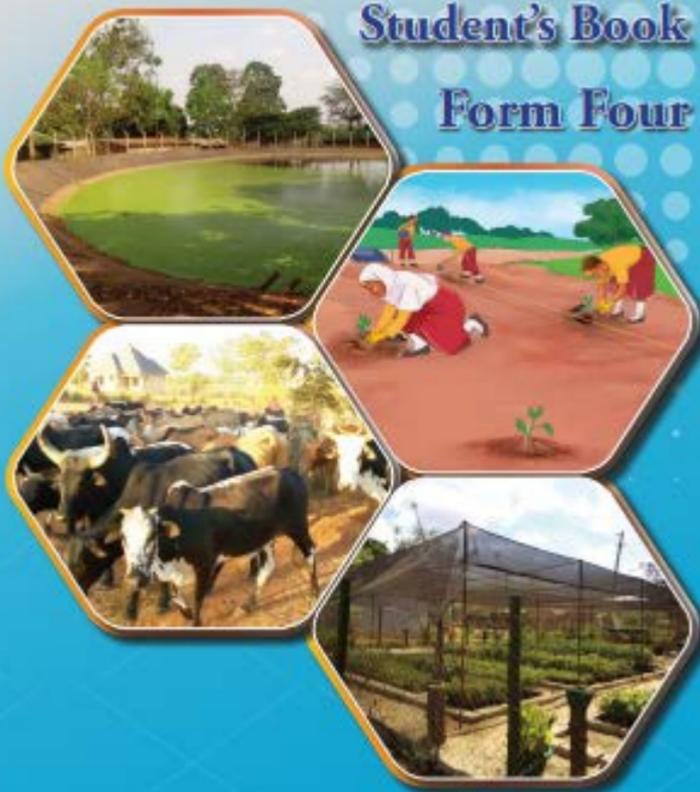


Agriculture

for Secondary Schools

Student's Book

Form Four



Tanzania Institute of Education

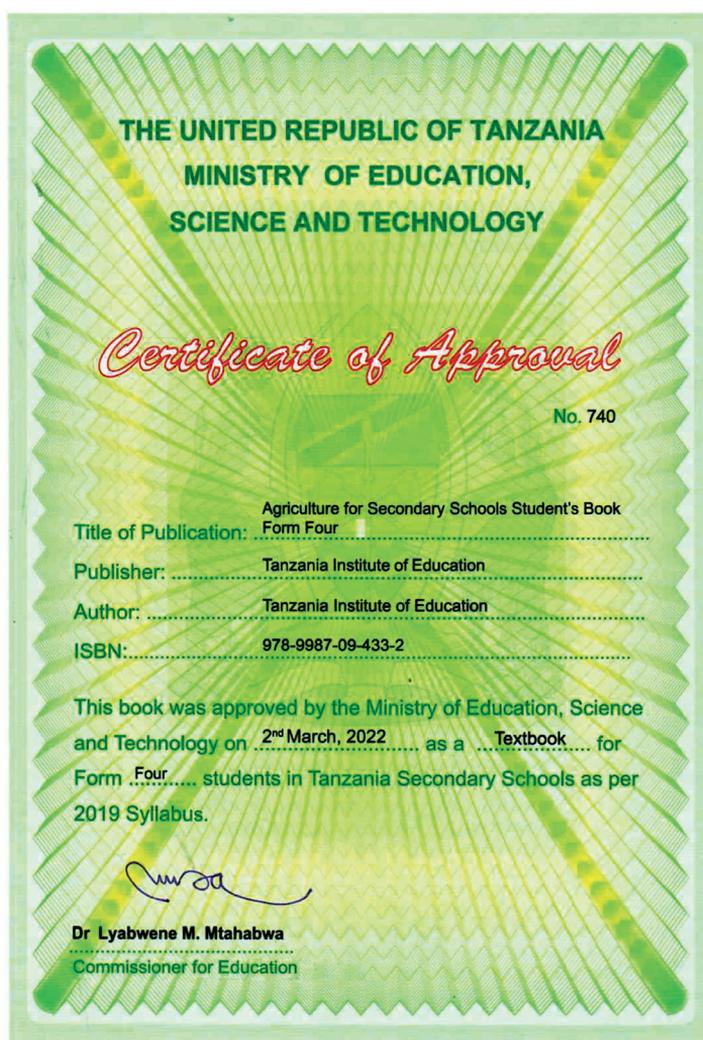


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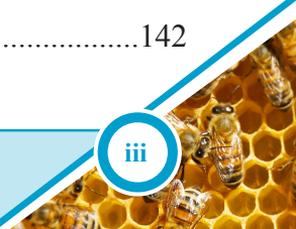
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Dr Aneth A. Komba
Director General
Tanzania Institute of Education

Preface

This textbook, *Agriculture for Secondary Schools* is written specifically for Form Four students in the United Republic of Tanzania. It is written in accordance with the 2019 Agriculture Syllabus for Ordinary Secondary Education Form I-IV issued by the Ministry of Education, Science and Technology.

The book consists of six chapters namely, Agricultural development in Tanzania, Farming and land tenure systems, Agricultural marketing, Agroforestry, Farm structures, and Contemporary issues in agriculture. Each chapter contains texts, illustrations, activities and exercises. You are encouraged to do all the activities and exercises as well as other assignments provided by your teacher. Doing so, will enable you to develop the intended competencies.

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Chapter One

Agricultural development in Tanzania

Introduction

In Tanzania, the agricultural sector comprises crops, livestock, and fisheries sub-sectors. These sub-sectors play a significant role in the growth of the national economy and the development of the country. The performance of agricultural sector is seen in the key economic indicators such as its contribution to the Gross Domestic Product (GDP) and employment. In this chapter, you will learn the basic facts of agriculture and the characteristic features of agricultural and non-agricultural sectors in Tanzania. The competencies developed will enable you to appreciate and obtain insights into different opportunities available in agriculture.

Basic facts of agriculture in Tanzania

Agriculture is an important sector in the provision of adequate and nutritious food, employment, and raw materials for industries. For the past ten years, the contribution of agricultural sector to the national Gross Domestic Product (GDP) ranged between 23 and 29 percent. In the year 2020, the sector employed 65 percent of the population, contributed 65 percent of the raw materials to the industrial sector, and 30 percent of export earnings. The average contribution of various agricultural sector components to agricultural GDP was as follows: crops 18 percent, livestock five percent, forestry and hunting three percent, and fisheries 1.4 percent. Besides, Tanzania is endowed with an area of 94.5 million hectares of land, of which, 44 million hectares are classified as arable land for various agricultural uses as shown in Table 1.1.

Table 1.1: Basic facts of the agricultural sector in Tanzania

Available land resource	(Million ha)
Total land	94.5
Arable land	44.0
Cultivated land	9.5
Area suitable for irrigation	29.4
The planted area under irrigation	0.27
Area of high development potential	2.3
Area of medium development potential	4.8

Available land resource	(Million ha)
Land under medium and large-scale farming	1.5
Range land	50.0
Land under livestock	26.0
Tsetse infested area	24.0
Total land allocated to smallholders	11.9

Source: URT (2021)

The objectives of the agricultural sector in Tanzania

Development of the agricultural sector is guided by the Tanzania Development Vision (TDV - 2025) which envisions the agricultural sector to be modernized and commercialised, market-oriented, highly productive and profitable, and resilient. In this regard, various strategies and programs have been formulated and implemented. The objectives of the sector are as stipulated in the National Agriculture Policy of 2013, the National Fisheries Policy 2015, and the National Livestock Policy of 2006. The overall objective of the sector is to develop an efficient, competitive, and profitable agricultural industry that contributes to the improvement of the livelihoods of Tanzanians engaged in the sector and the attainment of broad-based economic growth. The specific objectives of the agricultural sector are summarised hereunder:

(a) Strengthening agricultural support and technical services

Key focus areas include reforming the agricultural research system and improving extension services. Strategies for realising this objective include encouraging collaboration of actors through Public-Private Partnership (PPP) in identifying and setting research priorities, funding and managing agricultural research, and integrating indigenous knowledge into scientific research. These strategies go alongside with ensuring that the developed technologies reach the intended farmers; agricultural extension workers are equipped with knowledge and skills to facilitate farmers produce efficiently, and promote the development of agricultural infrastructures.

(b) Enhancing national food and nutrition security and production of surplus for export

Though the country is generally self-sufficient, there are some challenges concerning food and nutrition security. These include occasional food shortages in some parts due to unfavourable weather conditions, inappropriate food management, low production, to meet domestic and export requirements, and inappropriate distribution systems. Therefore, the objective is to ensure that the country is entirely food and nutrition secure and has a surplus.

In this regard, the focus areas of the objective include promoting production and education on utilisation of agricultural products with high nutritional content in areas experiencing nutritional problems; strengthening and expanding food storage structures to enhance food stability; and strengthening mechanisms for continuous monitoring and assessment of food security, safety and nutrition from the national to the household level.

(c) Improving agricultural processing for value addition and job creation

The yields from most crops are marketed in a raw form with little or no value addition. Agro-processing provides an opportunity for increasing incomes and creating jobs along the value chain through such activities as handling, packaging, processing, transportation, and marketing of agricultural produce. However, agro-processing in this country is constrained by a limited supply of rural energy, inadequate raw materials, inappropriate machinery and technology, and limited skills. The objective focuses on the value addition of agricultural produce. In this regard, the focus areas include promoting rural agro-processing industry in collaboration with the ministry responsible for industries and trade, enhancing the supply of alternative sources of rural energy, developing mechanisms for handling and transporting perishables, promoting sufficient quantities of agricultural produce to meet processing requirements by facilitating importation and production of machinery for agro-processing that meets the required standards.

(d) Enhancing production of safe and quality products to improve their competitiveness and safeguard consumers

The objective focuses on expanding agricultural/livestock commodities or products base and improving quantity and quality to meet both internal and external markets. In this regard, the focus areas include promoting and regulating commodity standards to meet national and international market requirements; and promoting commodity supply chains. Other areas of focus are regulating contract farming while ensuring the rights of farmers particularly, women and youth, are duly respected; enhancing the transformation of small-scale production to modern and commercial farming as well as facilitating private sector investment in medium and large-scale production, processing, and marketing.

(e) Enhancing capacities of agricultural marketing actors to meet quality and standards of domestic, regional and international markets

The objective focuses on building capacities of market actors to improve the marketability of agricultural produce locally and internationally hence increasing income and foreign exchange earnings from the export. Focus areas include collaborating with other stakeholders in the establishment of price stabilisation funds; strengthening

and up-scaling marketing systems for example Warehouse Receipt System for crops; collaborating with farmers' organisations and experts to enforce regulations governing utilisation of designated buying posts and centres for agro-products, investing in agricultural marketing infrastructures, and training on agricultural marketing risk management and market information systems.

(f) Providing enabling environment to attract private sector investment

The objective focuses on expanding effective participation of strategic actors to engage and support strategic agricultural enterprises to take advantage of available opportunities and competitive advantages. Key focus areas include promoting commodity supply chains and regulating contract farming on a win-win principle, transforming small scale production to modern and commercial farming; promoting market penetration and expansion, developing mechanisms to reduce transaction costs in production, facilitating private sector investment in medium and large scale production processing and marketing, and ensuring quality products by promoting commodity standards that meet market requirements.

(g) Strengthen inter-sectoral coordination and linkages to increase efficiency and effectiveness

The operation and performance of the agricultural sector depend on services such as regulations and infrastructures from other sectors. These include investment and running capital from financial institutions, and setting standards from Tanzania Bureau of Standards (TBS). This means that coordination and linkages between agriculture and other sectors is important. The objective strives to ensure there is efficient inter-coordination and linkage system for timely operations in the agricultural sector. Therefore, the focus areas include strengthening financial institutions and financial intermediaries (rural/community banks and Savings and Credit Cooperative Societies (SACCOS) so that they are responsive to the financial needs of agricultural development; facilitating the accessibility of finance to farmers and other actors in the agricultural sector focusing on varied actors needs while maintaining social equity; strengthening mechanisms for collection, analysis and dissemination of agricultural information and data; and promoting agricultural insurance for mitigating farmer's risks lastly, enhancing effective policy formulation and management systems.

(h) Protecting and promoting integrated and sustainable utilisation and management of natural resources related to agricultural production

The sectoral objectives aim at ensuring that there is equitable distribution and access to production resources and sustainable utilisation of the same for present and future generations. Thus, the focus areas include facilitating access to production resources and registration services for issuance of title deeds for commercial production;

promoting public awareness on the existing policies, laws, and legislation of production resources such as land; enhancing mechanisms for conflict resolution particularly in areas facing land conflicts; promoting gender-equitable land tenure governance; ensuring production resources are protected against encroachment as well as promoting sustainable agricultural land use plans, and ensuring training of producers on proper use of natural resources for sustainable production.

(i) Promoting the implementation of cross-cutting issues in agricultural undertakings

Cross-cutting issues refer to issues that affect nearly all social and economic sectors including agriculture. These issues include environment, gender, diseases (HIV/AIDS, Malaria, Water-Borne and emerging diseases e.g., Covid-19) and Information and Communication Technology (ICT). These are further described hereunder:

Environment

Agriculture development is strongly dependent on environmental resources such as land, forest, air, and water. Sustainable utilisation of these resources in agriculture is vital to safeguard the environment. It should be noted that if agriculture is not practised following sustainable principles, it can greatly affect the environment and this will ultimately negatively affect the agricultural sector. Many critical environmental issues the world is experiencing today, such as climate change, pollution, deforestation, and soil degradation have a bearing on agriculture. For instance, in Tanzania and elsewhere, deforestation is a critical side effect of agriculture that greatly affects the environment.

On the other hand, while irrigation is critical in improving agricultural production, it can also create various problems to the environment if not carried out properly, for example, it can lead to the depletion of underground water that is crucial for the environment. Other negative environmental effects of farming include the contamination of water, the loss of topsoil, and the destruction of natural habitats, specifically wetlands. Therefore, the environment matters to agriculture and is important for agricultural development. The sector aims at mainstreaming the environment in food and agriculture systems by promoting public awareness of best practices on environmental conservation, the growing of environmentally friendly crops, and livestock husbandry; others include improving adaptation measures to climate change effects; strengthening the efficient use of renewable natural resources; strengthening the coordination of environmental early warnings and monitoring systems; and the enforcement of environmental laws and regulations that minimise environmental degradation resulting from agricultural activities.

Gender

Both men and women as well as youth contribute greatly to the development of agriculture. However, women play a critical role in food production as they contribute over 60 percent of the agricultural labour force in Tanzania. Women spend more time in agricultural activities such as planting, fertiliser application, weeding, harvesting, storage and processing. Another consideration for women in agriculture is that there is an increase in female-headed households in the country due to various reasons. It is unfortunate that despite the active engagement of women in agriculture they are constrained by several challenges due to cultural and traditional practices including limited access to production resources such as land, credits, and extension services.

Women are also actively involved in strenuous, manual, and highly time-consuming household activities. However, most of them face the challenge of inadequate skills and knowledge, inequitable access to productive resources, and appropriate technologies. Thus, to enhance agricultural development in the country closing the gender gap is critical. Therefore, the sector aims at engendering agriculture and food systems by ensuring equal access to agricultural resources including land to both men and women; enhancing equal participation of men and women in decision making processes to improve access to productive resources and sensitise communities on negative cultural attitudes; and promoting collaboration practices among women and men in agricultural production.

Diseases

Agricultural activities are in most cases labour intensive and therefore need a healthy labour force. The high prevalence of diseases such as HIV/AIDS, malaria, water-borne diseases, and currently Covid-19 pandemic, has a devastating negative impact on agriculture development. For example, HIV/AIDS affects the active labour force and the economically able category of people in society. Also, caring for the sick members in the household consumes the valuable time needed by healthy members of the household to participate in agricultural activities. Also, increased costs for medical treatment and care lead to a decline in household asset base and loss of labour; and thus low production, food insecurity, and poverty. Generally, the efforts in agricultural development need to ensure that the labour force is living a healthy life.

In this aspect, the sector aims: to ensure that diseases such as HIV/AIDS are integrated into the curricula of all training institutes. The government and non-government actors need to raise awareness among agricultural communities on the impacts, prevention and control of HIV/AIDS, Malaria, waterborne diseases, occupational diseases, and other emerging diseases such as Covid-19.

Information and Communication Technology (ICT) in Agriculture

Knowledge and information play a critical role in accelerating agricultural development by improving production, marketing, and distribution of produce/products. ICTs can facilitate the integration and efficiency of agricultural systems by providing new communication pathways and cutting down transaction costs; this is possible given greater accessibility of information on prices, transportation, and production technologies. Therefore, access to information and knowledge is very critical in agricultural development.

As a result of advancement in ICTs, new fields have evolved including e-agriculture. The field focuses on the use of ICTs for improving efficiency in agricultural development processes and services. It involves the conceptualisation, design, development, evaluation, and application of innovative ways of using ICTs in the agricultural value chains. ICTs are very useful in agricultural extension and advisory services and in facilitating reaching out to family farmers. The available statistics show that, over the last two decades, the use of ICT-based services has been increasing in the agricultural sector. This is potentially an opportunity of boosting the agricultural sector through improved exchange of information and knowledge, resources, and digital solutions to supplement conventional extension methods. It is also important to note that the youths aged (15-35) account for 34 percent of the population in Tanzania. The youth tend to be creative and innovative may therefore be attracted to agriculture and thus contribute to agricultural development.

Unfortunately, despite their potential, the application of ICTs in Tanzania has been constrained by several challenges including high cost of investing in telecommunication infrastructure, lack of resources among farmers, low knowledge of computers and low literacy level of the farmers, poor connectivity especially in the rural areas, absence of organised sources of information, and inappropriate content.

In this aspect, the sector aims at promoting the utilisation and applications of ICTs for increased efficiency in information sharing in the agricultural value chains, ensuring optimal use of existing and expansion of ICT capacity including its infrastructure especially in the rural areas, and fostering strong public and private partnership to improved ICT access and innovation for agriculture.

Strategies and programmes guiding realisation of sectoral objectives in Tanzania

The realisation of agricultural sector objectives is primarily made possible by ministries collectively referred to as Agricultural Sector Lead Ministries (ASLMs). The ASLMs consists of the Ministries of Agriculture; Livestock and Fisheries; Industries, Trade, and Marketing; and the President's Office responsible for Regional Administration and Local Government (PO-RALG). ASLMs are responsible for overseeing the implementation of the agricultural sector objectives at various levels of the government.

Operations towards the realisation of agricultural sector objectives are made possible through key strategies and programs namely, the Agricultural sector Development Strategy (ASDS I&II) and Livestock Sector Development Strategy (LSDS-2010). These two set broader issues that need to be considered in the efforts of developing the sector. To enhance the implementation of the strategies, the government further developed sector development plans. These include the Agricultural Sector Development Programme (ASDP I 2006/7-13/14 and ASDP II 2015/16-25/26) and the Tanzania Livestock Master Plan (2017/18-21/22).

Agricultural Sector Development Programme Phase I (ASDP-I)

In 2006, Tanzania launched ASDP-I Programme which was implemented between 2006/7 to 2013/14. This programme aimed at achieving and meeting the Tanzania Development Vision (TDV-2025) including the targets of reducing rural poverty from 27 to 14 percent by 2010 and rising agricultural growth to 10 percent per year by 2010.

Activity 1.1

In a group, use various sources including government websites such as www.kilimo.go.tz, www.nbs.go.tz and other agricultural official reports to summarize the achievements and limitations faced in the implementation of the ASDP (I).

The Agricultural Sector Development Programme Phase II (ASDP II)

This is a ten-year programme implemented in two phases of five years each. Phase One was to be implemented from 2017/18 to 2022/23 and Phase Two is expected to be implemented from 2022/23 to 2027/28. ASDP II builds on the lessons and experiences obtained from the implementation of ASDP I. Its overall aim is to transform the agricultural sector towards higher productivity and commercialisation levels. It also intends to increase incomes of smallholder farmers for improved livelihood, food and nutrition security, and contribution to the Gross Domestic Product. It has four main interlinked components which are:

- (i) Sustainable water and land use management: The objective is to enhance the expanded sustainable water and land use management for crops, livestock, and fisheries. Priority areas include land use planning, irrigation, water source development, and promotion of climate-smart agriculture technologies.
- (ii) Enhanced agricultural productivity and profitability: The objective is to increase the productivity and growth rate for commercial market-oriented agriculture for priority commodities. Priority areas include research, extension, training and promotion, access to inputs and mechanisation.
- (iii) Commercialisation and value addition: The objective is to improve and expand rural marketing and value addition promotion by a thriving competitive private

sector and effective farmer organisations. Priority investment areas include market access for all priority commodities in fisheries and livestock products and development of processing and value addition infrastructure.

- (iv) Sector enablers, coordination, monitoring, and evaluation: The objective is to strengthen institutions, enablers, and coordination framework. Priority areas include regulation, management, and technical capacity building, ICTs, promoting and strengthening gender inclusiveness, coordination, and providing microfinance services.

At the district and community levels, the implementation of the programme is realised through District Agriculture Development Plans (DADPs). The plans are based on a value chain of particular priority commodities as envisaged in districts' development plans based on available opportunities, profitability, and participation of other stakeholders. The financing of such program is by the government and other development partners.

Tanzania Livestock Master Plan (2017/18 – 2021/22)

This is a five-year plan that sets out livestock-sector investment interventions in six priority livestock sub-sectors: meat from cattle, sheep, and goats; poultry, pigs/pork, milk from dairy cattle and leather. Key interventions focus on improving animal breeds, feed and health services, and complementary policy support, which could help to meet the ASDP II targets by improving productivity in the key livestock value chains of poultry, pork, red meat, and dairy.

Activity 1.2

In a group, search from various sources including government websites such as www.kilimo.go.tz, www.nbs.go.tz and other recent agricultural official reports, then,

1. Outline the most current:
 - (a) Objectives of the agricultural sector in Tanzania; and
 - (b) Strategies and programmes guiding the realisation of the sectoral objectives in Tanzania.
2. Present your work in class for discussion.

Some institutions and agencies involved in the realisation of the sectoral objectives

In addition to strategies, programmes, and plans, different institutions and agencies under various ministries (Table 1.2) are involved in helping to achieve the sectoral objectives. These institutions and agencies include the Tanzania Agricultural Research Institute (TARI), Tanzania Livestock Research Institute (TALIRI), Tanzania Fisheries Research Institute (TAFIRI), Livestock Training Agency (LITA), the Ministry of Agriculture Training Institutes (MATIs), Tropical Pesticides Research Institute

(TRPI), Agricultural Seed Agency (ASA), National Food Reserve Agency (NFRA), Tanzania Official Seed Certification Institute (TOSCI), Tanzania Fertiliser Regulatory Authority (TFRA), National Land Use Planning Commission (NLUPC) and crop/product boards (For example Cotton, Tea, Sugar, Cereals and Other produce, Dairy and Meat boards). Other institutions are Universities such as Sokoine University of Agriculture (SUA) and Moshi Co-operative University (MoCU); and financial institutions such as Tanzania Agricultural Development Bank (TADB) and other development partners.

Table 1.2: Some of the institutions and agencies dealing with agriculture in Tanzania

Institution/ Agency	Main role
TARI	Mandated to conduct, regulate, promote and coordinate all agricultural research activities conducted by public and private research institutes or organisations in Tanzania.
TALIRI	Mandated to coordinate and conduct livestock research that will provide technologies to improve and sustain the development of the livestock sector in the country.
TAFIRI	Mandates to promote; conduct and co-ordinate fisheries research in Tanzania
LITA	To provide knowledge and skills on livestock development to client through training, production, and applied research and consultancy services for sustainable development of the livestock sector.
MATIs	To provide knowledge and skills on agriculture development to client through training, production, and applied research and consultancy services for sustainable development of the agricultural sector.
TPRI	To conduct research, training, and provide services on management of pests, pesticides and biodiversity for food security, promotion of human health and facilitation of internal and external trade for sustainable development.
ASA	To ensure high-quality agricultural seeds are available to farmers at affordable prices.
NFRA	Mandated to procure, reserve, and release food stocks and respond to food shortages in the country. Thus, maintaining a national optimal level of food reserve and price stabilisation.

TOSCI	Responsible for certification and promotion of quality agricultural seeds produced or imported into the country for sale to safeguard the farming community from poor (fake) seeds from vendors of farm inputs.
TFRA	Mandated to enforce laws/policies/regulations governing the manufacturing, importation, and use of and trade in fertilisers, or fertiliser supplements, for example growth stimulators and regulators and similar products.
NLUPC	To ensure preparation and implementation of land use plans to create equitable and secure land tenure, enhance land productivity, and ensure conservation of both the environment and biodiversity.
Crop/product Boards	Entrusted with the mandatory responsibility of regulating the specific industry in Tanzania.

The availability and suitability of land for agricultural productivity in Tanzania

Land is the most important resource in agricultural production. Tanzania has an area of about 947 300 km², among these 61 500 km² are covered with water. The remaining 885 800 km² are landmasses. The total land suitable for agriculture (farming and livestock) is estimated to be 620 227 km² that is about 70 percent of the total land area. About 248 091 km² (28 percent) are conserved and protected areas (forest, national parks, and game reserves) whereas, about 17 208 km² equal to two percent is urban land. Furthermore, it is estimated that of the total land suitable for agriculture, 440 000 km² is arable land, and 100 000 km² (23 percent) is currently utilised for crop production. As indicated earlier, the country has the potential of 290 000 km² for irrigation farming, out of which only one percent is utilised. Rangeland accounts for 500 000 km² out of which approximately 240 000 km² (48 percent) is utilised for grazing.

Concerning land resources, two key dimensions are important to note. These are the availability and suitability of land for agriculture. Although there is a general perception that Tanzania has abundant land, availability and accessibility of land throughout the country is not uniform. It is important to note that the suitability of land for agricultural production is influenced by various factors notably the nature and quality of land, climatic and topographical conditions, and nature of the agricultural enterprise. The nature and quality of land vary across Agro-Ecological Zones (AEZs) as shown in Figure 1.1. By definition, an AEZ is a land resource mapping unit defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potentials and constraints for land use. Agricultural zones are suitable for different agricultural activities. The potentiality and suitability of land to crop production in the country, can be described by considering the following major AEZs in the country.

Crops and production conditions in the major agro-ecological zones

(a) Northern highland zone

This zone covers Arusha, Kilimanjaro, Manyara and some parts of Tanga region. The soil in this zone has variable textures. Volcanic ash soils are found on high-volcanic plateaus while volcanic sediments are found in the slopes. Generally, soils in this zone are fertile. The major crops grown in this zone include coffee, sisal, banana, beans, wheat, barley, sugarcane, maize, vegetables, tea and flowers.

(b) Lake zone

This zone covers Mwanza, Kagera, Geita, Simiyu, Mara and Shinyanga regions. It is characterised by sandy and loamy soils while some areas have clay heterogeneous soils characteristically hardpan with moderate to high fertility. The major crops grown include paddy, maize, beans, sorghum, millet, sweet potatoes, vegetable, coffee, banana, sugarcane, cotton, and tea.

(c) Western zone

This zone covers Tabora and Kigoma regions. Soils in this zone are mainly sandy and loamy in the upland and are seasonally or permanently waterlogged clayey in the lowerland. The major crops grown include maize, beans, cassava, paddy, coffee, tobacco, and oil palm.

(d) Southern highland zone

This zone covers Rukwa, Katavi, Mbeya, Songwe, Iringa, Njombe, and some parts of Ruvuma region. The soils in this zone vary from friable clays (of low to moderate fertility) to low altitude lacustrine alluvial. The zone has fertile soils of medium to heavy textures and volcanic ash at volcanic highlands plateaux. Crops grown in this zone are maize, paddy, wheat, round/Irish potatoes, banana, beans, vegetables, flowers, coffee, sunflower, and tea.

(e) Southern zone

This zone covers Mtwara, Lindi, and some parts of Ruvuma region (particularly Tunduru District). The soils in this zone have variable texture from predominantly sandy soils along the coast, friable clays to heavy clays in valleys and lowlands. The fertility status of soils is low to medium. The major crops grown are paddy, cassava, cashew nuts, groundnuts, bambara nuts, pigeon peas, cowpeas, coconut, sorghum, and finger millet.

(f) Eastern zone

The zone covers Pwani, Dar es Salaam, Morogoro and some parts of Tanga region. It is mainly characterised by sandy and heavy textured clayey soils. Clayey soils dominate in tropical highlands. Fertility status is low to moderate. Coastal lowlands

and riverine flood plains are rich in alluvial soils. The major crops grown are sisal, sugarcane, tea, cotton, citrus, mangoes, vegetables, spices, banana, maize, cassava, paddy, and coconut.

(g) Central zone

The zone covers Dodoma and Singida regions. Soils in this zone are mainly sandy and loamy; and are of low fertility and seasonally waterlogged or flooded clays. The major crops grown are grape, beans, maize, paddy, sunflower, cotton, and groundnuts.

Figure 1.1 summarises the major Agro-ecological zones and some characteristic features of land in Tanzania.

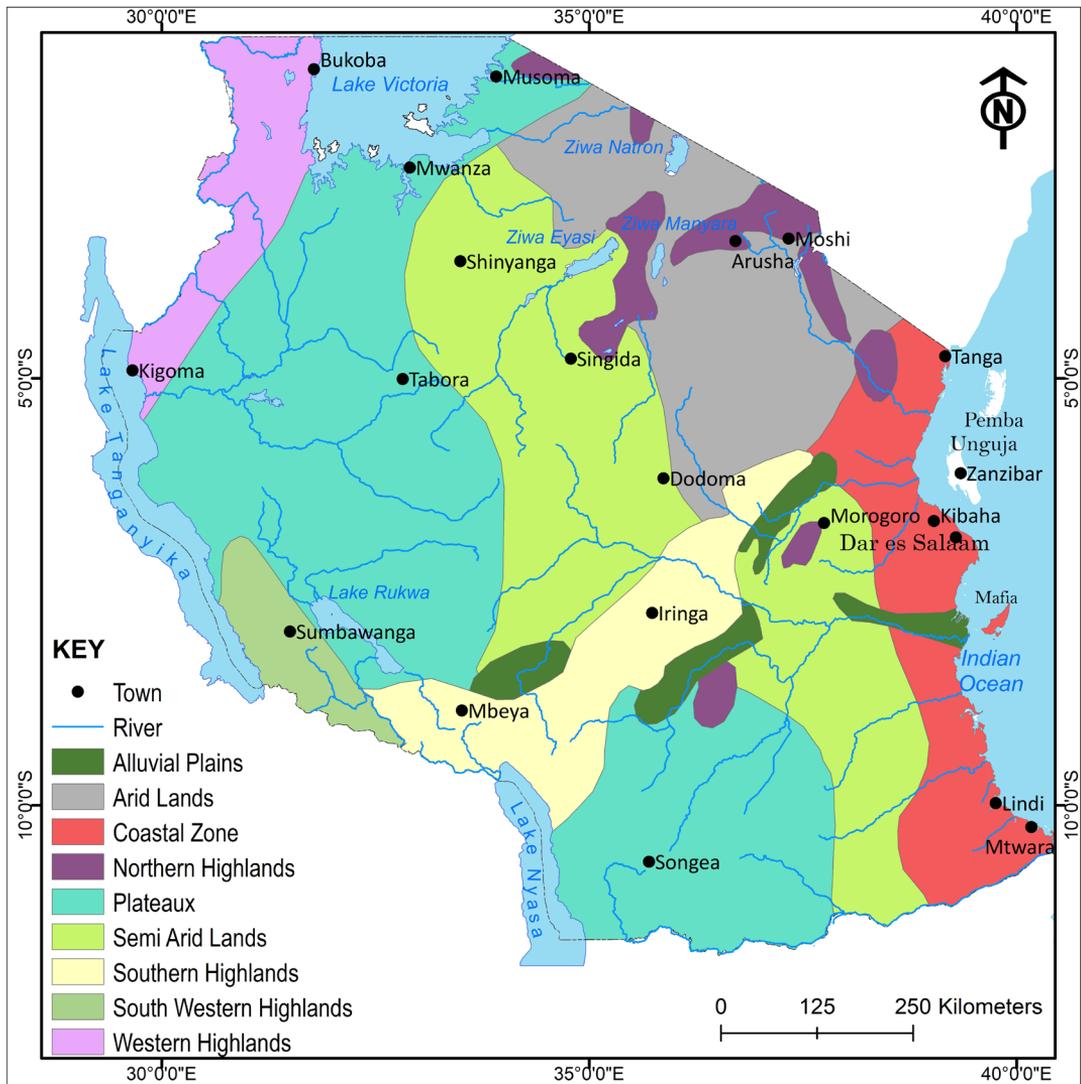


Figure 1.1: Agro-ecological zones in Tanzania

Source: URT (2021)

Livestock production

There are five livestock zones namely Coastal, Central, Northern highlands, Southern highlands, and Lake zone (see Figure 1.2). The coastal zone experiences humid and sub-humid conditions, the central zone experience arid and semi-arid conditions whereas highland zones experience highland climatic conditions. Based on the production zones, different livestock production systems are practised. In Tanzania, livestock (ruminant) production systems are categorised as grassland-based, mixed rain-fed and landless systems (zero-grazing). The grassland-based system is further divided into pastoral and agro-pastoral while the mixed rain-fed system is divided into semi-arid, sub-humid, humid, and highlands. It is also important to note that there is a commercial specialised livestock production system practised across the zones. In the following section livestock production zones are further described under three main groups: central, coastal and lake, and highland zone.

