaks off the ears of corn standing in the field, then husks and shells them. Varieties of corn which have uniform height, strong stalks, large, tough ears, and firm grains should be planted when harvesters are used. Planting must be done in rows and on flat land to allow the use of this equipment.

The **sugar cane harvester** cuts the cane stems, takes off the top shoots and chops the stems into small pieces. These pieces are then loaded into nearby trucks which move alongside the harvester in the field.

The **combine grain harvester** cuts the crop from the field, removes the grain, separates the grain from the straw and separates the trash from the grain. Plants must have uniform height, strong stalks and must also ripen at the same time to allow the use of this machine.

Rusting weakens metal parts of tools.
- Moving parts of farm machines should be oiled or greased regularly. Daily checks should be made on engine oil level, water level, tyre pressure and filters. Bolts and nuts should be tightened daily. Generally, the manufacturer of the machines usually advise farmers on other important checks to make when servicing the machines.
- When tools and equipment have to be stored for a long period of time, the metal parts should be painted with anti-corrosive paint. This practice prevents rusting. It is more effective than oiling or greasing since oil and grease run off the metal when room temperature is high.
- Straps and belts should be removed and checked for good condition, cleaned and stored. Chains should be removed and stored in lubricating oil.
- Dusters and sprayers should be thoroughly washed and flushed thoroughly with clean water after use. Separate sprayers should be used for insecticides and weedicides. Service sprayers and dusters periodically. Replace worn out parts before using the equipment.
- Milking machines should be thoroughly washed and sterilised after each milking. Make regular checks to see that the pulsator and teat cups have correct vacuum pressure. Rubber hoses should be checked for cracks and leaks. Cows suffering from mastitis must not be milked by machine.

**Care and maintenance of tools and equipment**

Tools and equipment are expensive. When they are properly cared for and maintained, they can be used efficiently for a long time. By so doing there is no need for farmers to replace them regularly.

- Tools that are used frequently lose value faster. Metal blades need to be sharpened regularly and wooden handles need repairing and replacing often. If tools and equipment are taken care of, this loss in value will be reduced. After use, they should be thoroughly cleaned, dried and oiled or greased. They should then be stored orderly in a dry, termite free store room. Tools left carelessly can cause injury to farmers and livestock. Wooden handles left outside to the heat of the sun will split and loosen in the rain, and then rot. Metal parts exposed to moisture will rust.
Safety precautions

Farmers should always observe some basic rules which would ensure their own safety and that of their labourers and livestock. Some of these rules are listed below:

- Always check tools for good condition before using them.
- Ensure that there is enough space around you for working before you start to use tools.
- During a short work stoppage in the field when tools are not in use, stick cutlasses, forks and other similar tools into the ground; in this way they can quickly be seen.
- Avoid smoking when refuelling petrol engines.
- Avoid adjusting anything on a machine while it is running.
- Never dismount from a tractor when it is moving.
- Never carry guns on tractors or harvesting machines.
- Avoid splashing chemicals.
- Use protective clothing when handling poisonous substances.
- Wash clothing thoroughly after use.
- Avoid eating, drinking or smoking when working with chemicals.
- Follow instructions for use of chemical substances.
- Dispose of all empty containers by burying.
- Never put blocked nozzles to your mouth to clean them.
- Wash hands thoroughly after working with chemical substances.
- Never allow spray drift to travel towards you.
- If you feel ill after spraying, see your doctor, give him/her the name of the chemical you used.

Exercises

1. In your own words give brief descriptions of:
   a) Two tools used for land clearing.
   b) Two tools used in a crop nursery.
   c) One machine used for harvesting.

2. Farmer John has ten hectares of rice land in Essequibo. He is putting that land under cultivation for the first time. List the tools and equipment he will need from land preparation to harvesting of his crop, and state the functions of the tools and equipment you have listed.

3. Draw and label a knapsack sprayer. Explain the uses of any three parts.

4. What is a mould board plough? Name the main parts and explain the function of each. How does the ridger shown in Fig 6.8a in the book differ from the mouldboard plough?

5. List the various ways in which farm tools can be kept in good condition.
Summary

WE HAVE LEARNT THAT

- most tools and equipment have primary functions, i.e. functions they are designed to carry out, but they could be used successfully to carry out other functions.

- the proper use and care of the tools and equipment reduce the chances of accidents and prolong the life of these valuable farm assets.
In this chapter we will look at the cultivation of five crops namely corn, blackeye, tomato, pakchoi and cassava under the following heads:

- origin and distribution
- economic importance
- soil requirement
- varieties
- land preparation
- planting
- care and management
- harvesting

### Economic importance

Corn is rich in carbohydrates. The embryo or germ of the grain is fairly high in protein. The yellow variety is fairly rich in carotene, which produces Vitamin A. In the Caribbean, corn is used in many ways. The young cobs are boiled and grains eaten. Dried grains are crushed into smaller pieces and made into a variety of dishes. In the crushed form, it is mixed with other concentrate feeds and used as livestock feed. Corn is grown to be used as fodder in Europe and North America. In Guyana, dried grain of yellow corn is used in the form of flour to make ‘corn pone’. It is the staple food of most people in some African countries like Kenya, Tanzania.

### Soil requirement

Corn can be grown on a wide range of soil, but well drained loam and silt loams with fine tilth are ideal. Corn is essentially a tropical crop but it could grow elsewhere, provided the temperature averages 24°C. The rainfall should be well distributed for most of the growing period. Towards the time of harvesting, dry conditions are required to facilitate drying of the grains.

### Varieties

In Guyana the following varieties are recommended to be grown on the coastlands:

- Charity
- Darefoot
- Tuxpene
Land preparation

In riverain areas where shifting cultivation is practised, cutting trees, de-stumping and burning precede planting. Here ploughing and fertilizer applications are not necessary for the first crop.

Land preparation should be done before the rainy season, but at the right soil moisture in order to produce an ideal seed bed. It should commence in April and May, for May/June planting and in September and October, for November/December planting. On coastal areas of Guyana, the land should be ploughed 15 - 20 cm deep and harrowed (chipped) to break clods and level the land. In the wet season, ridges or mounds 10-15 cm high should be formed to provide adequate drainage. No ridging is necessary on sand reefs.

Planting

Corn is propagated from seed. The seeds should be uniform in size, well formed, not physically damaged and free from insect attack. The amount of seeds required to plant a hectare varies from 17 - 28 kg. Seeds should be treated with fungicides like thiram before planting. About 57g of the fungicide to 45 kg of seeds, should be used to protect seedlings from fungal diseases found in the soil.

Seeds are planted directly in the field in rows 90 cm apart and 30 cm apart within the rows, to a depth of 2-4 cm. Two seeds are sown per hill (hole). On small plots, when the seedlings are 15 cm high they should be thinned to 1 or 2 seedlings per hill, leaving the sturdy, vigorously growing seedlings in each hill.

Care and management

IRRIGATION

Corn plants need a lot of moisture to grow well. In dry weather they need to be irrigated. The need increases as the plants grow. When there is water shortage at the time of silking (appearance of stigma), the yield is seriously affected or reduced.

PESTS OF CORN

- Weeds should be destroyed when they are small because they rob the plants of light, moisture and nutrient supplies. The first cultivation should be done relatively close to the plants about 2 - 3 weeks after planting to loosen the soil and to permit lateral root growth. Succeeding cultivations done at 15 days interval, should be relatively shallow and further away from the plants. This should continue until the maize plants have grown big enough to cover the weeds. Weed killers like Simazine or Gesaprin could be used to control weeds 10 days after maize plants have been planted.

- Army worms (Spodoptera frugiperda). Adult is a moth. The larvae feed on the leaves, the silk and young grains on the cob.

Control – Spray with Monocrotophos. Direct the spray at the whorls of leaves. Repeat at 10 days interval if necessary.

- Corn earworm (Heliothis zea). The adult is a brown moth with a pale hind wing, bordered by a dark band. It lays eggs on the silk. On hatching the striped larvae bore their way into the cob, feed on the tassels and the young soft grains at the top of the cob and make the cob unmarketable.

