UNIT 4 SYSTEMS OF CROP PRODUCTION

CONTENTS

1.0 INTRODUCTION

Cropping systems probably originated as a second and advance phase in the transformation of intensive food gathering by the Early Man, with the practice of food selection and cultivation around settlements. The compound farms system is the most widespread permanent cropping system. It often forms the centre of diversity to other field systems. A common feature of traditional farming systems is the production of several crop species and varieties of each species by each farmer. However, a great variety of farming systems ranging from the "true" shifting cultivation to permanent cultivation, have developed thereafter and these were significantly intertwined with man's history and the need for abundant food supply, in different parts of the world. Basically, the two common objectives of these diverse systems are soil sustenance for adequate food supply and sufficient agricultural productivity.

2.0 OBJECTIVES

By the end of this unit, you should be able to learn:

- the fundamental aspects of cropping systems
- their practical benefits and limitations in food production.

3.0 MAIN CONTENT

3.1 Evolution of Farming Systems in Tropical Africa

The factors influencing the diversity in the number of cultivated crops and variations in cropping systems include cultural diversity, economic differences, colonial background, political history, experience, level of technological development, and availability of resources.

The early cropping systems are based on these factors and include nomadic herding, shifting cultivation, rudimentary sedentary cultivation, non-rice-based intensive agriculture, special horticulture and plantation agriculture. More advanced classification schemes of tropical agriculture have identified the influence of vegetation type, migration, rotation, clearance, cropping and tool systems on cropping systems. However, the most important bases for differences in cropping systems are intensity of cropping and duration of the fallow period for soil fertility restoration. Based on the various classification schemes, two categories of farming systems are identifiable:

A. Traditional and Transitional Systems- These Comprise of

i. Nomadic Herding (Shifting Cultivation Phase I, Land Use Factor (L) > 10^2 years)'
ii. Bush Fallowing/Land Rotation (Shifting Cultivation Phase II, L= 5-10 years),
iii. Rudimentary Sedentary Agriculture (Shifting Cultivation Phase III, L= 2-4 years),
iv. Compound Farming & Intensive Subsistence Agriculture (Shifting Cultivation Phase
v. IV, L < 2 years),
vi. Terrace Farming & Floodland Agriculture, and
vii. Mediterranean Agriculture (traditional).

B. Modern Farming Systems and their Local Adaptations

i. Livestock Ranching,
ii. Intensive Livestock Production (poultry, pigs, dairying),
iii. Large-scale Farms & Plantations

- Large-scale Food & Arable Crop Farms, based on natural rainfall
- Irrigation Projects involving Crop Production
- Large-scale Tree Crop Plantations

iv. Specialised Horticulture

- Market gardening
- Truck Gardening and Fruit Plantations
- Commercial Fruit & Vegetable Production for Processing

v. Mediterranean Agriculture (modern).

3.2 Types of Cropping Systems

3.2.1 Nomadic Herding

This system is common in t he arid regions where low rainfall prevents the cultivation of crops on a large scale. Therefore, animal husbandmen herd their livestock from place to place in search of green pasture (especially grass) and water. This practice is referred to as "transhumance pastoral nomadism".

3.2.2 Bush Fallowing

This is a type of subsistence agriculture in which land is cultivated for a period of time and then left uncultivated for several years so that its fertility will be restored. It involves fixed settlements, but periodic shifting rotation of fields within the cultivated land. In the early times, fallow fields may be left untilled or tilled but not planted for the fallow period. Sometimes, the fallow fields were used for pasturage for animals, which had the incidental benefit of fertilizing the soil. Short rotational bush and grass fallow systems are the dominant systems of traditional agriculture of both the forest and savanna environments. Reasons for this are lack of a suitable alternative for soil fertility sustenance and crop production and higher frequency of cultivation. Fallow types may be natural (colonized by invading weeds), or planted with quick, improved fertility-regenerating leguminous (weed) species e.g. Peuraria phaseoloides, Mucuna utilis (herbs) and Crotalaria spp. (shrub). Planted green fallows are common in some parts of Eastern Nigeria in response to high population pressure on available land. An added advantage of this is the superior competitive ability of the green fallow species over the native weeds in the fallow, although the practice requires huge time and money investments in seed sowing, which may reduce the cost/benefit ratio.