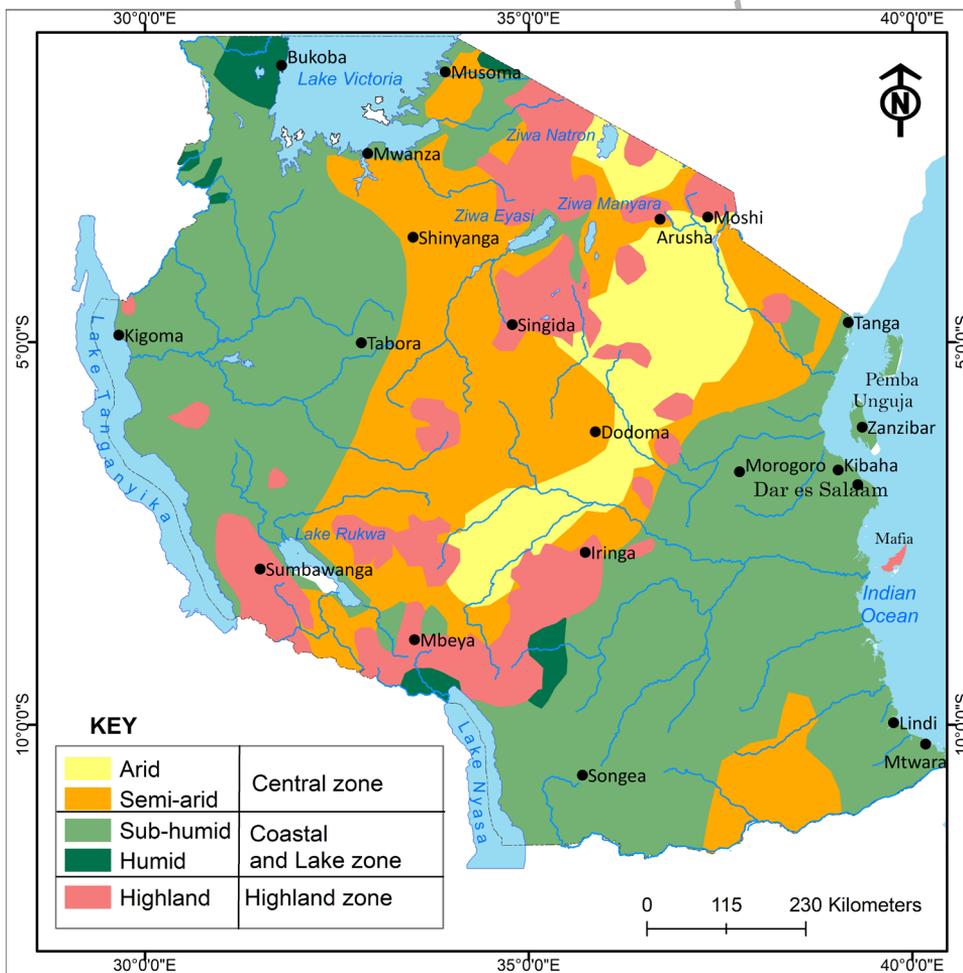


Figure 1.2: Livestock production zones

Source: URT (2017)

(a) Central zone

The Central livestock production zone represents agro-pastoral and semi-arid production systems which mainly covers the central regions of Tanzania. The major livestock kept in this zone are cattle, goats, and sheep.

(b) Coastal and lake zones

Coastal and Lake livestock production zones represent mixed rain fed-sub-humid and humid production systems. It mainly covers the lake and coastal regions of Tanzania. The livestock include cattle, goats, and sheep.

(c) Highland zone

The Highland zone represents a mixed rain-fed highland production system. It mainly covers regions in the Southern and Northern Highlands of Tanzania. The livestock kept include cattle, goats, and sheep. Commercial dairy production is mainly concentrated in this zone. Table 1.3 summarises livestock production zones based on characteristic features of the traditional ruminant production system.

Table 1.3: Ruminant production zones in Tanzania

Feature	Central zone	Coastal and Lake zone	Highland zone
Annual rainfall (mm)	500–1 000 Unimodal	750–2 000 Bi-modal	1 000–2 000UM/BM
Altitude (M)	800–1 500	500–1 800	>1 500
Humidity	Low	High	Low
Species	Cattle, goats, sheep	Cattle, goats, sheep	Cattle, sheep, goats
Breeds	Indigenous	Indigenous, exotic	Indigenous, exotic
Major crops	Sorghum, millet, cashew nut, cotton	Paddy, sorghum, sisal, cotton	Maize, coffee, tea, wheat
Cultivation intensity	Low to moderate	Moderate to high	Very high
Tsetse challenge	Absent	Present	Absent
Livestock movement	Semi-sedentary	Sedentary	Sedentary

Source: URT (2017)

Note: Urban and peri-urban dairy, feedlot, piggy and poultry production are not entirely depending on livestock zones.

Status of production in relation to population engaged in agricultural production

Since independence in the year 1961, agriculture has been the backbone of Tanzania economy. It has served as a major source of livelihood to over 80 percent of the people in the country. However, in the year 2021, the level of dependence on agriculture has decreased to about 65 percent due to various factors including the development of other sectors especially the non-agricultural ones.

For instance, in twelve years (2008-2020), the number of households engaged in crop production was 64.3 percent while those involved in both crop and livestock production were 33.3 percent. The households engaged in livestock keeping were only two percent while those engaged in fish farming and pastoralism were 0.3 percent. Agricultural censuses conducted in 2002/03 and 2007/08 showed that households involved in crop production only, livestock only and crop and livestock activities have been increasing, while the trend of those involved in pastoralism has been decreasing.

The main livestock species kept in Tanzania by 2019/20 include cattle (48.3 percent), goats (35.0 percent), sheep (12.1 percent), and pigs about five percent. About 99 percent of livestock were kept by smallholder farmers, whereas, large-scale farmers kept less than one percent. Poultry dominated by chicken, is another important livestock kept in Tanzania. For example, in 2019/20 Tanzania had an estimated 87.7 million chicken. Among these 85.6 percent were kept by smallholder farmers while 14.4 percent were kept by large scale farmers.

The trend of food, cash crop, and livestock production in Tanzania

Tanzania is endowed with climatic diversity as well as agricultural resources (mainly land and water) in different geographical zones. In this regard, farmers grow various crops (annuals, biennials, and perennials) . These crops include cereals, fruits, vegetables, roots and tubers, oil crops, legumes/pulses, and spices. Other crops traditionally grown for export include tea, coffee, tobacco, cotton, sisal, pyrethrum, and cashew nuts. Traditionally, crops have been classified into cash and food crops. However, it should be noted that a crop can be treated as food and a cash crop at the same time, depending on the prevailing circumstances and changing consumer preferences.

In addition, some farmers keep livestock including cattle, goats, sheep, pigs and chickens as well as small numbers of turkeys, ducks, and rabbits. To a great extent, the production of crops and livestock in Tanzania is dominated by smallholder farmers with few commercial production enterprises. In general, productivity for many crops is still low compared to the production potential. Overall, the production of crops and livestock in Tanzania is mostly influenced by rainfall distribution and temperature

variation, this is because agriculture in Tanzania is mainly rain-fed. Production trends of the selected crops (categorised as food and cash crops) and livestock in the last five years are described in the following section.

(a) Food crop production

Crops such as maize, paddy, bananas, cassava, sorghum, and potatoes which have traditionally been regarded as major food crops are widely produced in different regions of the country. For instance, the production of maize which is the staple food to over 70 percent of the Tanzanian population is widely distributed across agro-ecological zones. This is because the crop is adapted to different agro-ecologies ranging from near the sea level to 2 400 metres above the sea level, depending on the variety. However, the main maize-producing regions include Ruvuma, Njombe, Iringa, Kigoma, Rukwa, Mbeya, and Katavi.

Paddy is Tanzania's second most important food crop grown by 18 percent of farming households who consume about 30 percent of their harvest, while the rest is absorbed into the domestic and regional markets. The demand for rice in some cases surpasses local production leading to the importation of rice to cover the deficit. Paddy is produced in several parts of Tanzania; however, Mbeya (Mbalali and Kyela Districts), Morogoro, and Shinyanga are the main producers. The crop is grown along river basins including Kilombero and Usangu on a large scale.

Cassava is grown in almost all the agro-ecological zones in the country as a food security crop. For example, in 2019/20, cassava was grown by more than 1.9 million farmers with small plots of land averaging 0.4 ha per household. There are a few large-scale cassava farmers with more than 20 ha. The major cassava-producing areas are Lake zone (Mwanza, Geita, Mara, Kagera, Simiyu and Shinyanga), Southern zone (Lindi, Mtwara, and Ruvuma), Western zone (Kigoma) and Eastern zone (Morogoro, Tanga, and Pwani regions). For a span of 5 years, that is, from 2015 to 2019, cassava production has been fluctuating. The highest recorded production was 2.7 million tons in 2018 and the lowest was 1.3 million tons in 2017. Critical factors that may have contributed to the decline in cassava production include diseases, the use of low-yielding planting materials, and low adoption of recommended agronomic practices.

On the other hand, banana or plantain is also one of the food basket constituents in Tanzania. The crop also provides livelihood to about 3.7 million farmers in the Northern, Western and Southern Highlands regions. However, the crop is widely grown in Kagera, Mbeya (mostly in Rungwe District), and Kilimanjaro. Other regions producing a significant quantity of bananas including Morogoro, Kigoma, Mara, Arusha, Manyara, Ruvuma, Tanga, and Pwani. Over the past five years, banana production has been slowly increasing. For example, in 2017 the production of bananas

was 845 000 metric tons and reached 1 135 000 metric tons in 2019.

Common bean is the most common pulse produced in the country during both short and long rain seasons and equally important source of food and income. Other pulses are pigeon peas, cowpeas, green gram, bambara nuts, and green beans. As with other crops, the common bean production is dominated by smallholder farmers producing around 94 percent. In Mainland Tanzania, Kagera, Manyara, and Kigoma are the main producing regions. Other beans producing area include Arusha, Kilimanjaro, Ruvuma, and Unga North region.

The trend of production of other traditionally termed as food crops is shown in Table 1.4. A close look at the Table shows that the overall production of these food crops from 2015 to 2019 has been fluctuating. The main contributing factors could be the impact of climate change, low level of use of required inputs (mainly seeds and fertilisers), and low adoption of recommended technologies among others. This shows that more efforts and strategies are needed to improve production and productivity. However, the country has been food-sufficient. For example, 10 years' trend analysis (2010/11 to 2019/20) indicates that at the national level, the self-sufficiency ratio was above 100 percent, and the lowest was 105 percent in the 2010/11 season and the highest was 125 percent in 2014/15 and 119 percent in 2019/20 cropping season.

Table 1.4: Production trend of selected food crops ("000" ton) in Tanzania (2015-2019)

Crop	2015	2016	2017	2018	2019
Maize	5 903	6 149	6 681	6 273	5 652
Paddy	1 937	2 229	1 594	2 220	2 063
Wheat	72	76	50	57	63
Sorghum	1 007	1 003	1 064	988	1 117
Cassava	1 962	2 205	1 342	2 791	2 728
Legumes	1 808	1 959	2 318	1 823	1 888
Bananas	1 195	1 061	845	1 132	1 135
Sweet Potatoes	1 090	1 044	2 008	1 608	1 644

Source: URT, (2021)

(b) Traditional cash crop production

Cashew nuts, cotton, coffee, clove, tea, tobacco, sisal, sugarcane and horticultural crops are the main traditional cash crops produced in Tanzania. As it is with the traditional food crops, these cash crops are of great importance in socio-economic development. For example, in the year 2020, the major agricultural commodities

for export were tobacco, coffee, cotton, cashew nuts, tea, and cloves. Despite price fluctuation in the world market for some cash crops such as sisal, the production of most crops has been significant in recent years. Therefore, it is very important to look at the trends of important cash crops produced in Tanzania. This is imperative for the development of the agricultural sector in the country.

The production trends of eight cash crops (Table 1.5) indicate a slight growth. However, the production of pyrethrum from 2015 to 2019 experienced a significant decline of 16 percent. Likewise, cotton, tea, sugarcane, and cashew nut experienced a considerable decline in 2016. This decline was caused by different factors including the withdrawal of some farmers from production. Interestingly, the production of cotton in Tanzania rose from 149 445 metric tons in 2016 to 352 405 metric tons in 2019. This increase is a result of a government plan to boost cotton production by 2024/25, which encouraged farmers to return to cotton production because of higher fibre prices indicated in the plan. Similarly, cashew nut production increased from 155 416 metric tons in 2016 to 313 826 metric tons in the 2018 season. Tobacco followed an unstable production trend with several fluctuations. Clove is another important cash crop which is mainly produced in Zanzibar. In 2019, Zanzibar produced 1 691 metric tons while in 2018 the production was 675.2 metric tons showing a significant increase in production.

Table 1.5: Production of selected cash crops (ton) in Tanzania from 2015 to 2019

Crop	2015	2016	2017	2018	2019
Cotton	203 312	149 445	164 709	222 039	352 405
Tobacco	87 737	60 692	85 861	45 245	68 147
Sugar	304 007	293 075	556 522	303 752	359 219
Tea	35 750	32 629	41 495	34 010	37 193
Pyrethrum	6 050	2 011	2 151	2 400	2 014
Coffee	41 674	60 921	47 693	50 522	79 087
Sisal	39 204	42 314	36 533	40 635	33 271
Cashew nuts	197 933	155 416	265 238	313 826	225 053
Clove	3 322	4 679	8 277	675	1 691

Source: URT, (2021)

Activity 1.3

In a group:

- (a) Draw a map of Tanzania showing the areas where the following crops are commonly grown: maize, paddy, banana, and palm tree.
- (b) Explain the factors favouring the production of those crops in the identified areas.

(c) Livestock production

Livestock farming is one of the major agricultural activities contributing to achieve national development goals. It is a major source of meat, milk, and industrial raw materials. In 2019/20, about 2.7 million out of 7.8 million agricultural households in Tanzania were involved in livestock production. Among the households engaged in agriculture, 64 percent were engaged in both livestock and crop production, two percent were in livestock only, and one percent were in fish farming and pastoralism.

Among the most important livestock produced in Tanzania include cattle, goats, sheep and poultry such as chicken, ducks, goose, guinea fowl and turkey. Cattle were raised by about 2 million households (40 percent), goats were raised by about 1.9 million households (36 percent), sheep approximately 0.7 million households (14 percent) and pigs about 0.5 million households (10 percent). In terms of the population of livestock, cattle were the most dominant with 34 million (48 percent) herds; followed by goats, 24 million (35 percent), sheep, 8.5 million herds (12 percent) and pigs 3.2 million about five percent. In addition, during the same farming season, 4.3 million (55 percent) households raised chicken. About 4.2 million (98 percent) of these chicken-producing households were in Tanzania mainland and 100 538, equals to two percent were in Zanzibar. Livestock production is mostly dominated by small-scale producers. Economically, the contribution of larger-scale farms is less than one percent as most of the producers use indigenous breeds and traditional livestock keeping systems.

Available statistics indicate that during the last two decades, the livestock sector was growing at an average rate of about three percent, as indicated in Table 1.6. Generally, the production of livestock products has been increasing since 2015. However, in 2017, there was a considerable decline in meat production, especially from goats/sheep and pigs.

Table 1.6: Production of livestock products in Tanzania from 2015 to 2019

Product	2015	2016	2017	2018	2019
Milk Production ('000' litres)					
Indigenous cattle	1 381 451	1 423 288	1 460 900	1 608 099	1 874 923
Hybrid cattle	677 275	703 979	626 100	792 044	803 538
Total	2 058 726	2 127 267	2 087 000	2 400 143	2 278 461
Meat Production (tonne)					
Beef	319 112	323 775	394 604	471 692	479 071
Goat/ Sheep	124 745	129 292	81 064	92 999	94 453
Pork	54 360	91 451	18 899	37 191	37 773
Chicken	99 540	104 292	63 597	78 110	79 332
Total	597 757	648 810	558 164	679 992	690 629
Egg Production (number '000')					
Egg	4 153 800	4 353 182	2 758 000	3 156 692	3 575 621

Source: URT (2021)

Activity 1.4

Visit your ward or district offices responsible for agriculture or search information from various websites such as: www.kilimo.go.tz and www.nbs.go.tz; Then:

- Collect the most recent five years production data for the following in your area, district, and region:
 - Two food and two cash crops.
 - Livestock production (focus on cattle and chicken).
 - Fish production.
- Compare the established production trends in your area with the regional trends.
- Organise the collected data in your portfolio.
- Present your work in class for discussion.

Characteristics of agricultural and non-agricultural sectors in Tanzania

Agricultural sector

The sector has continued to support the livelihoods of the majority of Tanzanians. However, the sector has remained underdeveloped and generally vulnerable. The sector comprises the establishments primarily engaged in growing crops, raising livestock, and fishing. The sector covers a wide range of occupations from the majority smallholder farmers (about 94 percent) producing food to medium and large agricultural enterprises. Most of the agricultural exports have continued to be in a raw form, mainly due to a weak agro-processing industrial base. Most of the privatised key agro-processing industries, for example, leather, and coffee have not performed as expected, resulting in continued exports of raw produce.

Compared to non-agricultural sector, agricultural sector is characterised by the following features: climate-dependent, mainly concentrated on producing raw materials, labour intense, relatively low use of advanced technology, produces perishable goods, relatively difficult to control both quantity and quality, and difficult in product differentiation. In addition, the produce have inelastic demand, with a considerable lengthy-time of waiting to get returns, it is easy to enter (very low entry barrier) and has relatively more risks and uncertainty than its counterpart (non-agricultural sector). A detailed description of the non-agricultural sector is provided in the following section.

Non-agricultural sector

The non-agricultural sector includes economic activities such as tourism, manufacturing, processing, handicraft, construction, mining, communication and transport, trade, and service industry. These are economic activities although are not directly related to agriculture. However, they have a great influence on the family livelihood and national economy.

(a) Tourism

Tourism is one of the most important non-agricultural sectors in Tanzania that attracts foreign exchange earnings. The sector recorded an improved performance in recent years especially before the Covid-19 pandemic. This can be evidenced by the increased number of international tourists arriving in the country. For example, in 2011 the number of tourists was 867 994 and increased to 1.4 million in 2018 generating a total earning of USD 2.4 billion. This made the sub-sector a primary foreign exchange earner in that specific year. Essentially, Tanzania has tourist sites and attractions including wildlife and marine parks, game reserves, conservation

areas, beaches, historical sites, hunting, and forestry. The good performance is largely attributed to the macroeconomic reforms and increased promotion of Tanzania as a unique tourist destination.

(b) Manufacturing

This sector consists of food processing (24 percent), textiles and clothing (10 percent), and chemicals about nine percent. Others include beverages, leather and its products, paper and paper products, publishing and printing, non-metallic mineral products, and plastics. Recently, due to technological development, the sector is also moving towards product specialisation, especially products that provide inputs to other processes (i.e., intermediate technologies relating to machinery, electronics, and textile).

The share of manufacturing sector in the GDP, remained relatively low at five percent in 2015, with food and beverages accounting for more than 40 percent of the manufacturing. The share of the manufacturing sector in total exports increased from 17 percent in 2012 to 23 percent in 2014 and declined to about 19 percent during 2015/16. In 2019, six percent of the employees in Tanzania were active in the industry and 28.44 percent in the service sector. In 2018 and 2019, the contribution of the sector to the GDP was 8.1 and 8.5 percent respectively. This growth was attributed to stability in power supply and availability of raw materials, coupled with expansion in market outreach including regional markets. The conducive business environment created by the government also contributed to the growth of the sector. Nevertheless, most manufacturing firms lagged behind the required pace of increasing value addition and diversifying their production towards more advanced/high-tech products.

Key constraints affecting the growth of the manufacturing industry include technical problems, administrative issues, market challenges, and financial barriers. Other challenges include low productivity and weak managerial skills, weak market conditions (quality standards and supply chains), inadequate finances, unfavourable international trading relations, low usage of advanced and modern technologies, challenging business environment, as well as capacity underutilisation.

(c) Building and construction

The construction industry in Tanzania includes real estate, transport infrastructure, and other civil works, including water supply. This is one of the fast-growing sectors in Tanzania, with high potential for further growth. The contribution of the sector to GDP increased from 7.8 percent in 2010 to 12.5 percent in 2014, and further to 12.7 percent in 2015. In addition, the sector generated USD 6.7 billion (14 percent) of

the GDP in 2018 compared to USD 4 billion in 2014. The sector recorded a growth rate of 13.2 per cent in the first quarter of 2019 compared to 15.6 percent in the corresponding quarter of 2018. This sectoral growth could be attributed to the growing public investments (construction of standard gauge railway, bridges, airports, roads and expansion of ports), as well as the on-going rehabilitation of the metre-gauge railway. Also, there has been an increase in public and private expenditure in the construction of residential and government buildings including schools, dispensaries and hospitals as well as administrative buildings. This could also be linked to an increase in the local production of construction materials such as cement, iron, and steel.

It is also important to note that, increased government funding on the development of infrastructure in almost every financial year, has catalysed the continued inflow of investments in the construction industry. The establishment of the Tanzania Mortgage Refinance Company Limited (TMRC) has also contributed to increased investment in the construction because the associated financing arrangement has motivated retail and commercial banks to start including mortgage products in their service portfolios, such as home purchases, commercial property mortgages, and plot purchases.

Despite the growth, the main challenges facing the construction and building sector include limited local participation, mostly, due to low access to finance, capital and skilled labour; fluctuating input prices and their availability. While foreign contractors constitute less than 10 percent of the registered contractors in the country, they account for over 60 percent of the value of civil construction works.

Relationship between agricultural and non-agricultural sector

It should be noted that a prosperous agricultural sector encourages manufacturing by supplying the required quality raw materials at considerably affordable prices, food for workers and providing a markets for industrial products. Local manufacturing in turn, creates a large and more reliable market for agricultural products.

The role of the non-agricultural sector in rural development

Tanzania is predominantly based on agriculture and agricultural-related activities for its sustenance. Thus, the economy of the majority of Tanzanians depend on the agricultural sector for both livelihood and employment. At the same time, non-agricultural sector is also playing an important role in providing opportunities for employment and a source of income for the labour force. It is also important to note that as the population increases, agricultural sector alone can neither create enough opportunities to absorb additional labour force nor can it provide sufficient income

to sustain the livelihood of an increasing population. Therefore, the contribution of the non-agricultural sector is imperative. Indeed, the growth of the non-agricultural sector is an effective measure in addressing the emerging challenges of unemployment, poverty and out-migration of the rural labour force.

Activity 1.5

In a group, visit the school library, internet facility, or any other resource centre. Then,

- (a) Study the characteristic features of the following sectors at your district and region levels
 - (i) Agricultural sector; and
 - (ii) Non-agricultural sector.
- (b) Compare and contrast development of the two sectors.
- (c) Write a report and present it in class for discussion.

Exercise

1. Using various sources such as TDV 2025, describe the objectives of Tanzania agricultural sector.
2. With evidence, show the current status of agricultural production in Tanzania.
3. With examples, show the percentage of the population of women and men involved in the agricultural sector.
4. Using examples, distinguish between agricultural and non-agricultural sectors.
5. Discuss the ways in which non-agricultural sector supports agricultural sector.
6. Describe the role of non-agricultural sector in rural development.
7. Explain four (4) factors that affect crop and livestock production in Tanzania.

Chapter summary

This chapter has covered aspects of basic facts of agriculture that provide insight into potential opportunities available in the agricultural sector such as availability and suitability of land for agricultural production in Tanzania. The chapter has also presented objectives of the agricultural sector in Tanzania. In addition, strategies, programs, institutions and agencies that guide the realisation of sectoral objectives have been equally described. The agricultural sector is critical for investments on one hand, and career opportunities on the other hand. The chapter also highlighted

the production trends of selected ‘food’ crops, ‘cash’ crops, as well as livestock production. Lastly, the chapter has analysed the characteristics of agricultural and non-agricultural sectors and how the two are interrelated.

Revision exercise 1

1. Explain the meaning of the following terms:
 - (a) Crop production
 - (b) Cash crops
 - (c) Agricultural sector
2. Elaborate at least five (5) roles of agricultural sector to Tanzanian economy.
3. With examples, describe the characteristics of agricultural sector in Tanzania.
4. Explain how agro-ecological zones influence agricultural production in Tanzania.
5. With examples, show how you can advance commercial farming in Tanzania.
6. How do human diseases affect agricultural production in Tanzania.

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Chapter Two

Farming and land tenure systems

Introduction

Farming system takes into account the components of soil, water, crops, livestock, labour, capital, energy, and other resources. Land tenure system is the arrangement of how an individual and/or groups secure access to land and associated resources. Therefore, farming and land tenure systems are closely interrelated in the sense that the later provides legal room where the former is practised. In this chapter, you will learn farming and farming systems, land tenure systems, and land use patterns in Tanzania. The competencies developed will enable you to get insight on different farming systems and the operating land tenure systems in Tanzania.

Farming and farming systems

Farming is a process of growing crops or raising animals for both, food and income earnings. Farming involves the keeping of livestock such as cattle, goats, sheep, pigs, poultry, and cultivation of crops such as maize, beans, banana, tea, coffee, potatoes, and sunflower. Fisheries, forestry, and beekeeping are also farming activities. The main role of farming is to produce crops and animal products for food and income generation. Farming also provides employment and serves as a source of foreign currency for the nation. Based on the type of enterprise, farming system may be explained as an approach which is used by farmers to produce crops and/or livestock to achieve a specified objective. Types of farming systems may be classified according to the nature of farming enterprise and the purpose of production.

Types of farming systems based on the nature of farming enterprise

A farming system may be described as arable farming, livestock farming, or mixed farming depending on which enterprise is dominant.

Arable farming

This is a system where farmers grow crops for food, sale, or both as their main enterprise. There are two types of arable farming system which are settled (continuous) and shifting cultivation.

(a) Settled/continuous cultivation

Settled cultivation is usually practised in areas with scarcity of land and high population density. Therefore, it becomes difficult for a farmer to shift to other areas.

Advantages of settled cultivation/continuous cultivation

- (i) It enables farmers to save time, money, and energy that could be used for clearing fresh land every season.
- (ii) It maximises and economises resources, mainly land.
- (iii) It helps farmers to develop farming managerial skills due to long-time engagement in the same enterprise.
- (iv) It is easy to practice field management such as fertiliser application and weed control especially, if there is only one type of crop on the farm.
- (v) It encourages the development of permanent farm infrastructure.

Disadvantages of settled cultivation

- (i) It can lead to rapid loss of soil fertility as the soil is being used continuously.
- (ii) It requires high amounts of inputs, for example, fertilisers, to keep the soil fertile.
- (iii) It may cause deformation of soil structure and thus expose the soil to the agents of soil erosion.
- (iv) It is easy for crop pests and disease agents to build up, hence affect negatively the crops.
- (v) It leads to a decrease in production with an increase years of cropping.

(b) Shifting cultivation

Shifting cultivation which is also referred to as fallow cropping, is a system in which a farmer clears and cultivates a piece of land and grows crops for a short period. Then, abandons it and shifts to another area. Shifting cultivation involves six steps, namely site selection, slashing, burning, cultivation, harvesting, and abandoning the old site (fallowing). Shifting cultivation as a form of land use is common among resource-poor communities. It is very unfortunate that the practice involves clearing of forests and burning of organic materials leading to land degradation. This method is normally practised where there is abundant land and low population density. As human population increases, shifting cultivation becomes difficult to practise.

Advantages of shifting cultivation

- (i) Crop specific pests and diseases, are controlled due to the absence of preferred crop plants during fallowing thus, it plays a critical part in pest management.
- (ii) Organic matter is conserved during fallowing hence, well-fertilised soil.
- (iii) It restores soil structure and helps to replace lost nutrients.
- (iv) It allows nutrients restoration in the soil.
- (v) It is a simple method of farming as minimum investment is needed.

Disadvantages of shifting cultivation

- (i) Constant clearing of vegetation causes soil erosion thus, it contributes to land degradation.
- (ii) Leads to a loss of soil micro-organisms through burning of vegetation to open up new land for cultivation which results in poor soil structure.
- (iii) No long-term development plans as farmers are poorly motivated to develop the land.
- (iv) There is low output per unit area due to lack of proper care and maintenance of the land.
- (v) Burning produces greenhouse gases and contributes to air pollution.

Livestock farming

This is a farming system where farmers primarily depend on livestock production. In Agriculture Student's Book Form One, you were introduced to livestock farming systems, namely intensive, semi-intensive and extensive systems. Nomadic pastoralism and ranching are examples of extensive livestock farming systems.

(a) Nomadic pastoralism

Nomadic pastoralism is a traditional farming system practised by nomads such as Maasai and Barbaig whereby a livestock keeper keeps a large number of animals such as cattle, goats and sheep and moves from place to place in search of pasture and water. Figure 2.1 shows examples of nomadic pastoralism practice.



Figure 2.1: Nomadic pastoralism

Source: <https://www.tzbusinessnews.com/bill-and-melinda-gates-set-to-transform-dairy-farming-in-tanzania/>

Advantages of nomadic pastoralism

- (i) Useful for utilisation of areas especially dry lands where it is almost impossible to grow crops.

- (ii) It is the main livelihood of people in the drylands.
- (iii) It does not require so much equipment and buildings.

Disadvantages of nomadic pastoralism

- (i) A large number of livestock per unit area cause land degradation and destruction of natural vegetation and water catchment areas.
- (ii) Most pastoralists find themselves in conflicts with other land users for water, pasture and farming lands.
- (iii) Time and energy are wasted through moving from one place to another.
- (iv) When animals move from one place to another, they can easily spread parasites and diseases.

(b) Ranching

Ranching is an advanced and significant livestock farming system. This is a commercial system of livestock rearing particularly cattle. Both dairy and beef cattle can be managed under a ranching system. Since animals are raised for highly organised markets, the system is characterised by the following features:

- (i) It is managed and run following scientific principles or animal husbandry practices like disease control and management.
- (ii) Herds and flocks are usually very large occupying an extensive land area.
- (iii) The animals to be kept are chosen very carefully for maximum utility.
- (iv) Efforts are made to ensure a continuous vegetation cover.
- (v) Moderate input of capital and human resources (labour management) per unit area of land are used.

Examples of ranches in Tanzania include Kongwa Ranch in Dodoma Region, Ruvu Ranch in Pwani Region and Mkata Ranch in Morogoro Region. These ranches are owned by the National Ranching Company (NARCO). Other private owned ranches include Kibebe in Iringa region. Ranching is highly recommended for sustainable agriculture as it involves balancing livestock units and land carrying capacity.

Mixed farming

This is a farming system which involves the growing of crops as well as raising of livestock. For example, a farmer can keep cattle and goats while at the same time growing maize and beans.

Advantages of mixed farming

- (i) Provides means of product diversification which act as a buffer in case there is a failure of any one of the enterprises (for example, due to changes of weather and disease outbreak).
- (ii) Livestock manure helps in the fertilisation of the soil hence, improve crops productivity.

- (iii) Residues from crops may serve as animal feeds.
- (iv) Income is improved since the land is used in production throughout the year.

Disadvantages of mixed farming

- (i) Where land is a limiting factor, livestock (particularly grazing systems) may compete for land.
- (ii) If not well managed livestock can feed on crops and cause conflicts.
- (iii) It requires farmers to have adequate knowledge and skills of managing crops and livestock.

Activity 2.1

Visit a nearby farm (s), then:

- (a) Identify the types of farming systems that are used in the visited farm (s).
- (b) Compare the identified systems in terms of advantages and disadvantages.
- (c) In class, discuss and suggest what would be the best system for the visited farms.

Types of farming systems based on the purpose of production

Based on the purpose of production, farming systems can be classified as subsistence or commercial farming.

(a) Subsistence farming

Subsistence farming is a system of agriculture in which farmers grow crops and/or raise livestock to meet household needs. Nearly all crops produced or livestock raised are used to sustain the farmer and his/her family. In this system, very little or no surplus is left for sale. The following are some characteristics of subsistence farming:

- (i) Labour is normally provided by the family members and farming is done manually with simple tools such as hand hoes and machetes. Farmers use organic manure to improve soil fertility.
- (ii) Mixed farming is commonly practised.
- (iii) The food obtained under this system is normally used for the family and only small surplus is sold to obtain non-food items such as clothes, shelter and other family needs.
- (iv) It is normally practised under small-scale and relies on rainfall.
- (v) Generally, farmers in this system have relatively low income.
- (vi) The land that is available for cultivation is small and its productivity is relatively low.

- (vii) There is a minimum or no use of agrochemicals such as fertilisers and pesticides.
- (viii) Traditional tools such as machetes and hand hoes are used.
- (ix) There is minimal use of improved technologies.

Advantages of subsistence farming

- (i) It requires little investments in terms of resources and management.
- (ii) It is a source of food supply and livelihood for the household.

Disadvantages of subsistence farming

- (i) Much time is spent during farming operations.
- (ii) Lacks organised markets for selling the produce due to small quantities of the yields.
- (iii) It is difficult to access extension services.

(b) Commercial farming

Commercial farming is a production system in which crops and/or livestock are raised for selling to make profit. Crops and/livestock may be produced for food, raw materials or export. Unlike subsistence farming, commercial farming may use advanced farming technologies.

Commercial farming may be in small, medium, or large scale. Examples of large-scale commercial farms in Tanzania include clove plantation in Zanzibar, oil palm plantations in Kigoma, and sugarcane plantations in Kagera and Morogoro regions. Others include, dairy farms in Iringa and Arusha regions, and poultry farms in Dar es Salaam and Pwani regions. Figure 2.2 (a-f) shows some crops/livestock produced commercially in Tanzania.



(a) Oil palm



(b) Sugar cane



(c) Cloves



(d) Fish farming



(e) Dairy cattle



(f) Chicken

Figure 2.2: Some commercially produced crops and livestock in Tanzania

The characteristics of commercial farming

- (i) Normally it involves large scale production mainly for sale.
- (ii) It is capital-intensive and lower prices of produce as it takes advantage of economies of scale.
- (iii) It involves the use of high yielding crop varieties and livestock breeds.
- (iv) Mostly only one type of agricultural enterprise (crop/livestock) is done on a large area.
- (v) It requires at least one full time employee.
- (vi) It is practised throughout the year as this type of farming does not depend on rainfall due to the use of advanced technologies.
- (vii) It requires high level of management and technology.