Control – Spray Sevin 85% wettable powder.
• **Corn leaf aphids** (*Rhopalosiphum maidis*). Numberless, greenish-blue pinhead size insects may be seen on the leaves and male inflorescences. Sometimes leaves are entirely covered with these insects. They suck the sap from the leaves and inflorescences. The affected leaves are frequently seen to turn yellowish or reddish-yellow in patches.

**Control** – Spray Decis - 1.5 ml/litre water or Sevin 85/WP - 1-5g/litre water.

Fig. 7.1 Aphid

**FERTILIZER APPLICATION**

Corn is a heavy feeder and needs additional nutrients for vigorous growth. In the coastal areas it is recommended to incorporate the following amounts of fertilizers per acre at planting:

- Triple superphosphate - 77 kg
- Muriate of potash - 27 kg
- Urea - 68 kg

Fertilizer is best placed 5 cm below the soil and 5 cm away from the seed at planting. The second application of fertilizer is done 30 days after planting, at the following rates per acre:

- Muriate of potash - 27 kg
- Urea - 68 kg

The second dose should be placed 15 cm away from the rows of young plants. After the application of fertilizer, it should be covered by soil and irrigated.

**HARVESTING**

Maize is harvested by hand, by a downward twisting action 90 - 110 days after planting. On large scale farms, maize is sometimes combine harvested. For green corn, (fresh corn) the ears should be harvested when the grains are in the milky stage. This stage is reached when the silk first becomes brown and the ears feel plump. For mature corn the ears should be harvested when the grains are hard. The dried ears are shelled by hand or corn sheller and dried to 11 - 13% moisture content and stored in corn crib.

On the coastland, yields vary from 1136 - 2841 kg of grain per hectare. Better varieties with good management could yield 3408 - 5680 kg of grain per hectare.

**Blackeye**

Botanical name - *Vigna unguiculata*

Family - *Leguminosae*

**Origin and distribution**

The origin of blackeye is uncertain but it may probably be Africa. It is widely grown in Africa, Asia, lowland and coastal South America and West Indies. It is a popular crop in Guyana and forms an important part of Guyanese diet.

**The structure of the plant**

They are annual plants with a large tap root and alternate trifoliate leaves with ovate leaflets. The flowers are in pairs on long flower stalks. They are
self-fertile and give rise to long, smooth, cylindrical pods.

![Cowpea (Vigna unguiculata)](image)

Fig. 7.2 External structure of the cow pea plant

**Economic importance**

The blackeye is grown mainly for its dried seeds, but may sometimes be picked as immature green pods. Dried seeds are rich in protein (23.4%) and used whole or ground into meal which is used in a number of ways. The fresh seeds and immature pods are sometimes eaten cooked or they may be canned. The plant could be grown with grasses in pasture or made into hay or silage. It is also used as green manure crop because of its nitrogen fixing habit. Rice and cowpea are a traditional food to Guyanese and so are pea soup and stewed peas.

• **Soil requirement and climate**

The crop grows on moist, deep, well drained soils but does best on sandy loams. The soil must not be acidic. If acidic, lime stone is added to correct acidity in the soil. Blackeye is a warm weather crop which could tolerate drought. It could be grown in semi-arid conditions (less than 600 mm of rainfall a year).

**Varieties**

- **California No. 5** is recommended and popularly grown in Guyana.
- **California 8152** is grown in Trinidad and Tobago.

**Land preparation**

The land should be ploughed and harrowed, or if on a small scale it must be forked and chipped. In the wet season in coastal areas, it is recommended to plant on raised beds 90 cm -120 cm wide and of convenient length. The beds should be slightly cambered, that is, the centre being 10-15 cm higher than the edges. Adequate drainage should be provided at all times.

**Planting**

In Guyana, it is planted in late November or late April so that the pods will ripe during the dry weather. Seeds are planted direct in the field about 4 cm deep ,60 cm between rows and 15 cm within rows. About 22 -27 kg of seeds will be required to plant one hectare. Germination occurs 5 days after planting.

**Care and management**

**IRRIGATION**

Blackeye is grown mostly as a rain-fed crop in Guyana. Little irrigation is done to the crop as it could withstand drought conditions.

**PESTS OF BLACKEYE**

- **Weeds.** Hand hoeing and moulding between plants help to control weeds. Two to three shallow weedicings should be done until plants are large enough to choke out the weeds. Chemicals like
*Planuvin* and *Amitben* could be used to control weeds immediately after planting.

- **Aphids.** These are tiny sucking insects seen on the underside of the leaf. They can also be found on the terminal bud which they destroy, thus reducing growth and plant yield.

  **Control** – Aphids are controlled by spraying with Decis, Karate or Sevin 85% WP.

- **Flea beetles.** These are tiny black or reddish brown beetles which chew round holes in the leaves.

  **Control** – Spraying with *Dimethoate* or *Malathion* 57% EC., can control this pest.

- **Weevils.** The larvae of this pest tunnel into the pod. Adult weevils are major post-harvest pests of this crop.

  **Control** – Control measures include spraying with *Rogor* 40 under field conditions. Dry seeds for storage must be fumigated or treated with premium grade *Malathion*.

**FERTILIZER APPLICATION**

Fertilizers should be applied based on the recommendations of soil test on that soil. On clayey soils in Guyana, the following quantities of fertilizers are recommended per acre, and have to be applied at planting time:

- Urea - 23 kg
- Triple superphosphate - 68 kg
- Muriate of potash - 45 kg

Fertilizers should be applied in a band 8 cm away from the seed and 5 cm deep. Second application of fertilizer should be applied 3 - 4 weeks after planting. A quantity of 45 kg of Muriate of potash is applied to one acre at this stage.

**Harvesting**

Eight weeks after planting dry pods can be harvested by hand or by combine harvester. If harvested by hand, pods should be well dried before storage. Threshing is done by putting the dry pods in sacks which are beaten with stick. Then the seeds are winnowed to remove empty pods, husks and other foreign matter. After shelling the seeds are stored in sacks, barns or silos. In the case of mechanical harvesting, pods should be well dried in the field before harvesting. A combine harvester with special setting could be used.

**Tomato**

Botanical name - *(Lycopersicon esculentum)*

Family - *Solanaceae*

**Origin and distribution**

Tomato originated in South America, in the Peru/Ecuador region and was taken to Philippines and Malaya by 1650. For some time, it has been cultivated in the temperate regions of America and Europe. Until the 20th century, it was not cultivated in the tropics except in Central America, but now it is grown very widely throughout the world.

**Economic importance**

The fruit is used as a vegetable, raw or cooked, made into soup, sauce, juice, ketchup, or may be canned or used unripe in chutneys. The fruit is a rich source of Vitamin A, B and C.
Soil requirement and climate

Well drained, deep, friable sandy loam is ideal. However, good results may be obtained in clays and clayey loams provided that drainage is good. Whatever the soil type, it is advisable that pen manure or compost be adequately incorporated before planting. A warm season with moderate rainfall is preferred during growth of the plant.

Varieties

Varieties selected must be high yielding, disease resistant and suited to climate and season.

- Creole - A local variety most commonly grown in Guyana. The fruit is small, flat, heavily lobed and slightly acid. The plants are very hardy and can withstand most pests and diseases which will normally affect other varieties.

- Oxheart, Heinz 1350, Manalicue, Cambell 403 and Marglobe are English varieties. These are successfully grown in Guyana and the Caribbean. They are large, smooth and round fruits.

