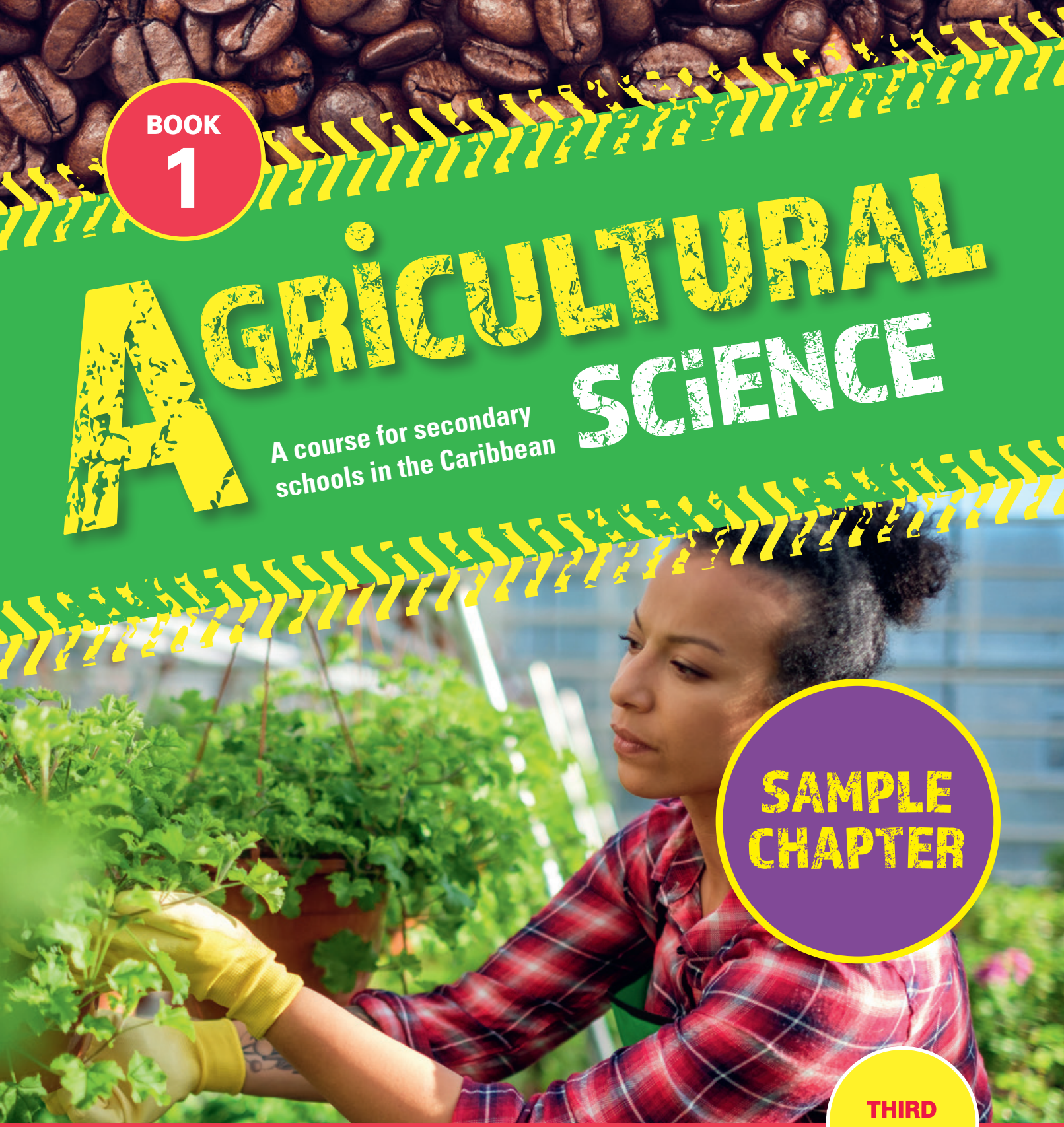
BOOK 1

AGRICULTURAL SCIENCE

A course for secondary schools in the Caribbean



SAMPLE CHAPTER

THIRD EDITION

Amrith Barran ■ Augustine Vesprey
Edmund Berahzer ■ Orville Wolsey
Ricardo Guevara ■ Ian Elliott
Joy Clarke ■ Michelle John