Advantages of commercial farming

- (i) High quality products are produced due to advanced technologies that are used during farming.
- (ii) Source of employment opportunities.
- (iii) Commercial farming is one of the major sources of foreign exchange.
- (iv) It is relatively easy to plan and manage the agro-business.
- (v) It is a source of government revenue through taxes.

Disadvantages of commercial farming

- (i) Crops and livestock are produced using advanced, efficient and up to date technologies which are very expensive.
- (ii) Large scale farms may cause land scarcity, particularly to smallholder farmers.
- (iii) Specialisation in production may be risky due to changes in environmental conditions and market demands.
- (iv) When only a single crop is produced for a long time, soil structure tends to be poor.
- (v) The crops produced are mostly cash crops which are normally produced at the expense of food crops.

Determinants of farmers' choice to adopt a particular farming system

It is important to note that farmer's choice of a system is largely influenced by natural and socio-economic factors. Natural factors can further be categorised into two groups, namely physical (soils, climate, and topography) and biological (crops, livestock, weed, pests, and diseases) socio-economic factors include access to credit, culture and traditions, the level of education and government policies. Generally, a farming system to be adopted by the farmer will depend on the following criteria:

- (i) Available natural resource-base, including water, land, grazing areas, and forest.
- (ii) The climate of the area in terms of rainfall and temperature.
- (iii) Topography that is, whether the landscape is flaty or sloppy.
- (iv) Farm size and labour availability.
- (v) The land tenure system and organisation.
- (vi) The dominant livelihood activities such as productions of field crops and livestock, aquaculture, processing, and off-farm activities.
- (vii) Available technologies which determine the intensity of production and integration of crops and livestock.

Activity 2.2

In a group, visit two large scale and small scale farms nearby your school, make observation, then write a report based on the following items:

- (a) Dominant farming enterprise of the visited farms; and
- (b) Observed characteristic features which determine the production scale of the visited enterprises.

Exercise 2.1

1. What do you understand by the term farming systems?
2. With examples, describe the farming systems practised in Tanzania.
3. Compare and contrast nomadic pastoralism and ranching.
4. Discuss how subsistence farming differ from commercial farming.
5. Of the two systems, (Nomadic and Ranching) which one would you prefer? Provide at least three (3) reasons.
6. How can extension services be made possible and effective under subsistence farming?

Land tenure systems in Tanzania**Concept of land tenure systems**

The term “land tenure” is derived from the Latin word “tenere” which means “to hold”. Thus, land tenure means a system of land ownership or holding the land. Land tenure is defined as the relationship that individuals and groups hold land and its related resources. It also stipulates how an individual can access and gain land, use rights, and associated relations between the landholder and the state. In other words, land tenure is defined as rules invented by societies to regulate access, the holding and use of land by individuals or communities. Rules of tenure define how property rights to land are to be allocated within societies. They define how access is granted to the rights to use, control, and transfer land, as well as associated responsibilities and restraints. This means that the absolute ownership of land rests with the government which gives proprietary rights to individuals or communities.

The Land Act No. 4 and the Village Land Act No. 5 of 1999 states that, the land in Tanzania belongs to the public but is vested in the President as the trustee for and on behalf of all the citizens of Tanzania. Land tenure is governed by institutions or rules and can therefore be legally or customarily bound. Land rules help to define how land rights are distributed to the landowners including individuals and society. It also points out how access to use, control, transfer of land and its associated responsibilities, and

constraints are undertaken. It is important to note that the land tenure system differs from one country to another. Also, the land tenure system has a great influence on land management and prospects of land improvement.

Categories of land tenure

Land tenure in Tanzania can be categorised into four main categories namely: private, communal, open access, and state-owned. These categories are described below:

(a) Private

For this category of land tenure, the rights on use, control and transfer of land are given to the private party which may include an individual, a married couple, a group of people, or a corporate body such as a commercial entity or non-profit organisation. Landowners have exclusive right of occupancy to the land and its resources while other members of the society are automatically excluded.

(b) Communal

This is land tenure category whereby all community members have the right to use independent communal land and its resources (right of commons). Under this arrangement, the land is owned and managed by the community rather than an individual, corporate bodies or company. Non-community members have no right to use land. However, the communal land tenure system often lacks mechanisms for regulating access to land. A good example is when members of a community have the right to graze cattle on common pasture land.

(c) Open access

This type of land tenure category a community/individual has no control on access to land and its resources as specific rights are not assigned to anyone and no one can be excluded. While in communal land tenure, non-members of the community are excluded from using the common areas, under open access, any one has right to access common areas. This category may include rangelands and woodland that are not governed by other laws. Where there is free access to the resources for all.

(d) State-owned

For this category of land tenure, ownership, access, and control rights are assigned to some authority in the public sector. Land rights can range from use, derive income, control the use, and alienate a portion to other people and protecting land resources. In Tanzania, forest lands fall under the mandate of the government (local and central). In state land tenure system, multiple rights can be held by several individuals, groups or the state hence called a bundle of rights. Each right may be held by a different party and the bundle of rights may be shared between different stakeholders upon agreed terms.

Importance of land tenure

Land tenure has several advantages including:

- (a) Promoting protection of land and its resources.
- (b) Safeguarding food security and peoples' lives by accessing the land resources.
- (c) Promoting gender equity and equality.
- (d) Promoting self-reliance of people and communities.
- (e) Helping to mitigate land conflicts for example between farmers and pastoralists.
- (f) Encouraging investment hence contributing to the development of agriculture as it makes ownership of land secure.
- (g) Raising the value of land hence land can be used for various economic purposes.
- (h) Making land administration easy and efficient.

Activity 2.3

Visit a nearest local government authority office for example village/'mtaa' or ward and collect the following pieces of information:

1. (a) Category of the land tenure system that is used in the local community;
 (b) Major activities practised in the area;
 (c) How the land is acquired in the area; then
2. Organise the data in your portfolio and present them in class for discussion.

Challenges encountered in land tenure arrangements in Tanzania

Although there has been a significant progress in land tenure issues, land tenure system faces several challenges. These include:

- (a) Absence of adequate and right information on land tenure especially in rural settings.
- (b) Conflicts over land use in rural areas especially between farmers and pastoralists.
- (c) Tenure conflicts between holders of customary and those granted land rights.
- (d) Urbanisation causing encroachment of forests and other nearby land uses.
- (e) The current tenure system paves a way for monopoly and excessive owning of land which creates some segments of the society for example, it makes women and small-scale producers vulnerable to land insecurity.
- (f) Provides room for alienation of the local people from their land once they lose the land to the elite.

Activity 2.4

In a group, visit a nearby ward, or district Land Tribunal Office and inquire about critical problems associated with land tenure they commonly deal with and then, do the following:

- (a) Identify different problems associated with land tenure arrangements.
- (b) Discuss effects associated with identified problems in (a).
- (c) Suggest how to overcome problems associated with land tenure arrangements in the area.

Exercise 2.2

1. Explain the meaning of land tenure.
2. Describe the land tenure systems practised in Tanzania.
3. Based on the strengths, recommend the best land tenure system (s) in Tanzania.
4. Do you think the prevalence of land conflicts in some parts of Tanzania is influenced by land tenure system(s)? If yes, what should be done to resolve the conflicts?
5. What are the major strengths and weaknesses of land tenure systems in Tanzania?

Land use patterns in Tanzania

Land use patterns can be explained as the arrangement of the use of available land as dictated by urban and regional planning and also the social, economic, political, and geographical conditions. The land use patterns can determine the landscape pattern in areas where land use is intensified. Therefore, land-use patterns may be essential factors in determining landscape stability. For local planning needs, land use patterns provide users with local planning knowledge. In addition, it is important to note that land use and zoning are not the same. While land use is the way that people adapt the land to suit their needs, zoning is used by the government to regulate land use.

Importance of land use patterns

Understanding land use patterns has many benefits. First, it prevents costly and time-consuming misunderstanding between land bearers and regulators. On a larger scale, understanding land-use patterns reveals the arrangements that are associated with land and urbanisation.

The major land-use patterns in Tanzania

The land policy re-affirms that all land in Tanzania is considered public land vested in the President as the trustee on behalf of the citizens. To be able to plan for land use, it is necessary to have information on land tenure and suitability, potential productivity, the level of technology needed, the population density and the needs and standards of living of the people. Understanding land use specific needs will facilitate to determine the use. There are many different categories of land use, the five most common land uses are agricultural, residential and social services, commercial, transport, and recreational, as described hereunder:

(a) Agricultural land

Agricultural land is a land that is devoted to growing crops and keeping of livestock. These include ranches, farms, forests and pastures which are meant to produce food or other services for humans. It is sometimes called cropland or farmland.

(b) Residential and social land

Residential land is land designated for building homes that could be of variable sizes and types. The land is also meant for social services buildings such as schools, hospitals, and worshiping places. In Tanzania, residential land is administered by government through the Commission of Land or customary systems.

(c) Commercial land

This type of land is designated for commercial purposes. This refers to any plot or a subdivided land earmarked for business. Examples include land designated for warehouses, shops, manufacturing plants, parking and any other infrastructure related to commerce including profit-generating residences.

(d) Transport land

Transport land is designed for the establishment of structures that help movement of people and goods from one destination to the other. Transport land includes land designated for roads, airports, railway lines, train/bus stations and harbour (ports).

(e) Recreational land

When land use is defined as recreational, it is meant to be used for leisure and may include parks and open spaces for athletic fields, playgrounds and swimming pools. These areas are not meant for direct development of the community but are used to attract residents and visitors.

Activity 2.5

In a group, visit a nearby ward, district or regional office responsible for land use and planning or listen to a presentation from the invited expert. Then:

1. Enquire from a resource person on how:
 - (a) Land is used in the country; and
 - (b) Land use has been changing over time.
2. Describe different categories of land use found in your district.
3. Share your work in class for discussion.

Factors influencing land use patterns

The land use pattern is influenced by many factors. At the level of individual land unit, influencing factors include local climate, weather, topography, bedrock and soil type, surface water, and groundwater.

The choice of land use and decisions to change its uses is influenced by various factors. Some of these are socio-economic factors (including age, gender, education, and employment) site-specific factors (land size, costs, competition level, accessibility, and transport costs) and regulatory factors (area specific land use structural regulations, allowed land management practices, and land tenure). Other factors include costs of production, public and private financial support, and land cover change.

Characteristics of land use

Land use characteristics are attributes of land that can be measured or estimated. Some attributes considered for land use are slope angle, rainfall, soil texture, available water capacity, and the biomass of the vegetation. These land characteristics are determined by land surveyors as land mapping units.

Exercise 2.3

1. Describe the major characteristics of land-use systems in Tanzania.
2. With examples, differentiate between land use and land zoning in Tanzania.
3. Explain the meaning of land use patterns common in Tanzania.
4. Evaluate the major land-use patterns in Tanzania.
5. With examples, analyse the factors influencing land-use patterns in your local community
6. With examples, analyse factors influencing land-use patterns in Tanzania.

Chapter summary

Important aspects covered in this chapter include types of farming and farming systems where the meaning, types and importance of farming and farming systems have been described with examples and activities showing different farming systems existing in Tanzania. Meaning, importance and types of land tenure systems have been described. Major challenges facing land tenure in Tanzania have also been outlined. Finally, land use pattern including the concept and factors influencing land use pattern in Tanzania, was also been discussed.

Revision exercise 2

1. What do you understand by the following terms:
 - (a) Land tenure systems
 - (b) Farming systems
 - (c) Land use patterns
2. With examples, describe farming systems practised in Tanzania
3. Using examples, differentiate between nomadic pastoralism and ranching.
4. Discuss how subsistence farming differ from commercial farming.
5. With examples, explain how you can advance the existing commercial farming practised in Tanzania
6. Describe major characteristics of land-use systems in Tanzania.
7. What are the major strengths and weaknesses of the land tenure systems in Tanzania?
8. Briefly describe seven characteristics of subsistence farming systems.

Chapter Three

Agricultural marketing

Introduction

For about a century ago, most farmers in Tanzania were producing at subsistence level. Today, the focus has shifted towards commercial farming. In Form Two, you learned the key aspects involved in producing agricultural products. This chapter, will focus on the concept of agricultural marketing, theory of demand and supply, market access and marketing of agricultural commodities. The competencies developed will enable you to apply the marketing skills to market agricultural products competitively.

The concept of agricultural market and marketing

Understanding the meaning and importance of a market, market place, marketing and marketing system, forms a foundation for understanding the concept of agricultural marketing.

- (a) **A market** is a situation where buyers and sellers are in contact with each other in order to exchange goods and services. The contact can either be physical, electronic or by any other means of communication such as brochures, newspapers, radio and television.
- (b) **A market place** refers to a specific place where buyers and sellers meet to exchange goods and services at certain agreed prices and conditions.
- (c) **Marketing** is a process of identifying the needs and wants of consumers and meeting those needs through the delivery of products and services. In this process, a seller is responsible for collecting information on the market needs and wants and develop good relationship with buyers and other actors in the value chain. This is done to make sure that goods or services are delivered as per the requirements of the customers.
- (d) **Marketing system** is the inter-connected network of actors that interact to shape the outcome of economic exchange. These actors are government institutions, private enterprises, producers and their associations, Non-Government Organisations (NGOs) and consumers. All these actors have an impact on marketing system and its operations during the economic exchange.

Agricultural marketing

Agricultural marketing includes all business activities that are carried out in the chain of agricultural products and services from their initial point of production to the hands of final consumers. Marketing of agricultural produce is somehow different from that of non-agricultural products due to their peculiar characteristics, such as perishability and bulkiness.

The concept of agricultural marketing is as old as the history of man on the planet. This means that for human being to meet basic needs it is possible that some of the goods and commodities can be sourced from their own production but some can be purchased. Improvement in the means of production, specialisation and technological development has enabled the production of surplus at the household level. Availability of surplus makes exchange of goods possible and leads to the emergence of markets which is very important in facilitating members of the society to get their needs. The process of exchange can occur in kind or cash to facilitate transfer of ownership.

Importance of agricultural marketing

Agricultural marketing is very important in the development of economy of the country. Agricultural marketing is important in the following:

- (a) **Optimization of resource use and output management:** Agricultural marketing enhances efficient use of factors of production and careful management of the resulting outputs.
- (b) **Increase in farm income:** Through marketing of agricultural outputs, farm income is increased when farmers get better prices and reliable markets.
- (c) **Widening of markets:** An efficient and well-known agricultural marketing system enables smooth marketing of farm produce from remote areas to meet consumers at both domestic and international markets.
- (d) **Growth of agro-based industries:** An improved and efficient system of agricultural marketing helps in the growth of agro-based industries by providing raw materials and stimulates the overall development process of the economy through taxes paid by growers.
- (e) **Adoption and spread of new technologies:** An efficient marketing system helps farmers in the adoption of new scientific and technical knowledge.
- (f) **Employment creation:** Marketing system provides employment to millions of people engaged in various agricultural activities, such as packaging, transporting, storing, and processing.
- (g) **Creation of utility:** Marketing adds satisfaction of various stakeholders in the value chain through providing various utilities, including:

- (i) **Form utility:** The processing function adds form utility to the product by changing it from raw form into a finished form. As a result, the product becomes more useful than in its raw form. For example, through processing, oilseeds are converted into oil, sugarcane into sugar, cotton into cloth, and wheat into flour and bread. The processed form is more useful than the original raw materials.
- (ii) **Place utility:** The transportation function adds place utility to products by shifting them from a place of production to a place of need. Products command higher prices at the place of need than at the place of production because of the increased utility.
- (iii) **Time utility:** The storage function adds time utility to the products by making them available at the time when they are demanded.
- (iv) **Possession utility:** The marketing function of buying and selling helps in the transfer of ownership from one person to another. Products are distributed through marketing channels from persons having a low utility to persons having higher utility.
- (h) **Contribution to national income:** Marketing activities add value to products and hence increase the nation's Gross Domestic Product (GDP) and Net National Product (NNP).
- (i) **Improving living standards of actors:** One of the reasons that encourage farmers to continue with production is availability of stable and profitable market. Stable market assures farmers that their produce will be consumed; thus, they invest more in production. This in turn leads to an increase in production and hence, improves living standards of all actors in the agricultural marketing system.

Exercise 3.1

- Explain the meaning of the following terms as applied in agricultural marketing:
 - A market;
 - A market place;
 - Marketing; and
 - Agricultural Marketing.
- Giving at least five (5) specific examples, discuss the importance of agricultural marketing in Tanzania.
- What challenges would Tanzania face, if there were no agricultural marketing? Mention at least five (5) challenges.

Characteristics of agricultural produce

Agricultural produce has exceptional characteristics compared to industrial products or services. These characteristics make marketing of agricultural produce unique and different from the marketing of manufactured goods or services. These characteristics influence decision making process on pricing, promotion and designing of packaging materials, and storage. Some of the characteristics are described hereunder:

(a) Perishability

Most farm produce are perishable in nature. However, their shelf life vary from one produce to another. Agricultural produce need attention on handling, storage, and distribution. That means once produced, they have to reach the market or be processed within a short time. For example, tea leaves, once harvested have to reach tea factory within eight hours. On the other hand, manufactured goods have comparatively longer shelf life.

(b) Seasonality of production

Farm produce are grown in a particular season; they cannot be produced throughout the year. During the harvesting season, prices fall due to high supply compared to the demand. But the supply of manufactured goods can be adjusted or made uniform throughout the year. The prices of these goods therefore, remain almost the same throughout the year.

(c) Bulkiness of farm produce

Bulkiness nature of most farm produce makes transportation and storage relatively difficult and expensive. Thus, the bulkiness requires a location of production to be near the place of consumption or processing. For example, maize shelling needs a maize sheller near or within the farm. This reduces the bulkiness and transportation cost of the maize to the warehouse.

(d) Variation in quality of produce

Variation in quality (taste, size, colour and texture) is one of the common challenges in agricultural produce. There are numerous reasons which lead to quality variation of agricultural produce such as soil characteristics, the use of fertilisers or the quality of animal feeds, water availability, and farm management. These variations in quality can lead to price differences for a product from the same farm or region. Big variations in quality make grading and standardisation of the farm produce difficult to some extent. Variation of the quality of manufactured products is minimal because these are uniformly standardised in the manufacturing process.

(e) Smallholdings and scattered production

Farm produce are grown in small-sized and scattered farms throughout the country and most of the producers are smallholder farmers. This makes the estimation of

supply difficult and creates problems in marketing. In addition, it increases costs of marketing in term of transportation and collection of farm produce. For manufactured goods, even if the product is scattered, it is still possible to know the quantity of the product to be produced and marketed in a certain season.

(f) Processing

Most of the farm produce have to be processed before they are consumed by ultimate consumers. The processing involves transforming raw materials into a finished product. Processing functions of agricultural produce increase the cost compared to manufactured products which are ready made for sale.

Exercise 3.2

1. Using a table, summarise the key differences in marketing of agricultural produce and manufactured products.
2. Mention challenges that face agricultural produce. What approaches can be adopted to address the challenges which you have identified?
3. Explain six (6) characteristics of agricultural produce.

Classification of agricultural markets

Agricultural markets exist in different forms based on certain criteria. These criteria include location, time span, the volume of transaction, the nature of transactions, the number of commodities sold, the degree of competition, the nature of the commodity, the extent of public intervention, and the type of population served. These are discussed in details in the following sections.

(a) Location

- (i) **Village market:** Is an agricultural market which is located in a village, where major transaction takes place among the buyers and sellers.
- (ii) **Primary market:** Is a market located near the centres of production of agricultural commodities. In this market, a major part of the produce is brought for sale by the producers (farmers) themselves. Transactions in these markets usually take place between farmers and primary traders (village collectors).
- (iii) **Secondary market:** This market is generally located at district headquarters or trade centres or at railway junctions. Traders collect commodities from different primary markets for sale at secondary markets. The major transactions of commodities in this market take place between primary and wholesale traders. The produce in these markets are handled in large

quantities compared with primary market. Therefore, there are specialised marketing agencies such as commission agents and brokers, performing different marketing functions.

- (iv) **Terminal market:** A terminal market is one where the produce are either finally disposed off to the consumers and processors; or assembled for export. In these markets, merchants are well organised and use modern methods of marketing.

(b) Time span

- (i) **Short period market:** Is a market which is held only for few hours or a day. The market deals with highly perishable products such as fish, fresh vegetables, and liquid milk. In this market, prices are governed mainly by the extent of demand rather than by the supply of the commodity.
- (ii) **Periodic market:** Is a congregation of buyers and sellers at specified places either in villages, semi-urban areas or some parts of urban areas on specific days and times. These markets are held weekly, biweekly, fortnightly or monthly according to the local traditions for example, secondary livestock market.
- (iii) **Long period market:** Is held for a longer period than a short period market. The commodities traded in these markets are less perishable and can be stored for some time like food grains and oilseeds. The prices are governed by both the supply and demand forces.
- (iv) **Secular markets:** Are directed by forces which are likely to be permanent or stay over longer time. These factors can cause value of a commodity or investment to increase or decrease for a long period.

(c) Volume of transactions

- (i) **Wholesale market:** Is a type of market in which commodities are bought and sold in large quantities to customer at wholesale price. The customers in the wholesale market can be retailers, processors or institutions. For example, at the livestock auction market live animals are sold at wholesale price.
- (ii) **Retail market:** A retail market is one in which farm produce are bought and sold to the consumers in small quantities at retail price. The transaction in this market takes place between retailers and the consumers. The retailer (kiosk 'genge' and butchery) purchases the goods from the wholesale market and sell in small quantities to the consumers.

(d) Nature of transactions

- (i) **Spot or cash market:** Is an agricultural market in which goods are exchanged with money immediately after sale.
- (ii) **Forward market:** Is an agricultural market in which the purchase and sale of a farm product takes place at a certain time but the exchange of the product takes place on some specified date in future.

(e) Commodities transactions

- (i) **General market:** Is a market in which all types of commodities, such as food grains, oil seeds, fibre crops are bought and sold.
- (ii) **Specialised market:** Is a market in which transactions take place only with one or two farm produce. Examples include, Pugu International Livestock Market and Kibaigwa grains market.

(f) Degree of competition

Perfect market: Is one with large number of buyers and sellers; in this market, buyers and sellers have perfect knowledge of demand, supply and prices; and goods are homogeneous in nature.

Imperfect market: Is a market in which the conditions of perfect competition are lacking. Based on the degree of imperfection, the following types of imperfect markets may be identified:

- (i) **Monopoly:** An imperfect market whereby one firm controls the industry with homogeneous goods. For example, Tanzania Electrical Supply Company in Tanzania (TANESCO).
- (ii) **Oligopoly:** Is a market characterised by a small number of firms who realise they are interdependent in their pricing and output policies, examples include, Kilombero sugar, Mtibwa sugar, Kagera sugar, and Tanganyika Planting Company (TPC) manufacturers in Tanzania.
- (iii) **Duopoly:** Is a situation where two firms control the market, for example, tomato paste business is controlled by Dabaga Company Limited and Dash Industries Limited (Redgold) in Tanzania.
- (iv) **Monopolistic competition:** Is a situation where many firms offer homogeneous products for example, processors of maize flour.

(g) Nature of commodity

- (i) **Commodity market:** Deals with goods and raw materials, such as wheat, barley, cotton, fertilisers and seeds.

- (ii) **Commodity mercantile exchange:** Is a market in which commodities such as coffee, and cocoa are sold based on future contract, which depends on the price of an underlying physical conditions. Investors believe that in the future the price of a commodity will increase. For example, Tanzania Mercantile Exchange (TMX).

(h) Extent of public intervention

- (i) **Regulated market:** These are markets in which business is done in accordance with the rules and regulations framed by the statutory market organisation representing different sections involved in the marketing. Marketing costs in such markets are standardised and, marketing practices are regulated; examples include, marketing of cashew nuts through warehouse receipt system.
- (ii) **Unregulated market:** In unregulated markets, business is conducted without any set of rules and regulations. Traders decide the rules for the conduct of the business and run the market. These markets face many challenges, ranging from unstandardised charges for marketing functions to imperfections in the determination of prices. Examples include marketing of maize.

(i) Population served

- (i) **Urban market:** A market that mainly serves the population residing in urban areas.
- (ii) **Rural market:** A rural market is for direct sales of small quantities of produce by farmers to village traders and consumers. It is usually conducted on a specific day.

Understanding all these types of agricultural markets enables producers to know at what time and situation of the market they can produce and supply farm products to meet consumers' demand.

Activity 3.1

Visit at least four nearby markets and observe their operations. Write a report on the type of markets they fall in terms of:

- (i) Location.
 (ii) Volume of transaction.
 (iii) Time-span.

Agricultural marketing functions

In order for agricultural produce to reach final consumers, there are several functions that have to be performed by market participants at different nodes of the value chain. Some of these functions can lead to huge or slight changes in marketing of agricultural produce. In practice, each of these functions adds value to agricultural produce. Every single activity performed by an actor in the agricultural commodity value chain, from the point of production to the ultimate consumer is termed as a marketing function. In agricultural marketing, the functions include grading, selling, buying, standardisation, processing, packing and packaging, storage and handling, distribution, and marketing intelligence.

(a) Grading

Agricultural produce are graded according to quality specifications of the destined market. For example, Arabica coffee is graded based on weight and size. Grading is a marketing function which enables market penetration of the farm produce. Different grades get different prices at the market. Fixed grade is universally accepted and followed by all actors in the value chain. If this approach was not adopted there would be problems in quality perception among consumers. Some of the advantages of grading include:

- (i) Enabling farmers to get better price at the market;
- (ii) Facilitating marketing of the produce;
- (iii) Enabling market penetration;
- (iv) Helping consumers to get high quality products at fair prices; and
- (v) Contributing to market competition and pricing efficiency.

(b) Standardisation

Standardisation means the establishment and maintenance of uniform measurement of produce in terms of quality and quantity for different commodities to meet specification of a particular market. This function makes buying and selling of agricultural produce simplified, and reduces marketing costs by enabling buyers to stipulate precisely what they want and what the producer will be willing to provide. Aspects to be considered in standardisation include weight, texture, colour, moisture content, size, and other physical and chemical characteristics of the commodities. Standardisation of produce is very important in order to meet consumers' demand and specific legal requirements.

(c) Processing

Processing is the conversion of farm produce from raw state into consumable form. Examples include the conversion of wheat into flour, preparation of butter and ghee from milk and hulling of paddy into rice. Processing adds value, hence increases the price of the products. Advantages of processing include:

- (i) Conservation of the surplus produced;
- (ii) Reduction of bulkiness of the product;
- (iii) Increasing the value of the product;
- (iv) Prolonging shelf life of the product; and
- (v) The problem of seasonality of agricultural produce is addressed as products can be stored for a comparatively longer period to ensure steady supply of the produce.

(d) Packaging

Packaging is a marketing function that refers to all activities related to designing, evaluating, and making containers/wrapping materials for a product. Packaging involves preservation and storage of agricultural products designed to serve a certain market. Different markets in the country have developed different packaging requirements for farm produce. For example, supermarkets require chicken to be branded and chicken parts to be wrapped and packed with packing materials that absorbs blood. Packaging for agricultural produce is appropriated for agricultural produce that has been processed to add shelf life as in coffee or subjected to ultra-heat temperature (UHT) as in milk. Figure 3.1 shows packed and packaging materials.



Figure 3.1 Packed products and packaging materials

Source: https://media.springernature.com/full/springerstatic/image/rt%3A10.1007%2Fs1257101605621/MediaObjects/12571_2016_562_Fig5_HTML.gif?as=webp

Advantages of packaging

Packaging has the following advantages:

- (i) Protects goods against breakage, spoilage, leakage or pilferage during movement from the production to the consumption point.
- (ii) Involves compression of some commodities such as cotton, jute and wool which in turn, reduces the bulkiness of the commodity.
- (iii) Facilitates handling of commodities such as fruits during storage and transportation.

- (iv) Helps to reduce the marketing costs by reducing handling and transportation costs.
- (v) Ensures cleanliness and prevents adulteration of the product.
- (vi) Prolongs the shelf life of products by providing protection from the ill-effects of weather, especially for fruits, vegetables and other perishable goods.
- (vii) Makes product attractive and appealing to consumers.

(e) Storage and handling

Storage involves handling and preserving of farm produce from the time they are produced to the time they are needed for consumption. Storage of farm produce can be done by using cold rooms, refrigerators, warehouse and silos. For storage, facilities such as pallets and bags with good ventilation are needed in order to prevent spoilage of farm produce. The storage function therefore, adds utility time to products which may lead to better price in the future or assurance of food availability.

Generally, storage of agricultural produce is necessary for the following reasons:

- (i) It assures a constant supply of agricultural products for producers and consumers.
- (ii) It protects the quality of perishable and semi-perishable products from deterioration.
- (iii) Some of the farm products, for example sisal sacks have seasonal demand.
- (iv) It helps in stabilisation of prices by adjusting demand and supply.
- (v) Storage of some farm produce is necessary to attain market requirement.

(f) Transportation

Physical movement of farm produce from the point of production to the final consumer is called transportation. Transportation creates place utility. It takes place through different means including road, rail, air, and water. One of the importance of transportation as a marketing function is to allow goods to reach a final destination in time. Further, transportation is associated with types of goods such as perishable, semi-perishable or dried. For example, transporting of eggs need to be well arranged to prevent any possible damage; and a van or a truck to be used has to be designed in such a way that it can accommodate the transfer of eggs with less damage. Agricultural business and transportation go together, because they reinforce and strengthen each other. Therefore, transportation is an important function for the development of agricultural business for any farm product.

Advantages of transportation

Transportation has the following advantages:

- (i) It widens the market: Transport helps to widen markets by bridging the gap between the producers and consumers who are located in different areas.

- (ii) It narrows the price difference over space: Transportation of goods from surplus areas to the places of scarcity helps in controlling price rise where there is scarcity and price fall in areas where there is surplus.
- (iii) It creates employment: The transportation function provides employment to a large number of persons through construction of infrastructure, loading and unloading of agricultural products.
- (iv) It facilitates specialised farming: Farmers can decide to specialise in commodities which are most suitable in their areas, and exchange the goods required from other areas at a cheaper price than their own production cost.

(g) Distribution

Consumable agricultural commodities have to be brought from the farm to the local market; then to primary wholesale markets, secondary wholesale, retail markets and ultimately to the consumer. Farm inputs such as fertilisers, seeds and insecticide from factories must be taken to the warehouse and from the warehouse to wholesalers, retailers and finally to the consumers (farmers).

To reach the final consumer, the channel of distribution has to be selected between direct and indirect distribution. For direct distribution, farm produce are distributed directly from the farm to the end user. For example, a poultry keeper can sell eggs directly to the end user. This enables farmers to get high profit margin but will incur more costs and risks if the end user is buying on credit.

(h) Selling

This is another type of the marketing function that generates revenue to the organisation or an individual. It brings together sellers and buyers either face to face or through other means of communication. To achieve its objective, communication skills are needed to enable a seller to communicate and negotiate a deal with a consumer. Sometimes, buyers express specification in advance on the goods they want; on this occasion, you need to find them and persuade them on the products that you can offer. This makes selling to be about the ability to persuade buyers.

In addition, during selling, negotiation skills are needed to achieve a 'win-win' situation. It is very important to understand that the aim is not only to achieve farmer's objectives of selling everything he/she has, but also to meet customer's wants and needs. With this in mind, there is a chance of developing a long-term relationship with the buyer.

(i) Buying

Buying is one of the most important agricultural marketing functions whereby motives of two different actors meet. Buyers' motive can either be to make profit or satisfy their needs. While producers' motive is to make profit from selling a given produce.

Buyers' interest is to get a farm produce with high quality at the lowest cost so that they can generate more profit. One of the things that producers can do to meet the market needs is to produce quality farm produce.

Buying has to add value to both the producer and the buyer by ensuring that profit is made. A producer should aim to supply high quality produce at the minimum cost of production. One of the mechanisms that can bring actors motives together is the use of contract farming whereby actors will understand one another's desire in terms of quality needs and price offered for the cost to be incurred.

(j) Marketing intelligence

Marketing intelligence is a process of collecting, interpreting and disseminating information relevant for marketing decisions. In practice, during buying and selling, some terms of doing business will be stipulated and agreed by both actors (seller and buyer). Some of the conditions such as payment mode need to be well screened with the understanding of the financial position of the buyer. Failure to do that can lead to financial problems to the seller while their goods have already been produced. Any marketing function involves making of decision by farmers and buyers. To make a decision, you need to have correct information, therefore, the role of marketing intelligence is to ensure the availability of correct information.

Through marketing intelligence, a producer can find the correct buyer's needs and wants and engage in production which is based on those reliable pieces of information one has. In practice, it is not possible for the majority of farmers to conduct marketing intelligence, however, through Agricultural Marketing Cooperative Societies (AMCOS), farmers' groups or Government agencies, farmers can get correct information on marketing demand, and who is a reliable buyer or a seller of a certain commodity.

Activity 3.2

Visit a nearby market and identify any five (5) agricultural commodities sold.

For each product identified:

- (i) Present a summary of the marketing functions that have been performed in relation to the commodity until it reached the market.
- (ii) Based on your agricultural marketing knowledge and with examples, identify marketing functions which were supposed to be done but were not done?
- (iii) Why were such functions not taking place?
- (iv) Write a report and present it in class for discussion.

Exercise 3.3

1. What does the term utility means in agricultural marketing?
2. Critically, think and suggest the utilities derived from executing the following marketing functions:
 - (a) Grading.
 - (b) Processing.
 - (c) Packaging.
 - (d) Storage.
3. Describe five (5) criteria to be considered when classifying agricultural markets.
4. Elaborate three (3) characteristics of each of the following type of markets
 - (a) Monopoly; and
 - (b) Oligopoly.