Nursery

Tomato plants are grown from seeds. The ripe fruits are squeezed and the seeds are washed with dilute hydrochloric acid or washing soda to remove pulp from them. They are then dried. The seeds remain viable thereafter for 3 - 4 years if stored. Seeds are sown in nursery beds or seed boxes. For a good start in the nursery, it is preferable to mix clay, sand and well rotten pen manure or compost in the following proportion:

- Clay (garden soil) - 2 parts
- Pen manure or compost - 1 part
- Sand - 1 part

The soil used for nursery should be sterilized by using chemicals like Methyl Bromide, Shell DD or Formalin to destroy damping off organisms causing root rot. The nursery bed or seed box should be watered and the soil allowed to settle down before seeds are sown to avoid air pockets. Seeds are either broadcast or sown in rows. If sown in rows allow 8 cm between rows and 5 cm within rows. After sowing, the seeds are covered with sifted soil to form a fine layer over them. The nursery bed or box is then covered with straw, paper or coconut leaves to prevent drying out. The nursery should be watered morning and evening at the start using a watering can with a fine rose. Seeds germinate 7 - 10 days after sowing.

Land preparation

The land should be ploughed, chipped, incorporated with well rotted pen manure or compost at the rate of 35-65 tonnes per hectare. It must be well mixed with soil and land levelled. In the wet season, in low lying areas, raised beds are prepared 90 - 120 cm wide and of convenient lengths with 30cm wide drains between beds 15 - 20 cm deep to remove excess water from the beds.

The plants are removed from the nursery when the seedlings are 4 - 5 weeks old, and only the sturdy plants should be used for transplanting. The seedlings are uprooted from the nursery with soil attached to the roots. The spacing depends on the variety grown.

The plants can be staked or allowed to trail on the ground. Staking produces large-sized, disease-free fruits. If staked the recommended spacing is 60 cm between rows and 45 cm within rows, otherwise the spacing could be 90 cm between rows and 75 cm within rows. After planting the seedlings in the field, the soil is pressed firmly around the roots and the plants watered. Transplanting is best done in the late afternoon when the weather is cool.
Care and management

IRRIGATION

The plant is watered often after transplanting. Later it may or may not be regularly irrigated depending on the rainfall.

STAKING AND PRUNING

When the plants are 45 cm high they should be provided with support (stakes) 1.2 - 1.5 m high, about 10 cm away from the base of the stem and tied lightly. Staking helps to produce high quality, clean fruits with reduced disease incidence. Different countries adopt different methods to provide support to the plants.

![Staking system used in the tropics for supporting tomato plants](image)

Local varieties may be grown in bush form as they fruit heavily without pruning. Varieties that are shy bearers have to be pruned to promote flowering and formation of large sized fruits. Tomato plants are pruned by pinching out the side shoots as they appear in the axis of the leaves. They should be trained to a single stem or two stems and allowed to grow on stake or trellis.

PESTS OF TOMATOES

- **Weeds.** Weeding should be done regularly using hoes and cutlasses in small plots. Weeds could be controlled by mulch, using black plastic sheets, rice straw or paper. It is desirable to control weeds during first 30 to 40 days after transplanting.

- **Tomato hornworm** (Manduca sexta). The adult is a moth. The larvae are large, green or dark brown and about 8 cm long with oblique white stripes on the sides and a red horn at the rear end of the body. They are voracious feeders and can strip the leaves. When mature, the larva pupate (change into the next stage) in the soil.

![Larva of tomato horn worm](image)

**Control** — Mix 2 tablespoonsful of *Malathion 5% EC* to each gallon of water and spray the mixture onto the plants infested with the caterpillar.

- **Cutworms** (*Agrotis spp.*). The adult insect is a moth. The caterpillars live in the soil during the day. At nights, they climb the seedlings and eat the leaves. A few greenish black excreta pellets may be observed below the attacked seedlings, but no trace of insects on the plants can be seen during the day.
Control – Spray the cultivated areas with Basudin 60°/EC at a rate of 2ml/litre of water.

- **Tomato fruit worm** (*Heliothis zeae*). This is also called *cotton bollworm* or *corn earworm*. They are prevalent in North, Central and South America. The larvae bore fruits and feed on it.

**Control** – Spray sevin or carbaryl 85 at 6g per litre of water.

- **Aphids**. Tomato leaves are sometimes attacked by small black aphids. They suck the sap from the leaves.

**Control** – Use Decis or Karate or Sevin 85°/WP at a rate of 1.5 ml/litre of water.

- **Damping off** – Tomato seedlings are very susceptible to damping off. This is a disease caused by different fungi (*Pythium*, *Phytophthora* and *Botrytis*). They could cause decay of germinating seeds or destruction of seedlings before they can push their way through the soil or within two weeks after they have emerged from the soil. In the later case, a brown discolouration begins in the roots and infection progresses up through the seedlings. The stem shrivels at ground level, causing the seedlings to fall over and die.

**Control** – Damping off is associated with excessive soil moisture, so proper drainage must be made to remove excess water from the seed bed or field. Seeds should be treated with *Thiram* or *Captan*, and the soil in the seed bed should be treated with *Chloropicrin* or *Methyl Bromide*.

- **Fusarium wilt** (*Fusarium oxysporum*). This disease is caused by a fungus.

It is identified by yellowing, wilting and death of leaves from lower leaves upwards, followed by wilting and death of plants. Often one side of the stem shows infection. Xylem tissues show brown discolouration.

**Control** – Use disease resistant varieties. Treat seeds with fungicides like *Captan* and the soil treated with either *Methyl Bromide* or *Chloropicrin*. Rotate with other crops that could tolerate the disease.

- **Early Blight** (*Alternaria solani*). The same fungus that causes early blight in potatoes causes this disease. It is one of the common and serious diseases of tomato. It can attack the plant at any stage of development. Small (2-4 mm in diameter), brownish-black, round to angular injury is seen on the leaf. In severe attacks the spots may
enlarge rapidly and unite to cause complete yellowing, wilting and death of leaves. In stems elongated, sunken dark lesions about 2 cm long could be seen. In seedlings collar rot may develop at soil level and extend above and below the soil surface leading eventually to death of the plant.

**Control** – Use clean seeds. Practise crop rotation, i.e. do not use plants belonging to Solanaceae family like potatoes, egg plant or pepper in the rotation. Treat seeds with Thiram. When the first symptom appears on the plant spray Captan.

**Fertilizer Application**

To get a good yield, application of chemical fertilizers is recommended. The actual quantity needed for any particular area should be determined by a soil test. In Guyana 15-15-15 mixture is recommended to be applied at the rate of 14g per plant (507 kg per hectare) one week after transplanting and a further application of 7g per plant (253kg per hectare) ammonium sulphate at flowering time. Where the land is fertile or if manure or compost has been used, less fertilizer is required.

**Harvesting**

Tomatoes can be harvested in 8 - 10 weeks after transplanting. As they begin to ripe, they are picked by hand with the calyx on. Picking continues for another 3 - 4 weeks at every 2 or 3 days interval. Fruits are kept indoors in straw in shallow boxes, and placed in a cool open space to ripen. Damaged fruits are discarded. An average yield of 25-30 tonnes per hectare will be satisfactory, but with good management much higher yields could be obtained.

**Pak-choi (Chinese Cabbage)**

**Botanical name** - *Brassica chinensis*

**Family** - *Cruciferae*

**Origin and Distribution**

It originated in eastern Asia and is grown extensively in China and Japan. It has now spread to other countries including Malaysia, Indonesia and West Indies.

**Structure of the Plant**

It is cultivated as an annual. Basal leaves are broad, shining, 20 - 50 cm long with thickened white petioles, not forming a compact head as in cabbage. Flowers are pale yellow, about 1 cm long. Fruit is slender, 3 - 6 cm long.

**Variety**

There are two main types of pak-choi grown in the West Indies, the long leaf and the short leaf types. Market for the long leaf type is better.

**Soil and Climate**

Pak-choi grows well in very rich, well drained, moist soils. If adequately manured and watered it could well be grown in warmer areas as well.

**Planting**

Plants are grown from seeds. Seeds are sown in the nursery beds or seed boxes and transplanted in the field 3 - 4 weeks after sowing; or seeds are sown direct into the field and thinned to desired spacing when the plants are 2 - 3 weeks old.
Land preparation

Land is ploughed or hoed, chipped and incorporated with 25 - 30 tonnes of well rotted manure, mixed well with the soil and the field levelled. In low lying areas in wet weather, raised beds about 90 cm wide with convenient length and 30 cm drains are made. Ideal spacing between plants in the field is 30 cm between rows and 30 cm within rows.