3.2.3 Shifting Cultivation

In this system, a piece of land is cultivated for a few years and when the soil is showing exhaustion in form of poor crop yields, the farmer abandons the land and moves to another, more productive site for

cultivation. Unlike bush fallowing, shifting cultivation in addition to periodic rotation of fields, involves an occasional movement of settlements with cultivated fields. It is the most common system of subsistence farming, and specifically incorporates slash-and burn practice (the cutting and burning of forests or woodlands to create fields for agriculture or pasture for livestock). The advantages include keeping the soil sufficiently fertile when there is abundant available land for farming and preventing the spread of insect pests, other pests and plant pathogens. The disadvantages are greater, and include inadequate cultivable land for food production, requirement of large land area, inadequate time for soil fertility restoration and waste of farmers' energy resources in frequent slashing of agricultural fields.

3.2.4 Mixed/Multiple Cropping Systems

These involve the simultaneous cultivation of two or more crops on the same piece of land in at least a part of the growing season. No organization or sequence of crop planting is required in this system as in multiple cropping. The systems constitute a major component of traditional farming and typically mimic species diversity in uncultivated and virgin lands. Significant advantages include security of food and income and the maintenance of soil productivity, through prevention of soil erosion and weed interference and soil nitrogen fixation by legume components. The most widespread varieties of mixed cropping are mixed intercropping and relay cropping and relay intercropping. Relay cropping involved two crops following each other in sequence such that the time between the growth periods of the two crops is reduced to the barest minimum; one crop is brought in as the first crop is maturing e.g. wheat/soybean. In relay intercropping, the component crops grow together for longer e.g. cassava/maize; cassava is planted 4 weeks before sowing maize. Other mixed cropping systems include double cropping, triple cropping and alternate strip cropping in market gardens and with specific vegetable crops.

3.2.5 Continuous Cropping

This is a modern cropping system in which the same piece of land is cultivated year-in-year-out. The system is a response to frequent human population pressure and unavailability of arable land. Chemical fertilization and organic manuring are very critical practices for soil fertility sustenance. Components of this system include monocropping, plantation agriculture (monoculture) and rotational cropping.

3.2.6 Crop Rotation

Crop rotation practice dates back to the end of the Middle Ages, traceable to the ancient Romans, African and Asian cultures and thereafter, with the practice of three-year rotation by farmers in Europe. This is the practice of growing a well-planned series of dissimilar and specific types of crops in the same space in sequential seasons to avoid the build-up of pathogens and pests that often occur in continuous cropping of a plant species. The succeeding crops are of a different genus, species, subspecies, or variety than the previous crop in the rotation. No two crops subject to similar diseases follow each other within the disease's incubation period while the rotation makes it more difficult for emerging insect pests to find their preferred food, either above (in the growing crops) or below the soil. A well-planned rotation helps create a garden that is constantly new (green) and fascinating. Rotation sequences may be for a two- or three-year or longer. It is mainly targeted at the use of organic farming, where pest control may be achieved without expensive synthetic pesticides and sustainable soil fertility without bush fallowing. The general purposes of crop rotation are

i. improvement or maintenance of soil fertility through the use of green manure in sequence with cereals and other crops;
ii. reduction of soil erosion
iii. reduction of the build-up of pests and pathogens, thereby reducing reliance on chemical pest and disease control;
iv. spread of the workload on farms
v. reduction of the risk of weather damage
vi. reduction of the reliance on agricultural chemicals, including inorganic fertilizers;
vii. increased of net farm profits
viii. beneficial residue herbicide carry-over, thereby improving weed control especially parasitic weed species;
ix. improvement of soil tilt and aggregate stability through alternation of deep-rooted and shallow-rooted crops;
x. soil water management
xi. reduction of allelopathic or phytotoxic effects, and shifts in weed populations, whereby certain weed species are suppressed by competition from the crop or by selective use of herbicides.