Boost
HODDER EDUCATION

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Contents

Chapter 1
An introduction to agriculture and agricultural science

At the end of this chapter you will be able to:

- Define agriculture
- Define agricultural science
- Explain the history of agriculture and agricultural science
- Understand the importance of agriculture
- Explain the importance of agriculture in Caribbean economies
- Describe some specialised areas of agriculture

Figure 1.1 Growing flowers in a greenhouse is just one aspect of agriculture

Agriculture and agricultural science

The word *agriculture* is actually made up of two words taken from the Latin language. The first part of the word, *agri-*, comes from the Latin *agrarius*, meaning 'of the land', and the second part, *-culture*, comes from the Latin *cultura*, meaning 'to till or cultivate'.

Today, agriculture is a major industry with many branches, including crop and livestock production as well as engineering and economics.

The term *agricultural science* was first used in the United States of America in the Hatch Act of 1887, which came about because farmers wanted to find out about the ingredients in **fertilisers**. Although **agriculture** is almost as old as humans themselves, agricultural science is a fairly new applied

science. Presently, agriculture is a major industry with many subsectors and it is supported by the study of agricultural science.

When farmers are growing crops they need to carry out many different tasks, such as clearing the land; ploughing the soil; sowing and caring for nursery seedlings; planting; caring for plants, including irrigating in dry conditions; **pest** and disease control; harvesting and processing crops; and selling and marketing crops and products.

When farmers are rearing animals they take part in activities such as preparing pasture; constructing livestock pens; selecting **breeds**; caring for young and adult livestock; slaughtering animals for meat; collecting and processing eggs and milk; and marketing unprocessed and processed animal products.

All of these activities, from food production to the processing and sale of farm produce, are part of the agriculture industry. We must not forget that agriculture has a business side to it. Farmers grow what people want to buy, and they hope to make a living from the sale of their produce. The industry is therefore organised and controlled by the **demands** of the market.

DEFINING AGRICULTURE

Agriculture can be defined as *the growing of plants and rearing of animals for human use or benefit*. It can be done on a small or large scale. It is done on a large scale to provide food and other raw materials for the world population. Without agriculture we would have no food to eat! Farmers and gardeners use their knowledge and practical skills when carrying out agricultural activities. More and more scientific methods are being used to improve productivity in the many subsectors of agriculture.

The business aspect of agriculture is very important. Land may be owned or leased by farmers. Farmers employ skilled, semi-skilled and unskilled people to provide labour. They also spend money to produce crops and rear animals, and then they sell these to earn an income. If a farmer earns more than they spend, they are said to make a **profit**. Some of this profit can be put back into the farm, invested in other types of **farming**, or put into savings. If the farmer earns less than they spend, they are said to have made a **loss**.

DEFINING AGRICULTURAL SCIENCE

Agricultural science is the *scientific study of the art and practice of agriculture* with the underlying intention of improving agricultural productivity in a manner that is sustainable and minimises the negative impact on the **environment**. A large part of the scientific study involves practical work and field **research**.

All over the world, people at agricultural research stations and in the science laboratories of colleges, universities and other organisations, are doing research or experiments into how to improve the growth, harvesting and processing of plant and animal products.

Today agricultural science increasingly includes more **technology** and leans on computer science. People are employed by small and large machinery and equipment manufacturing companies to design and build agricultural tools and equipment. These professionals have a range of qualifications, which may include degrees and post-graduate qualifications.

Consider this

Applied science converts scientific knowledge into something that can be used for reasonable and practical purposes in our daily lives.

Many other sciences impact agricultural science. For example, knowledge of chemistry and biology is converted in the creation of pesticides and fertilisers which are used to maximise the production of plants on farms.

As you read through this chapter, identify the things that confirm that agricultural science is an applied science.

The history of agriculture and agricultural science

If you visit your national museum, old villages or plantations, you will realise that the country you live in today was not always exactly as you see it now.

Figure 1.2 The ancient Sumerian hunted animals and practised agriculture

HUNTER GATHERERS

Early humans met their basic needs for food, clothes and shelter using the natural resources of the Earth. They did not practise agriculture as we know it. Instead they lived by hunting animals and gathering wild **fruits**, roots and berries. This is why early people have been given the name of **hunter gatherers**.