Care and management

Weeding must be done in the early stage of plant growth to promote quick and vigorous growth. Daily watering is essential where rainfall is limited. Plants could be harvested 6 - 8 weeks after sowing.

PESTS OF PAKCHOI

Few pests attack the crop. Caterpillars and aphids may sometimes be seen to attack the plants.

Control 1 - Dissolve 6g Sevin 85% in 1 litre of water and spray the solution on the plant where insects are present.

Fertilizer Application

The plant requires adequate amount of nitrogenous fertilizer, since it is important in promoting luxuriant leaf growth for which purpose the plants are grown. At planting time it is good to use 125kg of 15 - 15 - 15 mixture per hectare.

Cassava (Tapioca)

Most of you reading this book must have used cassava and cassava products in one way or another. In some places the cassava plant is very important as it provides the 'staple' or chief food for the people.

Because cassava is a hardy crop it can be grown almost anywhere. In addition, almost every part of the cassava plant could be used.

Now, let's talk about the cassava plant.

Origin and distribution

Cassava was first grown in Central Africa.

As people moved from one place to another they took plants with them and so cassava is now grown in many parts of the world.

Description

Have you ever seen a cassava plant? Did you stop to examine its stem and leaves. Let's see how much you know about the cassava plant.

What does the stem of the cassava plant look like? Is it smooth throughout its length?

Look at the picture which follows and refresh your memory of what the cassava stem looks like then let's name the parts you see on it.

Fig 7.7 Cutting rooted 16 days after planting
What is the name given to the raised structures you see? Those structures are called growth buds or "eyes."

Those eyes grow at the node or joint on the stem. The portion between two nodes is called the inter-node.

Can you remember anything else about the cassava stem? Is it soft? Or is it hard? Can you peel off the covering from the cassava stem? Examine a piece of cassava stem carefully and note what you see.

Let us talk about the leaf of the cassava plant. Look at the picture carefully.

---

Fig. 7.8 Tip of stem

Do you think the cassava plant has simple leaf structure? Why did you say that? The leaf of the cassava plant can be described as simple because the lobes do not reach right down to the petiole.

What else can you say about the cassava leaf? How is it shaped? Examine leaves from a cassava plant, draw one of the leaves and see how well you could describe it.

Does the cassava plant bear flowers? Have you ever seen the cassava flower? Have you ever seen fruits and seeds from the cassava plant? The cassava plant produces flowers but since we do not use cassava seeds as planting materials we do not place any emphasis on the cassava flower. It is important to know that the cassava plant, when it is mature, produces flowers, fruits and seeds.

(a) Cassava flower

Fig. 7.9 (b) Cassava fruit

**Planting cassava**

We have just said that the farmer does not use cassava seeds as his planting material. What then does the farmer use to propagate cassava plants? Does he use the cassava leaf?

Does he plant the root of the cassava?

No. The cassava plant is propagated from stem cuttings. Each piece of stem to be used must have at least two undamaged eyes on it and it must be taken from the mature portion of the stem. The farmer must ensure that his cassava stem is fresh and not dry and brittle. If the stem is dry the eyes will
be dead and new plants cannot grow from them.

When the farmer selects the stems he will use for propagation he removes the leaves carefully. He removes the young portion at the top of the stem, then he stores his planting material in a cool, dry place.

Can you tell what will happen if he stores the cassava stem in a damp place? Well, the eyes will sprout before it is ready to plant, and he may lose all his planting material.

On the other hand, if he stores his material in a hot place it will become too dry and the eyes will die.

Storage of planting material is very important to the farmer. If he is not careful he could damage his planting material through poor storage.

When the farmer is ready to plant he may cut the cassava stem into pieces called stem cuttings or he may cut the stem as he plants. In the second phase he places a portion of the stem underground then cuts off the length he wants above ground. Planting may also be done by machines.

soil is too hard the cassava or tuber will not develop. Too much water in the soil will give rise to poor quality cassava and, if flooding happens when the crop is mature the farmer will lose all his cassava as they will rot.

Having selected his plot, the farmer ploughs the soil and harrows or chips it to ensure it is loose enough for the crop. Most farmers grow cassava without fertilizer because the cassava plant can obtain its nutrients from deep down in the soil. The farmer must lay out his beds to ensure drainage in the rainy season and to keep water for his plants during the dry season.

Cassava stem cuttings may be placed in two positions in the soil.

Let's look at the diagrams in Fig 7.11.

Fig 7.10 Cassava planting machine

Does the farmer need a special type of soil to plant his cassava? Yes, every crop plant has a type of soil in which it grows best. Cassava plants need soils which do not retain or keep much water. They grow well in sandy soils or sandy loam soils. If the

Fig 7.11 Planting and spacing
You can see three positions in which the farmer may place his planting material in the soil. He should ensure that the cuttings are not placed upside down. Roots grow from around the nodes while the shoot grows from the eye on the stem.

**Care of crop**

As the cassava crop grows the farmer must remove weeds from among his plants. Do you know what a **weed** is? It is any plant growing where it is not wanted.

On small plots the farmer may remove weeds by pulling them out with his hand. On large areas the farmer may use an appropriate herbicide. Do you know what a **herbicide** is? It is a chemical which is used to kill weeds but if the wrong chemical is used it could kill the crop plant also. The farmer needs to use a **spray shield** to protect his crop from drifts of herbicide.

**Pests and diseases of cassava**

The major pest of the cassava crop is **white fly**.

- a **scale insect** which covers the leaf-stalks and stems causing the plant to become weak by sucking the juice from the stem and leaves.
- a **mealy bug** specie which covers the tips of stems, surrounding themselves with white flakes. They reduce production especially in the dry season.

These pests are controlled by the use of chemicals called **insecticides**. In some cases, as with the mealy bugs, farmers use other organisms which feed on the pest as its means of control.

![Fig 7.13 Mealy bug, young branch attacked by bugs](image)

Animals such as the rat and wild hogs damage cassava crops also. I am sure you could describe the type of damage they do.

**Diseases**

Common cassava diseases are:

- African Mosaic which causes leaves to be **deformed** and mottled. It is a serious disease in Africa and India. It does not occur in the Americas.
Harvesting cassava

Have you ever observed how cassava is harvested? Can you describe what you saw? What part of the plant is harvested?

The farmer harvests the root of the cassava plant. The root of this plant grows into tubers as was mentioned before. Cassava tubers grow from large quantities of starch which the plant stores in its roots.

On small plots harvesting may be done manually, that is, the farmer carefully pulls up the plant.

Fig 7.15  Bacteria blight of cassava, angular spots on leaves , blight burns

The farmer must keep all around his farm clean and select healthy planting materials to prevent spread of the pests and diseases which attack the cassava plant.

Fig 7.16  Harvesting of cassava

On large farms machines may be used to harvest the cassava crop. That is called mechanical harvesting.
Uses of cassava

Let's list some uses of cassava:

- as food e.g. boiled, processed into casareep and cassava bread etc.
- in laundry - starching garments
- in industry - paste for materials.

Now, is there any difference between the cassava that is boiled and eaten and the cassava that is processed before use? Yes. Persons who purchase cassava must make sure that they get the correct cassava for the purpose for which they want it.

All cassava plants contain a substance, when it breaks down its produce another substance called hydrocyanic acid. That substance is poisonous if much of it is taken. The type of cassava that is called bitter cassava contains a large quantity of hydrocyanic acid and is therefore poisonous if cooked and eaten. To get rid of this acid bitter cassava is processed into cassava bread and casareep, farinah and other products.

Can you say why we could cook sweet cassava and use it without processing it like bitter cassava?

Do you know that the leaf of the sweet cassava plant is also useful to man? In some places young sweet cassava leaves are used as calaloo. They are steamed, fried with meat or fish, or cooked in rice and other dishes just like we would use calaloo.

