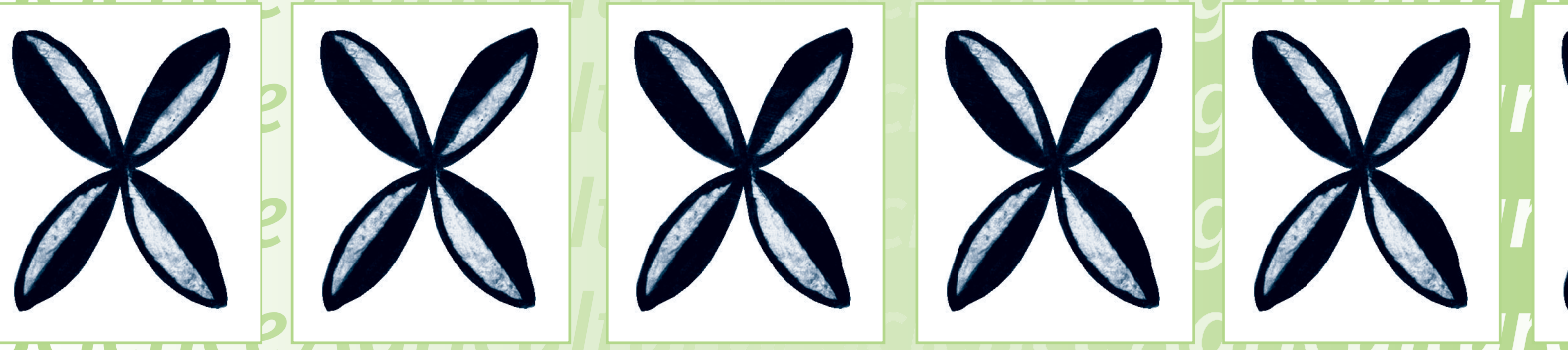


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AGRICULTURAL SCIENCE



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Year 13 Learning Guide

AGRICULTURAL SCIENCE

LEARNING GUIDE
Year 13



GOVERNMENT OF SĀMOA
MINISTRY OF EDUCATION, SPORTS AND CULTURE

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Introduction

Why study agricultural science?

Study in agricultural science supports the growth and development of all students and aims to assist students to develop knowledge, skills and attitudes to allow them to best utilize the resources they have available to them. It also increases the potential of students to work in the agricultural industry or to study the subject further. In Samoa, agricultural science is offered from Year 9 right up to University. Agricultural science enables the students to adopt the use of sustainable agricultural techniques and appropriate technology to help the community economically, socially and culturally. It also increases understanding of agricultural technology and techniques, and their impact or effects on the environment and production.

Agriculture is an important way of life in Samoa. About seventy percent of the population is engaged in rural production, producing crops and livestock for either home consumption or for sale. Samoa has a strong traditional culture that depends on agricultural produce for traditional ceremonies.

The farmer enjoys a certain amount of independence and a healthy outdoor life. As a business, farmers make a living by selling their farm products.

The aim of agricultural science is to study farming and find ways of making it as efficient as possible. We should try to find ways of making plants and animals grow as fast as possible with little energy wastage. Plants and animals will grow much faster if we can find out how to stop losses of energy due to pests and disease, poor nutrition, harsh climate or plants and animals being the wrong breed.

How to use this learning guide

This learning guide is intended to assist in the teaching and learning of agricultural science at Year 13. The achievement objectives are given for each section. The key concepts for each section and references in the textbooks are included. The key to learning agricultural science is making the best use of resources and scientific knowledge to improve production and quality. The reduction or elimination of the factors that affect production is also very important.

The following textbooks are referenced in the information given below:

1. Senior Secondary Agricultural Science by Oluyemi Akinsanmi, 1976, Longman (abbreviated as **SSAS**).
2. Introduction to Agriculture 6th edition by J.A. Southerland, 1989, McGraw-Hill (abbreviated as **ITA**).