During hunting season have you ever been out in the forest hunting for wild animals, such as manicou (opossum) and iguana in Trinidad and Tobago, tatou in Grenada or mountain chicken in Dominica? Have you ever collected edible fruits and nuts from the forest? If so, you are copying some of the activities of early people as they hunted or searched for food.

Figure 1.3 Example of a spear tip used in a hunter gatherer society

NOMADIC HERDSMEN

Much later people began to **domesticate** (tame) animals. Some followed the grazing herds, which moved from place to place to find food. People who follow wandering herds are called **nomads**. Even today there are nomadic herdsmen, such as the Lapp of northern Europe who follow their reindeer herds. Some drawings on rocks still exist, showing Amerindian animals which were herded by the people of that time in Central and South America.

Figure 1.4 Nomadic herdsmen following their herd of camels

DOMESTICATION OF PLANTS AND ANIMALS

It takes time and patience to tame animals so that they are not afraid to stay near people, but eventually herdsmen learnt to domesticate animals. They chose the quiet, less nervous animals and bred from them. In this way they began to keep herds near to home.

Recent research has shown that the domestication of plants and animals took place between 7000 and 9000BCE in several widely separated places. These included the Fertile Crescent of Mesopotamia and the Near East (Iraq, Turkey, Jordan and Syria), northern and southern China, Central Mexico, the Peruvian Andes, Papua New Guinea, West Africa and eastern North America.

The emergence of agricultural science

Various examples of scientific approaches to agriculture are seen in ancient artwork of the earliest civilisations, from Mesopotamia, Egypt, China and India to name a few. However, written information on scientific agricultural practices in a language we understand was not made available until quite recently.

Here are a few people who helped develop the field of agricultural science:

- **Robert Bakewell** (1725–1795) was a British agriculturalist and a key figure in the British Agricultural Revolution. He did a lot of work on improving agronomy (agricultural plant science) and on the breeding of livestock such as sheep, cattle and goat.
- **Luther Burbank** (1849–1926) and **George Washington Carver** (1860–1943) were American agricultural scientists whose work helped to improve agriculture throughout the world.
- **Thomas Phillip Lecky** (1904–1994) was a Jamaican scientist and environmentalist who became known internationally for developing high producing cattle breeds for Jamaica, including the widely known Jamaica Hope. These breeds are now found throughout the Caribbean.
- In the Caribbean, Guyanese-born soil scientist **Professor Nazeer Ahmad** (1932–2013) became world famous for his research into Caribbean soils. He became an international consultant.

All over the world there are numerous colleges and universities dedicated to the study of agricultural science. The **Imperial College of Tropical Agriculture** (ICTA) was started at St Augustine, Trinidad, on 30 August 1921. In 1924, the college published the first issue of its *Tropical Agriculture Journal*, featuring articles on tropical agricultural research, both Caribbean and international. In 1960 the college became the second campus of the **University College of the West Indies** (UCWI), which then became the **University of the West Indies** (UWI) in 1962.

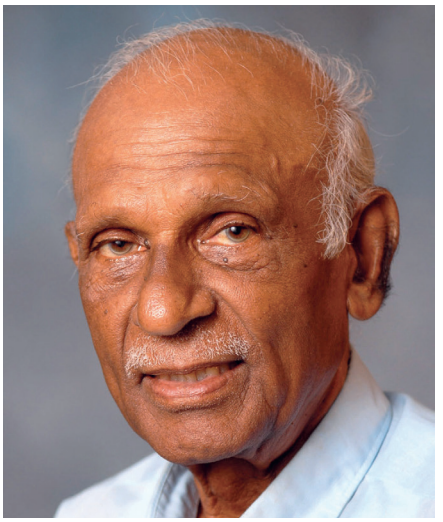


Figure 1.5 Professor Emeritus Nazeer Ahmad (1932–2013)

Figure 1.6 Stamp showing the Imperial College of Tropical Agriculture building in the 1920s

Did you know?

Dr Norman Borlaug, an American agriculturalist, was called 'the father of the green revolution'. He was awarded the Nobel Peace Prize in 1970 for increasing food **supply** globally and saving billions of people from starvation.