From this we can see that nearly every part of the cassava plant is useful to man. Sweet cassava as well as processed bitter cassava is used on a large scale for livestock feeds.

Well, we have just looked at the cassava plant, how it is grown and ways in which we use it.

See how well you could answer the questions which follow.
Exercises

1. Why is the cassava plant described as hardy?
2. Why can the farmer grow cassava without fertilizer?
3. List seven manufactured products obtained from the cassava.
4. (a) Will you grow cassava in your yard? or in the school farm?
(b) Give two reasons for your answer.

Project

Compile a file to show either:
(a) the processing of cassava into cassava bread and casareep or farinah
or
(b) the growing of cassava from land preparation to harvesting.

N.B. Pictures or diagrams of equipment, tools and other materials should be included.

Summary

WE HAVE LEARNT THAT each of the five crops mentioned in this chapter.
• has a botanical name, a family name and different varieties;
• is of economic importance as it provides food as well as earns money for the farmer.
• must be grown in the suitable soil if the yield is to be high;
• must be protected against attack by pests and disease-causing organisms.
The two main branches of agriculture are crop science and livestock science. This chapter gives an introduction to livestock science. Livestock include poultry, cattle, sheep and goats, and swine. Here we are going to look at the following aspects of poultry production.

- classes of poultry
- feeding poultry
- housing poultry
- pests and disease management in poultry
- uses of poultry.

Poultry farming is a lucrative source of income for many farmers and non-farmers all over the world. Some persons engage in poultry keeping on a large scale and market such products as live birds, plucked birds and eggs. There are others who rear poultry on a small scale as a source of food or to supplement their income. Poultry products are very good sources of protein.

**Classes of poultry**

Poultry can be defined as those species of birds that are of economic use to man. These birds are reared for their meat and eggs and they include fowls (chickens), ducks, geese, turkeys, guinea-fowls, pigeons, ostriches, and swans. Chickens, ducks, turkeys and geese are the most common classes of poultry in Guyana.

Among the different classes, there are several breeds that are specially reared for meat or eggs or for both. Meat birds are referred to as *broilers*. Egg type birds are *layers* and those reared for meat and eggs are *dual purpose* type.

![Rhode Island Red](image1)
![Light Sussex](image2)
![White Leghorn](image3)
![Hybrid Broiler](image4)
![Pekine Duck](image5)
![Khaki Campbell](image6)
![Aylesbury](image7)

*Fig. 8.1 Breeds of poultry*
Table 8.1 Breeds and types of poultry.

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<thead>
<tr>
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<th>Breeds</th>
<th>Types</th>
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<tbody>
<tr>
<td>Chickens</td>
<td>creole/common</td>
<td>Dual-purpose</td>
</tr>
<tr>
<td></td>
<td>Rhode Island Red</td>
<td>Dual-purpose</td>
</tr>
<tr>
<td></td>
<td>Plymouth Rock</td>
<td>Meat</td>
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<tr>
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<td>Vantress Cross</td>
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Table 8.2 Terms used to describe poultry

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<tr>
<td>Goose</td>
<td>gosling</td>
<td>gander</td>
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</table>

Rearing chickens

The most important reason for rearing chickens is to obtain the food that the birds produce, i.e. meat and eggs. The manure is also important for maintaining soil fertility and structure.

Rearing chickens for eggs is a very common practice. Chickens reared for egg production are layers. The eggs that are produced are either fertile or infertile. Fertile eggs can be incubated, while infertile eggs are strictly table eggs i.e. for food only.

When producing fertile or hatching eggs, the farmer must allow cocks to run with the hens in order to fertilize the eggs. One cock should be reared with every 10 - 15 hens.

Hatching eggs which produce chicks usually come from specialised ‘breeder-birds’. Infertile or table eggs are those which have not been fertilised by a cock. These eggs are produced by egg type or dual purpose type pullets which do not run with cocks.
Incubation is the process of hatching chicks either by natural or artificial methods. In natural incubation a **broody hen** sits on a small number of fertile eggs in a **coop** or a dry darkened area for three weeks. The hen turns the eggs regularly so that the embryo within each egg can develop properly.

Baby chicks needed in commercial quantities are hatched artificially in **incubators**. Fertile eggs are placed inside an incubator in special racks. The automatic machinery of the incubator turns the racks with the eggs. The incubator keeps the eggs at a temperature of 38°C, and the air at a humidity of 60%. After 21 days the eggs are hatched and the chicks are taken out. They are vaccinated and debeaked before delivery to farmers.

### Systems used in rearing chickens

Farmers use different systems to rear chickens. The systems employed will depend on whether the chickens are reared for commercial purposes or not. There are basically three general systems used in rearing poultry. These are:

- extensive systems
- semi-intensive systems
- intensive systems
**Extensive systems**

The extensive systems are the **free-running system** and the **range system**.

**The free-running system.** In the villages and other communities, croule chickens are allowed to forage for food without any restrictions. Very little shelter is provided for the chickens to roost at night. The hens may make their nests in the bushes where they lay their eggs. The owners may sometimes put hens to sit on eggs when the hens show signs of broodiness.

**Range system.** The chicks are allowed to run in a fenced area during the day. During the night they are confined in a hut or shed. This system is similar to the free-running system except that there are some restrictions.

**Semi-intensive systems**

These are the **run system** and the **fold system**.

**Run system.** In this system the chickens are reared in a fixed house but have access to grass runs which are adjacent to the house. During the day they are allowed to run. Food and water are provided in troughs in the house and the birds will enter occasionally to eat and drink. During the night the birds are shut in the pen. The run provides grass, insects, worms and grit on which the chickens forage during the day. This system has been used reasonably well for layers.

**Fold system**

In this system a small portable house in a fenced grass run is used. The chickens make use of the run during the day and the portable house at night as in the run system. However the unit is moved to an area of clean grass on a daily or weekly basis or whenever the area becomes depleted of grass. A fold unit 6 m x 1.5 m will accommodate about 18 adult birds.
Intensive systems

In these systems the birds are confined in houses all the time and are not allowed to run outside. These systems are generally used for commercial egg and broiler production.

Intensive systems require less land space but the money spent on housing, equipment and feed is very high. The feed provided has to be of a good quality and special attention has to be paid to sanitation to control diseases and parasites.

The intensive systems are the deep litter or built-up litter system and the battery cage system.

The battery cage system. The birds are kept in cages which may be placed one on top of the other. Each cage will carry its own litter collecting pan. The cages are kept in a house. The birds are kept either one in a cage or in groups of five. One chicken requires 0.05 m²

HOUSING

In the commercial production of layers and broilers, housing is one of the most important considerations for the farmers. The farmer should build cheap houses which are durable and good enough to protect the chickens. The floor should be of concrete, and the roof can be shingled or thatched. The building should be on well drained land and should be well ventilated.

Deep-litter system. The house must be well constructed to protect the chickens from cold air, rain and predators. In this system the chickens are reared all the time on a litter of wood shaving or bagasse which is placed on the floor to protect the birds from cold and to absorb the moisture in the dung. The litter can be built up by adding fresh material whenever the need arises. Other materials used as a litter include rice hulls and dry grass or straw.

Facilities are provided for feeding and drinking. A house 100 sq. ft. (9. m²) will house approximately 100 broilers and approximately 33 layers.

EQUIPMENT

The equipment used should be durable and easy to clean. Generally the equipment needed for both layers and broilers will include:

- electrical facilities for lighting and other purposes
- brooding equipment such as the infra-red lamp, electric bulbs, or lanterns
- feeders e.g. feeding troughs and feed hoppers
• waterers e.g. water fountains and automatic waterers
• brooms for sweeping
• hay forks and rakes for turning of litter
• spades for removing litter
• buckets
• debeaking machine
• vaccination kit

Other equipment will depend on the nature of the enterprise. Broiler production will need equipment such as:
• scales for weighing
• knives for slaughtering and dressing
• killing cones for draining blood from chickens after they are killed
• plucking machine

Egg production will require:
• nest boxes
• egg baskets
• egg trays
• egg grader
• perches
• candler

Fig. 8.9 Poultry equipment

Care and management
In managing a number of chickens for meat or eggs a farmer should know how to:
• prepare the house for the baby chickens
• brood baby chicks
• feed his chicks until they mature
• keep healthy chickens by controlling pests and diseases
• recognise when chickens are showing signs of illness
• keep records
• prepare and market his products

PREPARING THE HOUSE AND EQUIPMENT
Before chicks are introduced into a pen or a house, it is important that the house be cleaned and disinfected at least one week before the introduction of the chicks.