Agriculture

Agricultural ecosystems

Students will be able to investigate and develop their skills and understanding of:

Agricultural ecosystems when they:

- ❑ Describe the characteristics of an ecosystem, e.g. producer, consumer, decomposer.
- ❑ Describe the differences between a managed and a natural ecosystem.
- ❑ Describe the types of agricultural management systems – traditional, mixed farming, inter-cropping, mono-cropping, organic farming, integrated pest management (IPM), agro forestry.
- ❑ Investigate local and regional examples and discuss the impacts agricultural practices have on the natural ecosystem, e.g. pesticides, over-fertilisation, over-cultivation, deforestation.

Genetically modified foods when they:

- ❑ Investigate genetically modified organisms (GMOs).
- ❑ Explain improvements in production as a result of **breeding**, e.g. heritability, line breeding, cross breeding and hybrid vigour.

Farming practices impact on the natural and managed ecosystems. When selecting what practices to use it is important to also consider their effect on the environment. Practices that are used should not only achieve the objectives of the farmer but also have minimum impact on the environment.

Genetically modified organisms and products are now commonly sold in other countries and are expected to be locally available as well. Little is known of their side effects, therefore consumers and farmers should be aware of the content of these products and potential effects on their produce and other organisms.

Genetic engineering and breeding will continue to be used to improve the characteristics of livestock and crops. The breeding methods used have different purposes.

Key Points

- ❑ Ecosystems are made up of producers, consumers and decomposers. Producers are mainly plants. Consumers in an ecosystem can consist of organisms like insects, birds or animals. Decomposers are mainly fungi and bacteria. (ITA page 4)
- ❑ Ecosystems can be divided into two groups, managed and unmanaged. Managed ecosystems include ecosystems that are managed by people. This includes ecosystems, like farms, parks, grounds, gardens and reserve areas that are managed by government organisations. Unmanaged ecosystems include ecosystems that are not managed by people, like natural rain forests, grasslands and mangroves. (ITA page 5)
- ❑ There are many types of management systems in agriculture. Each serves a different purpose and has its advantages and disadvantages over other management systems. Farmers select and use management systems that meet their needs and achieve their farm, personal and environmental objectives. (SSAS pages 112–113, 170–175; ITA pages 2–6)
- ❑ Genetically modified organisms are developed through genetic engineering. Genetic engineering is used to improve certain characteristics of organisms, for example size of cobs in maize. This process has been improved and takes a shorter period compared to the natural process of breeding. However there can be undesirable side effects on other organisms that consume these products. (SSAS pages 135–136, 63–65)
- ❑ Breeding is used to improve certain characteristics of organisms. For example, breeders can modify the gene for length of breadfruit trees (ulu) to produce shorter trees for easier picking when fruits are mature. Cattle can be bred to produce beef cattle that produce high quality meat in hot weather conditions. (ITA pages 264–269)

Questions

1. What is the difference between a managed and unmanaged ecosystem?
2. What are the main characteristics of good agricultural management systems?
3. Why is it important to minimize the negative impact of farming practices on the environment?
4. What can be some side effects of using genetically modified organisms or products?
5. Why is breeding practiced?



Soil Fertility And Soil Conservation

Students will be able to investigate and develop their skills and understanding of:

Soil fertility and management when they:

- ❑ Investigate the properties of a soil in physical (texture, structure, colour), chemical (pH, nutrient status) and biological terms (micro and macro organisms; nitrogen fixing bacteria and legumes), and origin (volcanic, coral).
- ❑ Investigate how composting/mulching (organic content; structure; texture; nutrient status), liming (pH; structure; nutrient status), organic fertilizers, e.g. animal manure, green manure (nutrient status), inorganic fertilizers (nutrient status; micro/macro organisms), irrigation and drainage (nutrient status; micro/macro organisms), tillage (structure), crop rotation (micro/macro organisms; nutrient status), herbicides (micro/macro organisms; nutrient status), overgrazing/burning/deforestation (nutrient status; micro/macro organisms) affect soil properties.
- ❑ Investigate the effect of decomposers and earthworms on soil texture and structure.
- ❑ Investigate different types of growth media in seed raising and potted plants.

Soil conservation when they:

- ❑ Evaluate the effects of different techniques of soil conservation, e.g. terrace, cover crops, mechanical barriers.