Principles of agricultural marketing

Principles of agricultural marketing are also called marketing mix. Marketing mix are the variables that can be controlled by the producer to satisfy customers' needs in the target market. These principles are used as a basic tool to evaluate and re-evaluate the performance of the agricultural produce and to ensure the business is reaching its full potential. Traditionally, there are four marketing mix commonly known as 4Ps which are Price, Product, Promotion and Place (distribution). Overtime, marketers have been interested in adding more Ps to accommodate other marketing mix including: processing and packaging. To date, there are about 13Ps. However, for the purpose and focus of this book, four basic marketing mix apply in agriculture, namely Product, Price, Promotion and Place; these are described in detail in the following section.

(a) Product

A product is something offered for sale by the producer to meet the consumers' needs and wants. Understanding market needs is important for the producer before they are engaged in production. When thinking about a product, consider, the key features such as benefits, needs and wants of the customers. For crop production, it is very important to consider varieties before producing for a particular market. For example, retailers who sell tomatoes in kiosks (genge) prefer Hasira tomato variety because it has a thick peel that can withstand harsh environment and transport huddles. This is important because, customers need to know features and benefits that one can enjoy by buying the produce or services.

(b) Price

Price is the amount of money expected, required or given in payment in exchange for services/products. However, price is more than just the amount of money expected, it is also a communication and bargaining tool. Therefore, price can be defined as the amount of money that a customer is ready to give based on the evaluation of the value attached on a product. For agricultural produce, price has to reflect a number of issues such as the nature of the product, production cost, demand and supply, and alternative use of the product.

In marketing, price has to communicate some attributes to customers such as quality and even possibility of a bargain. If your product is of high quality, you can start with price skimming, that, if you are selling your product at a competitive market, you can use price penetration. Price penetration is when the offered product is sold at the lowest price to access certain market while price skimming is a higher price offered for the product for quick return. To achieve this, it is important to develop a routine of examining and re-examining prices of the farm produce and services you sell to make sure it is still appropriate for the current market conditions. Sometimes, a seller is forced to lower the price if the demand is low and supply is high.

It may be appropriate to raise your price if the supply is low and demand is high. This occurs at a certain time of the year in agricultural marketing due to seasonality. For example, tomatoes are scarce from February to May in the Southern Highland of Tanzania. This happens because, at this time of the year, major tomato producers are not engaged in this crop due to high cost in management during rainy season. Growers have found that profitability of certain farm produce or services does not justify the amount of effort and resources that go into the production. By raising their prices, they may lose a percentage of their customers, but the remaining percentage generates a profit on every sale.

(c) Promotion

This is another aspect of the agricultural marketing mix that aims at designing ways of informing consumers on the availability of farm produce. Promotion can be defined as the tactics that are aimed to influence customers' decisions in the short run to try, to purchase and re-purchase a product. For example, each year, the Tanzania Dairy Board (TDB) organises a one-week promotion campaign known as 'Wiki ya Maziwa' with the aim of promoting and encouraging milk production and consumption in the country.

As an important element of marketing mix, promotion has the purpose of creating awareness, informing and persuading consumers. Promotion messages have to be designed by reflecting on the availability of means of communication tools, budget line, level of education of the targeted population, and culture. Different tools can be used to enable a seller to deliver the intended message to consumers. Promotion activities include advertising, personal selling, direct marketing, sales promotion and sponsorship, and publicity and public relation. Small changes in the way you promote and sell your products can lead to dramatic changes in your sales. Likewise, small changes in your advertisement can immediately lead to higher sales.

Both, large and small-scale farmers should continually test their products in different ways including advertising and promoting. But note that, whatever method of marketing and sales is used today, it will sooner or later not be appropriate tomorrow.

(d) Place

The term place in this context refers to the ways (mechanism) in which goods or services are timely moved from producers to consumers to have a constant supply of products. It is about how goods/services will be distributed to the right place and time. This includes warehouse, mode of transport, location, assortment, logistic, and inventory management. In this regard, a producer has to select a market channel for the distribution of farm produce by reflecting on transport mode, availability of warehouse, and the nature of products. In this marketing mix, a farmer has to develop the habit of reviewing and reflecting upon the exact needs of customers and design the means of meeting them. For example, a farmer who is selling cut-flowers in Arusha can decide to use a plane to meet consumer's need in Zanzibar. This is because of the nature of flowers as are used in their fresh state.

A farmer can sell the products in different places using different strategies. For example, some farm enterprises use direct selling by sending their sales people out to personally meet and talk to customers, some sell by telemarketing; trade fair or in retail establishments; some agricultural firms use a combination of these methods. In each case, the farmer must make the right choice about the best location or place for the customer to receive essential buying information on the product or service.

Exercise 3.4

1. In your own words, explain the term marketing mix as applied in agricultural marketing.
2. Explain seven (7) basic marketing mix as applied in agricultural marketing.
3. Suppose you have been requested to advise farmers engaged in marketing of maize in your area, what issues will you consider in relation to the marketing mix for their farm produce to penetrate Dar es Salaam market?

Agricultural value chain

A value chain is a sequence of target oriented combination of production factors that creates a market product or service from its conception to the final consumption. In agriculture, a value chain includes activities such as input supply, farm production, transportation, storage, processing, distribution, as well as wholesaling and retailing. Therefore, marketing is one of the components of agricultural value chain. Marketing participants are actors or organisations that are involved in value chain development or promotion directly or indirectly. Most of the farm produce reach consumers through several participants (actors) also known as intermediaries such as middlemen, traders, and other public agencies.

The higher the number of intermediaries the lower the share of revenue accrued per actor since the product reward is spread among many actors. However, the length of the chain depends much on the nature of the product and legal issues. For example, cashew nuts are sold through warehouse receipt system that requires every farmer to sell their produce through primary cooperatives (AMCOS). This calls for actors to understand the value each actor adds to the produce and if possible, eliminate those who are not adding any value to the produce.

In agricultural production, not all commodities are produced in all geographical areas because of variation of agro-climatic conditions. Hence, the need for marketing channels to move them from producers to consumers.

Marketing channels

Marketing channels are routes through which agricultural produce/products move from producers to consumers. A marketing channel may be defined as a chain of intermediaries through whom various agricultural products pass from producers to consumers. The length of the marketing channel varies from one commodity to another depending on the quantity to be moved, the form in which the consumer demand, and the degree of regional specialisation in production. There are two main routes through which agricultural commodities can reach the consumers as explained hereunder:

(a) Direct route

This happens when agricultural commodities directly pass from producers to consumers. This arrangement allows farmers through cooperatives to sell their coffee to buyers outside Tanzania under certain private brands such as Starbucks coffee scheme. For example, some AMCOS sell coffee directly to external buyers without passing through the exporters. However, only a small proportion of the agricultural commodities which move through this route.

(b) Indirect route

Agricultural commodities generally move from producers to consumers through intermediaries or middlemen. The chain of participants through whom various farm product/produce passes from producers to consumers constitutes their marketing channels. The intermediaries can be AMCOS, co-operative union, traders, wholesalers or retailers. The number of intermediaries may vary from one commodity chain to another. The role of market middlemen has increased in recent years because of a substantial part of the produce that moves through them.

Factors affecting the length of marketing channels

Marketing channels for agricultural products vary from product to product, country to country, lot to lot and time to time. For example, the marketing channels for fruits are different from those for food grains. The level of development of a society or country determines the final form in which consumers demand the product. For example, recently there has been increased demand for processed and packed food. Therefore, processors play a dominant role in such societies.

Some consumers are still purchasing food grains in raw form and the processing is done at the consumer's level. Also, the lots originating from small farms follow different routes or channels compared to the one originating from large farms. In some instances, small farms sell their produce to village traders, in such a situation the produce may or may not enter the main market. However, large farms usually sell their produce at the main market, where it goes into the hands of wholesalers. The produce sold immediately after the harvest usually follows a longer channel than the one sold in later months. Improvement in transportation and communication network has changed the structure, demand, and the marketing channels for farm products in Tanzania. Some of the factors that may contribute to the length of the value chain include:

(a) Nature of the produce

Fresh produce need to reach final consumers immediately after they have been harvested to avoid loss from spoilage. This makes most of fresh produce to have shorter value chain compared to dried commodities such as maize or common beans.

(b) Availability of infrastructure

Availability of infrastructure such as warehouses, financial services, road and processing factories enables the reduction of a number of value chain actors compared to situations where infrastructures are not available. For example, in the absence of all weather passable roads, village collectors who can assemble commodities from a remote area to a certain town would be needed.

(c) Terms of doing business

Supermarkets and some buyers normally have terms of doing business with suppliers. Some of these terms, for example, payment mode and delivery frequencies are difficult for small scale farmers to comply with. For instance, if a buyer pays after 30 days since the delivery of goods, some small scale farmers will not manage to wait for that long time. This can discourage farmers from selling directly to that buyer, instead they will prefer to sell through a trader who pays them cash on delivery. This can lead to adding another actor in the value chain.

(d) Legal requirements

Some commodities are regulated by their respective boards and laws which set guidelines and procedures of doing business. These procedures and guidelines can shorten or extend value chain. For example, the government has directed all coffee to be sold through warehouse receipt system and thus allowing AMCOS to collect and sell coffee on behalf of the producers. In this case, AMCOS are involved in direct selling without passing through intermediaries. This led to the shortening of the value chain as actors such as village collectors are removed in the value chain.

(e) Consumer's preference

Depending on the consumer's preference, some commodities have short or extended number of actors in the chain. For example, some people prefer fresh slaughtered chicken meat to frozen ones. This has caused a business for chicken meat in such situation to have a short value chain.

Marketing channels for different produce

Producers of agricultural products are scattered in the remote villages, while the majority of the consumers are found in the semi-urban and urban areas. Produce have to reach consumers for final consumption. There are several distributing channels of farm produce depending on the type of the produce. The distribution channels of

cereals differ from the distribution channels of oil seeds, fruits, or vegetables. These differences result from the following factors:

- (a) Perishability nature of agricultural produce: The produce such as fruits, vegetables, flowers, milk and meat are highly perishable;
- (b) Bulkiness and weight of the produce: Cotton and fodders for example, are bulky but light in weight; and
- (c) Distance between the producer and the consumer: either to the local or distant market.

Some examples of marketing channels for specific produce in Tanzania are described hereunder:

(a) Channels for fresh produce

Marketing channel of fresh produce such as tomato, cabbage, watermelon, and milk vary from commodity to commodity or producer to producer. In rural areas and small towns in Tanzania, the majority of producers perform the function of retail selling and large producers are directly selling their produce to the wholesaler or processing firm. Some common marketing channels for agricultural fresh produce are shown here under.

- (i) Producer → consumer
- (ii) Producer → Trader → consumer
- (iii) Producer → Pre-harvest contractor → retailer → consumer
- (iv) Producer → commission agent → retailer → consumer.
- (v) Producer → pre-harvest contractor → agent → retailer → consumer
- (vi) Producer → commission agent → secondary wholesaler → retailer → consumer.

(b) Channel for food grains

Marketing channel of food grains such as wheat, corn, barley differ from that of fruits. The areas where the produce are produced affect the marketing channels of a particular produce. For example; in villages, farmers sell their produce directly to consumers, different from a farmer who sells the produce in urban setting. In villages the marketing channel is shorter than that in urban settings. Different marketing channels for food grains are shown hereunder:

- (i) Producer → consumer (village sale)
- (ii) Producer → village merchant → consumer (local sale)
- (iii) Producer → wholesaler → commission agent retailer → consumer
- (iv) Producer → primary wholesaler → secondary wholesaler → retailer → consumer

- (v) Producer → Primary wholesaler → miller → consumer (bakers).
 (vi) Producer → govt. procurement → retailer → consumer.
 (vii) Producer → government → miller → retailer → consumer.

Marketing channels have great influence on marketing cost such as transportation, commission charges and casual labour. As a result of these channels, market margins received by intermediaries such as traders, commission agents, and wholesalers are small. Increasing the sales margins to intermediaries render the final consumers to suffer from high cost of the produce. Therefore, a channel is considered good or efficient when the price is cheap to ensure the highest share to the produce.

Activity 3.3

Visit a nearby market and identify any two agricultural produce that are commonly sold in that market. Interview the sellers about the source of their produce and customers of such produce, then:

- Using arrows, illustrate the chain through which the commodities passes before it reaches the final consumers;
- Identify the key market participants in the chains of the produce of your choice;
- Determine the differences in the length of the two commodity chains; and
- Outline factors which influence marketing channels of each of the identified commodity.

Challenges facing agricultural marketing system

The majority of Tanzanian population depend on the agricultural sector for their livelihood, agriculture is also the major source of employment, however, agricultural marketing system in Tanzania face some barriers as outlined hereunder:

(a) Lack of constant supply

About 65 percent of the population engaged in agriculture is mainly small-scale or smallholder farmers. These are characterised by lack of finance and sufficient knowledge for better farm management. As a result, they can hardly produce surplus for the market, rather they produce for home consumption. This is because they cannot invest in niche market of urban consumers. This leads to a lack of constant supply of commodities to buyers who want the produce in large quantities and of a certain standard and grade. Therefore, specialised markets such as tourist hotels, supermarkets and mining sites depend on a few large-scale farmers for such products as chicken, eggs, meat and vegetables.

(b) Lack of sophisticated storage facilities

Most of the agricultural produce are perishable and are produced seasonally. But

their demand is throughout the year. This means that agricultural produce need to be stored in warehouses so that they can be made available at the right time in the market. It is possible that producers of agricultural goods may not have their own storage facility. This is different from consumer and industrial goods marketing where the producers have their warehouse. The lack of appropriate storage facilities, forces farmers to sell their produce immediately after harvesting at the prevailing market price. Sometimes, selling at very low price, as a result a farmer, as a producer, gets very low or even no profit at all.

(c) Poor infrastructure

Most of small scale farmers in Tanzania are in remote areas where most of the roads are not in good conditions throughout the year. As a result, farmers either carry their produce to the market using ox-carts, bicycles, motor cycles or on their heads. This delays the produce from reaching the market thus, possible loss of some perishable products. Although refrigerated vans are increasingly used in transporting perishables goods, the cost of transportation is generally high, as a result farmers get very low returns from their output.

(d) Length of agricultural commodity value chain

In most cases, agricultural produce have relative long chain of middlemen (intermediaries) especially when the produce are transported from rural areas to urban setting. The intermediaries include wholesalers, brokers, commission agents and retailers. Agricultural commodities pass through all these actors before they reach the final consumers. As they pass through each individual, the price increases. So, it is the consumer who is finally made to bear the burden. Unfortunately, the high price paid by the consumer does not reach the farmer rather it is pocketed by the intermediaries.

(e) Accessing market information

Producers of industrial goods get information from various sources both from within and outside the organisation. The availability of internet now has given every industry owner an easy access to an information. The poor and illiterate farmers have limited access to information about markets for their agricultural produce.

(f) Weak enforcement of grading guidelines

Standardisation enables the producer and the consumer of industrial goods to get the right price for the product. Agricultural goods can be graded according to their size, shape, quality, and other criteria. However, in the market, little attention is given to grades of the farm produce. This lowers the quality and hence the value and price of the produce. For example, the Meat Industry Act, 2006 requires every animal sold at a livestock auction market to be sold based on weight but this is not always

adhered to during marketing process. The challenges on law enforcement make farmers vulnerable to low prices compared to the investment costs they had injected in raising the animals.

(g) Inadequate access to finance

Agriculture in Tanzania is mostly dependent on rain and most of the farmers do not have title deeds for their lands. These make lenders to consider farmers as high risk borrowers who cannot meet conditions of commercial borrowers. In addition, commercial banks in the country want loan to be paid one month after the disbursement of the loan. This condition is very difficult due to the nature of agriculture commodities that demands not less than 90 days before harvest. This results in marginalisation of farmers in accessing funds from financial institutions.

(h) High price of farm inputs

High price of farm inputs is one of the challenges facing agricultural marketing in Tanzania. Normally, high price of inputs makes the cost of production relatively high and unbearable to farmers. For example, in 2020/21 cropping season, the price of maize in Ruvuma before government intervention through National Food Reserve Agency (NFRA) was 230 TZS per kilogram. The production cost of maize was estimated to be 370 TZS per kilogram. This shows that the cost of production was relatively high compared to the market price of a given produce.

(i) Unethical behaviour

In some situations, unethical behaviour can be revealed in marketing of agricultural produce. These include introduction of foreign objects in the produce to increase weight (adulteration), over pricing and cheating. All these unethical behaviours make buyers to believe that producers are opportunists and in that regards, buyers offer low prices with the aim of reducing loss.

Unethical behaviours have deterred farmers from accessing some of the markets and financial institutions, hence becoming difficult to link them with niche market such as tourist hotels that are mushrooming in the country.

Activity 3.4

In activity 3.2, you identified various marketing functions which are performed in agricultural marketing.

- (a) Revisit those functions and identify key challenges that are associated with each of the functions.
- (b) Verify the identified challenges by holding discussions with market participants in a nearby market.

Exercise 3.5

Marketing of agricultural commodities in Tanzania faces several challenges.

1. Outline at least 10 challenges that affect agricultural marketing in Tanzania.
2. For each challenge outlined in (1) above, propose one strategy to solve it.
3. Illustrate two examples of marketing channels for different agricultural produce.
4. Identify any two produce found in your local area, then:
 - (a) Use arrows to illustrate their marketing channels.
 - (b) Briefly explain factors affecting the length of each marketing channel.
5. Describe different ways through which agricultural produce reach consumers.

Theory of demand and supply in agricultural marketing

This section reviews the basic economic concepts of demand and supply. These concepts are important for a farmer to understand and apply in marketing agricultural produce. The supply and demand is the theory that explains the interaction between the sellers of agricultural produce and the buyers. The theory defines the relationship between the price of a given produce and the willingness of people to either buy or sell it. Price is dependent on the interaction between demand and supply components of a market. An exchange of a product takes place when buyers and sellers agree upon the price.

The theory of supply and demand is based on two separate laws: the **law of demand** and the **law of supply**. The two laws interact with each other to determine the actual market price of the agricultural produce and the volume of that produce to be sold or purchased at a particular time.

The meaning of key terms

Before going into details of the theory of supply and demand, first, it is important to be familiar with some key terminologies used in agricultural marketing.

Demand: Is an economic want that is accelerated by the purchasing power. Therefore, demand is the number of products that a buyer is willing and able to purchase at possible prices in a given time, assuming all other non-price factors remain constant.

Demand schedule: Is a table that shows the quantity of a good or a service demanded at different price levels.

Demand curve: Is the graphical representation of the relationship between the price of a good or service and the quantity demanded for a given period of time.

Supply: Is the quantity of a given commodity that producers are able and willing to offer for sale at a given price.

Supply schedule: Is a table that shows the relationships of quantity supplied by the producer or seller at a certain price offered by a buyer.

Supply curve: Is the graphical representation of the quantity of goods that a producer is willing to supply at a given price offered by the buyer for a period.

Price: Is the amount of money expected, required or given for payment in exchange for services/products. Under free market conditions, prices are determined by forces of **supply** and **demand**.

Equilibrium price: Is the price at which the quantity of a product or a service offered is equal to the quantity of the product demanded.

Study the demand curve in Figure 3.2 which illustrates the demand theory. The curve shows that as the price of maize increases from 1 000 to 2 000 TZS, the demand for maize will decrease from 100 kg to 50 kg per week. This decrease is due to the buyers limited purchasing ability.

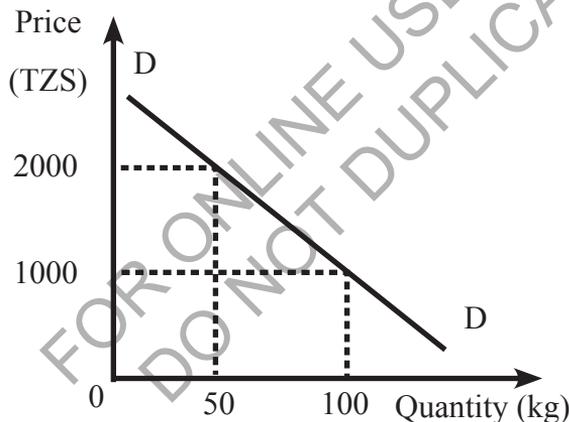


Figure 3.2: Demand curve

Example 1

A farmer was selling rice at a price of 2 000 TZS per kg, at this price level, the farmer was able to sell up to 50 kg per week. During christmas holidays, the farmer decided to offer 50 percent discount, which reduced the price from 2 000 to 1 000 TZS per kg. This resulted in an increase in sales of rice to 100 kg per week. From this example, it can be seen that the quantity of a commodity demanded increases with decreasing price and vice versa.

Activity 3.5

Mkulima managed to sell 100 kg of onions on Monday at a price of 1 200 TZS per kg. Draw a demand curve for his sales after five days (Monday to Friday), if the sales decreased by 10 percent per kilogram per day from previous sales.

Study the supply curve (Figure 3.3) which illustrates the theory of supply. The curve shows that as the price of an agricultural product increases from 1 000 to 2 000 TZS, the supplier will be willing to supply more of that product as seen in the graph from selling only 50 kg to 100 kg. Therefore, a farmer will keep increasing the supply as the price goes up and enjoying the higher profit by selling that product.

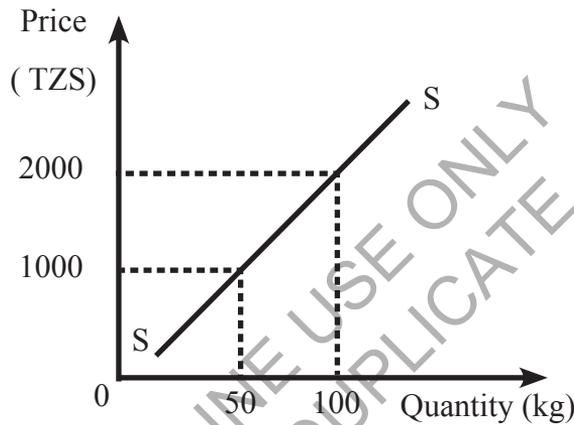


Figure 3.3: Supply curve

The implication of the above curve to marketing of agricultural product is that, as the prices go up, farmers are willing to supply more commodities because they are enjoying the higher pay, and the higher prices offered seem to cover the costs of production. However, the number of buyers with the ability to pay for the quantity supplied decreases. From these two examples, we can conclude that demand has an inverse relationship with price whereas supply has a direct relationship with price.

Example 2

Activity 3.6

A farmer is ready to supply 50 bags of maize at a price of 1 000 TZS and 100 bags if the price is offered at 2 000 TZS. Use the provided data to sketch a supply curve, then using arrows indicate the increase of price from 1 000 to 2 000 TZS, also show an increase in the quantity of bags to be supplied.

Demand and supply as key factors in price determination

Supply and demand model in agricultural marketing is a relationship between the quantity of a commodity that farmers wish to sell at various prices and the quantity of the product that consumers wish to buy. It is the main model of price determination used in economic theory. The price of a commodity is determined by the interaction of supply and demand in the market.

The theory of demand

The theory of demand states that, if all other factors remain constant, an increase in the price of a product, lead to a decrease in the demand of that particular product. In other words, the higher the price, the lower the quantity will be demanded (Table 3.1). The amount of goods that buyers purchase at a higher price is less because as the price of a product goes up, so does the opportunity cost of buying that good. As a result, people will naturally avoid buying a product that will force them to forgo the consumption of something else they value more. The demand curve (Figure 3.2), shows that the curve is a downward slope.

Table 3.1: The demand schedule for Irish potatoes

Price TZS per kg	Quantity demanded in kg
1 500	8
1 400	20
1 300	38
1 200	60
1 000	90

The theory of supply

Like the theory of demand, the theory of supply demonstrates the quantities that will be sold at a certain price. But unlike the theory of demand, the supply relationship shows an upward slope. This means that the higher the price, the higher the supplied quantity as shown in Table 3.2. From the seller's perspective, the opportunity cost of each additional unit that they sell tends to increase. Producers supply more at a higher price because the higher selling price justifies the higher opportunity cost of each additional unit sold. For both supply and demand, it should be noted that time is always an important factor in price determination. The quantity demanded or supplied, found along the horizontal axis, is always measured in units of the product over a given time interval. Longer or shorter time intervals can influence the shapes of both the supply and demand curves.

Table 3.2: The supply schedule of Irish potatoes

Price (TZS per kg)	Quantity supplied (kg)
1 500	90
1 400	60
1 300	38
1 200	20
1 000	5

The importance of the theory of supply and demand in agricultural marketing

The Laws of Supply and Demand are important because they help farmers, investors and entrepreneurs to understand and predict conditions in the market. For example, a farmer producing a new agricultural produce might deliberately try to raise the price of their products by increasing consumer demand through advertising. At the same time, they might try to increase their price by deliberately restricting the number of units they sell, in order to decrease supply. In this scenario, supply would be minimised while demand would be maximised, leading to a higher price.

Activity 3.7

Using data in the demand and supply schedules provided in Tables 3.1 and 3.2:

- Draw a demand and supply curve of Irish potatoes
- Describe the direction of demand and supply curves and explain the relationships with prices in each curve.

Price determination

Price of a product is determined by forces of supply and demand. As price of a certain commodity increases, farmers are willing to supply more goods. On the other hand, the ability of the buyers to purchase more goods decreases as the price increases. Therefore, supply and demand are key factors of price determination. The point at which supply and demand are equal is called an 'equilibrium point'. Figure 3.4 shows equilibrium at point E where demand and supply of goods supplied at a certain price are equal.

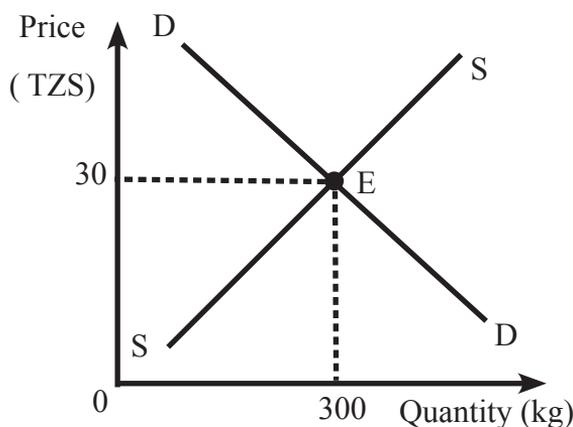


Figure 3.4: Equilibrium point

Table 3.3 shows that the price of orange is at equilibrium when sold at 30 TZS and the quantity supplied was 300 oranges. That means the price of 30 TZS per orange was offered by buyers.

Table 3.3: Demand and supply schedule for oranges

Price per orange	Quantity demanded	Quantity supplied
50	100	500
40	200	400
30	300	300
20	400	200
10	500	100

The rate of change in prices to a large part depends on the market structure within which the commodity is being traded. For example, trading in perfect competitive market is characterised by many sellers and buyers and free entry and exist or monopoly with few sellers and many buyers. These market structure will have effects on speed and efficiency on price change.

Generally, prices of agricultural commodities in each market structure or types are influenced by many factors. These factors can originate from domestic or international market. They include consumers' preferences, attributes relating to production processes (weather, pests and diseases, input costs), the prices of substitutes in either production or consumption, and government policies. The following are some of the factors influencing the price of agricultural commodities.

(a) Cost of Production

Cost of production is one of the most important factors that influence the price. It

includes total or fixed cost and variable cost incurred in the process of production, distribution, and selling of the product. Fixed cost means, those costs which remain unchanged at all levels of production or sales. Examples include, land rent, farm structures, machinery and salaries for permanent employees. Variable cost includes the costs which are directly related to the levels of production or sales. Examples include, costs of seeds and fertilisers. In this case, no farmer can sell his/her product or other services at less than a cost of production. Thus, before price fixation for a particular product, it is necessary to compile data relating to the cost of production and keeping that in mind when setting the price of a commodity.

(b) Local demand and supply conditions

Generally, the price of an agricultural commodity is lower in areas of production due to high supply compared to the demand. For example, during harvesting season, maize supply is higher compared to the demand and thus price decreases.

(c) Price of competing related produce

Related goods are classified as substitutes or complements. Substitute goods are goods which satisfy a similar need or desire. For example, common beans and green peas are substitute goods. Their uses cannot go together, that means, individuals can either use common beans or green peas. Therefore, an increase in the price of common beans will increase the demand for its substitute goods because consumers will start to consume green peas as substitute of common beans which is offered at lower price.

Complements are goods which consumer use jointly. For example, bread and butter. An increase in the price of bread will decrease the demand for its complement (butter) and vice versa. It is necessary to take into consideration the prices of the related products prior to fixing the price.

(d) Customers' income

Income of customers is one of the factors that will affect the demand for agricultural produce. In general, as the income of the individuals increase, their consumption of some agricultural produce also increases. But in some cases, the demand for some of the products decreases as the income increases while the demand of other products increases as income increases. If an increase of income will result in a decrease in the demand of a certain product while a decrease in income will increase the demand of the product, that product is called inferior good. For example, if in a certain community, individuals are used to consume product X and when their income increases, they

shift from consuming product X to product Y, then product X is considered inferior to product Y. An increase in purchasing power leads to an increase in the consumption of the product. Conversely, a decrease in the purchasing power leads to a decrease in the consumption of the product. This is the financial ability of a customer to buy products and services. Therefore, when fixing the price of a commodity, also consider this factor.

(e) Government policies and interventions

Several government policies have direct and indirect effects on the supply and demand of agricultural products. Government support varies from inputs subsidies to tax reduction or increase for different farm produce such as maize, cotton, tea, coffee, cashewnut or cloves. In general, government subsidies have effects on the crops that had received incentives which result in an increase in supply. Since, the support is only on the supply side, there is a possibility of oversupply which usually results in low price.

Furthermore, government policies can dictate prices of certain commodities through setting of indicative prices which can result in low supply or demand. If customers find the price is high, then the demand for that product will be low and vice versa. If the price of the commodity and services is to be fixed as per government regulations, the buyer should be aware of the government directives on indicative prices.

(f) Taste and preferences

Taste and preference are important elements that influence demand and supply of agricultural commodities. These elements are influenced by cultural awareness and knowledge. Awareness can lead to an increase or a decrease in the demand of agricultural commodities. For example, if consumers are aware that consuming organic food can lead to better health, it is likely that the demand for organically produced foods will increase while that of the conventionally produced agricultural commodities will decrease.

Activity: 3.8

Basing on the demand and supply schedules provided in Table 3.3:

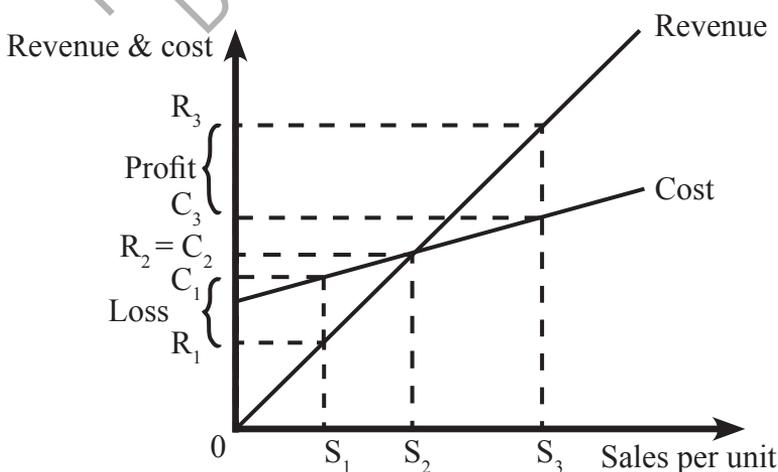
- Use a graph paper to draw a demand and supply curve on the same X-Y plane.
- Describe the trend of the data and explain the direction of each curve.
- Indicate the price level at which the two curves intersect.
- Give the technical name of the price where the demand and supply curves intersect.

Exercise 3.6

- Define the following terms:
 - Inferior goods.
 - Equilibrium point.
 - Demand.
 - Supply.
 - Substitute goods.
- Explain factors determining prices in agricultural marketing.
- Discuss the effects of related products in setting agricultural commodity prices.
- Outline factors that affect:
 - Demand; and
 - Supply of agricultural commodities.

The concept of break-even-point

A break-even-point is the point where the total sales in the farm enterprise is equal to the total costs invested. At the break-even-point, profit is zero. That means the farm is bringing the same amount of money that is needed to cover all expenses incurred in the production process. This implies that, what is received from selling the product is equal to what is used in the production process. When agricultural business break-even, it means the business is neither making profit nor loss. Typically, when agricultural business reaches break-even point, it means a positive return for a business. That is, the agricultural business is making enough to cover the variable costs. Figure 3.5 illustrates graphically the break-even point, that is $R_2 = C_2$.

**Figure 3.5:** Illustrations of the break-even point

Break-even point, helps a farmer or an entrepreneur to recognise if he/she realises profit or loss during production. However, it should be noted that, it takes time to realise profit after investment. At the beginning, a farmer or an entrepreneur would keep on injecting resources without realising profit (loss making) that is $C_1 > R_1$ as indicated in the curve (Figure 3.5). Finally, as you invest the return will start to be realised which is indicated by the revenue curve being above cost curve. The meeting point is the point of break-even meaning that, above that point, the business is generating profit (profit zone) that is $R_3 > C_3$, but below that point the business is generating loss. It is important for the farmer and other entrepreneurs to bear in mind this concept for development of their agricultural business.

The importance of break-even point

Knowing the break-even point helps in deciding a price of a given commodity, setting a budget, and preparing a business plan. The break-even point calculation is a useful tool to analyse critical points for the realisation of business profit including sales volume, average production costs and average sales price.

Therefore, break-even point, is used to determine how much you need to sell in order to cover costs or make a profit, it helps to set budgets, control costs, and decide on a pricing strategy. This allows a farmer as an entrepreneur to forecast and plan around external factors that might otherwise affect a business. Specifically, break-even point helps in:

- Determining market selling price which would give a desired profit.
- Fixing price of sales volume to cover a given return on capital employed.
- Forecasting costs and profits.
- Making inter-firm comparison of profitability.
- Determining the cost and revenue at various levels of output.