Activities

Practical work

Agricultural training centres

With your teacher or parents, arrange to visit (a) an agricultural village or a farm and (b) an agricultural training centre or institute near to where you live.

1. Describe the activities that you observe in each location. You can use photographs to illustrate your description. Remember to ask for permission before you take pictures, especially of people.
2. Make a table listing the characteristics of each place you visit.
3. What information about each place impresses you the most?

Technology-based activity

1. Using the internet, research some international and Caribbean people who helped to advance agriculture and/or agricultural science.
2. Prepare a presentation for your class based on your research. You can create a written, dramatic, audio or visual presentation.

The importance of agriculture

Figure 1.7 Why is agriculture important to us?

The history of humankind is very closely related to the development of agriculture. Even though many products used today are synthetic (produced artificially), many come directly or indirectly from agriculture.

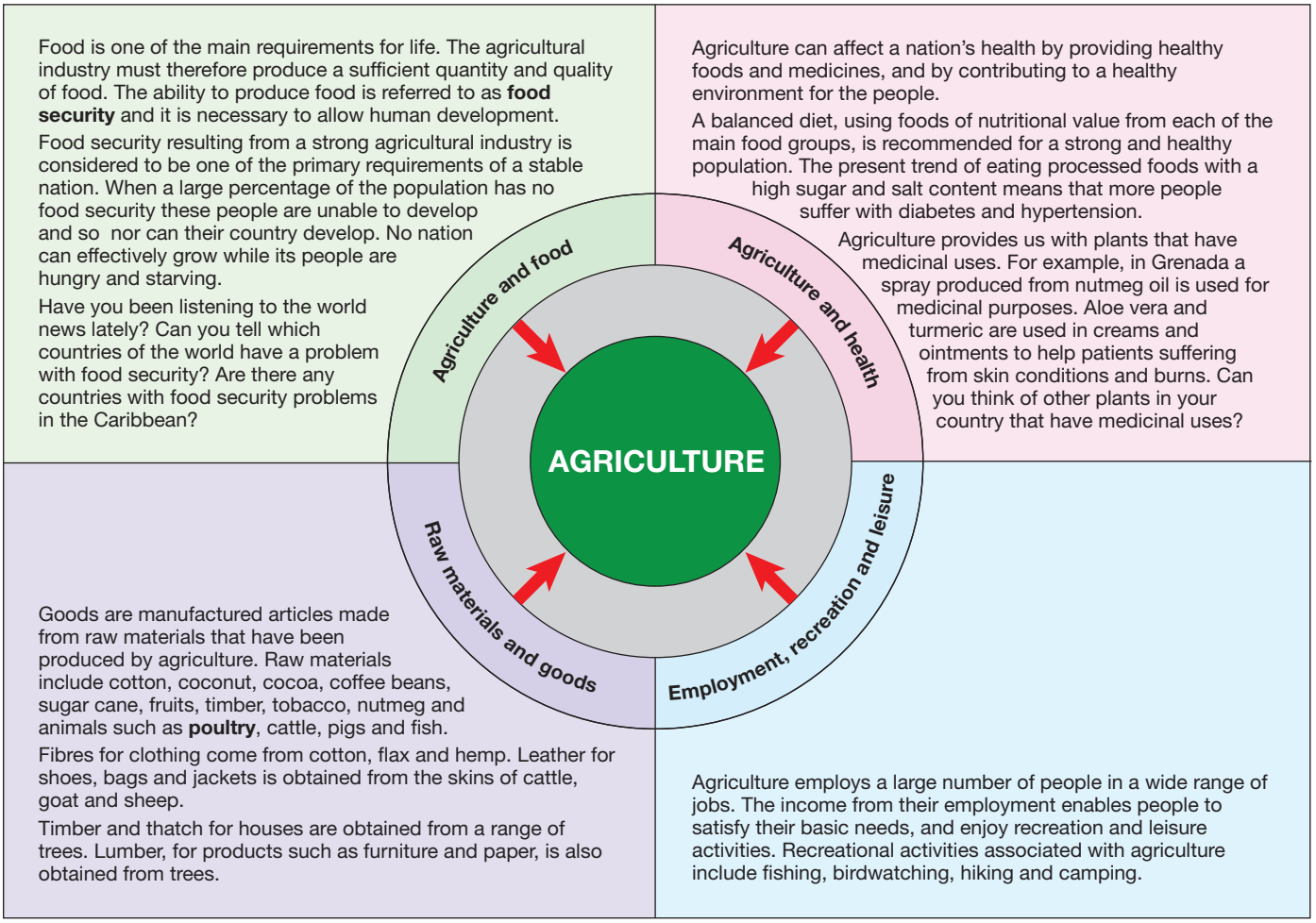


Figure 1.8 The importance of agriculture

Consider this

On a small **subsistence** farm the farmer will be engaged in all the occupations. The farmer will be the labourer, the skilled worker, the supervisor and the manager.

On the other hand, a large **plantation**, **estate** or **commercial farm** employs a large number of people. In this case the farmer will most likely be the manager.

Food for thought

We know that agriculture plays a role in many areas of human life in general, but have you ever wondered about the role of agriculture in the Caribbean?

The big question

What is the importance of agriculture to Caribbean economies?

Breaking this down

Group activity

Each group will be assigned a list of Caribbean countries. You can work out with your teacher how best to do this. For example, one group could focus on the Greater Antilles.

In your group, create a table or graphic organiser to show:

1 **The structure of the agricultural sector**
- What crops are grown?
- Are these crops grown for **subsistence farming**, or for **commercial** purposes on smallholdings and large plantations?