Nutrients are constantly lost from the soil by erosion, leaching, harvesting and evaporation. To maintain nutrient levels in soil, nutrients must be added through organic and inorganic fertilizer. Other techniques of maintaining soil fertility include reducing nutrient loss through smart farming practices and systems like mixed cropping, minimum tillage, mulching, fallowing, crop rotation and intercropping.

Managing the physical, chemical and biological properties of the soil plays an important role in improving soil fertility.

Key Points:

- ❑ The main soil properties are the physical, chemical and biological properties. Together they determine the fertility of a soil. Physical properties include the colour of the soil, structure or the shape of soil particles and texture or type and size of particles that make up soil. Chemical properties include the soil pH or acidity of the soil and the nutrient status or availability of nutrients in the soil. Biological properties include soil organisms. (SSAS pages 154–169; ITA pages 22–46)
- ❑ The management of soil fertility involves the manipulation of physical, chemical and biological properties. For example, farmers can change the pH of acid soils by adding lime. Farmers can then plant cabbage, which grows well in the new soil pH. (SSAS pages 154–169; ITA pages 73–76)
- ❑ Organisms play an important role in improving the soil texture and structure. For example, earthworms by burrowing in soil allow more air and water circulation. Decomposers like fungi and bacteria break down plant and animal tissue by using them as food, at the same time adding nutrients to soil that are important for plant growth and development. (SSAS page 153; ITA pages 47–52)
- ❑ Plants grow and develop well in mediums that provide them with nutrients and water. This is the key to good mediums. They should make available nutrients and water for plants to absorb. (SSAS pages 176–182, 183–189; ITA pages 73–74)
- ❑ Soil conservation is basically trying to reduce or stop soil erosion or loss. The two main agents that cause major soil loss are water and wind. Techniques that can be used to reduce soil erosion include mulching, using stone or plant barriers, using terraces, contour planting, keeping the soil covered by plants and avoiding planting on steep slopes. These techniques should be integrated in farming practices and systems used by farmers. (SSAS pages 190–195; ITA pages 77–80)

Questions

1. What is soil fertility management all about?
2. Why are soil properties important in relation to soil fertility management?
3. What are the roles of soil organisms in improving soil fertility?
4. What are the key components of successful plant growth mediums?
5. How can soil erosion be reduced?
6. Barren soils are soils that cannot support plant growth. How can we avoid our soils becoming barren?
7. How can barren or unfertile soils be made fertile?



Farm Management, Economics And Marketing

Students will be able to investigate and develop their skills and understanding of:

Record keeping when they:

- Investigate the role of record keeping in the management of an agricultural enterprise.
- Report the findings of their investigation using charts and graphs.
- Use records to forecast production using the moving averages method.

Management when they:

- Investigate the factors that influence management decisions – goals and aspirations of the manager, human resources, physical resources, financial resources and the role of financial institutions, e.g. development banks and banks, storage systems, sustainability (economic and environmental), market opportunities and land tenure.

Marketing of products when they:

- Investigate the market opportunities available for a product, e.g. papaya, ulu, banana and taro.
- Investigate post-harvest handling steps used to meet local and/or export market requirements for the product, including these requirements:
 - a. quality control to meet regulatory requirements, e.g. grazing system
 - b. quarantine requirements, e.g. interior quality (objected products)
 - c. pricing and market prices
 - d. economics of production.
- Investigate how processing can add value to a local primary product.
- Identify and describe the marketing roles of agricultural grower organisations, e.g. identify potential market
- Report findings of their investigation using graphs, tables and charts.

The farmer or farm manager supervises and manages a farm on his/her own or on behalf of another entity. He or she is essentially concerned with deciding what type of crop or animal to produce and how to produce it, acquisition of inputs or resources to be used in production (for example, fertilizers and seeds), determining

what quantity and quality to produce, how to sell or market produce, and bearing the risks of his or her actions.

Farm records serve as a powerful tool in farm organisation and management. They serve as a management tool to help in decision making, especially to identify the strong and weak points of the farm. The human mind, for all its powers, cannot remember or recall everything all the time. Keeping records of the farm helps the mind to analyse the information available to improve upon the current situation. By keeping records and recording important information, the farmer can analyse the information to identify possible problems and take corrective actions.