Determining break-even point

To calculate the break-even sales volume, price and revenue the following formula are used:

$$(i) \text{ Break-even sales volume} = \frac{\text{Total fixed costs}}{(\text{Sales price per unit} - \text{Variable costs per unit})}$$

$$(ii) \text{ Break-even price} = \text{Variable cost per unit} + \left(\frac{\text{Total fixed Costs}}{\text{Projected unit sales}} \right)$$

$$(iii) \text{ Break-even revenue} = \frac{\text{Fixed costs}}{(1 - \text{Variable costs per unit})}$$

The key concept of the formula is contribution margins which is the selling price minus the variable costs per unit.

Example 1: Break-even price

If Ujamaa, an AMCOS that deals with the production of tomatoes has a variable cost per a wooden crate of 20 TZS, fixed costs of 600 000 TZS and projected sales unit of 200. Calculate the breakeven price, revenue and quantities of a wooden **crate of tomatoes**.

Solution 1: Break-even price

$$\begin{aligned} \text{Break-even price} &= \text{Variable cost per unit} + \left(\frac{\text{Total fixed Costs}}{\text{Projected unit sales}} \right) \\ &= 20 + \left(\frac{600\,000}{200} \right) \\ &= 20 + 3000 \\ &= 3\,020 \end{aligned}$$

Thus, the break-even price is 3 020 TZS.

Solution 2: Projected break-even revenue

$$\begin{aligned} \text{The projected break-even revenue} &= \frac{\text{Fixed costs}}{(1 - \text{Variable costs per unit})} \\ &= \frac{600\,000}{1 - \left(\frac{20}{200} \right)} \\ &= 666\,667 \end{aligned}$$

Therefore, the projected break-even revenue is 666 667 TZS

Solution 3: Break-even sold units

$$\begin{aligned} \text{Forecasted break-even sales units} &= \frac{\text{Fixed cost}}{(\text{Selling price per unit} - \text{Variable costs per unit})} \\ &= \frac{600\,000}{(200 - 20)} \\ &= 3\,333.33 \end{aligned}$$

Therefore, the forecasted sales units is 3 333 wooden crates.

Activity 3.9

Work in a group to:

- (a) Collect the following data with respect to crops produced at your school or any nearby farms:
 - (i) Total production volume,
 - (ii) Fixed costs,
 - (iii) Variable costs; and
 - (iv) Selling price of products.
- (b) Using collected data, calculate break-even point.
- (c) Use the data to predict market price of the selected crops for the farmer to break-even.
- (d) Present your work in class for discussion

Market access and marketing of agricultural commodities

Access to agricultural markets and its information is essential for market participation. A skilled and well-equipped participant benefits more in the agricultural marketing chain.

Market access is the ability of moving a product to the desired market based on correct market information on price and demand. An increase in demand in urban market, is expected to enable farmers gain access to the market and thereby boosting their productivity, increasing income and enhancing food security.

Lack of information and poor access to agricultural markets make most rural farmers disadvantaged compared to other market actors such as traders, brokers and other intermediaries. Remoteness, poor road infrastructure, high transportation costs, inadequate knowledge and poor business skills are some of the factors that constrain farmers from access to the market.

It is important to learn different tactics that can be used to increase farmers' market access such as the use of contract farming, the provision of ICT tools to increase marketing information access, training on good agronomic practices, formation of farmer groups, law enforcement, improvement of infrastructure and training on business skills.

Major stages in marketing of agricultural commodities

Agricultural commodity transaction involves a sequence of stages to ensure that those who produce agricultural commodities are able to get them into the hands of consumers. These stages vary depending on the commodities and actors. Table 3.4 shows a summary of agricultural commodity marketing stages and their associated participants.

Table 3.4: Stages of agricultural commodity marketing

Stage	Participants
1. Assembly	Hawkers, village collectors, traders and AMCOS
2. Transportation	Train, aviation, ships, and road haulage companies
3. Storage	Warehouses, silos, cold chains, freezers owners
4. Grading and classification	Government grading system and private standards schemes
5. Processing	Millers, processors of milk, curing plants, ginneries, canning
6. Packaging	Manufacturers of bottles, glass jars, cups, tins, paper boxes, plastic and paper trays, crates, sack and polymers bags
7. Distribution and retailing	Wholesalers, distributors, stockiest, retailers

Assembly stage

The primary process of marketing agricultural commodities involves collecting or assembling which is performed at the production areas by village traders, hawkers or AMCOS. These actors have the role of buying commodities from farmers at specified prices. Some of the commodities, for example, coffee and cashew nuts exclude private buyers due to government directives. Instead, farmers are involved at this stage through warehouse receipt system. Due to low productivity, this process is very costly if one wants to collect commodities in large quantities.

Transportation stage

Farmers have to transport their produce to the market; therefore, transportation infrastructure is critical to ensure that the produce get to buyers in time. For any agricultural commodities, timely transportation is essential. If the product is not transported immediately, it can be spoiled by the time it reaches its destination. This problem compromises producer's reputation and causes buyers' dissatisfaction with the service provided. Transportation also goes hand-in-hand with proper storage. For example, for fresh milk to be transported from different parts in the country to reach processors in Dar es Salaam or Tanga, requires cooling tanks to ensure favourable temperature for milk is maintained. The same rigorous and modified storage solutions mentioned in stage three are required while the stock is being transported. Supply chains cannot be properly managed if transportation is not done properly.

Storage stage

Storage is a key part of commodity supply chain for any agricultural produce. This is because most agricultural commodities will perish if not stored properly.

Proper physical infrastructure must be in place in order to store these products to prevent them from spoilage. This includes ensuring that there are no pests or fungi damaging the products. Required temperature, humidity, air circulation and, in some cases, light levels must be guaranteed for a product to remain viable. Storage facilities include warehouses, silos, milk cooling tanks, and storage bags. In practice, for some commodities, this stage cannot be separated from the assembly (stage one). For example, milk collected through AMCOS during assembling is stored in cooling tanks to prevent spoilage. It is very important also to understand the costs associated with storage.

Grading and classification stages

One important value addition activity is grading, where the produce is separated on the basis of size or quality. Grade A or one, referring to the best quality, fetches the best prices. Through grading, farmers are able to get better prices for their produce as compared to selling ungraded produce. However, farmers have to spend time and effort on grading; and must have storage facilities to be able to take advantage of this step. In the case of ungraded produce, the value addition activities are passed on to traders who do this job instead.

Grading enables farmers and buyers to deliberate on the price and agree on the production process. However, it is very important the reward to be similar with the efforts and resources used to achieve that grade. Ungraded product can lead to unfair price and is very difficult for market actors to decide on the price. For some commodities, grading is done at the stage of storage or assembly while for some commodities grading takes place at the processing stage. For example, coffee grading takes place at the curing plant and it is very difficult to occur at the storage or assembly point.

Processing stage

At this stage, different raw agricultural produce are converted to new products. For example, raw milk can produce pasteurised milk, cheese, yoghurt, and fresh milk. For sustainable enterprise of these products, producers have to make sure that the products are of high quality for the market to absorb.

Packaging stage

Manufacturers of consumer goods know the value of attractive packaging and labelling in the market. Consumers are willing to pay higher prices for goods that are packed attractively and certified for their quality. Absence of grading and packing at farm stage makes this step quite difficult.

For some of the products, packaging has been set by the law. For example, coffee is required to be stored in sacks that allow ventilation. This implies that packaging is crucial at the assembly stage for some of the commodities. Packaging stage of some commodities like yoghurt needs cups with aluminum lining and other plastic bottles.

Distribution and retailing stage

Distribution and retailing refer to sending the farm produce where it is needed for selling. Farmers can achieve economies of scale and logistical efficiencies at this stage, besides getting better prices. However, distribution and retailing stage need good transport systems, storage facilities, the ability to hold on to their stock, and knowledge of the markets and prices. Many farmers fail on all fronts, and that is why they depend on agents to manage their entire stocks at whatever prices they offer.

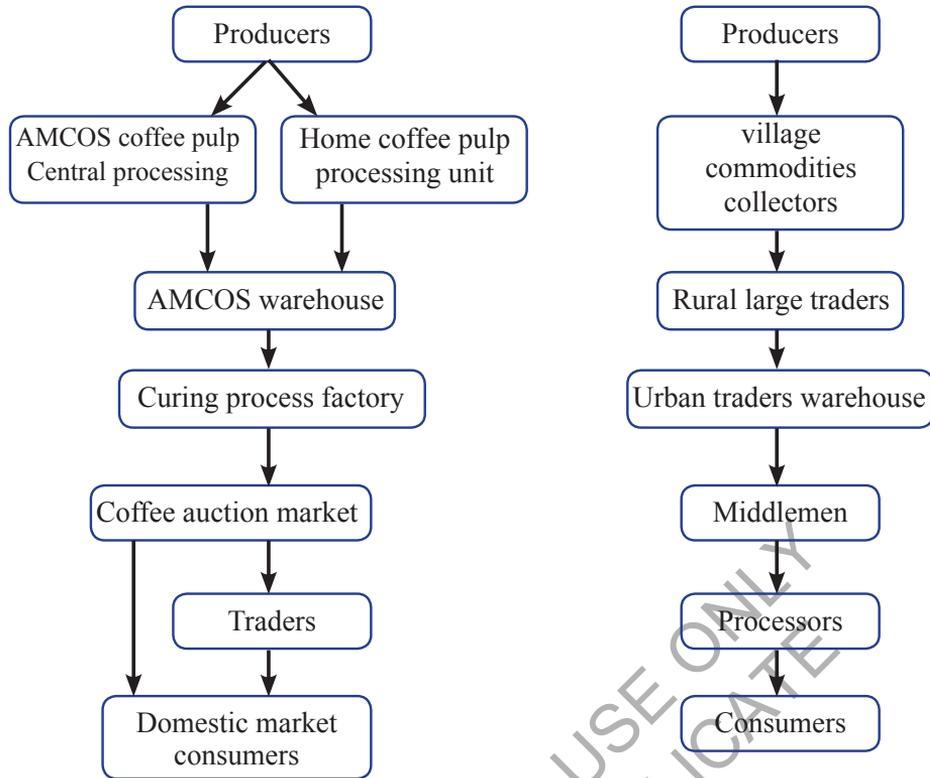
Activity 3.10

In a group, visit a nearby agricultural commodity market, observe various participants in the market. Then, write a report on:

- (a) Different participants and their roles in the market;
- (b) Share your observations in class for discussion.

Marketing of basic agricultural commodities in Tanzania

Marketing of basic agricultural commodities in Tanzania is based on two main marketing system which are planned and free market system. Each of these markets has different actors. When agricultural commodities are sold through warehouse receipt system, commodities have to pass through AMCOS and auction markets as shown in Figure 3.6 (a). Farmers and buyers meet at the auction market which is regulated by the marketing board with indicative price. When commodities are sold through unregulated market system farmers and buyers meet at the market through different actors as shown in Figure 3.6 (b).



(a) Coffee marketed through regulated market system

(b) Maize marketed through unregulated market system

Figure 3.6: Marketing of coffee and maize in Tanzania

Barriers of agricultural marketing systems in Tanzania

Agricultural marketing is strongly influenced by transportation services. Expensive transportation services result in low farm gate prices and high consumer prices at the market. Poor road condition existing in most of rural settings increases transportation costs, creating a barrier to farmers in accessing markets for their produce. Most of the roads in rural areas are seasonally passable and this limits cars and trucks from travelling to some villages to collect food crops. For example, during rainy season, the roads to the markets in most areas are only passable on foot due to muddy condition. Thus, forcing farmers to carry relatively small volumes of produce on their heads to the selling point. Common means of transport available to rural farmers are draught animal carts, bicycles, motorcycles, and tricycles. Unreliable transport with poor storage facilities also discourage farmers from sending produce to markets. Other barriers of agricultural marketing system include:

- Lack of reliable markets of farm produce.
- High taxes and processes that limit growth of the sector.

- (c) Multiple regulators on the same products.
- (d) Unethical behavioural practices.
- (e) High interest rates for agricultural credits.
- (f) Inadequate agricultural finance.
- (g) Lack of logistical facilities.
- (h) Weak law enforcement.

Activity 3.11

In a group, visit any local market and pay special attention on various agricultural products sold, including vegetables, cereals, and animal products. Supplement the information by visiting electronic sources and media. From this survey:

- (a) Compile a list of key agricultural market barriers.
- (b) Suggest appropriate measures to overcome the identified barriers.
- (c) Write a report and share it in class.

Chapter summary

Agricultural marketing is the main driver of the agricultural sector. This chapter has addressed key terminologies that are applied in agricultural marketing, the importance of agricultural marketing, agricultural marketing functions, marketing channels, and the associated participants. Other learnt concepts are the theories of supply and demand and their role in price determination, and challenges that affect agricultural marketing in Tanzania. More importantly, the approaches of addressing marketing challenges have been highlighted.

Revision exercise 3

A. Choose the correct answer

1. The best term to describe the process that adds value to an agricultural produce by changing it from the raw to finished form is:
 - (a) Form utility
 - (b) Place utility
 - (c) Possession utility
 - (d) Time utility
2. A situation where buyers and sellers are in sufficient contact with each other for the exchange of goods and services is called:
 - (a) Supply and demand
 - (b) A market
 - (c) Marketing
 - (d) A market place

3. One of the importance of agricultural marketing is
 - (a) Selling and buying the produce
 - (b) Going to the market to purchase the product
 - (c) Increase family and farm income
 - (d) Reducing the marketing of agricultural produce
4. The following are some of the marketing functions in agricultural marketing
 - (a) Grading, processes, and packaging
 - (b) Retail, middlemen, and trader
 - (c) Supply, Demand, and piece
 - (d) Storage, distribution, and supply
5. The quantity of goods/products or services that are bought at the market at a particular price during a certain period is called:
 - (a) Demand schedule
 - (b) Demand
 - (c) Demand Curve
 - (d) Supply

B. Briefly answer the following questions.

1. Marketing of agricultural products is the major challenges in Tanzania. Describe any five (5) challenges facing farmers in marketing their farm produce in your region.
2. Manufactured and agricultural produce are different in many ways. Explain at least five (5) points that differentiate manufactured goods from agricultural produce.
3. Agricultural marketing involves exchange of product from one hand to another until it reaches the final consumer. This process is facilitated by marketing function. Outline at least five (5) marketing functions of agricultural marketing.
4. Variables that can be controlled by value chain actors to satisfy the target market is called marketing mix. Mention four (4) marketing mix, then describe each one and its function in marketing of agricultural produce.
5. Explain the marketing channels that you can advise tomato growers in Iringa to reach consumers in Dar es Salaam.

6. Most of the agricultural produce reach the consumers through several value chain actors. Select a commodity that is mostly produced in your area and draw a value chain and explain the role of each actor.
7. In the cropping year 2020/21, a farmer was selling beans at the price of 2 000 TZS per kg. At this price, the farmer was selling up to 50 kg per week. During Al-haji period, the farmer reduced the price to 1 500 TZS per kg as an offer. At this offered price, a farmer was able to sell up to 100 kg per week.
 - (a) Using a graph paper, draw a graph using the transaction of a farmer.
 - (b) What is the name of the graph you have drawn?
8. Break-Even Point (BEP) is an important aspect in analysing critical point for the realisation of profit of the agricultural business.
 - (a) Write down the formula for calculating break-even sales volume
 - (b) Hodari sales coffee at 2 500 TZS per kg, and variable cost for production is 500 TZS per kg. If the total fixed cost for maintaining his coffee trees is 800 000 TZS. What is the break-even sales volume?

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Chapter Four

Agroforestry

Introduction

Agroforestry is an important component of agriculture in which different production activities are carried out. It is one of the land management approaches that integrate crops, trees, shrubs, and livestock. In this chapter, you will learn the concept of agroforestry, establishment and management of tree nurseries, and beekeeping. The competencies developed will enable you to apply the knowledge and skills on agroforestry for sustainable agricultural production and effective land management.

The concept of agroforestry

Agroforestry is a collective name for land use systems and technologies where woody perennials such as trees, shrubs, palms or bamboos are deliberately combined with animals, insects, crops or aquatic life on the same piece of land. Agroforestry can simply be defined as “farming with trees”. The practice may be in the form of spatial or temporal arrangement with both ecological and economical interactions among different components. Agroforestry combines three main renewable resource sub-sectors of crop, forestry, and livestock.

Agroforestry provides several environmental benefits including climate change mitigation through carbon sequestration, biodiversity conservation, soil health enrichment, air and water quality improvement as well as improved nutrition and food security. Other benefits of agroforestry include controlling run off and soil erosion which in turn, reduce losses of water, soil nutrients, and soil organic matter. Agroforestry also creates a more diverse agricultural operations and helps to boost farmers’ profits. Figure 4.1 shows an example of agroforestry practised in Tanzania.



Figure 4.1: An example of agroforestry practised in Tanzania

Forms of agroforestry

There are five main forms of agroforestry which are practised in Tanzania. These are agrosilvicultural, silvopastoral, agrosilvopastoral, aposilvicultural, and aquasilvicultural agroforestry. More explanations on these forms are provided hereunder:

(a) Agrosilvicultural

This is a form of agroforestry which involves a combination of woody perennials such as trees or shrubs, coconuts, and bamboos managed together with herbaceous crops such as maize, beans, bananas or groundnuts on the same land at the same time. Figure 4.2 shows an example of agrosilvicultural where trees and woody perennial plants are combined with herbaceous crops on the same piece of land.



Figure 4.2: Woody perennial plants with herbaceous crops on the same piece of land

(b) Silvopastoral

This is a form of agroforestry that combines trees or shrubs and grazing animals on the same piece of land (see Figure 4.3). The combination may include woody perennials such as trees or shrubs, coconuts, bamboos, and other trees managed together with animals such as cattle, goats, sheep and chicken.



Figure 4.3: Woody perennial plants with cattle on the same piece of land

(c) Agrosilvopastoral

This involves an integration of woody perennials such as trees, shrubs, coconuts or bamboos together with herbaceous crops such as maize, beans, bananas or groundnuts kept together with animals such as cattle, goats, sheep or chicken in a controlled way as shown in Figure 4.4.



Figure 4.4: Woody perennial plants (background), herbaceous crops (middle ground) and cattle (foreground)

(d) Aposilvicultural

This is a combination of woody perennials such as trees or shrubs, coconuts, and bamboos managed together with useful insects like bees, grasshoppers, butterflies, and caterpillars on the same piece of land. The most common form of aposilvicultural in woodlands is the combination of honeybees and woody perennials as shown in Figure 4.5.



Figure 4.5: Woody perennial plants combined with honeybees

Source: <https://blog.superbeehoney.com/beekeeping-selection-of-apiary-site-and-risk-factor/>

(e) Aquasilvicultural

This involves a combination of woody perennials such as trees, shrubs, coconuts or bamboos managed together with aquatic life-forms like fish, shrimps, crocodiles and /or crabs. The harvesting of aquatic products for example fish does not lead to destruction of woody vegetation. This is a common technique practised in many countries to conserve catchment areas. Figure 4.6 shows woody plants combined with aquatic life forms.



Figure 4.6: Woody perennial plants combined with aquatic life forms

Meaning of land management

Land management is the use and development of land resources for supporting sustainable development. Land management is also a process by which land resources



are integrated in planning to maximise social, environmental, and economic benefits. Land resources are used for a variety of purposes such as agriculture, reforestation, water resources conservation, and ecotourism. Therefore, land management is very important in enhancing the production of crops and the capacity to buffer against environmental degradation. It is also used in conserving natural resources, and preventing degradation of soil and water.

Advantages of agroforestry in land management

(a) Solution to farm limited resources

Due to limited resources especially suitable land, labour and time for forestry, crop, and animal husbandry, agroforestry is a solution to such limitations as it integrates all the three main components. It facilitates the enhancement and diversification of products on the same land unit. It further permits interactive conservation improvement and sustainability of environmental resources. It also reduces conflicts among different users through integration of different components on the same piece of land.

(b) Rehabilitation of degraded environments and increasing biodiversity

Agroforestry renews farm potential for production through nutrients recovery in the soil and returns lost biodiversity by creating suitable microclimate environment that attracts micro-organisms. With continued recycling of nutrients, it ensures sustainable production of farm outputs. Planting trees between crops reduces soil erosion and maximises nutrients recycling. This enhances soil recovery and improves life support to animals and hence improve biodiversity. This is because trees have a great capacity of maintaining soil fertility by building up organic matter and mediating nutrient cycling. This lowers the costs of inputs especially the costs of inorganic fertilisers.

(c) Hydrological systems maintenance and enhancement

The woody perennials play a great role in capturing rain water, reducing surface run off, improving water infiltration in the soil, water holding capacity, water conservation and sustain water discharge from catchments. Woody perennials also sustain water table, flow of water springs, streams and rivers, water surface areas from evapotranspiration, maintenance and enhancement in quantity, distribution and reliability of the rainfall and water supply.

(d) Climate change regulation and mitigation

Agroforestry is an important practise in mitigating the impacts of climate change. Carbon dioxide (CO₂) emitted from industries and other sources is absorbed by woody perennials thus, averts greenhouse gas effects. There are two ways in which agroforestry helps to address problems related to climate change. Firstly, it sequesters atmospheric carbon, and secondly, it reduces deforestation and restores degraded land and biodiversity.

(e) A means of controlling soil erosion

Evidence from various studies demonstrates that erosion is limited in agroforestry systems. Pruned branches and litter of leaves cover the soil and make it less susceptible to erosion through direct impact from rain drops and run off. Trees and shrubs also contribute to soil stabilisation through network of their roots.

(f) Improvement and sustainability of production systems

Trees add an extra crop that gives the farmer protection against poor harvests. Fruits, nuts or timber can provide an alternative source of income if the main crop fails due to various reasons. Diversified cropping through agroforestry can support farm businesses to operate throughout the year and prevents peaks of seasonal demands and therefore, provide a source of year-round income.

Limitations of agroforestry

Agroforestry systems can be as diverse as natural ecosystems in the sense that, what works on one farm may not necessarily work on another. The combination of crops, animals and tree species interacts in complex ways such that prediction of outcomes can be difficult. The following are limitations of agroforestry:

(a) Time for payback

Some tree species take long time to grow to bring positive effects including wind breaking and soil erosion control in the farm. However, you do not need to wait to harvest all the components at the same time. Thus, while waiting for trees to mature, a farmer can harvest other crops, aquatic lifeforms or livestock.

(b) Competition between different plant species in a farm

Competition in agroforestry systems is mainly between different plant species in a farm. Competition may be for sunlight, nutrients, soil moisture or growing space. The selection of tree species is characterised with long, narrow, vertical crowns, limited branches, and sparse narrow leaves, solves the problems of aerial competition. A solution to the aerial competition is further strengthened by using proper tree spacing. The below ground competition, especially for nutrients, can be prevented by the selection of vertically oriented deep root system trees. This will narrow the competition with the herbaceous crop roots which occupy a shallow soil horizon (i.e. within the top 45 cm) of soil profile.

(c) Vulnerability of crops to pests and diseases

The presence of woody plants (trees and shrubs) on the farm may attract wild animals, birds and insects that can in turn cause problems to the associated crops. Monkeys and various rodents are typical examples. Similarly, grazing animals like cattle can escape into crop-farms. Birds and insects may be attracted by trees which provide ready resting and nesting grounds while the associated crops become reliable food sources for them. On the other hand, there are chances of some plant diseases to affect food crops and vice versa. This is because some pathogens have a wide range of hosts.

(d) Insufficient knowledge in integrating components of agroforestry

The selection of crops and trees for intergrating on the same piece of land needs proper biological knowledge. Farmers need to master the methods of combining different plants, considering their compatibility and long-term effects on each other. Farmers also need to think about the main objective of agroforestry system they plan to practice. Trees and crops characteristics must be well understood by farmers for making the right decisions of choices on tree–crop interaction.

(e) Incompatibility of agroforestry components

Some trees release or exude chemicals which harm other trees or crops or animals (allelopathy) making it difficult to coexist on the same agroforestry unit. Proper selection of components to be on the same area may prevent the said effect for proper growth and production. For example, eucalyptus trees suppress vegetation including crops up to a distance of 11 meters away as they release a toxic substance called ‘volatile terpene’ which inhibits growth of other trees or crops. Some other components may be planted at alternating space and time to maximise performance of the other. For example, cattle and crops cannot occupy the same place at the same time.

Activity 4.1

In a group, visit a nearby school or home area and do the following:

- Observe and identify different forms of agroforestry;
- Describe the objectives of establishing the observed forms of agroforestry; and
- Write a report and present it in class for discussion.

Exercise 4.1

1. Explain the meaning and importance of agroforestry.
2. With relevant examples, discuss the importance of agroforestry in land management.
3. Describe various forms of agroforestry which are practised in Tanzania.
4. State the advantages and disadvantages of each form of agroforestry.
5. Assess the extent to which agroforestry is practised in your local area.
6. Besides its advantages, agroforestry has its own limitations. Explain any five (5) of them.

Establishment and management of tree nurseries

Trees constitute an important component of agroforestry forms. The selection of good quality tree species is one of the most important decisions to make when considering planting trees in agroforestry. Good quality tree species lead to maximum survival, growth and productivity; and minimise stress, insect pests, and pathogen attacks. Tree nurseries are used to produce quality seedlings with high survival and initial growth and development in the field. Therefore, nurseries help to ensure that genetically improved seeds and propagules are used for the establishment of productive and quality agroforestry systems.

Concept of a tree nursery

A tree nursery is an area purposely prepared for special care and management of young trees (seedlings). The establishment and management of the nursery include practices of providing the necessary care or control to increase seedlings survival and growth. This is done to provide adequate moisture, nutrients and light to allow the production of healthy and hardy seedlings. Tree nurseries can range from small or individually owned nurseries, to large commercial scale nurseries. Nursery establishment is important for anyone interested in adopting any form of agroforestry.

Procedures to establish a tree nursery

Successful seedling production needs proper choice and evaluation of the environmental factors and seedling production techniques. The following are some steps to follow for a productive nursery:

(a) Select a suitable site

The first and most important step in establishing a productive nursery is to find a suitable site. The suitable site must have the following features:

- (i) It must be easily accessible and where possible, near to a homestead for easy management of the nursery.
- (ii) The land should be well drained, flat or with gentle slope to prevent water logging.

- (iii) The area should be near a reliable water source such as stream but not prone to flooding.
- (iv) Areas with pests and diseases affecting the same tree species must be avoided.
- (v) It should have a shade to protect both workers and plants from intense direct sunshine and wind. It is also important that the site is fenced to protect it against animals and strong wind.

(b) Clear the site

Remove stumps, roots, rhizomes and stones in the area. Leaves and other non-wood debris can be separated and made into compost and the soil must be dug to 30 cm deep.

(c) Construct a structure to provide partial shade

Although some vegetation surrounding the nursery can provide shade, a fully enclosed structure of at least one bed can be constructed. For example, banana leaves or grass can be used to provide more shade if needed. Figure 4.7 shows a partial shaded tree nursery.



Figure 4.7: Partial shade in a nursery

(d) Prepare seedbeds

A seedbed is a place where seeds are sown before being transplanted into pots or main field. If many seedlings are to be raised, it is generally easier and cheaper to raise them in a seedbed and transplant the bare-root seedlings (uprooted seedlings

without soil). To prepare a seedbed, consider the following procedure:

- (i) Dig the soil and break lumps then, remove all roots and rhizomes.
- (ii) Loosen the soil and make a raised bed narrow enough to allow for weeding without stepping on it.
- (iii) Add and mix thoroughly compost or manure and sand. Sand loosens the soil for better drainage and easy uprooting of the seedlings.
- (iv) Level the bed using a rake or a stick and make shallow furrows as shown in Figure 4.8.

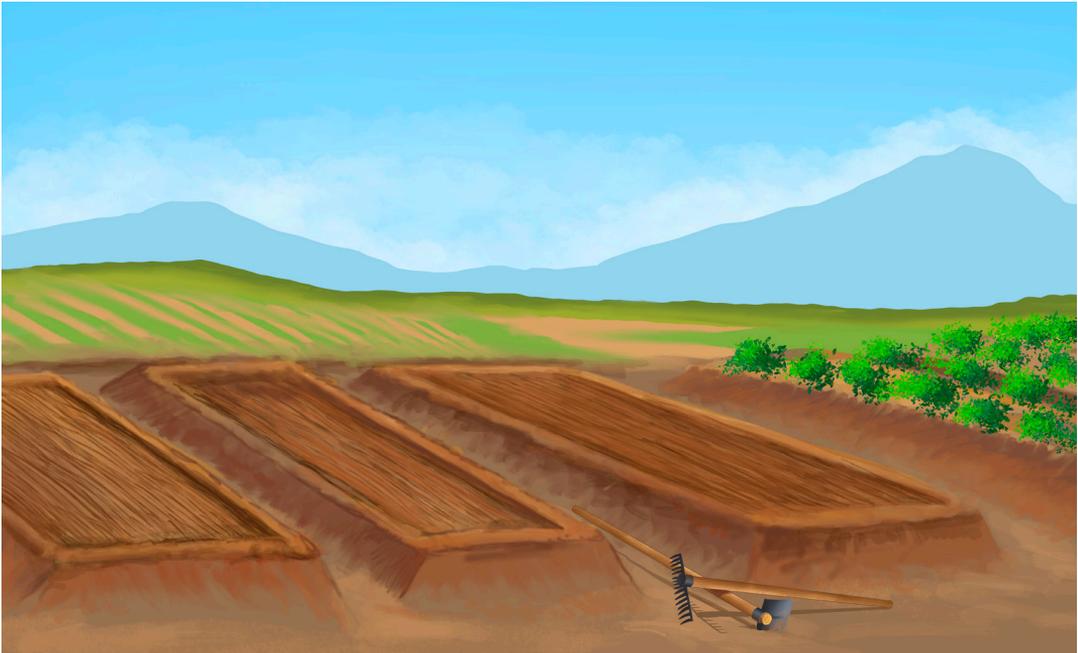


Figure 4.8: Nursery seedbeds prepared for sowing seeds

(e) Sow seeds in furrows

Tree seeds can be sown directly into poly-pots, seedbeds, or seed trays and can be pricked out into poly-pots later. Allow sufficient room for the seedlings to grow if they are to be directly out-planted. If the seedlings will be transplanted to the pots when they are still small, the seeds may be sown more densely. Cover the furrows thinly with soil not more than 2-3 times the thickness of the seeds.

(f) Transplant seedlings into individual pots

If only a few large seedlings are to be raised, it is better to sow seeds directly into the pots. Fruit tree seedlings are always potted as rootstocks for budding and grafting.

Activity 4.2:

In a group, visit a nearby tree nursery site and do the following:

- Based on observable features, describe the purpose of the established nursery.
- Enquire on the stages involved in the nursery establishment.
- Write a report and present it in class for discussion.
- Use the acquired skills to establish a tree nursery at your school.

Selection of appropriate trees and shrubs

Indigenous or exotic tree species grow well when grown at the right place with suitable climatic conditions and soil characteristics. Different areas in Tanzania have different climatic conditions (rain, wind and temperature) and soil characteristics and therefore, the choice for suitable tree species is important in establishing a given form of agroforestry.

Table 4.1: Examples of tree species, uses, and growing zones in different areas of Tanzania

Scientific name/ common name/ Kiswahili name	Uses	Suitable climatic zones to grow
<i>Moringa oleifera</i> /Drum Stick Tree/ 'Mlonge'	Fodder, fruits, environmental decoration and medicine	Moist plateau, Dry tropical, Wet tropical, Coastal belts
<i>Jacaranda mimosifolia</i> / Jacaranda/ 'Mjakaranda'	Firewood, environmental decoration	Wet montane, Dry montane, Transitional montane, Moist Plateau
<i>Delonix regia</i> / Flamboyant/ 'Mkakaya'	Firewood, charcoal, building poles, environmental decoration	Transitional montane, Moist montane, Dry tropical, Wet tropical, Coastal belt
<i>Senna spectabilis</i> /Scented cassia/ 'Mjohoro'	Firewood, charcoal, environmental decoration	Moist montane, Dry tropical, Wet tropical, Coastal belt
<i>Senna siamea</i> /Yellow cassia/ 'Mjohoro'	Firewood, charcoal, timber, environmental decoration, shade, medicine	Moist montane, Dry tropical, Wet tropical, Coastal belt

<i>Grevillea robusta</i> / Silky oak/ 'Mgrevilea'	Firewood, Timber, Poles	Wet montane, Dry montane, Transitional montane, Moist Plateau
<i>Acacia senegal</i> /Gum Arabica/ 'Mgunga'	Firewood, shade, medicine, fodder, Agroforestry	Dry tropical, Wet tropical, Coastal belts, Moist Plateau
<i>Syzygium cuminii</i> / Java plum/ 'Mzambarau'	Firewood, timber, poles, environmental decoration	Dry tropical, Wet tropical, Coastal belts, Moist Plateau
<i>Brachystegia speciformis</i> /Bean pod tree/ 'Myombo'	Bee fodder, firewood, timber, poles	Dry tropical, Wet tropical, Coastal belts, Moist Plateau
<i>Leucaena leucocephala</i> / Leucaena/ 'Mlusina'	Fodder, firewood, poles, agroforestry, charcoal	Wet montane, Dry montane, Transitional montane, Moist Plateau, Coastal belts

Activity 4.3

In a group, visit the local community around your school and:

- Identify trees found in the area.
- Explain the uses of each identified tree.
- With reasons, identify food crops that can be grown together with the trees identified in (a)
- Write a report and present it in class for discussion.

Exercise 4.2

- Explain the meaning and importance of a tree nursery as used in agroforestry.
- Describe the procedure to be followed when establishing a tree nursery in agroforestry.
- Why is it important to choose appropriate tree species to be used in a given form of agroforestry?