Generally, these combine to give immediate economic benefit through improved crop yields, while allowing the farmers to keep their fields under continuous production. This obviates the need for bush fallowing as well as expensive chemical fertilizers.

3.2.7 Monocropping

This is a modern cropping system in which different but specific crops are grown on the same piece of land in a logical or scientific sequence. The component crops are selected on the basis of complementary or supplementary relationship; deep soil feeders (e.g. yams) should follow shallow soil feeders (e.g. maize. The system is chemical intensive, and problematic because farmers practice a lot of deforestation and shorter fallowing.

3.2.8 Taungya Farming

This is an agro-forestry practice whereby crop husbandry is combined with forest management, especially in forested areas protected as reserves. Timber contractors are allocated plots within which they are allowed to fell valuable timber trees, and simultaneously use the land for the cultivation of annual and biennial crops. Forest tree seedlings are nurtured along with the food crops. The main target of the system is to enhance an optimum establishment of a forest.

3.2.9 Alley (Hedgerow) Cropping

This involves managing parallel single or multiple rows of perennial woody plants with annual agronomic and horticultural crops, and forage crops planted in the wide interspaces (alleys) of the woody species. Advantages of alley cropping are high soil fertility from both nitrogen fixation trees (NFTs) and green manure from decomposing periodic mulch prunings, and weed suppression by hedgerow canopy cover and mulch. This also reduces the demand on chemical fertilizers. When yams are cultivated, the stalks of hedgerow species serve as stakes for the growing yam vines. Examples of woody hedgerow species are *Leucaena leucocephala*, *Gliricidia sepium*, *Gmelina arborea*, *Calliandra calothyrus* and *Sesbania grandiflora*. On sloping land, trees act as a physical barrier to surface water runoff and erosion. The hedgerow species also enhance soil physical conditions which improve nutrient utilization, reduce wind erosion and modify the microclimate for improved crop growth. Alley cropping also provides excellent opportunities for improving wildlife habitat.

3.2.10 Mixed Farming

This system involves the complementary raising of crops (arable agriculture) and livestock (pastoral farming). In a typical mixed farm, a farmer may cultivate pasture or maize to feed some of the animals while the animals provide traction and transportation services as well as manure. The manure (additional droppings, wastes) facilitates soil

improvement which ultimately improves crop yields. When properly maintained, mixed farming encourages the intensification of land use for cropping through short fallows. In this system, the farmer is usefully engaged throughout the year thus spreading labour and re-utilising resources to earn more income from the crop and livestock enterprises. Mixed farming is a lower-risk strategy than monoculture, especially when climate, pests and disease and market prices are unfavourable for one crop or type of livestock. Mixed farming also preserves natural resources and the environment, thus improving biodiversity and environmental benefits of agriculture. Generally, the efficiency of the system depends on the socio-economic preferences of the farmers and biophysical conditions such as rainfall, radiation, soil type and disease pressure. Mixed farming systems are classified on the basis of land size, type of crops and animals, geographical distribution, market orientation, etc. The three major categories in four different modes of farming are on-farm versus between-farming mixing, mixing within crops and/or animal systems and diversified versus integrated systems. The modes of farming refer to different degrees of availability of land, labour and inputs, and these range from plenty of land to a shortage of land. Mixed farming was first introduced into parts of Northern Nigeria in the 1930s. In these areas, the rotational grass fallow system of food and export-crop production is combined with aspects of animal husbandry.

4.0 CONCLUSION

Cropping systems originated from the pre-historic era of subsistence agriculture but have systematically transformed into highly advanced, specialized and diverse systems which essentially guarantee soil sustainability for adequate food production, agricultural productivity and environmental preservation.

5.0 SUMMARY

Farming systems vary widely the intensity of cropping and duration of bush fallowing for soil fertility restoration, from traditional /transitional agriculture to modern sedentary systems, which assure commercial food production.

6.0 TUTOR-MARKED ASSIGNMENT

1. State any four factors which influence the type of cropping system practised by a farmer.
2. State the major difference between Bush Fallowing and Shifting Cultivation.
3. Define the following cropping systems:

(a) mixed cropping, (b) mixed farming, (c) Taungya farming, and (d) alley cropping.

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