Marketing involves the whole process from market research, planning, production, harvesting, processing and selling until the consumer buys the product. It is important to satisfy the consumer. Farmers must produce what the consumer wants. Processors do this and thus promote and advertise produce to attract customers. By processing, we add value and cost to the raw product.

Key Points

- ❑ Records are essential for good management. Managers cannot remember all farm information and therefore depend on good records. Data gathered and analysed from records help managers review, evaluate and improve their performance. These data also enable managers to forecast events, plan and make sound decisions. Farm records include production records, labour records, financial records, assets and liability records and supplementary records. (SSAS pages 220, 226–228)
- ❑ Managers and farmers make decisions all the time, it is one of their main roles. They base their decision making on sound agronomic, financial and economic data that they have recorded and collated as well as having obtained from outside the farm or enterprise. The factors that influence their decision-making are also called the production factors. (SSAS pages 209–213)
- ❑ There are always market opportunities for produce. The key is for farmers to first find out what produce is required in the market before producing it. Producers should find out information like seasonal requirements (supply), volume needed (demand), price, quality and costs. This will ensure that their produce will be more competitive with that of other producers. (SSAS pages 213–220, 229–232)
- ❑ Careful post-harvest handling is important to maintain the quality of produce before marketing it locally or overseas. Post-harvest handling and treatment must also comply with the quarantine and certification standards of importing countries.
- ❑ Processing adds value to a product. When you clean, cook, add other ingredients, package and label a raw product you are adding value to it. For example, a kilogram of raw tomatoes may cost 50 sene, but after processing, a can of tomatoes may cost 2 tala. This cost is transferred to the customer who buys the can of tomatoes.
- ❑ Farmers can market their own products or do it as a group or organisation. For a single person it is difficult and expensive without the volume and a unified stronger voice to influence decision making relating to cost, price, transport and so on. As part of a group, you may be able to satisfy a market that requires large supplies every week, for example (SSAS pages 229–232).



Questions

1. Why do farmers and manager need records?
2. What are the functions of the farmer or manager?
3. What is marketing all about?
4. Why is post-harvest handling and treatment important for producers and exporters?
5. Why do some agricultural products need to be processed?
6. Who pays for the added cost of processing?
7. What are the advantages and disadvantages of group or organisational marketing?



From practical experience students will develop and use knowledge to:

Grow plants when they:

- ❑ Explain how **asexual reproduction** is used to maintain purity of line and increase plant numbers.
- ❑ Demonstrate asexual reproduction, e.g. marcotting/air layering, grafting, budding and tissue culture.

Manage plant growth when they:

- ❑ Investigate the **main groups of pests and disease** and the effects they have on crops, e.g. pests – insects and mites, slugs and snails and vertebrates (rats, bats, birds). Diseases – fungus, bacteria, viruses and nematodes.
- ❑ Investigate the **behaviour of an insect** at different stages of its life cycle with reference to its control, damage and spread, e.g. incomplete metamorphosis (egg, nymph and adult), complete metamorphosis (egg, larvae, pupa, adult), gradual metamorphosis.
- ❑ Explain the **economic reasons for controlling pests and diseases** in relation to product, e.g. quality, quantity/yield, movement/trade.
- ❑ Describe **pest and disease control measures** and the impact they have on target organisms and the wider production system, e.g. crop rotation, pesticides, cultural practices, physical control, biological control, integrated pest management.
- ❑ Investigate how **regulations** affect management of agricultural enterprises, e.g. quarantine, environment laws and regulatory control (tariffs, tariff barriers, quotas).
- ❑ Investigate the role of **bio-security** in protecting the agricultural and the natural environment, e.g. safety measures, regulations (phytosanitary certificates, import/export permits).
- ❑ Investigate how **seed germination** is affected by the environment (oxygen, water, temperature), dormancy and viability (storage and quality).
- ❑ Investigate how **growth and development** in plants is influenced by

nutrients, the environment, hormones, training and weeds.

- ❑ Explain how the growth, development and sexual reproduction of plants to produce a quality product is affected by cultivars, light, water, nutrients, pruning and training, pollination, plant hormones and growth regulators.