Beekeeping

Beekeeping has long been known to associate with man and therefore forming an important component of culture in some communities of Tanzania. Beekeeping has received added attention in recent times due to increased recognition of its socio-economic and environmental benefits. It is a valuable conservation approach which facilitates people to derive economic and socio-cultural benefits from agroforestry without destroying the environment. Beekeeping also makes a very significant contribution to agricultural production and ensures food security through pollination services to more than 70 percent of economically important crops.

Concept of Beekeeping

Beekeeping is the art and science of introducing and managing honeybees to obtain the desired benefits which include honey, beeswax, propolis, bee pollen, bee venom, royal jelly, and pollination services. Beekeeping has a long history of being a traditional activity conducted in many places in the world with honey and beeswax as the major products. Bee products have several uses including food and medicinal uses in both homes and pharmaceuticals.

The role of beekeeping as an important source of income and employment has increased because of increased demand for bees' products at local and international markets. Beekeeping can be apiculture (management of stinging bees of genera *Apis*) or meliponiculture (management of stingless bees of genera *Melipona*). Figure 4.9 shows the two main types of honeybees.



(a) Stinging honeybee (*Apis*)

(b) Stingless honeybee (*Melipona*)

Figure 4.9: Main types of bees in beekeeping

Establishment and management of apiary/meliponary

A specialised area used for rearing and managing bees of genera *Apis* is called an apiary while that for rearing and managing bees of genera *Melipona* is called

meliponary. In many places of Tanzania, apiary or meliponary are referred as ‘Manzuki’. The apiary or meliponary is composed of a set of purposively colonised beehives made in a special arrangement for easy management. Bees as animals have basic requirements to enable them survive and reproduce in addition to the production of honey and beeswax for their life. The need to consider bee’s requirements before thinking of where to conduct beekeeping is important. In selecting a site for establishing an apiary/meliponary, the following factors need to be considered: presence of bee fodder plants; availability of reliable water source, safety to human and bees, availability of shade, accessibility to site and the site should be free from strong winds, fire and pests. These factors are described in detail in the next section:

(a) Presence of bee fodder plants

Food is necessary for the life of bees just like any other living organism. Fodder plants are the sources of food for the honeybees and therefore, the survival and growth of bees. Fodder plants are blooming plants where honeybees collect nectar and pollen as their sources of food. In natural vegetation, tree species like *Brachystegia speciformis* and *Julbernardia globiflora* (miombo species) are predominant bee plants while under agroforestry settings, crops like sunflowers, maize, bananas, and beans can be good fodder plants. Indeed, sunflower is a good fodder plant (Figure 4.10).



(a) Sunflower fodder plant



(b) Bees foraging on sunflower

Figure 4.10: Honeybees foraging on sunflower plant

(b) Availability of reliable water source

Apiaries and meliponaries are to be closer to reliable water sources. If an area lacks natural occurring water sources like rivers, lakes or springs, an artificial drilled well or basin can be an alternative means. Water is important for dilution of honey for feeding young bees and also used for cooling beehive during hot weather. Closer water source enables bees to spend less energy in search for water. Bees search water all the seasons but more so during the prolonged dry months.

(c) Safety of human and bees

Safety of honeybee colonies and human beings is very important for a successful beekeeping enterprise. Theft of bee products is uncommon scenario in Tanzania but assurance of safety is a prerequisite for assured harvest. In addition, neighbouring communities and animals must be kept safe from bee sting. It is recommended to conduct beekeeping activities at least four kilometres away from schools, the community, social halls, markets, and hospitals. To ensure safety against theft or predators, beehives should be placed in a bee cage or in the bee house (Figure 4.11). In order to safeguard bees' health and quality of their products, apiaries should be located at least seven kilometres away from places where agrochemicals are used. It is also important to keep bee products and beekeeping equipment and gears in a safe environment.



(a) Bee house

(b) Bee cage

Figure 4.11: A bee house and bee cage**(d) Shade**

In general, bees need cool weather. Areas that are too exposed to sunlight are discouraged for the establishment of an apiary or meliponary. If this is not observed, bees will spend much energy and time in cooling the nest than in other productive activities of foraging and ripening honey. Bees need more water in hot days but its demand is reduced when hives are sited under a shade. In protected or private forests, beehives can be hanged under trees or sited in bee cages or bee houses.

(e) Accessibility

Apiaries and meliponaries must be accessible throughout the year to allow transportation of beekeeping equipment such as beehives, harvesting equipment, and bee products after harvesting. Accessibility by roads, railway or water simplifies the visitation to and from the apiaries or meliponaries and allow easy management of the bees.

(f) Free from strong winds, fire and pests

Strong winds make honey bees lose direction or spend substantial energy in flight especially when flying against wind direction. Areas with moderate or no strong winds are encouraged in selecting sites for the establishment of apiary or meliponary. Strong winds reduce the load carried by bees back to the hive. Sites with pests such as ants and honey badger and high fire risks should be avoided to ensure good production of bee products.

Activity 4.4

In a group, visit your nearby forest, observe and discuss factors for apiary site selection based on the following questions:

Factors	Questions
Food resources	Is there forage for the honey bees? Are there any apiaries nearby?
Water	Does the site have reliable source of water, if no, what solution do you provide?
Sun and shade exposure	How am I going to keep the position (hive face position) of the bee-hives in the apiary?
Wind exposure	How am I going to keep the position (hive face position) of the bee-hives in the apiary?
Accessibility	Is there convenient access, with minimal carrying for the beekeeper to bring in equipment, carry management and collect bee products?
Visibility to the public	Will the site cause a nuisance to neighbours or the general public? Is it safe from vandals?
Exposure to agrochemicals	Do nearby farmers use pesticides on their crops? If yes, what will be your strategy to handle the challenge?

Beekeeping methods

Beekeeping has gone through a series of changes from the honey hunting traditional approach to improved mechanisms or modern approach. In a traditional approach, people never kept bees instead they collected honey from tree trunks and crevices using poor equipment and tools. Besides honey hunting, beekeeping has developed

over the centuries where beekeepers provide protection for the bee colonies for periodic harvests of honey and wax. This kind of approach is called modern/improved beekeeping. Different places practise beekeeping using materials and resources available in their area and this is observed on the types of hives used, equipment for extracting honey and rendering beeswax, hanging hives and means for storage.

Beekeeping equipment and tools

In order to obtain maximum benefit, appropriate equipment, tools and gears must be used. In beekeeping, there are special gears, tools, and equipment that are used as described in the following section:

Beekeeping protective gears

A need for safety in any occupation is important and the need to establish safe working environment is a prerequisite. Beekeeping protective gears are special devices used to safeguard a beekeeper while conducting different beekeeping activities. The gears provide confidence to beekeepers in dealing with stinging honeybees and simplify the operations which later ensure quality of the bee products. Table 4.2 shows important beekeeping protective gears:

Table 4.2: Beekeeping protective gears and their roles in beekeeping operations

Protective gear	Function	Picture
Beekeeping hat (Ventilated helmets)	(i) Keeps the head cool on hot days (ii) Gives firm support for the bee veil.	
Bee veil	Ensures separation of the beekeeper's face and the bees outside the veil.	

Protective gear	Function	Picture
Beekeeping overalls	Protect the body against bee sting. Most beekeepers wear khaki or white overalls (a colour which does not threatens bees). The overall, are fitted with elastic cuffs and wrist bands to prevent bees from crawling inside.	
Beekeeping gloves	Pliable to allow movement of the fingers when lifting boxes and frames while protected from bee sting.	
Footwear	<p>(i) Elastic sided boots are commonly worn because they cover the ankles.</p> <p>(ii) Sock protectors provide additional protection for the ankles.</p>	
Bee smoker	Special tool used to calm down bees by disrupting their communication during honey harvesting.	

Beehives

Beehives are man-made nests for honeybees designed to suit the biological need of bees and the required spacing for comb construction. The natural nests of bees are mounds, ground and tree holes, rock crevices and under tree branches. The constructed beehives are a result of difficulties encountered by the honey hunters in search for honey in the wild which did not guarantee them getting the products, it was impossible to estimate the coming annual harvest. The variations of the beehives make a difference in management and other operations of bees. There are two main types of beehives used in beekeeping namely traditional and improved beehives.

(a) Traditional beehives

Beekeeping is considered a traditional activity in many societies in the world. The resources and materials used are extracted from the rural setting based on the available resources. Different societies construct different types of beehives. The commonly used traditional beehives are log and bark hives. Others include grass hives, pots, gourds, straw skep and banana leaf sheath hives (Figure 4.12). The construction of bark hives is discouraged as it contributes to deforestation and therefore, the government of Tanzania has banned the use of bark hives as a control measure.



(a) Bark hive



(b) Banana leaf sheath hive



(c) Log beehives.



(d) Grass thatched hive

Figure 4.12: Some traditional beehives used in different parts of Tanzania

Advantages of traditional beehives

- (i) They are a cheap type of beehives as the materials for their construction are locally collected by beekeepers near the apiaries or homes.
- (ii) Easy to construct and do not require substantial knowledge or carpentry skills.
- (iii) Family labour is commonly used to construct this type of bee hives.

Disadvantages of traditional beehives

- (i) The fixed combs make it impossible to conduct some management activities such as opening the hives for inspection, cleaning and transfer of combs or uniting colonies.
- (ii) Have a short life span of about 1 – 3 years, except log hives, which can last for over 10 years.
- (iii) A large number of bees and even the whole honeybee colony can be killed during harvesting.
- (iv) Low production of a hive per season due to their small size and difficulties in management.
- (v) Poor quality products due to failure in selecting ripe honey and separating with other hive products.
- (vi) There is colony loss or abandonment at the end of harvesting seasons.

(a) Improved beehives

These are hives with movable frames. They include the Transitional hives (top bar hives) like the Tanzania Top Bar Hives (TTBH), Kenya Top Bar Hive (KTBH), and the Langstroth (Tanzania Commercial Hive).

Transitional beehives

These are improved beehives from the fixed non movable comb hives (traditional hives). The commonly used transitional hives in Tanzania are the Tanzania Top Bar Hive (TTBH) and the Kenya Top Bar Hive (KTBH) (Figure 4.13). These hives are constructed with a box and bars and are usually provided with a lid to cover the bars and protect the bees from rains and colds. The diameter of bars which is also referred to as bee spacebar is 1.25 inches. It is of the same size as that between the adjacent combs. An average number of bars in Tanzania is 21–28 per hive. The management and harvesting of bee products in top bar hives are simple and usually end with good quality products.





Figure 4.13: Top bar beehive

Langstroth hive

These are the most improved beehives after the traditional and transitional hives, and are usually called commercial or modern beehives. These hives are made with two or more boxes (Figure 4.14). The lower box is called brood box or breeding box where the queen lays eggs while the upper boxes are called super boxes. Between the brood box and the first super box, there is a queen excluder which because of its mesh size, allows the bee castes and prevents the queen from going to the super boxes.



Figure 4.14: Langstroth hive

Advantages of improved beehives

Improved beehives have the following advantages:

- (i) Movable bars and frames make the management of bee colonies easy.
- (ii) Good quality products are obtained from these beehives because it is easy to select combs with ripe honey.
- (iii) They offer a friendly operational environment for both men and women.
- (iv) Each comb is accessible without disturbing other combs, thus, less disturbance to bees.
- (v) The hives have a long life span.
- (vi) They provide high yield of bee products per hive per season (i.e., they have high productivity).

Disadvantages of improved beehives

The following are some disadvantages of improved beehives:

- (i) They are expensive.
- (ii) They require carpentry skills to construct.

Activity 4.5

In a group, visit an apiary site near your school, then:

- (a) Observe the management activities conducted at the apiary.
- (b) Discuss and write a report.
- (c) Present your report in class for further discussion.

Bee management practices

Bee hives should be kept healthy and productive at all times. There are many threats to honey bees including pest, fire, parasite, diseases, and agrochemicals. In this case, preventing bees from such threats is important.

Honeybee pest, fire, and parasite control

Bees like any other organism face a number of enemies in their environment. Natural bees' enemies are known to cause great damage to the life and products of honeybees. These enemies also cause disappearance and migration of bees. Some enemies feed on bees, others bring about disturbance and thus, lowering the productivity or consume the stored products resulting to annual losses. The common honeybee enemies include ants, honey badger, spider, bee-eating birds, beetles, wasps, moths and lizards. Figure 4.15 shows examples of some pests that affect the honey bees.





(a) Honey badger

(b) Bee-eating birds (*Meropidae* sp)

(c) Hive beetles



(d) Hive ants

Figure 4.15: Common honey bee pests

Apart from pests, bees are also threatened by wild fires and parasites. Since most of the beekeeping activities take place in woodlands which are prone to annual wild fires, it is important to control fire to enhance honey bee productivity. Sometimes, bees can be negatively affected by parasites such as varroa mites (*Varroa destructor*). Presently, there are few diseases affecting honeybees in Tanzania. However, care should be taken to ensure that there is no importation and transmission of diseases in apiaries or meliponaries.

Pest control

The means of controlling bee pests must consider the wellbeing of bees and maintenance of the quality of bee products. The use of chemicals such as spraying insecticides in apiaries or meliponaries is discouraged. The following are some of the methods used to control honeybee pests in apiaries or meliponaries:

- (i) Regular cleaning of apiaries/meliponaries: Regular cleaning removes debris and accumulated litter which attract ants and other pests. It helps to remove any attempt of an apiary invasion by pests and provides an opportunity to

regularly check the possible infestations and act upon earlier.

- (ii) Applying ash at the base of beehives stand: Pests especially ants do not move easily on ashes and therefore ashes control them from entering into hives or apiaries. Ash can be applied across the vulnerable entry routes of ants into an apiary or meliponary or at the base of beehive stands.
- (iii) Construction of water pan at the base of beehives stand: Many ant species cannot cross through water. Therefore, putting water pan around beehive stand reduces possibility of ants invading the hives.
- (iv) Regular application of grease at the base of beehive stand: Sticky grease controls invasion of hives by small insects. Only a small amount of grease should be applied to avoid irritating honeybees and contaminate bee products.
- (v) Fencing apiaries and meliponaries: This reduces the possibility of wild animals invading apiary/meliponary. Regular checking of fence status provides an assured means of controlling wild animals from destroying hives and bee colonies.
- (vi) Avoid hanging hives under ants preferred trees: Some of the tree species are highly preferred by ants and therefore, hives should not be hanged under these trees.
- (vii) Construct a bee cage or a bee house: In addition to other techniques of pest and bee enemies control methods, bee cages and bee houses seem the best way of controlling pests and theft cases especially honey badgers.

Wildfire management

Wildfires are common environmental problems in many communities bordering forests with apiaries and meliponaries. Fire affects adversely beekeeping by killing bees, weakening colonies, destroying fodder plants, and burning beekeeping equipment and tools; therefore, wildfire reduces annual harvest. The following are some methods of controlling wildfires:

- (i) Creating fire lines or fire breaks: Fire from outside, apiaries are blocked from entering apiaries or meliponaries by making a fire line, which is a space cleared between the forest/bush and the apiaries/meliponaries to prevent fire from the burning bush to reach the apiaries.
- (ii) Awareness creation to the surrounding communities: Create awareness to the communities on managing and controlling wildfires especially uncontrolled or

escaping fires during the preparation of farms for crop production. Awareness can be created through extension programs.

- (iii) Prescribed or controlled burning: Fire purposively initiated before maximum fuel pilling. This is usually done immediately at the end of rain season. This fire is usually easily managed and burns the selected areas of apiaries only.

Bee products processing and packaging

Harvesting bee products is the act of extracting bee products from beehives. The quality and hygiene of bee products depend on the handling of the products. For effective harvesting and processing of bee products, proper choice of harvesting tools and equipment is important. Some tools are used in the extraction of honey from combs while others are used in rendering of beeswax. Honeybee combs from top bar hives or traditional hives are squeezed by using honey pressing machines (Figure 4.16(a)) to obtain honey and the remaining materials are processed to obtain beeswax. Frames from the Langstroth hives are usually placed in centrifugal machines (Figure 4.16(b)). The machine spins to extract honey from the frame cells without destroying the combs which are returned to the hive.

Storage equipment for honey must be clean and/or should be the one not previously been used for the storage of other smelling products. For example, containers previously used in storing oil and alcohols are highly discouraged. Plastic and glass materials of varying sizes are the best available storage facilities in the country. Before approaching beehives for harvesting bee products or doing any other apiary operation, a beekeeper must prepare all necessary equipment and gears including the containers and protective gears. Figure 4.16 and 4.17 show some bee products processing equipment and facilities.



(a) Electric honey press



(b) Centrifuge machine



(c) Bee products processing facilities

Figure 4.16: Bee products processing equipment and facility



Figure 4.17: Honey packaging containers

Activity 4.6

1. Work in a group to analyse the following aspects of beekeeping project:
 - (a) Important requirements;
 - (b) Initial costs (starting costs);
 - (c) Running cost;
 - (d) Challenges and how to overcome them; and
 - (e) Availability of market for the honeybee products.
2. Use the information in 1 (a-e) to establish a group beekeeping project.

Activity 4.7

Visit a nearby bee products processing unit; then,

- (a) Observe the tools and equipment used in harvesting, packaging and processing of bee products.
- (b) Write a report on the tools and equipment used in harvesting, processing, and packaging of bee products.
- (c) Present your work in class for discussion.

Exercise 4.3

1. Briefly explain the meaning and importance of the term beekeeping.
2. Show how beekeeping relates to (a) forestry and (b) crops production.
3. (a) Describe the main methods of beekeeping which are used in Tanzania.
(b) Discuss the advantages and disadvantages of each described method.
4. Examine important factors to be considered when establishing an apiary.
5. Illustrate the uses of each of the following beekeeping protective gears:
 - (a) Bee veil
 - (b) Beekeeping overall
 - (c) Bee smoker
6. Outline the uses of honeybee products.
7. Discuss the main threats to honeybees and how each can be controlled.

Chapter summary

This chapter has covered three subtopics of agroforestry which are: the concept of agroforestry, establishment and management of tree nursery, and beekeeping. It should be borne in mind that a successful agroforestry as a production system, requires good quality seedlings, health plant, animal or aquatic life form. Knowledge on compatibility of components of agroforestry is necessary to ensure reliable outputs. Five common forms of agroforestry which are agrosilvicultural, agrosilvopastoral, aquasilvicultural, aposilvicultural, and silvopastoral agroforestry have been described. In nursery establishment and management, the need for selecting health and mature seeds from health plants suiting different climatic conditions is important. In addition, beekeeping is defined as an art of keeping and rearing bees and its management activities to ensure quality bee products. The chapter has also highlighted how beekeeping plays a great role in pollination and supplementing other products of an agroforestry forms.

Revision exercise 4

1. With examples, explain the following:
 - (a) Agroforestry.
 - (b) Seedbed.
 - (c) Silvopastoral.
2. Outline five advantages of agroforestry in your community.
3. Assess the factors to be considered in selecting a nursery site.
4. How can you ensure that sources of water remain conserved by using agroforestry knowledge you have learned in this chapter?
5. Distinguish between the following forms of agroforestry
 - (a) Agrosilvicultural and agrosilvopastoral.
 - (b) Aquasilvicultural and aposilvicultural.
6. Explain the following concepts as used in agroforestry:
 - (a) beekeeping;
 - (b) land management.
7. Describe the role of agroforestry in land management.
8. Illustrate the roles of each of the following beekeeping protective gears in beekeeping:
 - (a) Bee veil
 - (b) Overall
 - (c) Bee smoker
 - (d) Bee gloves
 - (e) Boots
9. Describe five necessary conditions to consider in the establishment of an apiary or a meliponary.
10. Outline the procedure of establishing a tree nursery.
11. Describe five common honey bee pests and suggest methods for controlling them.



Chapter Five

Farm structures

Introduction

Farm structures facilitate the production and storage of agricultural produce as well as management of farm operations. It is therefore important for a farm to have farm structures according to the type and scale of production. In this chapter, you will learn the concept of farm structures, basic considerations in selecting a site and designing for farm structures, materials for constructing farm structures, and farm fencing. The competencies to be developed will enable you to apply knowledge and skills in farm structures for increased agricultural productivity.

The concept of farm structures

Tanzanian farmers are increasingly becoming aware of the need for having farm structures as an integral part of their farms. Farm structures are the different types of physical structures constructed or developed on a farm to increase effectiveness and efficiency of livestock and crop production. They are composed of organised agricultural productive units typically for growing crops and rearing animals. The common farm structures include livestock sheds and enclosures, irrigation and drainage structures, rainwater harvesting structures, farm machinery and equipment storage structures, and crop produce storage structures. Farm roads are also important structures in the farm since they facilitate access to various farm units.

Types of farm structures and their uses

Farm structures can broadly be categorised as shelter and non-shelter. Shelter structures are farm buildings that have roofs for protecting people, livestock, crops, and farm equipment against harsh weather. These structures include farm houses, livestock sheds, crop production structures, farm workshops, and produce processing and storage structures. Non-shelter structures are farm structures that are not roofed. They include livestock enclosures, fences, roads, bridges, rainwater harvesting structures, and irrigation and drainage structures.

(a) Farm houses

These are residential buildings within a farm. They accommodate farm workers and their families. A farm house should provide necessary facilities for a comfortable living in the farm. These include sleeping spaces, cooking areas, toilets, and laundry. Figure 5.1 shows staff quarters in a tea farm.



Figure 5.1: Staff quarters in a tea plantation

(b) Crop production structures

These structures are used for producing crops that require different weather conditions compared to the surroundings areas. For example, screenhouses and mushroom production structures in Figure 5.2 (a) and (b) respectively. A screen/greenhouse is used in agriculture to modify the environment for crop production that could otherwise be ineffective under open field. A screenhouse is used to reduce incidences of crop pests and diseases and modify weather elements such as temperature and humidity for maximising crop production. For example, with a screenhouse a farmer can regulate weather conditions and hence consistently supply crop produce throughout the year. Also, the use of screenhouses makes the production of high value crops feasible.



(a) A screenhouse



(b) Mushroom production house

Figure 5.2: Crop production structures

(c) Livestock sheds and enclosures

Livestock sheds, also known as barns, are farm buildings that shelter livestock such as cattle, pigs, goats, sheep and poultry. These are buildings with roofs. Livestock enclosures, however, are enclosed places where livestock are kept either temporarily or for a long time. Livestock enclosures may or may not be roofed. They include fenced-in yards for poultry, cattle, sheep, and goats. An enclosure may be made of a plain or barbed wire (for cattle, sheep, and goats) or wire mesh for poultry. Other materials used to construct livestock enclosures include timber slabs, bamboo poles and sticks. Figure 5.3 shows a livestock shed and an enclosure.



Figure 5.3: Livestock sheds and enclosures

(d) Livestock handling structures

These are structures used in handling livestock when conducting various management operations. They include plunge dip tanks, spray races, crushes and milking sheds. Plunge dip tanks are used for complete immersion of animals in acaricides for the control of external parasites such as ticks. A spray race is an alternative to a plunge dip. It is used to control external parasites such as ticks in cattle and other farm animals. However, unlike plunge dip which work by means of complete immersion, spray race works by showering animals with acaricide. Animals are completely wetted as they walk through the spray race. Spray races are more gentle than plunge dip hence preferred for spraying dairy cows, calves and sick animals.

Crush is used for restraining animals when carrying out operations such as dehorning, administering drugs, castration or even determining weight. Milking shed is a farm structure in which cows are milked. Milking parlour is a specialised milking shed exclusively for automated milking of cows. Figure 5.4 shows selected cattle management and milking structures.



(a) Plunge dip tank



(b) Spray race



(c) Crush



(d) Modern milking parlour

Figure 5.4: Livestock management structures

(e) Produce processing structures

Agricultural produce are sometimes fully or semi-processed before storage or transported to the market. Processing is done in order to increase agricultural produce market and nutritional value or to improve shelf life, and therefore, make them available during off season. In processing agricultural produce, various processes are involved including heating, drying, pressing, grinding, canning, and freezing. These processes are carried out in specialised processing structures. Examples of products obtained from processed agricultural produce include sunflower oil, maize flour, spice powder, and coconut oil. Examples of crop produce processing facilities include cotton ginneries, sisal decorticators and coffee cherries pulping structures. Figure 5.5 shows a coffee pulping structure.



Figure 5.5: Coffee pulping equipment/structure

(f) Produce storage structures

Once harvested and processed or semi-processed, crop produce may be stored for some time before being marketed or consumed. In many parts of Africa, traditional storage structures are used as food safety nets. Some examples of produce storage structures include cribs, granaries, grain silos, and warehouses. Figure 5.6 shows selected grain storage structures.



(a) Traditional granary



(b) Grain silos



(c) Grains warehouse

Figure 5.6: Grain storage structures**(g) Farm workshop**

This is the structure in the farm that provides space for repair, maintenance, servicing, and storage of farm machinery, implements, and tools. Farm workshop can also be used for fabrication of new farm tools and equipment and prefabricating building materials to be used in constructing other farm structures. The size and design of a farm workshop depends on the size of the farm and its associated operations. A small farm may simply need a small workshop room within another farm building. The room may have a shelf to store work tools and a workbench with vice for holding tools while they are being worked on. On the other hand, large commercial farms may need a larger separate building equipped with facilities for servicing farm machinery and equipment. Figure 5.7 shows part of a farm workshop.

**Figure 5.7:** Inside of a typical farm workshop

(h) Rainwater harvesting structures

Most farmers in Tanzania depend on rains for agricultural production. However, because of the effects of climate change, the amount and distribution of rains have changed and therefore, negatively impacting crop production. Currently, rainwater harvesting is considered an important way of mitigating the effects of short duration of rains by ensuring availability of water for crop and livestock production throughout the year.

There are several farm structures used for harvesting rain water for agricultural use (see Figure 5.8). These include dugout ponds and embarkment dams. Dugout ponds are constructed by digging out soil from the ground surface. They are then filled by surface run off water during rain season. Embarkment dam constitute a barrier constructed along the valley or depression of the catchment area to hold water. It thus serves as a water reservoir. Water tanks can also serve as reservoirs for rain water harvested from the roofs of farm buildings.



(a) Dugout pond



(b) Embarkment dam



(c) Rooftop rainwater harvesting

Figure 5.8: Rainwater harvesting structures

(i) Irrigation and drainage structures

For optimum production of crops, a certain amount of water is needed. When the supply of water from rainfall is little, water is applied by artificial means to assist in the production of crops. This is called irrigation and is achieved through specific farm structures called irrigation systems or structures (Figure 5.9).



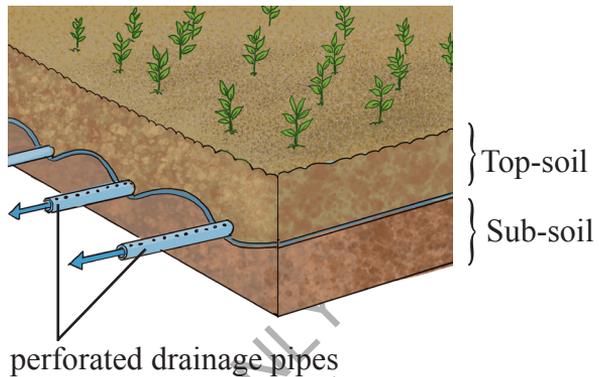
Figure 5.9: Furrow irrigation structure

On the other hand, excess rain or irrigation water leads to soils being saturated and hence raising water table above crop root zone. Saturated soils at the root zone negatively impact crop plants. In this case, artificial drainage is required. Drainage structures are constructed to lower the water table to below root zone of crop plants.

There are two types of drainage structures namely open drains and pipe drains. Open drains can either be shallow ditches constructed to remove surface water (surface drainage) or deep open drains (Figure 5.10 (a)) which aim to remove excess water from the root zone (subsurface drainage). Pipe drains (Figure 5.10 (b)) are perforated pipes installed to remove excess water at the crop root zone.



(a) Deep open drainage



(b) Sub-surface drainage

Figure 5.10: Drainage structures

Activity 5.1

In a group, visit a school or nearby farms, observe various farm operations and structures. Then:

1. Identify
 - (a) types of farm enterprise and associated operations; and
 - (b) the available farm structures and their respective uses.
2. Write a report and present in class for discussion. The discussion should base on:
 - (a) Relationship between the observed farm structures and operations.
 - (b) Sufficiency and relevance of farm structures to the identified farm operations.
 - (c) Whether there is a need for more structures required in the farm.

Importance of farm structures

Farm structures play an important role in agricultural production. Some structures provide housing for farm workers, others facilitate movement of people and goods around the farm, and yet others facilitates production of crops and livestock. Specifically, farm structures are important for the farm enterprise in the following ways:

- (i) Providing accommodation for the farm owner and/or farm workers.
- (ii) Facilitating operations such as milking, sorting and grading of farm produce.
- (iii) Livestock sheds protect farm animals from harsh weather conditions.

- (iv) Provide space for caring, feeding, and handling animals.
- (v) Produce storehouses are designed to protect/preserve/store agricultural produce against unfavourable weather, pests, and theft.
- (vi) Farmworkshop facilitates repair, maintenance and storage of farm tools, equipment and machinery; it also facilitates fabrication of other tools and pre-fabrication of building elements for the construction of other farm structures.

Exercise 5.1

1. Explain why basic knowledge on farm structures is important to a farmer
2. With examples, describe the main categories of farm structures.
3. Identify situations in which you would either need drainage structures or irrigation structures in a farm.

Basic considerations in selecting a site and designing farm structures

The construction of farm structures involves a number of stages including planning, designing, site selection, choosing of building materials and erecting the structures. Planning of farm structures is a crucial step that involves deciding among others the function of the proposed structure. Other stages such as designing, site selection and the choice of materials are also part of the planning.

Selecting a site for farm structures

Site selection refers to making decision on where to locate an intended farm structure in relation to the location of other structures in a farm. Success of enterprise for which the farm structure is to be erected, depends on selection of a good site. However, what is considered as good for one enterprise and the associated structures may not necessarily so for another enterprise and associated structures. For example, a site considered good for constructing a fish pond may not necessarily be suitable for erecting a residential farm house. Therefore, depending on the type of the enterprise and its associated structures, there are several considerations to make when selecting a site. These include the relationship with other structures, topography, soil type, direction of the prevailing wind, waste management, water availability, security, and safety. The description for each factor to consider, is given hereunder:

(a) Relationship with other structures

Some farm structures may be planned to complement the activities carried out in other structures or shared resources. For example, a biogas plant is to be constructed near a cowshed. In this case, site selection is dependent on the previous enterprise/structure.

(b) Topography

Topography influences drainage. On a relatively flat area, drainage is poor. Such areas, may be suitable for constructing dugout ponds. On relatively gentle slopes, drainage is good, these areas are suitable for constructing livestock houses.

(c) Soil type

Different soil types have different load-bearing capacities that affect the design and cost of the foundation of a farm building or structure. The selected soil should be able to withstand the stress exerted by farm structures. You also need to select a site with soil type that minimises cost of constructing the foundation of the building.

(d) Direction of the prevailing wind

When selecting a site for livestock house, you need to consider direction of the prevailing wind so that the incoming wind does not direct the odour from livestock houses to the residential house. Wind breakers are put perpendicular to the direction of the wind to reduce wind velocity.

(e) Waste Management

For livestock houses, consider how the produced waste materials will be managed. The site must conform to all national and local environmental regulations. When selecting a site for livestock enterprise, also consider the easiness of collecting and storing manure and other wastes to be generated.

(f) Water availability

Farm structures should be located at an area where access to clean and good quality water is possible. Nearly all farm enterprises require water. The structure can be located near the water source or at a place where water can be conveyed easily.

(g) Security and safety

Some of the constraints facing agro-entrepreneurs include theft, vermines infestation, and hazards (both natural or man-caused). Therefore, to avoid these, the area chosen for farm structure must be secured against theft, vermines and fire hazards.

Factors to consider when designing a farm structure

The main objective of designing a farm structure is to ensure that the final unit is capable of serving the intended purpose and able to resist applicable forces and loads applied to it. Design also informs the choice of a method and construction materials. When designing farm structures, the following factors should be considered:

(a) Intended use of the structure

Different enterprises have different requirements in terms of space, temperature, light, safety, sanitation, physical protection and many others. It is therefore important for the designer to fully understand the purpose of the intended structure.

(b) Load consideration

A farm structure should be designed to withstand loads to which it will be subjected. Farm structures are subjected to both dead and live loads. Dead loads are integral part of the structure that include weight of all the materials used in constructing the structure, such as stones, concrete, timber and roofing materials. On the other hand, live loads include weight of the produce, livestock, machineries and equipment stored

in the structure. The expected natural forces that will subject weight to the structure are also considered as live loads. These include forces of winds and earthquakes. It is therefore important to design the structure considering the expected loads to act upon it.

(c) Scale of the farming activities

In line with the purpose of production, the scale of farming activities should be considered. A farm structure should be carefully designed to meet the scale of the intended farming activities. This is important to ensure that the structure can sufficiently support the production scale.

(d) Economy of construction

A designer of a farm structure should bear in mind the overall costs of completed structure. However, the designer needs to strike a balance between quality and costs so that overall cost considerations do not compromise the quality of the finished structure.

(e) Flexibility of design

A design should allow any alteration to be made on a proposed enterprise. For example, a design should provide room for future expansion of the enterprise or a new enterprise to be established with minimum expenses and efforts. In other words, the design should be flexible enough to accommodate enterprises of different nature with few modification.

Activity. 5.2

In a group, visit a nearby commercial farm

- (a) Observe and identify various farm structures.
- (b) Take note of their design and locations in relation to each other.
- (c) Draw a sketch of the farm layout indicating positions of various structures.
- (d) Present your drawing in class for discussion. Discussion should center on type of structures, their functions and reasons for their locations, and positioning in relation to factors such as wind direction and topography.