- What percentage of the people are engaged in each different type of farming activity?

2 **Primary industries related to agriculture**
- What are the primary industries in these countries?
- Are there government agencies that govern and protect these primary industries?
- Are there changes in these primary industries because of **globalisation** and open trade with other countries?

Sharing the information

You may share your information in a number of ways. For example, you could prepare a documentary-type presentation. You could also pretend that you are interviewing specialists who can speak about each area. Of course, you are free to think of other creative ways to share your information.

Answering the big question

What can you now say about the roles that agriculture plays in Caribbean economies?

INFO

Caribbean territories

Greater Antilles

- Cuba
- Jamaica
- Haiti
- Dominican Republic
- Puerto Rico

Lesser Antilles

Leeward Islands

- US Virgin Islands
- British Virgin Islands
- Anguilla (UK)
- St Martin/Sint Maarten (Fr/Neth)
- St Barthélemy (Fr)
- Saba (Neth)
- Sint Eustatius (Neth)
- St Kitts
- Nevis
- Barbuda
- Antigua
- Redonda
- Montserrat (UK)
- Guadeloupe (Fr)

Windward Islands

- Dominica
- Martinique
- St Lucia
- St Vincent and the Grenadines
- Grenada
- Barbados
- Trinidad and Tobago

Leeward Antilles

- Aruba (Neth)
- Curaçao (Neth)
- Bonaire (Neth)
- Los Roques Archipelago
- La Orchila
- La Tortuga
- La Blanquilla
- Margarita Island
- Coche
- Cubagua
- Other islands

Other countries (not islands)

- Guyana
- Belize
- Suriname

Specialised areas in agriculture

There are many specialised jobs in the agriculture industry. Farming is the growing or production side of agriculture. However, there are also opportunities in product processing, engineering, agricultural research, extension work, business, marketing and transport, policy-making, academic and technological areas.

Some specialised types of agriculture are:

- production agriculture
- processing of agricultural products
- agricultural engineering
- research and extension services
- marketing and transport
- agricultural technology
- landscape architecture
- agro-tourism.

PRODUCTION AGRICULTURE

This area of agriculture involves producing plants and animals.