The keys to successful crop production are the reduction or elimination of the factors that affect crop growth and development, and the use of crop improvement methods to increase yield and improve quality. In reducing or eliminating factors that affect crop production, farmers must select the methods that are most cost-effective, practical and safe for the environment. Pests, diseases and weeds can be controlled using policy, regulations, barriers and on-farm control methods.

In producing crops, one must also keep in mind the market demand in terms of quantity and quality. Farmers should produce what their customers want.

Key Points

- ❑ Plant propagation involves the asexual and sexual reproduction of plants. Asexual reproduction, also called vegetative propagation, involves the production of plants using parent plant materials like buds, suckers, cuttings, bulbs and leaves. The plants produced will be identical to the parent, therefore purity of line is maintained. It takes a shorter period to produce plants asexually than through sexual reproduction and therefore plants can be produced in large numbers quickly using this method. Common asexual reproduction techniques used include budding, grafting, layering and tissue culture. (SSAS pages 17–22)
- ❑ Sexual reproduction involves the pollination, fusion and fertilisation of the male and female gametes so that seeds are produced that can be planted to produce new plants. (SSAS pages 11–16; ITA pages 100–106)
- ❑ Seeds will germinate if factors like moisture, temperature, oxygen and nutrients are favourable. If conditions are not right seeds will remain dormant. Some seeds will die if not kept in dry, cool conditions. They will also lose their viability if used after expiry date. (SSAS pages 13–15; ITA pages 116–117, 199)
- ❑ If all crop production factors like nutrients, temperature, water, weeds, and pests and diseases were controlled, farmers would produce good yields with high quality. In practice, this is not the case and farmers strive to control pests and diseases using a lot of money and other resources. (SSAS pages 43, 57; ITA page 119)
- ❑ Pest and diseases can be divided into groups. Knowing what groups they belong to makes it easy for farmers to select the best control methods to use. For example, pests can be divided into insects and mites, slugs and snails and vertebrates. (SSAS pages 43–51, 57–58; ITA pages 119–120)
- ❑ In controlling pests and diseases, one must know their life cycle and target control measures at the most vulnerable stage. This will ensure effective control. (SSAS pages 58–59)
- ❑ There are many control measures that can be used for pests and diseases.



Control methods must be selected that are effective and at the same time safe for the environment, economical and practical to use. Control can be implemented at various levels, for example at the policy level, regulatory level like border control and at the farm level. (SSAS pages 51–56, 59–60; ITA page 199)

- ❑ Growth and development in plants can be affected by many factors. These include factors like pests, diseases, weeds, water, nutrients, light, hormones and growth regulators, variety of cultivars, pollination and pruning. A farmer's or manager's job is to reduce or eliminate these factors so that they can produce high quality yields. (SSAS pages 23, 29–42; ITA pages 115–122)

Questions

1. Why is plant propagation important in crop production?
2. What are the advantages of asexual reproduction?
3. What are the processes involved in sexual reproduction?
4. Why is seed production important?
5. What are the main factors that affect crop production and how can they be controlled?
6. Why is knowing the life cycle of pests and diseases important?
7. What are the best methods of controlling pests, weeds and diseases?
8. What are the factors that affect growth and development in crop production and how can they be controlled?



Animal Production

Students should be able to investigate and develop their skills and understanding of:

Cattle, pig and chicken production when they:

- ❑ Evaluate the **management systems** used for raising livestock.

The use of livestock breeds when they:

- ❑ Evaluate the **characteristics of local and commercial breeds**.

The management of cattle, pigs and chickens when they:

- ❑ Carry out the **husbandry practices** of identification, drenching, castration, tail docking, de-beaking, trimming teeth and claws.
- ❑ Evaluate the effectiveness of one husbandry practice carried out on a farm.

The reproduction and growth of cattle, pigs and chickens when they:

- ❑ Explain the **factors that influence the growth and development** of animals, e.g. breeds, nutritive value of feed stock, environment, husbandry practices and hygiene.
- ❑ Explain how the manipulation of selected factors affects the growth, development and production of animals to achieve quality products, e.g. choice of breed, environment, animal behaviour, feeding regime, water and feed.
- ❑ Explain animal reproduction strategies in maintaining purity of line and increase of productivity, e.g. reproductive cycle, breeding system, breeding selection criteria and genetic gain.