The pen should be secured from predators such as rats, cats, dogs and mongooses The area
that will be used for brooding should be surrounded with bags to keep out rain and cold air. A foot-bath with disinfectant should be provided to disinfect the feet of anyone entering the pen.

**PREPARATIONS FOR BROODING**

These preparations will include:

- **litter** must be on the floor of the pen to a depth of 2 in. for a start and the depth built up after a few days.

- **guard** structures are placed to restrict the chicks in the area of the brooder. These structures are called chick guards and they prevent the chicks from wandering away from the heat. Brooding space should be about 50 cm² for one chick up to about three weeks old.

- **feeders and waterers** are placed in position. These should be filled the day before chicks are brought in. Feeders should be placed on paper on which a little feed is sprinkled to enable the chicks to distinguish the feed from the litter.

- **one feed trough** for every 30 chicks, or 2.5 cm feeding space per chick up to two weeks, and 5 to 7 cm feeding space per chick after four weeks should be in place. One water fountain for every 30 chicks, or 2.5 cm water space per chick up to two weeks.

- **brooder**. The brooder is installed to provide the required temperature. Chicks need a temperature of 34 -35°C for the first two weeks. The humidity should be between 40 - 50%. Extremes of temperature and humidity can make the chicks very uncomfortable and can lead to panting, huddling, cannibalism, respiratory stress and death.

- **purchasing chicks**. The farmer should purchase day old chicks from reputable hatcheries. These chicks should be debeaked and vaccinated at the hatcheries. One day old layer chicks should be sexed. Chicks should be transported in ventilated boxes and should not be exposed to rain, sun or draught.

**BROODING**

Brooding refers to the period of management for first three to four weeks during which some source of warmth is provided for the comfort of the chicks. Brooding can be done naturally and artificially.

![Fig. 8.10 Brooding](image)

**Natural brooding**. This is done by the hen, which provides her chick with warmth.

**Artificial brooding**. Artificial brooding is done by providing artificial heat from electric bulb or whatever may be used by farmer. A 75-100 watt bulb suspended over the head of 100 chicks will provide a suitable temperature for brooding. A shield may be used to reflect the heat directly to the chicks. The farmer having brought his chicks onto the farm, places them under the brooder.

**Control of temperature**. The temperature provided for day old chicks should be about 35°C. This temperature should be provided day and night and should be reduced weekly by gradually raising the hover. By the end of the third week the temperature should be 28°C.
Brooding should last 3 weeks for broilers and about 4-6 weeks for layers. At a low temperature the chicks tend to huddle together under the brooder. While at a high temperature they tend to move away. When the temperature is acceptable the chicks move about and drink at regular intervals.

**Feed and water:** During brooding, the chicks should be fed special rations. Laying chicks should be fed chick starter and broiler chicks should be fed broiler starter. Starter rations have a higher protein and mineral content.

Adequate feed and water must be provided all day. Waterers should be cleaned daily and the poultry reeler should make frequent checks to ensure that chicks are comfortable and safe. General precautions have to be taken to guard against vermins and to avoid suffocation and heat stress. During the first week antibiotics, vitamin and mineral supplements can be put into the water as a booster.

**Managing Litter:** The litter should be turned daily, and if wet, it should be removed.

**CARING FOR GROWING CHICKS**

The brooder and chick guard should be removed after 3 weeks for broilers and 4-6 weeks for layers. The growing chickens are allowed the freedom of the entire pen. During a hot day the blinds can be lifted to allow ventilation. Feeders and waterers used during brooding can be replaced with hanging type feeders which should be hung to the height of the backs of the chickens.

**CARING FOR GROWING BROILERS**

**Space.** The house should provide 0.1 m² of floor space per bird.

**Feed.** Growing birds should be fed broiler starter up to 4-5 weeks. After which they should be fed broiler finisher. Feeders should always be filled and should be raised as the birds grow.

<table>
<thead>
<tr>
<th>Age</th>
<th>Type of Feed</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1 to 5 weeks</td>
<td>Broiler starter</td>
<td>23%</td>
</tr>
<tr>
<td>6 weeks to maturity</td>
<td>Broiler finisher</td>
<td>19.5%</td>
</tr>
</tbody>
</table>

**Lighting:** Light should be provided at nights to enable the birds to feed continuously.

**Marketing:** Broilers are ready for market in about 8-10 weeks. They are marketed live and dressed (plucked). At 8 weeks live birds will weigh about 4.5 - 6.5 lbs. Dressed birds are sold whole or in parts such as leg quarters, back, wings, thighs, drum sticks and breasts. They are sold fresh, chilled or frozen. The ratio of dressed weight to live weight is the dressing out percentage.

**Dressing out. %:** This is about 75% of the live weight.

**CARING FOR GROWING LAYERS**

Layers grow slower than broilers, hence they are kept in the brooding area for a longer time. Brooding should cease after about eight weeks. Older birds require 0.3 m² or 3 sq ft.

**Feed:** After they have been removed from the brooder they should be gradually introduced to grower ration. Between 20-22 weeks they should begin to lay and about this time they are introduced to egg ration.

<table>
<thead>
<tr>
<th>Age</th>
<th>Type of Feed</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1-8 wks</td>
<td>chick starter</td>
<td>20%</td>
</tr>
<tr>
<td>9 wks - 20 wks</td>
<td>chick grower</td>
<td>14%</td>
</tr>
<tr>
<td>21 wks and after</td>
<td>egg ration</td>
<td>16.5%</td>
</tr>
</tbody>
</table>
Feeders and waterers should be evenly distributed and should always be filled. Calcium is required in the diet. This can be provided by placing crushed sea shells in a heap in the pen. Some greens can also be provided to supplement the vitamin requirements.

**Vaccination.** Growing birds should be vaccinated before they begin to lay.

<table>
<thead>
<tr>
<th>Table 8.5 Vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age /weeks</td>
</tr>
<tr>
<td>Day old</td>
</tr>
<tr>
<td>5 wks</td>
</tr>
<tr>
<td>8 wks</td>
</tr>
<tr>
<td>12 wks</td>
</tr>
<tr>
<td>16 wks</td>
</tr>
<tr>
<td>20 wks</td>
</tr>
</tbody>
</table>

**Debeaking.** This is the removal of a portion of the birds beak. Debeaking is done to prevent the birds from injuring one another by pecking which is described as **cannibalism.** Chicks are debeaked at one day of age and are then debeaked before they begin to lay.

**Perch:** Perches are structures on which the birds roost at nights.

**Laying boxes:** Laying boxes should be put into the pen before the birds begin to lay. There should be one nest for every 4-5 birds. Litter should be placed in each nest to cushion the eggs.

**Boxes should be kept dark to prevent egg eating and should be dusted every month with pyrethrum powder to prevent the development of mites.**

**Broody hens:** A broody hen is one that has stopped laying and spends her time sitting on the eggs in the nesting boxes. Broody hens should be removed from the boxes to prevent them from damaging the eggs and should be placed in an open cage for several days.

**Laying.** A good layer can be recognised by the following characteristics:
- bright red comb and large wattles.
- bright and alert eyes.
- moist vent.
- tail feathers are short and stubby due to her frequenting the nest boxes.
- width between the pelvic bones and the end of the breast bone is wide, to accommodate three to four fingers; layers usually produce economically for one year. Some produce longer but production decreases over a period of time after which the birds have to be culled.