Exercise 5.2

1. Describe two types of loads to which any proposed farm structures will be subjected.
2. Why flexibility is an important factor when designing a farm structure?
3. What are the likely consequences of erecting a farm building on a relatively flat land?
4. How does direction of the prevailing winds affect site selection for a farm structure?
5. State six factors that should be considered when siting a farm structure.

Materials for constructing farm structures

Construction materials are substances naturally occurring or industrially made that are used to construct different structures of various types and purposes. Construction

materials can generally be categorised as naturally occurring materials such as stones and woods, and man-made construction materials such as steel and metal bars. Construction materials usually require a certain level of preparation to make them more useful.

Types of construction materials

Farm structures are made from various types of materials. Different farm structures may be constructed using different types of materials depending on the intended use of a structure and properties of the type of material to be used. Construction materials commonly used for farm structures include stones, bricks, cement, sand, aggregates, mortar, concrete, steel bars and pipes, timber, poles and thatch grass. Other construction materials are pipe fittings, iron sheets, polythene sheets, fencing wires, monkey wires and wire mesh. Some construction materials commonly used in farm structures are described below:

- (i) **Stones:** Stones are obtained from rocks occurring in nature. As construction materials, stones are used for the construction of foundations, walls, columns, and lintels. Stones are also used for decorating structures and paving roads and tracks. Furthermore, stones are crushed to form other construction materials such as aggregates and murrum. Aggregates, together with sand and cement, are used in making concrete.
- (ii) **Bricks:** Bricks are the most common construction materials for making walls, columns, pavements and to some extent floors. They are made from clay soil by moulding into rectangular shape. Since the forms used to mould bricks are of uniform size the resultant bricks are usually of uniform size hence making them easier to use when constructing farm structures. There are two types of bricks, mud or un-burnt bricks and burnt bricks. Un-burnt bricks are bricks which are only sun dried after moulding. They are mostly used for the construction of cheap or temporary farm structures. They are not suitable in places with heavy rains. Burnt bricks are a result of burning sun dried bricks in kilns. These bricks are much stronger and capable of withstanding corrosion by rains. Figure 5.11 shows burnt and un-burnt bricks.



(a) Un-burnt bricks



(b) Burnt bricks

Figure 5.11: Burnt and un-burnt bricks

- (iii) **Concrete blocks:** These are similar in shape and use to bricks. However, the difference lies on size, composition and weight. Blocks are usually bigger and heavier; they are made from concrete (the mixture of cement, sand and sometimes fine aggregates). Concrete blocks can be hollow or solid (see Figure 5.12 (a) and (b)).



(a) Solid concrete blocks



(b) Hollow concrete blocks

Figure 5.12: Concrete blocks

- (iv) **Cement:** This is powdery substance with adhesive properties used as a binding material in construction. It is mixed with sand and water in appropriate proportions to make mortar used for different masonry works such as brick laying, plastering and pointing. Cement is also used to make concrete which is a mixture of cement, sand and aggregate in proportions that suit specific uses. Some uses of concrete include making slabs, floors, columns, lintels, concrete blocks and manufacturing of other prefabricated construction materials.
- (v) **Sand:** This is a naturally occurring material composed mostly of rock particles that are finer than gravel but coarser than silt. It is a commonly used material in construction works. When mixed in proper proportions with water, cement, aggregate, and sand provides the bulk, strength, and stability to the formed mortar and concrete.
- (vi) **Aggregates:** These are construction materials produced mainly from crushed rocks. In construction, aggregates are mixed with the right proportion of sand, water and cement to make concrete for floors, walls, columns, and beams of various farm structures. Aggregates can be classified as coarse, medium, and fine. Coarse aggregates have a diameter range of 16 mm – 64 mm, medium 8 mm – 16 mm and fine aggregates have a diameter of 4 mm – 8 mm. Figure 5.13 shows coarse aggregates.



Figure 5.13: Coarse aggregates

- (vii) **Timber:** Timber refers to wood prepared into beams and planks for use in construction and carpentry. Timber is used for the construction of doors, windows, roofs, beams, fencing posts, and partitioning of livestock houses. Figure 5.14 shows a bundle of timber.



Figure 5.14: A bundle of timber

- (viii) **Thatch grass:** Thatch grasses are grasses mostly from the genus *Hyparrhenia* used for thatching roofs. They are traditional construction materials in many parts of Africa. In farms, thatch grasses are ideal for the construction of specialised structures such as mushroom production houses. Thatch grasses are also used in the construction of roofs and partitions of other farm structures. Figure 5.15 shows thatch grass.



Figure 5.15: Thatch grass

Activity 5.3:

In groups, visit a school or a nearby farm (each group should visit a different nearby farm) then:

- (a) Observe various farm structures.
- (b) Choose one structure and identify all materials used in its construction.
- (c) Present your observation in class for discussion. Compare with other groups for establishing which materials appear common. Why do you think such materials are commonly used in the visited local area?
- (d) Discuss the advantages and disadvantages of the construction materials used.

Choosing construction materials

Proper functioning of farm structures depends on the quality of the construction materials used. This means, if the materials used to construct a certain farm structure were of low quality, the resultant structure will be of low quality and hence negatively affect its functioning. Therefore, it is necessary to choose appropriate quality construction materials so that a completed structure will be durable, able to bear dead and live loads and function properly. The performance of the completed structure, cost-effectiveness, availability of building materials, climatic conditions of the area where the structure is to be erected, aesthetic appeal, and environmental conditions are some of the important factors guiding the choice of construction materials for farm structures. These factors are explained in detail hereunder:

(a) Performance requirements

Performance requirements of the selected construction materials relate to their structural capabilities and durability. This means that the materials should be able to support the intended loads and be durable in order to minimise maintenance and replacement costs.

(b) Cost-effectiveness

Cost is a major concern in the construction of farm structures. Naturally, it is appealing to go for most affordable products. However, this is not always good since there are chances of compromising the quality of the finished structure and being costly in terms of maintenance. Therefore, when selecting construction materials, one needs to consider the quality and life span of the structures. Cost-effectiveness is therefore, essential in the selection of construction materials that will last longer at a reasonable price.

(c) Availability and affordability

Availability of construction materials influences cost in terms of finance and time. Locally available materials are cost effective and take less time to collect and deliver at site of work. Other materials are not locally available hence the farmer incurs transportation costs. It is therefore advisable to acquire locally available materials in order to save associated costs.

(d) Climate

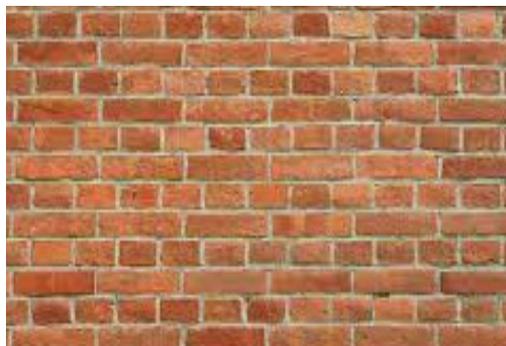
Climate has influence on the life span of construction materials and hence the completed farm structure. Different types of construction materials respond differently to climatic factors such as temperature, rainfall, humidity and wind. The selected construction material should be of certain level of resistance against the prevailing climatic conditions.

(e) Aesthetic appeal

This relates to the preferred appearance of the completed structure. A farmer obviously wants to construct structures that look good, be it a livestock house or a walkway to the poultry unit. Different types of construction materials offer different looks of the finished structure. For example, decorated stone wall and burnt bricks wall (Figure 5.16), look differently and hence have different appeals to people.



(a) Decorated stone wall



(b) Burnt brick wall

Figure: 5.16: Stone wall and brick wall**(f) Sustainability**

Sustainability of construction materials relates to being environmentally friendly. This means, the selection of construction materials should be from sources that have little negative impact on the environment. Similarly, it is about the ability to be reused, recycled or disposed of at the end of its life span without harming the environment. Such materials as earth, bamboo, sand and thatch grass are considered as environmentally friendly and hence sustainable construction materials.

Exercise: 5.3

1. Considering farm structures found in your school or nearby farms. Explain the criteria used in choosing the construction materials for the farm structures
2. What do you understand by the term structural capability of a construction material? Why should you consider structural capability when selecting construction materials?
3. How does climate influences the life span of construction materials?
4. Why sustainability is an important factor in selecting construction materials?

Maintenance of farm structures

Maintenance enhances life span and proper functioning by checking the rate of deterioration of farm structures, the use of the structures and natural phenomena. Natural phenomena such as temperature, wind, rain and humidity act on structural member of farm structures impacting their stability and aesthetic appeals. Similarly, weight and dirty resulting from the use of structures are responsible for continued deterioration of farm structures.

Maintenance strategies of farm structures

Two main strategies can be applied in the maintenance of farm structures. These are preventive maintenance and corrective maintenance. Preventive maintenance is carried out at regular intervals, aimed at reducing the risk of failure of a farm structure. This maintenance strategy is planned in a cycle and is referred to as routine maintenance.

Corrective maintenance is carried out to rectify the observed damage to a part of or the entire structural member. This maintenance is aimed at reinstating normal functioning of the structure. For example, following heavy rains, it has been observed that gates of water reservoirs are damaged such that normal functionality has been impaired. Restoring the gates of the reservoirs to the normal functioning state is considered as corrective maintenance.

General maintenance practices of farm structures

There are specific maintenance practices for each type of farm structure depending on the type of construction materials used. However, the general maintenance practices include cleaning, regular inspection, painting, oiling and repairing works.

- (i) **Cleaning:** Farm structures need regular cleaning in order to extend their life span. Each type of structure has its own mode and interval of cleaning. For example, water reservoirs may be cleaned once a year towards the beginning of rain seasons whereas milking sheds may be cleaned on daily basis.
- (ii) **Regular inspection:** Inspection of farm structures should be carried out regularly in order to identify defects at early stages before they become too costly to repair.
- (iii) **Painting:** Wooden parts of certain structures need to be painted periodically in order to prevent damage by weather, insects and moulds. Metal parts may also need periodic repainting with red oxide-based paints to prevent rust.
- (iv) **Oiling and greasing:** Moving parts of certain structures such as hinges need to be oiled or greased in order to facilitate ease movement and hence prevent damage.
- (v) **Repairing:** This is the practice of mending damaged parts of structural member. Repair works include mending broken fences, leaking roofs, blocked water ways and sewers, and cracks on walls and floors.

Importance of carrying out maintenance of farm structure

Generally, maintenance is important in ensuring structures continue to function in the best possible way. The following are specific reasons why maintenance of farm structures is important:

- (i) Maintenance prolongs the operational life of construction materials. For example, if metal pipes are used as stays of a cattle crush, routine painting with red oxide minimises rusting and hence improves their operational life.
- (ii) Maintenance improves appearance of farm structures. With time, structural members fade and lose their aesthetic appeal. Maintenance practices such as painting restore their original appearance.
- (iii) Maintenance ensures proper functioning of farm structures and hence prevent costs associated with non-functioning. For example, if a milking shed is out of service because of poor maintenance, arranging for alternative milking place would bring in unnecessary costs.
- (iv) Maintenance increases safety value of farm structures and hence ensures safety and security of properties and users.

Exercise 5.4

1. Describe the concept of 'farm structures' and explain their uses.
2. What are the basic considerations when selecting a site for erecting a farm structure?
3. Describe factors to consider when designing farm structures.
4. Suggest the locally available materials you would need to construct a cattle crush.
5. Compare and contrast preventive and corrective maintenance strategies of farm structures.
6. Explain any four general maintenance practices of farm structures.

Farm fencing

Fencing is functional in many ways within a farmstead. For example, a fence is commonly used in semi-intensive system for managing livestock. The use of fencing in farming is traced to times when farmers started practising mixed farming system. In mixed farming where crops and livestock are raised by the same farmer, farms are fenced to protect crops from being destroyed by livestock. Fences ensure security of livestock. Fencing is made by using different materials. The earliest fences were made using materials such as stones and wood. These materials are still in use today.

In the following sections, the concept of farm fencing, different types of fences, materials, and the uses of fences are discussed.

The concept of farm fencing

The main purpose of fences is to control movement of animals and people within the farm. It serves the functions of partitioning, demarcating, separating and enclosing an area for various uses in the farm. A farm may be partitioned to suit different enterprises or different systems of production. Fences make livestock enclosures, preventing them from damaging crops and protecting them from thieves and predators. Farm fencing, therefore, can be adapted for various uses and hence considered a versatile structure. There are different types of fences depending on the materials used and construction styles. However, two broad types of fences are discussed hereunder:

Living fences

A living or live fence is made from live trees and/or shrubs planted on areas where a fence is required, for example, farm or homestead boundaries. Live fences are further divided into live fence posts and live barriers or hedges. Live fence posts are widely spaced, single lines of woody plants that are regularly pruned back and used instead of metal or wooden posts for supporting barbed wire, bamboo or other materials. These fencing posts are more durable since they are more resistant to insects and fungi that attack dead wood. Figure 5.17 shows live fence posts.



Figure 5.17: Live fence posts

Source: Internet

Live barriers or hedges are trees or shrubs planted in very close spacing such that they form a barrier between neighbouring properties or enterprises. To improve their aesthetic appeal, hedges are normally trained by trimming. Usually, hedges are not planted to support other fencing materials. Figure 5.18 shows hedges.



Figure 5.18: Hedges

The importance of live fences

Live fences have numerous benefits to farmers. Specifically, the following are some importance of live fences.

- (a) Some tree species such as *Leucaena* and *Gliricidia* used in live fencing are multipurpose, providing fuel wood, livestock fodder and nutrient-rich mulch.
- (b) Provide protection to farmland against water and wind erosion.
- (c) Protect field crops from livestock and other wild animals.
- (d) Provide renewable supplies of wood.
- (e) Live fences serve as windbreaks to protect crops. Strong winds tend to stress crops and reduce their yields.
- (f) Some species may provide fruits, flowers and medicinal products.
- (g) Live fence provides shade and filters dusts.

Disadvantages of live fences

- (i) Take long time to fully establish: Live fences may take long time to be fully established into an effective fence. This is because trees need long time to grow.
- (ii) Take more space: Live fences are less efficient in partitioning land, especially for crops because trees occupy large space. Also live fences may have shading effects on crops.
- (iii) Harbour pests and disease-causing organisms: Using live fences may be disadvantageous since some crop and animal pests and disease-causing organisms may be harboured in the fence.
- (iv) Provide hideout for wild animals and thieves: Live fences may serve as a hiding place for thieves and wild animals.

Dead fences

Fence constructed from non-living materials such as dead wood, bricks, stones, wire mesh and barbed wire are considered as dead fences. Common dead fences used in some parts of Tanzania are made of posts and timber pad or wires of various designs. Posts are the main stay of fences and are made of wood, timber, concrete, steel, or aluminium. Timber slabs are obtained when logs are sawn into timber. The various types of wire used are barbed wire, plain wire, wire mesh and monkey wire. Bamboo and wood sticks can be used in place of timber slabs. The types of dead wire fences are derived from the construction materials used. These include barbed wire, plain wire, wire mesh, woven wire, chain link wire, and high tensile wire fences.

(a) Barbed wire fences

Barbed wires are made by twisting together two plain wires and winding wire barbs with sharp end a regular interval. Barbed wire fence consists of posts spaced at regular intervals of about 2 to 4 meters apart, and 3 to 5 barbed wires run horizontally at a space of 15 to 20 centimetres. If wood poles are used as posts, U-shaped nails are used to fix wires on the posts. A wire stretcher is used to pull the wire to the desired tension. Barbed wire fences are used to secure the property and keep intruders out. However, barbs may cause injuries to livestock and people who are working in the farm. Figure 5.19 shows barbed wire fence.



Figure 5.19: Barbed wire fence

(b) Plain wire fences

Plain wire fences are similar to barbed wire fences in terms of the main material used and construction method. However, as the name implies the horizontal wire is not fitted with barbs. This type of fence is less likely to cause harm to livestock and workers. However, the level of security offered by this fence is relatively low. Figure 5.20 shows a plain wire fence.



Figure 5.20: Plain wire fence

(c) Electric fences

Electric fences are a safe and effective way of discouraging wild animals and trespassers from coming into livestock enclosures, and ensuring that livestock stay

in their designated places. They offer higher level of security and safety compared to barbed wires. The main components of electric fences are the fence stay posts, strands of electrified wires, fence energizer and insulators. The posts may be of wood, concrete or metal spaced at regular intervals of 2 to 4 meters. Strands of wire run horizontally on posts. These wires include conductors which carry electric current from the energizer and earth wire which carries the current back to the energizer to make continuous loop of electric current. Fence energizers produce pulses of electric current. Insulators prevent electric current from passing through the posts to the ground and get lost. Figure 5.21 shows some of the electrical fences.



Figure 5.21: Electrical fences

(d) Wire mesh fences

Wire mesh fences are of three types depending on the type of wire mesh used. These are welded wire mesh, chicken wire mesh and chain link wire mesh. These are factory woven wires, hence, installation is easier than plain wires which have to be woven on the site. The fence is made of posts on which the wire mesh is fixed. Figure 5.22 shows the three different types of wire mesh fences.



(a) Welded wire mesh

(b) Chicken wire mesh

(c) Chain link wire

Figure 5.22: Mesh wire fences

(e) Timber slab fences

Timber slab fences are made from slabs obtained in the process of sawing timber from logs. The outermost part of the sawn log is what constitutes timber slab. They are the most common farm structure construction materials in areas where timber is produced. Figure 5.23 shows a timber slab fence.



Figure 5.23: Timber slab fence

Advantages of dead fences

Dead fences have the following advantages:

- (i) Space economy in stock management: Compared to live fences, dead fences use small space and leave enough space for various farm operations.
- (ii) Short installation time: Compared to live fences that might require several years to establish, dead fences take relatively short time to install.

Disadvantages of dead fences

Dead fences have the following disadvantages:

- (i) Wire fences tend to degrade over time due to rust.
- (ii) Barbed wire fences are likely to injure livestock and people.
- (iii) Construction materials for dead fences are more expensive compared to live fences.
- (iv) Dead fences need high skilled labour for construction.

Advantages of using live fences over dead fences

Live fences have the following advantages over dead fences:

- (i) Live fences are cheaper: Generally, monetary cost needed to erect and maintain a live fence is fairly low compared to dead fences.

- (ii) Durability:** Live fence posts are far more durable than wooden posts as they are more resistant to attack by termites and fungi. Also, live fences last as long as the lifespan of the species, some of which can be over a hundred years. The pruning of live fences encourages re-growth.
- (iii) Sustainability:** Live fences are considered more sustainable than dead fences. They are environmentally friendly and support biodiversity by creating micro-ecosystems where other insects and small animals can build their homes.
- (iv) Act as windbreak:** Live fences help in reducing and directing strong winds on a farm. Too much wind can stress out livestock and crops and reduce their yield. When the force of wind increases it also causes the soil to dry up. Through live fence, land will retain more moisture and this will enable the farmer to cut down on the amount of water used for irrigation.

Uses of farm fences

Different farm enterprises have different needs. Farm fences being versatile structures, can be adapted for different uses in a farm. These include:

- (a) Controlling grazing:** Fencing is used to force grazing animals to graze on a specific plot allowing pastures on another plot to recover from previous grazing.
- (b) Controlling livestock movement:** The performance of dairy cows, for example, is affected by energy lost through movements. Fencing prevents dairy cows from wandering, hence conserving energy that would have been lost on movements.
- (c) Protecting livestock and crops:** Fences protect crops and livestock from pests, wild animals, and thieves.
- (d) Protecting water resources:** Water resources such as streams, dams, and ponds may be damaged by livestock if not protected. Fencing these water resources will limit livestock from accessing them.
- (e) Marking boundaries of the farm:** Fencing around the boundary of a farm protects the farm from unwanted visitors. It is also a way of preventing conflicts related to boundaries.
- (f) Organising farm:** Fencing helps in organising the farm into sections of different enterprises. For example, separating the farm into horticultural unit, fish production unit, field crop unit, and residential area.

Activity 5.4

In a group, visit some nearby fenced farms, then;

- (a) Identify the type of fence made and the construction materials used;
- (b) Ask the farm owner on the reasons for choosing the particular type of a fence; and
- (c) Summarise your observations and present the findings in class for discussion.

Materials for farm fencing

Materials for fence construction commonly used on farms include barbed wire, woven wire, wire mesh, and high tensile wire. The type of fence that you will need depends on the livestock, crops, and other vegetation that border the fence. Figure 5.24 Shows some materials commonly used to construct wire fences.



(a) Wire mesh



(b) Wood poles



(c) Plain wire

Figure 5.24: Some materials commonly used in construction of wire fences.

Construction of simple farm fences

Building a fence requires good materials, proper construction techniques, and good common decision. The most appropriate fence design will depend on several factors including the type of farm enterprise. For instance, cattle exert more pressures on fences than goats. Therefore, fence design for a cattle enterprise will be different from that of a goat enterprise. Choosing a fence line, installing line posts, corner and end-post assemblies, and running strands of wire are important activities in constructing a wire fence.

(a) Choosing and clearing the fence line

Fence line is a line through which your fence will run. To choose a fence line you need to understand the purpose for which the fence is constructed. If it is for marking boundary of the farm, consider confirming the actual boundary line in order to avoid conflicts with neighbouring properties. Once the fence line is chosen, it has to be cleared of any obstructions to make it easy for erecting the fence. For easy of work, the line should be cleared to the width of at least 2 metres.

(b) Install corner and end-post assemblies

Corner-post and end-post assemblies are fence structures bearing the most tension forces of the fence line. In this way, they are considered as fundamental parts of wire fences. Corner-posts are installed at the points where the fence line changes direction such that the inside angle becomes less than 180 degrees. The end-posts are installed at the end of a fence line or where a gate is to be installed. When wire strands are properly tensioned, enormous forces of pull are applied to the corner and end-posts assemblies. These assemblies must be installed in a manner that they are capable of withstanding these forces. Corner-posts and end-posts are installed deeper than inline posts and are installed with supporters which are placed diagonally. These supporters are the ones that bear the tension forces. The key point is to build a corner and an end-post right and put them deep enough. This is because the corner or end-assemblies can be pulled out of the ground while tightening the wires because the posts were shallowly dug into the ground.

(c) Installing line posts

Line posts are all other posts that are installed between the corner-post and/or end-post. Their main function is to keep the wire strands in position and minimise sagging. To install line posts, stretch a wire between either corner-posts and/or between end-post and other end-post or corner-post. This wire will help guide the alignment of line posts. Install a line post at a range of 2 to 4 meters depending on requirement.

(d) Installing strands of wire

Wires used in fencing may be plain, barbed or mesh. These wires are unwound from their rolls and run through the length of the fence line. Stretch the wires to the required tension using a wire stretcher. Staple the wires using u-shaped nails if posts used were wooden poles. For steel posts use wire clips that come with posts. Figure 5.25 shows a wire fence with its components.



(a) Wire fence



(b) Corner-post assembly



(c) End-post assembly

Figure 5.25: a wire fence with its components.

Activity 5.5

In a group, design and construct a fence using locally available materials.

Exercise 5.5

1. What is farm fencing?
2. Explain the importance of farm fencing.
3. Why would a live fence be more advantageous than a dead fence?
4. Describe any four common types of dead fences.
5. Illustrate the main components of a wire fence.

Chapter summary

This chapter have presented the concept of farm structures and their importance in production and handling of crops and livestock. The chapter has highlighted various uses of farm structures. These include accomodating livestock and people, producing crops, repairing and manufacturing farm tools and equipments, processing farm produce, and storing agricultural produce. The chapter has also presented factors to consider when selecting a site for laying out farm structures and design considerations guiding design of farm structures. Various materials used in constructing farm structures and maintainance practices required to extend the life span of the structures have also been presented. Finally, the concept of farm fencing, types of fences, uses of farm fences, and materials required in constructing farm fences have been presented.

Revision exercise 5

Attempt the following questions.

1. Differentiate shelter from non-shelter farm structures.
2. Some farm structures are constructed for specific livestock handling functions, describe three livestock handling structures.
3. Explain the role of traditional granary in combating food shortage.
4. Differentiate live fences from dead fences.
5. Draw a wire fence and label its main components.
6. Describe the aim of having processing structures in the farm.
7. Briefly explain four ways of harvesting rain water in the farm.
8. Explain the causes of farm structures deterioration.
9. Outline ways for combating the deterioration of farm structures.

Chapter Six

Contemporary issues in agriculture

Introduction

Agriculture is the primary source of food and raw materials for industries. The increased demand for food and raw materials due to increased population, has necessitated the adoption of suitable practices in producing more crops and livestock. Some of these practices exert significant pressure on the environment, rendering agricultural production unsustainable. Sustainability in agriculture focuses on producing crops and livestock optimally but with minimum negative impacts on the environment. In this chapter, you will learn the concept of agriculture and environmental management, organic farming and genetically modified organisms. The competencies developed will enable you to evaluate some contemporary issues and develop strategies for meeting the ever-increasing demand for food and raw materials sustainably.

Agriculture and environmental management

Environmental management refers to the process of regulating and protecting the health of the earth planet by promoting human behaviour that positively impacts the natural environment. It ensures that ecosystem services and biodiversity are protected and maintained for equitable use by the present and future human generations. Agriculture and environmental management are two sides of the same coin in the sense that they depend on one another. While, agricultural productivity is dependent on suitable environment, good agricultural practices enhances suitable environment. Therefore, agriculture and environment depend on each other.

Poor agricultural practices in agriculture negatively impact the environment. The impacts vary extensively depending on the practices and scale employed by farmers. The environmental impact of agriculture involves soil, water and air. The common environmental impacts caused by agriculture include climate change due to deforestation; soil, water, and air pollution through wastes accumulation; and loss of biodiversity due to ecological disturbance. On the other hand, sustainable agriculture reduces environmental impacts through the adoption of best agricultural practices. To ensure harmony between human beings and the environment, it is necessary to promote sustainable agricultural practices. Indicators for sustainable

agriculture include increased land productivity, balanced biodiversity, soil health, maintained ground water levels, balanced nutrients in the soil and efficient use of nutrients by plants. Others are reduced quantity of runoff and pollutant concentration level. The effects of different management practices on agricultural systems and environment vary across agro-ecological zones due to variations in soil, climate and cropping systems.

Environmental degradation

Environmental degradation refers to the deterioration of environmental qualities through air, water and soil pollution, destruction of ecosystems, and a decrease of agro-biodiversity. In other words, it is a disturbance or change that is harmful or undesirable to the environment. In many aspects, degradation happens when natural resources such as forests, soil and water are depleted. It also affects animals, plants, and micro-organisms in the ecosystem. Degradation is mainly caused by human activities but can also be caused by natural factors such as floods, droughts, earthquakes, hurricanes, and temperature storms.

Causes of environmental degradation

There are several causes of environmental degradation. These include poor farming practices, inappropriate use of agrochemicals, use of polluted water for irrigation, soil erosion, invasive weeds, accumulation of heavy metals, deforestation, wild fires, and overgrazing. These are further explained in the subsequent sections.

(a) Poor farming practices

Poor farming practices such as monoculture; farming within catchment areas, along rivers and slopes; and over tilling results in environmental degradation. Degradation caused by poor farming practices leads to soil exhaustion and drying of water sources which adversely affect agricultural production. Some remedial practices to be adopted include the use of cover crops, mulching and terraces.

(b) Deforestation

Deforestation is defined as the act of removing trees from forest land that is then converted to non-forest use as shown in Figure 6.1. It includes converting forest land to agricultural land, grazing land or permanent settlement. Trees are major component of the forest and are used to store carbon dioxide (CO_2), hold soil, conserve water sources and provide fuelwood and construction materials. Trees also contribute to hydrological cycle thus are a key in influencing rainfall pattern and distribution. When trees are removed from the land, the soil remains bare and exposed to agents of soil erosion, leading to destruction of soil and water resources. Also, it increases the amount of carbon dioxide in the atmosphere, destroys water sources and consequently, degrades the environment.



Figure 6.1: Deforestation

(c) Wildfires

Wildfire plays a key role in shaping ecosystems by serving as an agent of renewal and change. Wildfire is also another cause of environmental degradation. In many parts of Tanzania, wildfires are common during dry season. Fire burns biomass from the vegetation exposing soils to erosion (Figure 6.2). Fire destroy trees which are a major producer of oxygen gas and serves as carbon dioxide sinks. Smoke produced by fire pollutes the environment and leads to health concerns.



Figure 6.2: Wildfire

(d) Overgrazing

Livestock such as cattle and other large animals can degrade the environment if kept in large numbers on a relatively small area as shown in Figure 6.3. In the past, livestock keepers would keep as many livestock as their land could support. However, keeping large number of animals in a small area leads to degradation through trampling vegetation and soil. In addition, animals (especially ruminants) emit methane gas from their wastes and thus, pollute the atmosphere with greenhouse gases.



Figure 6.3: Overgrazing

(e) Use of polluted water for irrigation

Inappropriate disposal of industrial and agricultural wastes pollutes water bodies and the environment in general. When contaminated water is used for irrigation, it adds pollutants into the soil which in turn, affects its quality.

(f) Invasive weeds

Growing of exotic crops in new environments has become common in many places. Some of these species exhibit characteristics of invasiveness including dominance and suppression of native species. With the introduction of new crops, the native population has to deal with new diseases, pests, and weeds they are not used to handle. As a result, the invasive weeds change the composition of local vegetation and ecosystem permanently. Good examples of invasive weeds are Kongwa weed (*Astripomoea hyoscyamoides*) locally known as “Mahata” and Carrot weed (*Partheium hysterophorus*) locally known as “Gugu karoti”. (Figure 6.4).



(a) Kongwa weed



(b) Carrot weed

Figure 6.4: Invasive weeds.

(g) Accumulation of heavy metals

The use of fertilisers and improper disposal of chemical wastes especially those containing heavy metals such as arsenic, cadmium and mercury can lead to their accumulation in the soil. Farming practices such as irrigation using polluted water can also lead to accumulation of selenium. When washed into water ways or percolate into ground water, these chemicals can directly be consumed by living organism and consequently affects them.

(h) Soil erosion

The agents of erosion such as running water and wind, erode the soil leading to loss of soil and soil fertility. When eroded soil is deposited into water bodies such as rivers, streams, dams and ponds it causes siltation, and when deposited on soil surfaces it causes sedimentation. Soil erosion causes severe deformation on the topography of agricultural land making agricultural mechanisation difficult (Figure 6.5).



Figure 6.5: Degraded land caused by soil erosion

Activity 6.1

Visit nearby local farms then observe and write a report on:

- (a) Farming activities that may contribute to the environmental degradation.
- (b) Remedial measures taken by the farmers to improve the degraded environment.

Effects of environmental degradation on agriculture

Environmental degradation affects agricultural production in different ways. These effects include destruction and degradation of suitable land for agriculture, destruction of aquatic life, soil pollution and depletion of soil fertility. Other effects are a decrease in crop yields, global warming, loss of biodiversity, reduction of available water for irrigation; and loss of rangeland, and agricultural fields. These effects are described in detail in the following section.

(a) Soil pollution and depletion of soil fertility

Soil pollution leads to a decline of soil fertility. Practically, agrochemicals contaminate soil that leads to soil pollution and depletion of soil fertility. Chemicals that are part of pesticides and other different kinds of agrochemicals can cause long-lasting damage to the soil. This can gradually alter soil microbial activities, soil chemistry and reduce soil fertility. Thus, every year, thousands of hectares of fertile soils are lost due to inappropriate use of agrochemicals such as fertilisers, pesticides, and herbicides.

(b) Decrease in crop yields

The application of excessive fertilisers and pesticides combined with other agrochemicals helps in the control of invasive pests, weeds, and diseases. and thus producing high crop yields. However, this benefit can last for a certain time since soil is likely to suffer from long-term effects. When these chemicals remain in the soil for years, they significantly affect the biological processes of the soil to regenerate its fertility. This is because microorganisms responsible for the processes are killed by these chemicals. In the long run, crop yields decline because the soil loses the optimal conditions to produce. A good example of the affected area due to long-term inappropriate application of inorganic fertilisation, is the Ismani Division in Iringa District. In the 1960s to 1980s, the area was prominent in maize production in Tanzania. However, after inappropriate long-term of a chemical application the soil became exhausted and thus, not capable to support high yields anymore.

(c) Affects human and animal health

The use of chemicals (for example, inorganic fertilisers and pesticides) in agricultural production on the upland area acts as source of pollutants. These pollutants are then

drained by moving water to lowland areas where they enter into lakes, rivers and other water bodies. Also, the pollutants can infiltrate into ground water and cause pollution. When the polluted water is used by people and animals, it is likely to cause health-related problems such as skin itching, skin cancer, and even death.

(d) Destruction of aquatic life

Polluted water affects life of various aquatic organisms and their ecosystems. Aquatic and terrestrial ecosystems are interdependent and therefore, pollution from terrestrial environment affects aquatic life. When organic and inorganic fertilisers are added to water bodies through runoff or seepage, they turn into nitrate and phosphate compounds. These compounds enhance growth of algae and weeds which in turn, reduce the amount of oxygen present in water, resulting in the death of aquatic organisms. For instance, the excessive use of fertilisers in agricultural production around Lake Victoria has magnified the problem of water weeds.

(e) Global warming

Global warming is the gradual heating of the earth's atmosphere which is mainly caused by human activities. It occurs when carbon dioxide (CO_2) and other greenhouse gases accumulate in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Global warming has negative effects on agriculture through changes in weather patterns and an increase in crop pests and diseases. In recent years, there has been a rise in temperature which causes frequent drought and erratic rainfall as a consequence of global warming. Temperature and precipitation are major factors driving distribution and growth of pests and diseases. Thus, global warming has increased the emergence of new crop pests and diseases which currently, farmers and experts are not able to handle effectively.