The **health** of cattle, pigs and chickens when they:

- ❑ Identify and describe pests (such as parasites), diseases (such as mastitis, brucellosis, tuberculosis and coccidiosis) and disorders (such as lameness, injury, chronic respiratory disease (CRD), starvation, dehydration, scouring and prolepses) and calving/farrowing/laying difficulties.

- ❑ Evaluate the impact pest and disease control measures have on target organisms and production systems.
- ❑ Explain the life cycle of parasites in a host animal.
- ❑ Investigate the economic reasons for controlling animal pests, diseases and disorders.

The nutrition and feeding of cattle, pigs and chickens when they:

- ❑ Investigate local feed stock, e.g. types, quality, availability and quantity.
- ❑ Investigate the nutritive value of pastures, e.g. local and improved.
- ❑ Investigate the feeding regimes of animals (stages of development).
- ❑ Formulate a feed ration for cattle, pigs or chicken.

Animal production is basically about managing breeds, animal health and nutrition and carrying out common husbandry practices. If farmers have the right breeds that are healthy and fed on a balanced diet, animals will grow and develop fast and reach their weight and age as expected. They will reproduce well and produce healthy offspring. Common husbandry practices vary with the type of livestock and may include such things as identification, castration, de-beaking, sanitation, breeding, feeding, hoof and horn trimming, weighing, and administering drugs and nutrients.

Key Points

- ❑ There are different systems of management of livestock production. These systems depend on the availability of resources and the goal of the farming enterprise. The three most common systems are the large commercial intensive system, the semi-intensive system and backyard extensive systems. The three systems differ in level of management. (SSAS pages 83, 112–114)
- ❑ Breed is an important component in animal production. Having the right breeds with desirable characteristics will contribute to high production. Some desirable characteristics that are sought in breeds include adaptability to the local environment, high conversion ratio of local feed, resistance to pests and parasites and adaptability to local management. (SSAS pages 110–112, 81–83, 136. ITA pages 273, 283–284, 309–311)
- ❑ Husbandry practices such as identification, drenching, castration, tail docking, de-beaking, trimming teeth and hooves, weighing and cleaning of pens and poultry sheds need to be carried out regularly as they contribute to the overall productivity of livestock. (SSAS pages 74–75, 115–116, ITA pages 279–280, 315, 324)
- ❑ In raising livestock the main objective is to manage your animals' nutrition, health, breed and other resources so that you produce animals that reach their expected weight or production age early. These are the factors that can affect growth and production if not managed well. For example, if a farmer buys a beef cattle breed that cannot stand the local heat conditions, the animals will have heat related, reproduction and feeding problems that will affect their production and health. The cattle will not be able to produce at



the expected level and will need to be culled. (SSAS pages 83–85, 132–134; ITA pages 244–250)

- ❑ Farmers can obtain good animal breeds by either buying them or breeding them. Once they have good breeds, it is important that they maintain these breeds so that they do not lose their desirable characteristics. (SSAS pages 83–84, 115, 135–137; ITA pages 264–269, 274, 285, 322)
- ❑ Animal health is an important component in the productivity of livestock. If animals are sick and unhealthy, they will not reproduce well and productivity will decrease. Prevention is better than cure and in most cases cheaper as well. Farm hygiene is important. The animal pens and houses must be cleaned regularly and rotation grazing practised to prevent parasite and disease infestation. Animals must be vaccinated and regularly tested for known diseases like TB and brucellosis. Piglets must be given their iron injections. In controlling pests and diseases, knowledge of the life cycle is important so that they can be controlled at their most vulnerable life stage. The method of control used must be economical and environmentally friendly. (SSAS pages 116–116, 123–134; ITA pages 260–263, 278, 288, 316, 323)
- ❑ Feed is an important component in the production of livestock. An unbalanced diet will result in low productivity. Animals must get a balanced diet suitable for different stages in their development. This also applies to the amount of feed they should get. A farmer must know what to feed his or her livestock and what feeds are available locally and overseas. (SSAS pages 86–87; ITA page 254)
- ❑ Cattle farmers must know the nutritive value of local available pastures. This will provide them with relevant information that will enable them to select the best pastures to feed their cattle on. It will also give them an idea of how much supplementary feed is required if it is necessary to supplement the nutrients that are not available in the pasture. (SSAS pages 86–91; ITA pages 258, 314, 320–322)
- ❑ Animals require different amounts and types of feed at different stages in their growth and development. For example, a pregnant animal will require more feed than a mature animal because she has to maintain herself as well as feed her baby. A mature animal only needs feed for maintenance, and therefore requires less feed than a growing or pregnant animal. A growing animal will need feed for maintaining itself as well as for growth and development. (SSAS pages 83, 92–97, 121–122; ITA pages 251–254, 276–278, 287–288)
- ❑ Feed can be bought ready mixed. Feed is expensive and makes up about seventy percent of the total cost. Most feed ingredients are available locally and can be mixed according to the feed requirements of animals at different stages. (SSAS pages 97–100; ITA page 255)