Table 1.1 Production agriculture

PLANT PRODUCTION	LIVESTOCK PRODUCTION
In plant production many types of crops are grown for food and other human uses under the following disciplines. • **Agronomy:** the science concerned with the production of crops, especially in relation to large-scale farming or plantations. • **Gardening:** the cultivation of crops in a garden, or very small-scale farming. • **Horticulture:** the cultivation of fruit trees, flowers and lawns to enhance the environment. • **Niche-market crops:** the cultivation of fruits and flowers that grow best in tropical areas, for example, hot peppers, carambola, aloe vera, shadow benny, orchids, heliconia and tropical foliage plants like croton.	Livestock production is a specialised area of agriculture where different types of livestock are grown for food and other useful products, such as hides and wool. The following are some livestock production disciplines. • **Poultry production:** the science concerned with producing chicken, turkey, ducks and other birds grown for food and other uses. • **Cattle production:** the rearing of cattle for meat in beef production or milk in dairy production. • **Rabbit production:** when rabbits are kept for their products (meat or skins). • **Swine production:** the rearing of pigs for their products (meat). • **Sheep and goat production:** these are reared mainly for meat, but there is now a growing market in goat milk. • **Fisheries and aquaculture:** for sea and inland fish harvesting or rearing. • **Apiculture:** bees are reared in hives for honey and close to orchards for the pollination of fruit crops.
MIXED FARMING	
Mixed farming is when many different crops and livestock are grown on the same farm. A mixed farm is usually managed by one person or by a management team.	

PROCESSING OF AGRICULTURAL PRODUCTS

Many foods are **processed** in some way. They may be canned, dried, baked, pasteurised or frozen. Foods are processed so that they are transformed into other foods. Processed foods usually keep longer than non-processed foods.

Processing includes activities such as:

- food technology (applying science to the selection, preservation, processing, packaging, distribution and use of safe, nutritious and wholesome food)
- preservation of foods
- quick-freezing foods.

Can you think of a range of foods that have been preserved in different ways?

Figure 1.9 Canning food is an example of agricultural processing

Career corner

Figure 1.10 Greenhouse manager

Profile: Greenhouse manager

As a greenhouse manager, I spend most of my day in these **greenhouses** or outside. I must be present to be an effective manager. Greenhouses are highly controlled environments and require constant supervision to ensure the safety of staff and a high yield.

My workday is typical; on weekdays, it begins at 9am and ends at 5pm; I sometimes work at weekends as well. Generally, I monitor all the activities in the greenhouse. This includes the supervision and training of staff, and oversight of everything from irrigation to pest control, to plant breeding, to the application of greenhouse technologies. I also oversee matters related to inventory, budget, construction and maintenance, as well as research.

When I decided I wanted to become a greenhouse manager I researched universities that offered the best programmes in horticulture, soil science, plant propagation and agricultural management. Along the way, I've also completed short courses in irrigation, and pest and disease control.

AGRICULTURAL ENGINEERING

The mechanical or machinery side is increasingly important in modern agriculture. Prominent disciplines include:

- **agricultural mechanics** – the routine maintenance and care of machinery
- **agricultural mechanisation** – the use of modern machinery and equipment to make agriculture more efficient.

Mechanisation allows farm jobs to be done much more quickly (for example, using a combine harvester for cutting sugar cane is much faster than using manual cutting methods).

RESEARCH AND EXTENSION SERVICES

Agriculture is constantly being improved through research. This involves careful scientific studies of things that may enhance or damage agricultural production on the farm. Positive findings from agricultural research are then demonstrated to farmers through the agricultural extension service. Agricultural Extension Officers from the Ministry of Agriculture visit farmers to show them how to use modern farming methods, follow Occupational Health and Safety rules when using chemicals and overall educate farmers on best agricultural practices.

In this area there are disciplines such as:

- agricultural experimentation
- agricultural research
- agricultural extension services.

Agricultural experimentation and research can be carried out in laboratories, on special farms or in controlled environment units such as greenhouses.

MARKETING AND TRANSPORT

Farm produce can be sold in local, regional and international markets. Farm inputs and farm produce have to be transported to and around the farm, and from the farm to the market. Special storage may be needed for perishable produce. With the advent of the internet, marketing is now also done via social media.

AGRICULTURAL TECHNOLOGY

This involves applying the results of scientific research to practical farming. Activities include:

- **biotechnology** (including genetic engineering and genetically modified crops)
- **artificial insemination** of cattle
- **embryo transfer** in cattle.

LANDSCAPE ARCHITECTURE

This involves preserving and/or making the environment more beautiful and sustainable by planting trees, shrubs and flowers. Ornamental horticulture is included as part of this subsector.

AGRO-TOURISM

This is an emerging sector whereby many visitors to the Caribbean now tour plantations and estates, where crops such as cocoa and coffee are grown, or factories where primary produce is processed. Some visitors actually work on site for a short while. Examples are tours of the River Antoine rum distillery and the Belmont Estate, both in Grenada, where tourists can see and participate in the running of a plantation.