(f) Loss of biodiversity

The term biodiversity emanates from the term biological diversity. Biodiversity refers to a variety of life forms on earth at all its levels, from genes (basic unit of life) to ecosystems, and can embrace the evolutionary, ecological, and cultural processes that largely sustain life. An ecosystem is quite sensitive to small changes that may also lead to big effects in the system. Persistent use of chemical products in agricultural production degrades soils and waters, affects living organisms and gradually alters the ecosystems which support biodiversity and life. Environmental degradation can cause death of soil microorganisms and beneficial insects, which have far-reaching effects on agriculture production. For example, soil microorganisms are responsible for decomposing soil organic matter making nutrients available to crops; where as, insects

like bees are responsible for pollination of most crops.

(g) Reduced available water for irrigation

Water from the degraded lands brings sand, mud and other soil deposits into water bodies like lakes and rivers. As a result, the depth of water bodies decreases and in turn affects negatively agricultural production. Besides, soil erosion and sedimentation equally contaminate water, making it dirty and increasing its turbidity hence making it unfit for irrigation.

(h) Loss of rangeland and agricultural fields

Soil erosion can affect the rangeland and agricultural fields by causing loss of vegetation cover. In doing so, potential areas for pastures and crop cultivation are reduced. This in turn, adversely affects agricultural production. It is also predicted that more invasive species will migrate into new areas, like rangelands and agricultural fields due to favourable climate condition.

Activity 6.2

Work in groups to determine agricultural activities which cause environmental degradation in your area. Then, suggest solutions which can help to conserve the degraded environment.

Environmental friendly agricultural practices

This is a set of practices that enable farmers to reduce environmental impacts and increase the capacity of the environment to support agriculture. These practices, vary across agro-ecological zones in Tanzania. The most dominant management practices include:

- (a) Best agronomic practices: These include the use of cover crops, crop rotations, intercropping with nitrogen fixing crops, and fallowing.
- (b) Organic fertiliser application: This includes the use of compost manure, animal/farm yard manure and green manure.
- (c) Minimum soil disturbance: This involves minimum tillage and mulching.
- (d) Soil water management: This includes terracing, contour farming, and rain water harvesting.
- (e) Agroforestry: This is a conservational farming practice in which woody perennials plants are combined with herbaceous crop plants.

Other conservational practices which are environmentally friendly include planting trees, mulching, and cover cropping. Figure 6.6 shows students planting trees on the school compound.



Figure 6.6: Students planting trees to conserve the school environment

Sustainable agriculture

Sustainable agriculture is the production of crops and animals using the naturally available resources especially land without compromising the needs of the current and future generations. Sustainable agriculture benefit the environment by improving and maintaining the quality of soil, and saving water resource. In other words, sustainable agriculture refers to the production of plants and animals by using farming practices that aim at protecting the environment, public health, and animal welfare.

Sustainable agriculture allows us to produce and enjoy healthy foods without compromising the future generations. Sustainable agriculture is about the right balance between the need for food production and the conservation of the environment. Sustainable agriculture should also satisfy human requirements, enhance environmental quality and the natural resources on which the agricultural economy depends. Sustainable agriculture enables a farmer to make the most efficient use of non-renewable and non-farm resources. It also, enhances the quality of life of the farmers and community as a whole.

Common practises of sustainable agriculture

The following are the most common practices of sustainable agriculture: crop rotation, use of cover crops, soil enrichment, biological control, and integrated pest management (IPM).

(a) Crop rotation

Crop rotation is among the essential techniques of sustainable agriculture. It involves the practice of planting diverse crops sequentially on the same plot of land. Crop rotation is practised to improve soil fertility, optimise soil nutrients use and combat crop specific pest and weed pressure. A simple crop rotation might involve two or three crops while complex rotation can involve up to twelve crops. This practice is done to prevent the associated consequences that may happen when the same crop is grown continuously on the same piece of land for many years. Crop rotation breaks the reproduction cycles of pests. During the rotation, farmers can plant certain crops for example leguminous crops which replenish soil nutrients and reduce the need for chemical fertilisers application.

(b) Cover crops

These are plants grown in the farm to cover the soil. They provide several benefits ranging from economic to biological. Farmers can choose to have these cover crops in the field to get such benefits. By planting cover crops such as cow peas, guinea grass and hyacinth bean, farmers can achieve their goals of preventing soil erosion, suppressing weeds and enhancing the quality of the soil. Appropriate use of cover crops, also reduces the need for inorganic fertilisers.

(c) Soil enrichment

Soil is a central component of agricultural production. It plays a significant role of increasing crop yields and is a good habitat for microorganisms. Healthy soil is full of life, which can often be killed by the overuse of agrochemicals such as fertilisers, herbicides and pesticides. Good soils increase yields of quality products. Although soil quality can be degraded by human and natural factors, it can also be maintained and enhanced by adopting good agronomic practices. Some of the strategies of maintaining soil fertility is incorporating crop residues in the field and using compost and animal manures.

(d) Biological pest control

In order to maintain effective control of pests, it is important to view a farm as an ecosystem as opposed to a factory. For example, many birds and other animals are in fact natural predators of parasites and pests. Managing your farm to harbour

populations of these predators, is an effective and sophisticated technique. This biological approach of controlling pest is more effective than using chemicals. The use of chemical pesticides can result into indiscriminate killing of pest predators.

(e) Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is a pest control approach that combines the use of biological, cultural and chemical practices to control insect pests in agricultural production. In order to be effective when using IPM programs, the most current and comprehensive information on life cycles of pests and their interaction with the environment is used. This information is used to manage pest damage in the most economical means, and with the least possible harm to people, property, and the environment. IPM also emphasises the importance of crop rotation to combat pest. Once a pest problem is identified, by this approach, chemical solutions will only be used as a last resort. The IPM approach can be applied in both agricultural and non-agricultural settings. This approach is useful in all pest management options including the sensible use of pesticides.

Benefits of sustainable agriculture

It is important to advocate for the use of sustainable agriculture because of the benefits associated to it. Some of the benefits include the following:

(a) Contributing to environmental conservation

By all standards, sustainable agriculture has numerous benefits ranging from biological to economic. Explicitly, the environment plays a huge role in fulfilling our basic needs to sustain life through agriculture and other environmental services. In this regard, it is our responsibility to look after the environment so that future generations will also benefit from it. Sustainable agriculture helps to replenish environmental resources such as water and air. This replenishment ensures that these resources are and will be available in the same quality for present and future generations to sustain life.

(b) Promoting Public health and safety

Sustainable agriculture minimises the use of harmful pesticides and fertilisers in crop production. The fruits, vegetables and other crops grown free from these chemicals are safer for consumers, farm workers, and the surrounding communities. Through careful and proper management of livestock waste, farmers practising sustainable agriculture are able to protect themselves from exposure to pathogens, toxins, and other hazardous pollutants.

(c) Preventing soil pollution

Sustainable agriculture ensures that any waste a farm produces remains in the farm through recycling. In this way, the waste cannot cause pollution to the environment. This means, there will be no pollution associated with the use of agrochemicals and other related hazardous chemicals and waste products.

(d) Reduction in farming cost

The use of sustainable agriculture reduces the need for synthetic fertilisers, resulting in significant cost savings in terms of purchasing as well as transporting them. This reduces the overall operation costs involved in the farming process. In turn, it strengthens rural communities and reduces farmers' reliance on the government for subsidies.

(e) Enhancing biodiversity

Sustainable farming promotes a wide variety of plant and animal life forms resulting in enhanced and balanced biodiversity. During crop rotation, plants are seasonally rotated and this results in soil enrichment, prevention of crop specific diseases, and pest outbreaks.

(f) Beneficial to animals

Sustainable agriculture results in animals being better cared for, as well as treated humanely and with respect. The natural behaviours of animals, including grazing or pecking, are catered for, as a result, animals develop in a natural way. Farmers and ranchers who practice sustainable agriculture, implement livestock husbandry practices that protect animals' health and observe animal welfare establishments.

(g) Beneficial to the environment

Sustainable agriculture reduces the need for the use of non-renewable energy resources and as a result benefits the environment. The world population is increasing; this is a challenge, but unlike many other sustainability challenges, we all need to eat. We can make the differences by reducing food loss and waste, eating diets that have lower impact on productive resources; and investing in sustainable production. From producers, right down to consumers, we all have a role to play. The challenge is to encourage people to take care of the world in which we are surrounded by such abundance.

Activity 6.3

In a group:

1. Carry out any five conservation practices to protect your school environmental resources.
2. (a) collect relevant materials and prepare compost manure;
(b) outline procedures and materials used in the preparation of composite.
3. Write a report and present it in class for discussion.
4. When the composite is ready apply it in your school farm or garden.

Exercise 6.1

1. With relevant examples, explain the meaning of the term environment.
2. Why sustainable agriculture is important in Tanzania?
3. Basing on the National Environmental Policy (NEP):
(a) Outline the major environmental issues in Tanzania
(b) Identify and discuss issues that are directly related to agriculture
4. Describe the underlying causes of environmental degradation in Tanzania.
5. With examples, discuss the environmental management practices for sustainable agriculture in Tanzania.

Organic farming

The concept of organic farming was first developed in the early 1900s by Sir Albert Howard, F.H. King and Rudolf Steiner, and other scientists who believed that the use of animal manure, cover crops, crop rotation and biologically based pest control could result to better farming. Until recently, more researches have further been conducted on organic farming.

The concept of organic farming in crop and livestock production

Organic farming is a production system which largely prevents the use of synthetic chemicals such as inorganic fertilisers and pesticides, and the use of growth regulators for promoting plant growth in plant management. It uses biological approach in the management of soil fertility such as application of green and compost manure and crop rotation in producing crops. The main objectives of organic farming are raising crops such as grains, vegetables, fruits, flowers, fibres; and keeping animals for products such as eggs, milk, and meat in the natural way, that is without using agrochemicals. The primary aspects of organic farming are: the use of organic manure (green manure or compost and animal manure), crop rotation, restoration

of soils through biological activities and interruption of pest habitats and diseases using biological means.

Organic farming is a strategy used in the agricultural sector to reduce public health problems and environmental risks. The use of chemical fertilisers destroy natural habitat of microorganisms in the soil. Thus, the use of organic manure and the adoption of crop rotation practice preserve soil health and provides the necessary nutrients for crop growth and development. Figure 6.7 shows different types of crops which are produced organically.



(a) cucumber



(b) carrot



(c) maize



(d) paddy

Figure 6.7: Different types of crops produced under organic farming

Basic features of organic farming

Some important features of organic farming in crop and livestock production, are outlined in Table 6.1:

Table 6.1: Features of organic farming for crop and livestock production

Crop production	Livestock production
(i) Naturally occurring crops	(i) Naturally occurring animals
(ii) Use of organic seeds and locally adapted varieties	(ii) Animal housing that allows for natural behaviour (examples: natural light and sufficient space)
(iii) Use cultural agronomic practices to improve soil fertility (examples: crop rotation, organic fertiliser, erosion control)	(iii) Use of organic fodder
(iv) Pest and weed control through mechanical or biological cultural measures.	(iv) Access to pasture or outdoor areas.

Differences between organic and conventional farming

Organic farming is comparatively costly than conventional farming due to extended time period and cost of organic seeds, hence organic products are also expensive which helps in increasing the economy of the producers and the country. The use of inorganic fertilisers to support the growth of crops is still prevalent as the crops mature before their natural time to feed the population. The role of organic agriculture, whether in farming, processing, distribution or consumption is to sustain and enhance the health of ecosystem and organisms.

Organic farming is intended to produce high quality and nutritious food that contributes to the maintenance of human health. The rate at which the knowledge of organic farming is diffusing among Tanzanian is relatively low. Most farmers prefer conventional farming to organic farming because in conventional farming crops grow and mature faster due to the use of inorganic fertilisers and pesticides.

Organic farming regenerates the health of soils, ecosystems and people. Organic farmers rely on natural processes, biodiversity, and cycles adapted to local conditions rather than the use of synthetic inputs such as chemical fertilisers, pesticides, and herbicides. Organically produced products are rapidly growing segment of the food market, offering new and high-value markets to farmers in developing countries.

Organic farming is considerably distinguished from conventional farming by looking at some particular aspect of human values, environment, nature, and animal welfare. Basically, this is incorporated in the basic principles of organic farming.

Conventional farming is the farming system which involves the use of synthetic

chemical fertilisers, pesticides, herbicides, genetically the modified organisms, concentrated animal feeding operations, intensive irrigation and tillage. It is normally very resource-demanding and energy-intensive system. However, it produces high yields. This system has been in use since 19th century, but it became more pronounced after 1950. Organic and conventional farming can further be differentiated by looking at their important aspects as follows:

(a) Pest control

From a sustainability point of view, pest control is a service that reduces or eliminates the need for pesticide applications and ensures sound health to human and ecosystems. Organic production relies primarily on systems that base on non-chemical methods of control, although some organically approved pesticide materials are used for aboveground pests and foliar pathogens. Chemical control is the dominant approach in conventional systems, with varied degrees of integration of cultural and biological strategies.

(b) Plant disease control

The management of disease is built around maintaining crop and soil health, the use of resistant cultivars, sanitation and cultural pest and disease controls. Soil borne diseases are generally well controlled in organic systems through good soil management and crop rotation with some key exceptions. For example, pathogens with a wide range of hosts are not easily controlled by crop rotation. In the conventional systems, soil borne pathogens are typically controlled by coating seeds with fungicides, direct application of fungicides, or soil fumigants, and the use of disease-resistant crop varieties.

(c) Weed management

The reliance on herbicide-resistant cultivars and herbicide applications for weed control in conventional systems is one of the challenges for weed management. The combination of cultural, mechanical and biological methods is universally effective. Therefore, organic crop growers depend on a combination of practices to achieve the objectives. Reliance on timely tillage for weed control makes organic systems vulnerable to yield loss if weather or other conditions delays tillage operations. The heavy reliance on herbicides in conventional agriculture has equally led to substantial problems with pollution of water sources, negative ecological impacts and an increase in herbicide-resistant weeds.

(d) Conservation of biodiversity

Organic agriculture is an important tool in protecting biodiversity from degradation. It provides significant benefits to endangered or rare species, by ensuring that conservation

of natural habitats in farm landscapes is also important aspect in farming. Sometimes, under conventional agriculture there is a high destruction of eco-system. Examples include the use of chemicals which kills most microorganisms in the soil including untargeted organisms.

(e) Human and livestock health

Exposure to agrichemicals which is common in conventional agriculture has negative impacts to humans especially farm workers and to livestock health. This is because conventional agriculture involves significant farm mechanisations and applications of agrochemicals. This is different from organic farming that has fewer health negative impacts.

(f) Nutrients cycling

Organic farming reduces nutrients losses through leaching and run off or erosion when cover crops are grown. It also, increases efficient use of nutrients by plants. On the contrary, in conventional farming methods, there is high likelihood of leaching which can cause problems in water bodies. These problems happen because leached chemicals from the fields pose serious threat to water ecosystem.

Activity 6.4

Visit a nearby farmer or an agricultural institution, and collect information on organic and conventional farming system, then:

1. (a) Identify organic and conventional farming practices.
(b) Compare organic with conventional farming practices in terms of sustainability, productivity and environmental conservation.
2. Write a report and present it in class for discussion.

The general principles of organic farming

The principles of organic farming provide a vision that inspires environmentally friendly cultivation and production. Organic farming aims to produce high quality products without the use of industrial chemicals. It aims to create a sustainable system that conserves energy, soil and water while maintaining the environment. As such, all organic production approaches are based on four principles namely: health, ecology, fairness, and care. These principles provide a vision for agriculture that encourages environmentally friendly and economically viable agriculture. The production principles are explained hereunder:

(a) Principle of health

Organic farming sustains and enhances the health of soil, plant, animal, as well as human beings and the planet as one and indivisible. This principle states that the health of individuals and communities is inseparable from the health of ecosystems. The principle also, points out that healthy soils are required to produce healthy crops which safeguard the health of animals and people. All components in the chain depend on each other. Organic farming produces high quality and nutritious food that contributes to good health and well-being of people, animal and environment.

(b) Principle of ecology

Organic farming should be based on the ecological systems and cycles. The ecological principle in organic farming emphasises that any production must be based on ecological processes and recycling. This principle acts as a base for organic farming within ecological systems. Here, the sustenance and well-being of an organism is achieved through the ecology of the specific production environment. For example, in the case of crops, this encompasses the living soil; for animals, it is the farm ecosystem; and for marine organisms, it is the aquatic environment.

Organic farming management must be adapted to local conditions, ecology and culture. Here, the inputs should be reduced by re-use, recycling and efficient management of materials and energy in order to maintain and improve environmental quality and conserve resources. Organic agriculture should attain ecological balance through the design of farming systems, the establishment of habitats and the maintenance of genetic and agricultural diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air, and water.

(c) Principle of fairness

Organic farming should build on the relationships which guarantee fairness with regard to the common environment and life opportunities. Fairness is characterised by equity, respect and justice, among both people and their relations to other living beings. This principle emphasises that those involved in organic farming should conduct the business in a manner that ensures fairness at all levels and to all parties including farmers, workers, processors, distributors, traders, and consumers. Organic farming should obviously provide good quality of life, contribute to food sovereignty and reduces of poverty to everyone involved.

This principle also insists that animals should be provided with the conditions and opportunities of life that accord them with physiological and behavioural well-being. Natural and environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

(d) Principle of care

Organic farming should be managed with precaution and responsibly to protect the health and well-being of current and future generations and the environment. Organic farming is a living and dynamic system that responds to internal and external requirements. Farmers practising organic farming enhance efficiency and productivity, but not at the risk of destroying the health and well-being of the environment. This principle states that precaution and responsibility are the key concerns in the management, development and technology choices in organic farming. Here, science is necessary to ensure that organic farming is healthy, safe, and ecologically sound. However, scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom, traditional and indigenous knowledge offer valid solutions. Organic farming should precisely prevent significant risks by adopting appropriate technologies. Decisions made should reflect the values and needs of all who might be affected, through transparent and participatory processes.

Advantages of practicing organic farming

Organic farming has the following advantages:

- (i) Products produced organically have minimum chemical residuals.
- (ii) Organic farming prevents the use of agrochemicals in the production of plants and livestock as these chemicals are harmful to the environment.
- (iii) Organically produced products have relatively longer shelf life.
- (iv) Practising intercropping, crop rotation and minimal tillage lessen the cost of crop production along with improving fertility, structure and water holding capacity of the soil.
- (v) Organic agricultural production systems foster cycling of natural resources to conserve biodiversity, protect the environment, and promote ecological balance.
- (vi) Animals and plants can live in the same place in a natural way which increases biodiversity.

Disadvantages of practicing organic farming

Organic farming has the following disadvantages:

- (i) Organically produced foods are more expensive due to higher production costs, as they need a large area to cultivate and more labour to produce optimal yield.
- (ii) Crops and animals produced through organic farming system are likely to suffer from various diseases.
- (iii) Organic farming is labour intensive in nature, therefore, it may demand more workers to do the work. This again brings extra expenses.
- (iv) Products from organic farming are in small quantities, thus, they may not support the needs of the existing population and meet market demand.
- (v) Organic farming requires appropriate knowledge and skills, thus it is not easy to practise.

Activity 6.5

In groups, debate organic and conventional farming systems. The first group will defend organic farming and the second group will defend conventional farming. The debate should focus on the sustainability, productivity and environmental conservation.

Exercise 6.2

1. Explain the concept of organic farming.
2. Briefly outline the advantages and disadvantages of organic farming.
3. Elaborate the general principles of organic farming.
4. Discuss the disadvantages of conventional farming to the environment.
5. With examples differentiate organic from conventional farming.

Genetically Modified Organisms**The concept of genetically modified organism**

A Genetically Modified Organism (GMO) is an organism whose genetic material has been altered using genetic engineering techniques. The technology involved in GMO development has been adopted to improve productivity and resistance to harsh environmental conditions. The production of GMOs involves the insertion and integration of a short segment of DNA from a wide variety of genes from unrelated plants, animals and other microbes into the genome of plants or another organism to form a new organism. This is done using laboratory techniques. The essence of adopting this technology is to get a new organism with improved characteristics such as increased productivity, resistance to diseases and pests, and environmental

shocks. In some countries, GMOs have been approved by regulatory authorities for commercial production and consumption, while others are yet to be proved but are currently undergoing regulatory evaluation. Although this method is highly debated, it has become increasingly common in everyday food production in developed countries.

Evolution of GMOs

In developed countries, this technology became more pronounced in the 1970s. However, in 1998 the first commercialised genetically modified crop was grown in the European Union. Estimates suggest that introductory quantities of insect resistant maize were grown primarily in Spain and France. Other crops that were subsequently developed in these countries include sugar beet, oilseed rape (herbicide tolerance) and potatoes (modified starch).

In 2012 for example, 93 percent of soybeans, 94 percent of cotton, and 88 percent of corn grown in the United States of America were genetically modified. In addition, recent information on GMO indicates that grapevine (*Vitis vinifera*), plum (*Prunus domestica*), apple (*Mallus domestica*), strawberry (*Fragaria ananassa*), blackcurrant (*Ribes nigrum*), raspberry (*Rubus idaeus*) and blackberry (*Rubus fruticosus*) are among the main fruit crops that have been grown as genetically modified crops. USA is the largest producer of GMOs followed by Brazil, Argentina, India, Canada, China, Paraguay, South Africa, Uruguay and Bolivia.

On the other hand, most developing countries especially those from Africa are not yet well-developed in GMO due to various barriers including technology. This situation also applies to Tanzania where there is one GMO Centre in Makutupora-Dodoma mainly researching on genetically modified maize crop. However, the product (i.e., maize) from this centre, is not yet allowed to be used in the country. Despite this, most of the developing countries receive GMO products from the developed countries.

Selective bred crops

Selective breeding is a breeding of plants or animals in order to selectively develop particular characteristics in the offspring by selecting males and females with the desired characteristics for reproduction. An animal breed and plant variety are artificial, man-made variations of the same species of animal or plant. In selective breeding, the breeder aims to retain only those characteristics of the breeds and varieties which are of interest and may be inherited. Figure 6.8 shows the process of crop breed selection.

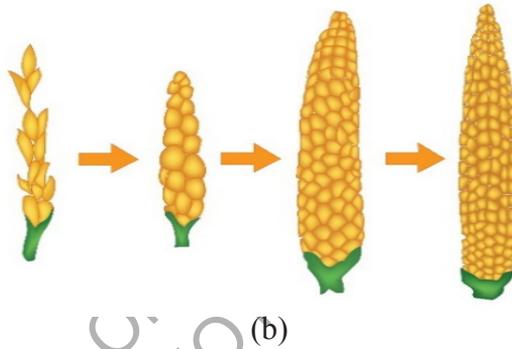
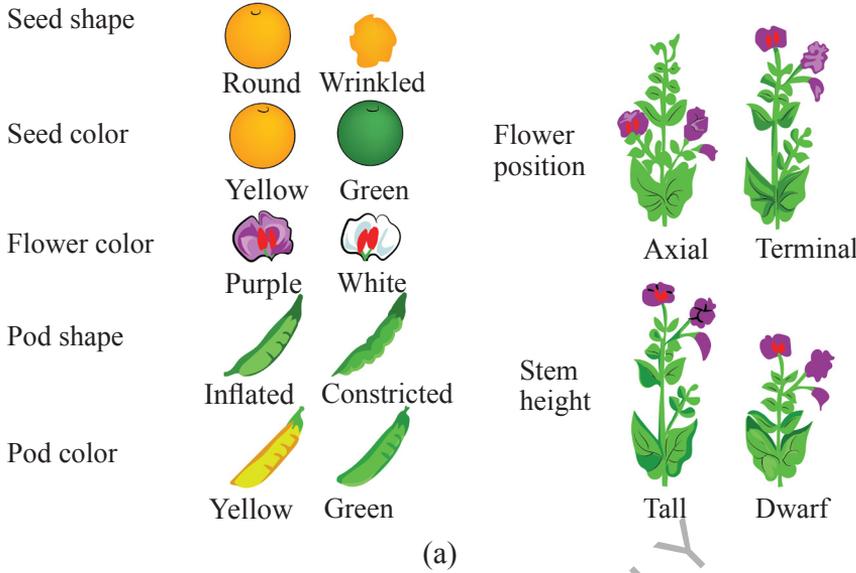


Figure 6.8: The process of crop breed selection

Sources: <https://www.twinkl.com.br/teaching-wiki/selective-breeding>

https://images.twinkl.co.uk/tw1n/image/private/t_630/u/ux/cornselectivebreeding_ver_1.jpg

Selective breeding aims at enhancing certain targeted characteristics of the species. For example, in the selection of watermelon seeds needed for sowing for the next season, farmers always prefer to harvest seeds from the largest and sweetest fruits.

The differences between GMOs crops and selectively bred crops

Table 6.2 shows some differences between GMOs and selective bred crops based on the meaning, time range, organism involved, combination of genetic materials.

Table 6.2: Differences between GMOs and selectively bred crops

Characteristic	GMOs	Selective breeding
Meaning	GMO is an organism which is subjected to an artificial genetic modification i.e., a modification which does not occur under natural conditions.	Selective breeding is the breeding of plants or animals in order to selectively develop particular characteristics in the offspring by selecting males and females with the desired characteristics for reproduction
Time range	The results of genetic engineering are detectable rapidly.	A number of generations is necessary to obtain the desired results of selective breeding.
Involved organisms	Genes from one species is inserted in other non-related one.	The individuals have to be from the same species.
Combination of genes	The scientists create new combinations of genes.	Genes combine on their own.
Introduction of foreign genetic materials	Genetic engineering introduces foreign DNA into the genome	Does not introduce foreign DNA into the genome

Activity 6.6

- From different sources of information such as books, online resources, and newspapers, find out and explain how crops can be genetically modified.
- Visit a nearby agricultural research and training centers or institutions and ask the experts some questions on the differences between GMOs and selectively bred crops, characteristics and importance of each.

Advantages and disadvantages of GMOs

Advantages

- (i) **Generating more profit:** GMOs is an effective way of providing farmers' profit. Besides high production, it reduces variable costs of production including weeding and application of inorganic fertilisers, pesticides and herbicides.
- (ii) **Promoting knowledge of genetic alterations:** This is done through mapping genetic material for GM crops. Plants can be engineered to resist temperature or produce higher yields which are good for regions where the climate limits productivity.
- (iii) **High yield:** The use of GMOs technology increases crop yields hence, decreases food prices and consequently enabling economically disadvantaged families to buy food for their everyday consumption, thus, it also prevents starvation.
- (iv) **Adding more nutritional values to crops:** The GMO method adds nutritional value to crops that lack necessary vitamins and minerals. This helps malnourished populations to receive more nutrients from the diet.

Disadvantages

- (i) GMOs are believed to be dangerous to living organisms such as insects which depend on crops, because new crop genes can be deadly to them.
- (ii) The process of making GMOs includes adding new genetic material into an organism's genome. Research on the effects of large-scale cultivation of GM crops has sparked various concerns specifically those ideas on ecosystems with GMO strains.
- (iii) Genetically modified crops threatens the existence of indigenous species as they are likely to cross-breed each other.
- (iv) GMO causes unwanted residual effects. A genetically modified plant can leave unwanted residual substances that can remain in the soil for extended period. Research has shown that it takes more than five (5) years for residues from GMO products to expire in the soil.
- (v) The engineered crops can act as mediators in transferring genes to wild plants which can lead to the emergence of new weeds. To keep these new weeds under control, scientists have invented new herbicides that were not necessary

for non-GMO weeds. These chemicals are also toxic to animals feeding on GMO crops.

- (vi) There are some kinds of resistance to introducing genetically modified (GM) genes on genetic diversity because these genes can spread to other organic farm crops and threaten crop diversity in agriculture. Decreased crop diversity will have a direct impact on the entire ecosystem and would affect the population dynamics of other organisms.

The risks are more pronounced when a large-scale plantation releases a GM strain during pollination, where the cross pollination to non-GM plants could create a hybrid strain. This means that there is a greater possibility of introducing new artificial strains into the environment that could potentially reduce biodiversity and affect the balance of nature.

Chapter summary

This chapter has covered the concepts of agriculture and environmental management, organic farming, and genetically modified organisms as the main issues in contemporary agriculture. The chapter has demonstrated that agricultural production depends on environmental management and vice versa. Unsustainable agricultural practices lead to environmental degradation; and degraded environment cannot support agriculture. Therefore, there should be a mutual beneficial relationship between agriculture and environment.

The chapter has also shown that there are several differences between organic and conventional farming systems where each type has its advantages and disadvantages. Farmers are advised to choose the best type of farming system based on the intended objective, available resources, and time. The demand for organic agricultural produce is growing especially in areas where the conventional farming system has degraded production resources such as land. It is therefore recommended that whichever system of farming one chooses, the issues of sustainability and health of living organisms including human beings should be given maximum consideration.

There has been a growing interest in the GMOs as a strategy to increase food production to meet the global growth on demand for food security. In Tanzania, however, there is low awareness of GMOs in terms of its effects to native crops, animals and human beings. This calls for continued research on GMOs and raising awareness among Tanzanians.

Overall, sustainable agricultural practices are effective tools in designing farm production and cropping systems. Crop rotation, the use of cover crops, soil enrichment techniques, biological pest control, IPM; and benefits of sustainable agriculture are some of sustainable practices discussed in the chapter.

Activity 6.7

1. There are several groups of people who think that genetically modified foods are better than selectively bred foods and vice versa. Using various sources of information and with examples provide five (5) reasons to justify which type of food is better than the other.
2. In a group, visit a school library, internet facility or any other resource centre, then:
 - (a) Identify the most agricultural contemporary issues apart from the ones covered in this chapter.
 - (b) Discuss opportunities and challenges they pose to the agricultural sector.
 - (c) Summarise your work and present it in class for discussion.

Exercise 6.3

1. Using relevant examples, explain the meaning of the term genetically modified organism.
2. What are the advantages and disadvantages of genetically modified organisms?
3. Discuss the likely impacts of genetically modified organisms to the environment.
4. Describe the impacts of selectively bred crop to the environment.
5. Differentiate between genetically modified organism and selectively bred crops.
6. With reasons, give your opinion on the use of genetically modified foods?

Revision exercise 6

Section A: Choose the most correct answer from the given alternatives

1. Which of the following is applicable in organic farming?
 - (a) Inorganic fertilisers
 - (b) Buffer zones
 - (c) Persistent pesticide
 - (d) Hormones

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2. Which of the following is not applicable in organic farming?
 - (a) Cover crops
 - (b) Application of pesticides
 - (c) Sewage sludge
 - (d) Crop rotation
 3. Which of the following is an organic farming practice that helps to maintain soil health?
 - (a) Sewage sludge
 - (b) Synthetic fertilisers
 - (c) Monoculture
 - (d) Crop rotation
 4. After being applied to soil, which of the following processes may destroy organic compounds?
 - (a) Biological degradation
 - (b) Chemical decomposition
 - (c) Leaching to groundwater
 - (d) Adsorption to clay or organic matter
 5. What is meant by the term ‘sustainability’?
 - (a) Returning the natural environment to pre-industrial conditions.
 - (b) Increasing agricultural output to feed the growing human population
 - (c) Preventing excessive urban developments
 - (d) Maintenance of a healthy environment and reasonable standard of living

Section B: Attempt the following questions

6.
 - (a) What do you understand by the term organic farming?
 - (b) Discuss the benefits of organic farming as a viable agricultural practice in Tanzania
7. Describe methods of conserving each of the following environmental resources:
 - (a) Water
 - (b) wildlife
 - (c) forest
 - (d) air and
 - (e) soil.

Glossary

Allelopathy	a biological phenomenon by which one organism produces biochemicals that influence the growth, survival, development, and reproduction of other organisms.
Aquatic life	a life form found in, on or near water.
Biodiversity	a variety of plants and animals living in the world or in a particular habitat.
Carbon sequestration	the process of reducing atmospheric carbon dioxide emissions from the atmosphere and storing them in terrestrial, oceanic or fresh water aquatic ecosystems.
Commodity	a product that is bought and sold.
Contract farming	agricultural production carried out according to a prior agreement where by the farmer commits to produce a given product in a given manner and the buyer commits to purchase the product.
Conventional agriculture	a farming system characterised by the use of synthetic fertilisers, pesticides and herbicides with the aim of getting the highest agricultural yields.
Dominant	having power and influences over others.
Ecosystem	a biological community of interacting organisms and their environment.
Ecotourism	a form of tourism involving responsible travel using sustainable transport to natural areas, conserving the environment and improving the well-being of the local people.

Gross Domestic Product (GDP)	the total market value of the goods and services produced by a country's economy during a specified period, normally a year.
Genetic Modified Organisms (GMOs)	organisms whose genome has been engineered in the laboratory in order to favour the expression of desired physiological traits.
Greenhouse	a structure designed for the protection of tender or out of season plant against excessive cold or heat.
Pliable	a substance which can bend freely or repeatedly without cracking or breaking.
Pollination	the act of transferring pollen grains from the anther (male part) to the stigma (female part) of a plant.
Portfolio	the collection of students works representing a selection of performance.
Price Penetration	a pricing strategy, in which a firm charges a lower initial price to the new innovative or much improved product than their competitors in an effort to gain market share.
Price skimming	a pricing strategy in which a firm charges a high initial price and then gradually lowers the price to attract more price-sensitive customers. The strategy aims to "skim" off customers who are willing to pay more for a new innovative or much improved product launched in the market.
Produce	food or other things that have been grown or produced on a farm to be sold.
Product	something that is grown or made in a factory in large quantities, usually in order to be sold.
Propagules	a vegetative structure that can become detached from a plant and give rise to a new for example, a bud, sucker, or spore.

Road haulage

commercial transport of goods by the means of roads.

Sedimentation

a process by which solid fragmented materials such as silt, sand gravel and chemical precipitates are transported by water and deposited elsewhere to form a layer on earth surface.

Selenium

a non- metallic, highly photosensitive element, that occurs in a grey crystalline form, as a red powder, or as a black glassy material.

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