Questions

1. What are the differences between the three systems of livestock management?
2. Why is breed important in animal production?
3. What are the common husbandry practices for poultry, pigs and cattle?
4. Why is nutrition important in animal production?



5. Why do animals require different feed at different growth stages?
6. How do you formulate a feed ration?
7. Why is it important to know the nutritive value of local pastures?
8. What are the advantages of using local feed ingredients?



Tools, Equipment And Facilities

Students will be able to investigate and develop their skills and understanding of:

The **safe use** of tools, equipment, chemicals and facilities when they:

- ❑ Demonstrate the correct use and storage of tools, equipment and chemicals.
- ❑ Demonstrate the safe and correct procedures of handling and maintenance of agricultural equipment, e.g. chain saw, rotovator, tractor, weed eater.
- ❑ Demonstrate the safe and correct procedures for mixing agricultural chemicals.
- ❑ Describe the best times and methods of applying agricultural chemicals.
- ❑ Explain why chemicals are withheld during certain times of the cropping season.
- ❑ Demonstrate first-aid safety procedures for contamination by agricultural chemicals.
- ❑ Develop a positive attitude towards safety procedures in disposing of chemical residue and containers.

Farmers depend on tools, equipment, facilities and chemicals for improved production. It makes their work easier, faster and more comfortable. Tools, equipment and facilities are expensive to replace and must be used in the right way, serviced regularly and stored properly after use.

Chemicals must be used wisely and only when needed. Protective clothing should be worn when mixing and spraying chemicals. When not being used, chemicals must be stored safely in a well-ventilated room away from children.

Key Points

- ❑ Tools, equipment and facilities help farmers to make their work easier and faster. This can improve production and profit. In order to make efficient use of tools, equipment and facilities, they must be used in the right and safe way. They must also be serviced regularly and stored properly after use. (SSAS pages 196–203; ITA pages 123–132)

- ❑ Agricultural chemicals are used regularly by farmers to assist them in controlling pest and diseases. Chemicals can be harmful to plants, animals, people and the environment if not used safely and correctly. It is always essential to read the instructions on the label before using chemicals, or disposing of chemical containers or chemicals. (SSAS pages 60, 132–134; ITA page 29)
- ❑ The best times to spray using chemicals are on dry, cool, non-windy days. When spraying, you must position yourself between the wind direction and spray mist. This will help you avoid breathing in the chemical. When using chemicals protect yourself by wearing protective clothing. Chemicals must always be locked away in a well-ventilated room away from children. (ITA page 329)
- ❑ Crops must not be eaten or sold 7–14 days after spraying. This will give enough time for the chemical to degrade or lose its toxic effects. If you feel you are being affected by chemicals you should seek medical help as soon as possible. (ITA pages 327–333)
- ❑ Chemicals must be used only when needed in a safe, careful and sparing way to reduce their toxic effects on the environment. (SSAS pages 59–60; ITA page 327)

Questions

1. Why should tools, equipment and facilities be used and stored correctly?
2. What are some impacts of the use of tools and equipment in farming?
3. What are the advantages and disadvantages of using agricultural chemicals?
4. Can the use of chemicals be avoided? Give reasons for your answer and include what can replace chemicals.
5. How should chemical containers and waste be disposed of?
6. What should be done if someone accidentally comes into contact with chemicals?