Food for thought

How much do you think agriculture has changed since the time of hunter gatherers? You could guess, but you will never be certain without doing some research!

You can use the internet or books in the library to find out how agriculture has changed to match the food needs of humankind.

The big question

How has agriculture changed since the time of the first hunter gatherers?

Breaking this down

1. How did people in hunter gatherer societies feed themselves?
2. How did people ensure **food security** as societies changed from hunter gatherer to more modern?

Sharing the information

It is good to share the information you gather as this will give you and others an opportunity to discuss ideas and think of different points of view.

For this activity you can share your information using:

1. a PowerPoint presentation with videos and illustrations
2. a Prezi presentation
3. a timeline
4. any other creative method that you can think of.

Answering the big question

After doing your own research and listening to what your classmates had to say, what is your answer to the big question?

Subject link

Agricultural science overlaps with biology, chemistry, physics, mathematics, geography, business studies, accounting and ICT.

Can you list at least one subtopic in agricultural science that overlaps with each of the subjects listed?

Revision tip

Write your own definitions for the terms *agriculture* and *agricultural science*. Do research on the internet and in your school library to find other definitions for these terms. For exam purposes you must know these definitions.

Activities

Practical work

Identification of specialised areas of agriculture in your country

1. Prepare a simple **questionnaire** on specialised areas of agriculture in your country.
2. Ask your teacher or parent to take you to the Ministry of Agriculture or its nearest branch in your country.
3. Complete the questionnaire that you created by conducting interviews with Ministry personnel.
4. Use the interview results to summarise the specialised areas of agriculture in your country.

What have I learnt?

Multiple choice questions

1 **Which of the following statements is not true?**
- a Agriculture focuses on the growing of crops and rearing of animals.
- b The earliest civilisations used some forms of agriculture.
- c All Caribbean territories are engaged in agriculture on a large scale.
- d Primary industries in agriculture consist of the harvesting of produce.

2 **Select the best answer to complete this sentence: 'Animals were domesticated …**
- a by selecting the gentler animals and breeding them.'
- b by keeping all animals captured in an enclosure.'
- c by keeping quiet animals close to home.'
- d by chasing away or eating the badly behaved animals.'

3 **Select the group of products that does not contain only raw agricultural materials:**
- a cocoa, rice, chickens, cattle skin
- b oranges, cassava, cut lumber trees, eggs
- c fish, cut flowers, nutmeg, milk
- d rabbit, honey, cotton, canned carrots.

4 **Select the correct statement to finish the sentence: 'A mixed farm …**
- a has more than one manager.'
- b has crops and livestock.'
- c has a range of activities that tourists come to participate in.'
- d is a farm with different types of worker.'

5 **Which statement about commercial farms and subsistence farms is correct?**
- a A subsistence farm is smaller and has more workers than a commercial farm.
- b A commercial farm is larger and has fewer workers than a subsistence farm.
- c A subsistence farmer only does a few of the jobs on their farm, while a commercial farmer does all types of job.
- d A commercial farmer has more workers and a larger farm than a subsistence farmer.

Short answer questions

1 **What is agriculture?**

2 **Why should you study agricultural science?**

3 **Shari and Mark are working together as partners on a school project. On a visit to a small local farm, where the farmer and his family eat most of what they plant and rear, Mark observed that since the farmer supplements his food supply by hunting animals in the forest nearby, he is a good example of a hunter gatherer. Shari disagrees, stating that the farm is a good example of agro-tourism because it has paying guests who are there for the purpose of experiencing life on a small rural farm for a short period of time. Who is correct? Give at least two reasons for your answer.**

4 **Why is agriculture important to the economy of your country? Give at least three reasons.**

5 **Write about the specialist areas of agriculture that people of your generation might be interested in. Explain why these areas might be of interest.**

6 **Why do you think agriculture will continue to be of importance to Caribbean territories?**