**Culling:** This is the practice of removing from the flock those birds which are not laying economically. These birds are either sold or used by the farmer. Layers are usually culled when their egg production falls below 40%.
How an egg is layed

Production of the egg starts in the ovary of the hen. Small ova (yolks) develop within the ovary and emerge from follicles of the ovary. These ova ripen and the follicle bursts and allows the ova to fall in the funnel of the reproductive tract. The funnel (infundibulum) is the opening of the oviduct or egg tube.

Each ovum moves down the oviduct to develop into an egg, whether the hen was mated or not by a cock. When a cock mates with a hen, the sperms pass from the cock into the cloaca, which is part of the hen's reproductive tract and which opens at the vent. The sperms swim along the oviduct and fertilise the ova in the funnel.

The thick egg white (albumen) is added to the yolk in the albumen producing region of the oviduct. Here the egg spends about three hours for the albumen to be added.

The yolk surrounded by albumen passes to the shell membrane producing region. Outer and inner membranes are formed at this point.

The egg then passes into the shell producing region (uterus). The shell is laid down around the egg and gradually hardens. A coating called cuticle is laid around the shell to make it water tight.

The egg spends between 19 - 20 hours in the uterus. After hardening it passes into the vagina and cloaca and through the vent to the outside.

Fig. 8.12 A hen's egg

Egg collection. Eggs are usually collected at least three times daily. They should be placed in wire baskets. After the eggs are collected they should be brushed with moist cloth and not washed. Washing affects length of time during which an egg can be stored.

After cleaning, eggs can be graded as large, medium and small. Broken and badly soiled eggs, should not be marketed. Eggs should be stored with the small end down on trays. They should be marketed at least twice weekly, so as to give the customer fresh eggs.
**Candling.** The passing of light through the egg in a dark room so that one can see inside of the egg is called candling. The practice is done to determine whether eggs are fertile or infertile. If fertile the embryo in the egg is seen as a speck with a network of blood vessels. Candling of the egg is usually done on the fifth day of incubation.

![Candling Image](image)

**Common diseases and their control**

Any disease is always a serious problem in poultry rearing and on big farms the risk of disease is greater. It is important therefore to pay close attention to the health of the chickens.

Good sanitation can prevent diseases from developing on a farm. The poultry farmer should identify signs of diseases by observing some of the following symptoms:

- loss of appetite among birds
- drop in egg production and rate of growth
- huddling, panting and dropping of wings
- weakness, drowsiness and drooping
- difficulty in breathing, sneezing, coughing and rattling sounds
- change in the firmness and colour of the droppings

- nervousness and twitching of the head
- high rate of mortality

Some serious diseases of chickens are:

- Fowl pox
- Fowl cholera
- New castle disease
- Pullorum
- Coccidiosis
- Marek's disease

**Record keeping**

Poultry farmers should keep records so as to be able to monitor the business.

Records will include the following:

- feed records
- broiler production record
- egg production record
- record of income and expenditure

**Format of some records which should be kept by the farmer**

(i) Feed intake for the month

<table>
<thead>
<tr>
<th>Kind of feed</th>
<th>Date received</th>
<th>Quantity received</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(ii) Feed consumption record for month:

<table>
<thead>
<tr>
<th>Kind of feed</th>
<th>Amount consumed</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(iii) Broiler production record

<table>
<thead>
<tr>
<th>Batch No.</th>
<th>Amount</th>
<th>Breed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rearing ducks**

Ducks are not as popular as chickens. However, ducks require less care and attention and most breeds are prone to less diseases than chickens. The meat of duck is very tasty and realises a higher price than that of chicken.

**Breeds**

Like chickens, some breeds are noted for meat and others for egg production. The most popular breed is the Muscovy which is very economical to rear for commercial purposes. These ducks perform best in areas that have swampy conditions.

In recent times the **Peking duck** has become very popular in Guyana. They are reared by some farmers in very large quantities for commercial purposes. The Ministry of Agriculture with the assistance of consultants from China has been promoting the rearing of Peking ducks. The Peking is a fast growing breed, which under good conditions can attain 4.5 lbs in eight weeks.

**Systems of rearing**

Different systems can be utilised to rear ducks. One system is to house ducks by fish ponds and allow them access to the ponds. The dung is an important food for the fish while the ducks in turn can obtain some food by catching some fish.

Muscovy ducks are usually reared on a free range system. During the day they search for food in surrounding ponds, trenches and swampy areas. At nights some shelter is provided for their security.

The Peking ducks are reared under an intensive system. Feed and water are provided in the house, which is adjacent to the duck pond.

**Housing**

Housing for ducks is relatively more simple than that used for chickens. Ducks are reared more outdoor than indoor; but in their early life there should be protection against extreme weather conditions and predators. The house should have facilities for nesting. The nesting area should be dry. The duck yard should be fenced and some shade should be provided.
Fig. 8.14 A duck house and pond

**Feeding**

Ducks eat a variety of feed materials such as boiled rice, rice bran, wheat middling, coconut meal, fish and some fruits. A meal mixed by a farmer can contain broken rice, rice bran, and some fish waste. This can be moistened with water. Peking ducklings are usually fed broiler starter from day one to four weeks before they are put on broiler finisher. These ducks are fed twice daily. At all times water should be available for drinking. Antibiotics can be added to the water to build resistance against some diseases. Peking ducks like to swim but this is not a necessity until they are more than 2 - 3 weeks old.

**Diseases**

**DUCK PLAGUE**

This is a fatal disease caused by a virus found in faeces. Ducklings should be vaccinated at 2 weeks old and have a second vaccination two months later, then a repeat every 6 months.

**DUCK VIRUS HEPATITIS**

This disease kills ducklings under one week old. The mother should be vaccinated twice before she begins to lay at about four months and then at 4.5 months old.

**Laying**

Ducks come into laying at about five months of age and good layers would produce up to 280 eggs annually. One drake (male duck) is needed for every 25 ducks. Muscovy ducks make better sitters, than most of the other breeds.

**Brooding**

A brooding duck should be given about 10 - 15 eggs on which to sit. If farmers are engaged in commercial production, they will buy their ducklings from commercial hatcheries. Farmers who rear Peking ducks usually obtain ducklings from the Ministry of Agriculture Livestock Farm at Mon Repos. The eggs take 28 days to hatch. Incubators need to be kept at 39.5°C and the humidity of 80 - 85%. The eggs should be turned three times daily. Ducklings are kept in a warm place for several days before they are allowed out in the yard with the mother. In artificial brooding ducklings are brooded in the same way as chickens.
Exercises

1. Draw a labelled diagram of a chicken.
2. Make a list of all the various classes of poultry reared in your community.
3. Visit a poultry farm in your community. Draw the poultry pen and list all the equipment found in it.
4. (a) Name the different systems of poultry rearing.
   (b) List the advantages and disadvantages of each system.
5. Explain the importance of temperature control in the brooding of chicks.
6. Explain each of the following:
   - brooding
   - vaccination
   - debeaking
   - cannibalism
   - candling
   - incubators
   - disease
   - parasite

Summary

WE HAVE LEARNT THAT:

- there are many classes of poultry but there are four classes which are produced on a large scale in Guyana and the Caribbean.
- a poultry farmer must decide whether he wants to produce eggs or meat or both eggs and meat. This will help him to select the best breed for his farm.
- it is always necessary to ensure that poultry are properly housed and fed and the surroundings are clean, then birds will be healthy and they will produce abundantly.
GLOSSARY

Absorption - the intake of water and other materials through the root and leaf cells.

Adverse effects - effects which are unfavourable or undesirable

Aerate - expose to the action of air.

Agro-industry - the business of producing farm supplies, farm products; providing services such as credits, transportation, processing, and distribution of agricultural products.

Alluvial soil - soil transported and deposited by water.

Annual - plants which complete their life cycle during a single season e.g. corn.

Antibiotic - a substance that prevents the growth of, or destroys bacteria.

Aquatic plants - plants which grow in water.

Breed - a group of animals having common origin and characteristics.

Brittle - extremely dry; easily broken

Carbohydrates - organic compounds containing carbon, hydrogen and oxygen e.g. starches, sugars, cellulose.

Carotene - an orange-red pigment which can be converted to Vitamin A in the liver.

Carpel - a single floral leaf of which the pistil is composed.

Casareep - food flavouring obtained from boiled bitter cassava juice from which the starch has been extracted.

Cattle ranching - the practice of rearing large herds of cattle on open pastures.
Chlorophyll - the green pigment contained in the chloroplasts of leaves or young green stems.

Climate - describes the average condition of temperature and rainfall at a particular place for long periods.

Commercial production - production so as to meet the demand of a market.

Commodity - an article or trade product.

Compaction - when soil particles are pressed together to form a hard layer through which air and water cannot pass.

Concentrate - is a feed which contains high levels of carbohydrates, proteins, minerals and vitamins.

Contagious disease - a disease that is catching or infectious. A disease that can be passed on from one organism to another by an agent.

Convulsion - uncontrolled movement of the body or limbs.

Crop - any plant type which is cultivated or managed by man for its economic value.

Cultivation - is the operation carried out in the field to loosen and break up the soil.

Cutting - part cut from a plant for propagation.

Damping off - plant disease caused by a fungus.

Diarrhoea - excessive looseness of bowels, expulsion of watery stool.

Disease - an unhealthy condition.

Domesticate - to bring animals under human control; to tame.

Dormant - active but not growing, a resting state e.g. winter bud.

Drainage - involves removal of excess water in the soil, surface and upper sub-soil, by artificial means.
Draught animals - animals used for doing work such as transporting load and ploughing fields.

Drawing - taking out the alimentary tract and internal organs from slaughtered animals.

Earth's crust - the layer of solid rocks, together with the surface solid and water.

Egg eating - the practice by poultry to peck or eat eggs while nesting.

Embryo - the undeveloped plant in the seed.

Enterprise - a business activity.

Establishment - a firm or an institution.

Fallowing - the practice of resting the land under water or bush.

Farine (Farinah) - cassava flour parched with animal fat.

Fertilizer - artificial manure; inorganic manure.

Fodder - dried grass, in the form of hay for cattle.

Forage - food for horses, cattle and sheep; the act of searching for food.

Fungicide - substances capable of killing fungi.

Furrow - narrow trench or drain.

Gravel - soil composed of large, rounded rocky particles.

Green manure - green plants or tree branches with green leaves, which are ploughed into the soil to add nutrients.

Gross Domestic Product (G.D.P.) - the yearly value of all goods and services produced in a country.

Hardy crop - crop which could be grown on poor soil and under extreme weather conditions.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrow</td>
<td>breaking down clogs of soil into smaller pieces.</td>
</tr>
<tr>
<td>Hay</td>
<td>grass cut and dried for use as animal food.</td>
</tr>
<tr>
<td>Hedge</td>
<td>fence of short trees or shrubs.</td>
</tr>
<tr>
<td>Huddling</td>
<td>the tendency of baby (birds) to get close to each other.</td>
</tr>
<tr>
<td>Humidity</td>
<td>the amount of moisture present in the atmosphere.</td>
</tr>
<tr>
<td>Husbandry</td>
<td>the practices employed in managing crops and live stock.</td>
</tr>
<tr>
<td>Hybrid</td>
<td>offspring of two animals of different breeds, or plants of different varieties.</td>
</tr>
<tr>
<td>Indigenous stock</td>
<td>those breeds of animals that are native of or that belong to a country.</td>
</tr>
<tr>
<td>Infra-structure</td>
<td>structures that form part of capital inputs which are built to help in the production of other goods and services e.g. roads, drainage and irrigation canals, electricity plants.</td>
</tr>
<tr>
<td>Inorganic</td>
<td>not belonging to any organism.</td>
</tr>
<tr>
<td>Irrigation</td>
<td>is the artificial application of water to the soil to ensure an adequate supply of moisture to meet crop needs.</td>
</tr>
<tr>
<td>Isolation</td>
<td>the practice of separating sick animals from those that are healthy.</td>
</tr>
<tr>
<td>Land preparation</td>
<td>making the soil suitable for planting.</td>
</tr>
<tr>
<td>Lava</td>
<td>liquid rock that flows in a volcano.</td>
</tr>
<tr>
<td>Larva</td>
<td>the immature stage between the egg and pupa of some insects.</td>
</tr>
<tr>
<td>Loam</td>
<td>soil made up of a mixture of sand, clay and humus.</td>
</tr>
</tbody>
</table>
Loggers - persons specialised in the selection and harvesting of logs.

Macro-animals - large organisms found in the soil.

Micro-organisms - microscopic animals and plant life found in the soil.

Mineralising - decomposition of substances which release minerals.

Mortality - the number of stock that died.

Mulch - any material placed as a surface layer over the soil to check loss of water, keep down weeds and lower soil temperature fluctuation.

Natural resource - a resource that is not man made e.g land, minerals.

Non-crystalline - a solid whose natural shape does not show geometrical form with plane faces.

Paralysis - inability to move.

Parasites - any organism that lives on or in other organisms.

pH - the measure of the acidity or alkalinity of any solution.

Perforate - make holes through something.

Pericarp - the wall of the fruit

Pest - an organism which attacks crops or animals and causes damage.

Pesticides - a poisonous chemical used to kill pests.

Photosynthesis - process by which carbohydrates are manufactured by chloroplasts in the leaves and other green parts of a plant in the presence of sunlight.

Pollination - transfer of pollen from another to the stigma.

Predators - animals that prey or feed on others.

Primary axis - part of the embryo which develops into the plant; consists of the plumule and radicle.
Productivity - the rate at which a plant or animal produces.

Propagation - producing new plants of the same species from parent material or seed.

Pruning - the removal of unwanted materials from plants.

Potting soil - soil which is well aerated, drained and disease free and which contains sufficient nutrients for healthy plant growth.

Radicle - lower part of the embryo of the seed. It grows downward and develops into the root system.

Ration - combination of feed materials that are fed to animals.

Rhizome - thickened stem lying flat under the surface of the soil, modified stem which function as a storage organ e.g. ginger, tumeric.

Ridge - a long narrow mound in which two sloping sides meet at the top.

Roost - perch or resting place for birds.

Rooster - a male fowl; or a cock.

Root-stock - the part of the plant which has the root system into which a bud or scion is fitted.

Root-tuber - a modified root that has the additional function of food storage e.g. cassava.

Rural community - developed community away from the town or city.

Savannah - a wide treeless grassy plain.

Seed leaf - modified leaf void of chlorophyll

Serrated - having jagged edges.

Shrubs - small plants with many branching woody stems
Silage - is a method of preserving good quality grass when it is in short supply during off season.

Soil clod - a clump of soil particles.

Soil profile - a vertical section of the soil that shows the different layers that comprise the soil.

Soil structure - the size, shape and arrangement of soil particles and soil spaces.

Soil texture - the proportion of sand, silt and clay in the soil.

Solvent - a substance which dissolves a solid, liquid or gas.

Spray shield - device placed on the lance of a sprayer to prevent chemical sprays from falling on the crop plant.

Species - a group of organisms of the same breed, with common characteristics not shared by other groups.

Staple - the main diet.

Stem cutting - mature parts of a stem used as planting material.

Subsistence farming - producing only to satisfy personal family needs.

Technology - the use of science in the production of crops and livestock.

Tendrils - spring-like sensitive structures formed on the tip of the shoot, or in the axil of the leaf. Used for coiling around support.

Testa - the hard outer coat of a seed.

Thinning - is the removal of extra seedlings from a stand.

Tilth - a soil which is ideally prepared for planting.

Transplanting - moving plants from one container to another or to the field.

Transmit - to carry from one organism to another.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trawling</td>
<td>to fish by using a boat to drag net along the bottom of the sea.</td>
</tr>
<tr>
<td>Trellis</td>
<td>light frame work of crossing strips of wood. to support climbing plants.</td>
</tr>
<tr>
<td>Top-dressing</td>
<td>is the application of fertilizer to plants after they are established in the field.</td>
</tr>
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