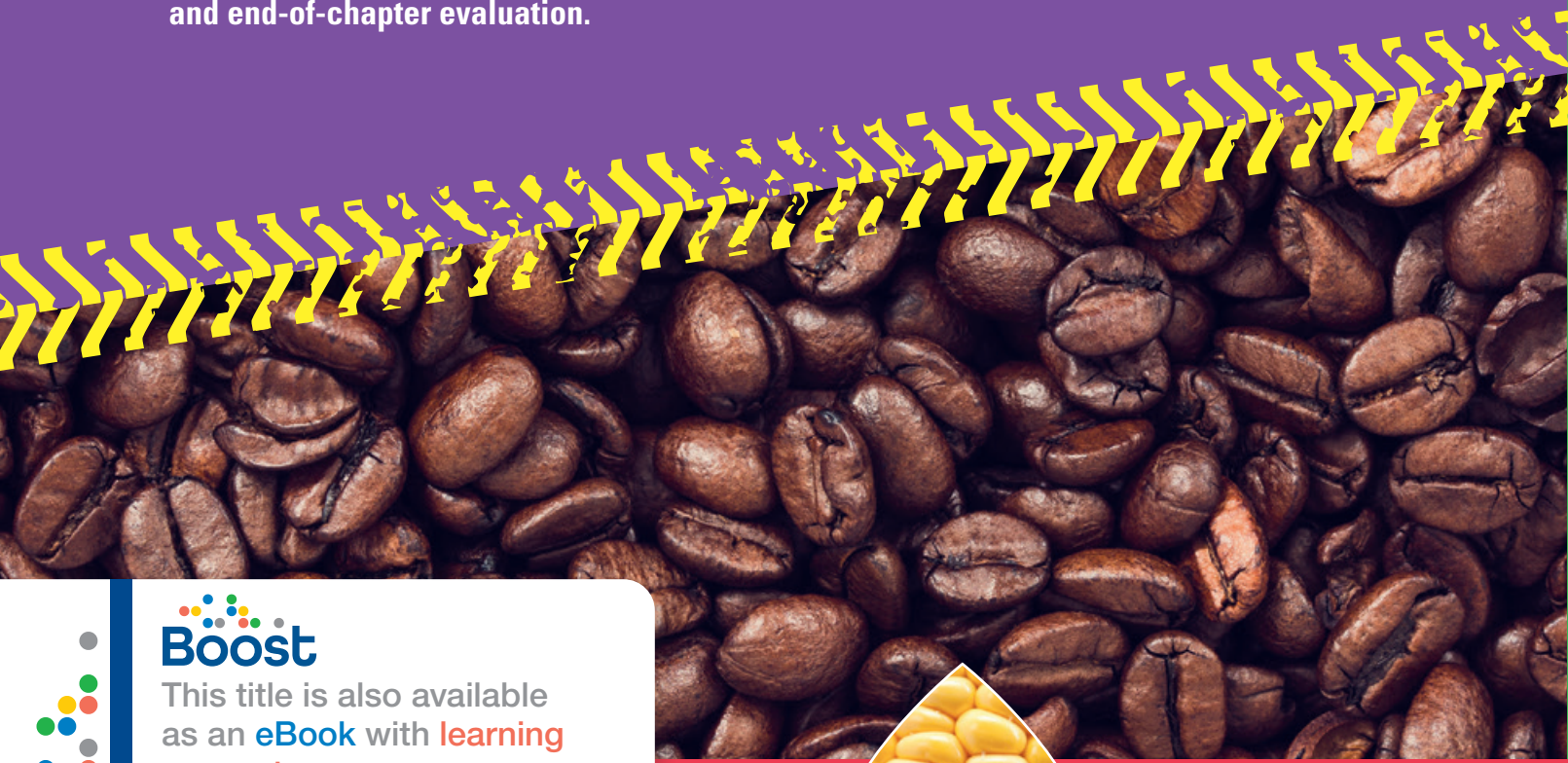
AGRICULTURAL SCIENCE

BOOK 1

Cultivate an interest in the agricultural sector with a three-level secondary course designed specifically for the Caribbean.

- **Explore regional and global practices and developments in agriculture.**
- **Review career options in an increasingly lucrative and essential sector.**
- **Enhance understanding of the relevance of agriculture with a project-based approach to select topics.**
- **Prepare for study at the CSEC® level with a dedicated project-based chapter scalable to other topics and SBA research at the CSEC® level.**
- **Consolidate learning with clear chapter objectives and end-of-chapter evaluation.**

SAMPLE CHAPTER



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