

DEPARTMENT OF PLANT PHYSIOLOGY AND CROP PRODUCTION

LECTURE NOTES

PCP-503

FARMING SYSTEMS

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FARMING SYSTEMS

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Topic 1

Concepts, Definitions and Classification of Farming Systems

A system is a set of inter-related, interacting and interdependent elements acting together for a common purpose and capable of reacting as a whole to external stimuli. It is unaffected by its own output and it has external boundaries based on all significant feed backs.

Farms are systems because several activities are closely related to each other by the common use of the farm labour, land and capital, by risk distribution and by the joint use of the farmer's management capacity. The analysis of farms is quite important to the subject of development. Relevance of the farming systems approach: Choosing policies for agricultural development requires the use of information about the existing farming situation. A farming system results from a complex interaction of interdependent and interrelated components of elements that bear upon the agricultural enterprises of the rural household. At the center is the farmer who takes decision in an attempt to achieve his aspirations, goals and desired objectives within the limits of technologies available to him. He uses inputs to get outputs in response to the technical elements which is the natural resource endowment in any given location restricting what the farming system can be. The human element provides the framework for development and utilization of a particular farming system.

Definition of Farming system

Farming system is a unique and reasonably stable arrangement of farming enterprises that a household manages according to well defined practices in response to the physical, biological and socio-economic environment and in accordance with the household goals preferences and resources. These factors combine to influence the output and production methods. More commonalities will be found within system than between systems. Farming system belong to a larger system and itself can be subdivided into subsystems

Characteristics of farms:

Goal orientation

A farm is taken to be an organized decision-making unit in which crop and/or livestock production is carried out with the purpose of satisfying the farmers goals On large scale market production and profits are the main objectives whereas for the small-holder farmer who farm most of the tropics the farm is a multi-objective system to in providing food for the household, raw materials for building huts, accumulation of capital in form of animals or plantations and accumulation of wealth

Boundaries

The farm as a system has a boundary that separates the system from the environment. The system embraces all workers and resources (elements of the system) which are under the management of the farmer

Activities and their relations

Classification of farming system

Farm as a unit transfers input into agricultural output and which undergoes changes over time. In the process of adapting cropping patterns and farming techniques to the natural, economic and socio-political conditions of each location and the aims of the farmers, distinct farming systems are developed. For the purpose of agricultural development it is advisable to group farms with similar structures into classes

Collecting

This is the most direct method of obtaining plant products. It includes regular and irregular harvesting of uncultivated plants. Hunting goes hand in hand with collecting. It is still being practiced to provide additional to the normal subsistence food supply. It is only in few cases like wild oilpalm in some parts of west Africa and gum Arabic in Sudan and wild honey in Tanzania that collecting is a major cash earning activity.

Cultivation

This class is more important than collecting.

Classification according to type of rotation

Cultivation alternates with an uncultivated fallow which may take the following forms Forest fallow made up of woody vegetation with trunks, a bush fallow comprising of dense wood without trunks 3. A savanna fallow comprising of a mixture of fire resistant trees and grasses and in which grasses are dominant 4. a grass fallow comprising grass without woody vegetation, Ley systems describes where grass is planted or establishes itself on previously cropped land. The grass is allowed to grow for some years and used for grazing. \wild and unregulated ley are common in the savanna. In regulated ley, the swards are established during the non cropping period. This is rare in the tropics but are found in some highlands (Kenya) and in LATIN America. Field systems occur where arable crops follow another and where established fieldsa are clearly separated from each other. System with perennial crops (field and tree crops)

Classification according to the intensity of rotation between cropping and fallow period

Considerable variation and degree of intensity exists between cropping and fallow period within one cycle. The symbol R is the number of years of cultivation divided by the length of the cycle

of land utilization multiplied by 100. If 20% of available land in one holding is cultivated, then R is 20%. The larger R becomes, the more stationary is farming. When $R < 33\%$, it is shifting cultivation: When $R > 33\%$ and $< 66\%$ it is Fallow systems; while it is permanent cropping when $R > 66\%$. Permanent cropping can again be classified according to the degree of multiple cropping. An R value of 150 would indicate that 50% of the area is carrying two crops a year, and three crops a year for a value of 300.

Classification according to water supply

This is in terms of whether it is irrigated farming or rain-fed farming.

Classification according to the cropping pattern and animal activities

This classification is according to the leading crops and livestock activities of the holdings. Each activity has different requirements as to climate, soils, markets and inputs e.g. coffee-banana holdings or rice-jute holdings.

Classification according to the implement used for cultivation

In different parts of the world, land is cultivated by methods that require no implement or simple tools. In the Sahara desert nomads sow millet without fire-farming or soil preparation, shifting cultivators frequently sow in ashes without touching the soil. Rice growers in Thailand make use of water buffalo to trample on moist fields. The main divisions vary from hoe-farming or spade farming to farming with ploughs and animal traction to farming with ploughs and tractors.

Classification according to the degree of commercialization

The 1970 World Census on Agriculture classified farms into three groups based on the destination of the agricultural output.

1. Subsistence farming – if there is virtually no sale of crop and animal products,
2. Partly commercialized farming – if more than 50% of the value of the produce is for home consumption
3. Commercialized farming – If more than 50% of the produce is for sale.

C. Grassland utilization

Low yields in grassland areas in the arid and semi-arid areas necessitated nomadic life, or semi-nomadic life, or development of ranching.

1. Total nomadism – the animal owner does not have a permanent place of residence. They do not practice regular cultivation and their families move with the herds tended by herdsmen.

2. Semi-nomadism where the animal owners have a semi-permanent place of residence near which supplementary irrigation is practiced. However they travel with their herds to distant grazing areas

Transhumance in which farmers with a permanent place of residence send their herds tended by herdsmen for long period of time to distant grazing areas

Partial nomadism is characterized by farmers who live continuously in permanent settlements with their herds remaining in the vicinity

Stationary animal husbandry occurs where the animals remain on the holding or in the village through the entire year

Topic 2

Factors Determining Farming Systems: Physical, Biological and Socio-economic

The determinants of farming system can be grouped into the natural and the socio-economic factors. The natural factors are comprised of the physical and the biological factors

I. Physical factors – These include All external conditions and influences affecting the life and development of an organism.

Climate

- Solar radiation
- Rainfall
- Temperature
- Relative humidity
- Wind

Soils

- Soil aeration and soil structure
- Soil reaction
- Soil fertility
- Supply of mineral nutrients
- Absence of growth-restricting substances

Topography – Position of farm on the toposequence

Physical structures

1. Biological factors

- Crops
- Livestock
- Weed
- Pests
- Diseases

2. Socio-economic Factors

Endogenous

- Family composition
- Health and nutrition
- Education
- Food preferences
- Risk aversion

- Attitude/goals
- Gender relations

Exogenous

- Population
- Tenure
- Off-farm opportunities
- Social infrastructure
- Credit
- Markets
- Prices
- Technology
- Input supply
- Extension
- Savings opportunities

Topic 3

Characteristics of the Small-Scale Tropical Farming Systems

a) Very small farm size

Farm size is very small in the tropics. The mean farm size is often less than four hectares. Farms are generally smaller in the forest agro-ecological zone than in the savanna. It is relatively easier to clear savanna vegetation than that of the rain forest. Farm sizes are influenced by ecological and socio-economic factors. Increased human population results in smaller farms; an example is Taiwan where the average farm size is 1.6 ha. There is flexibility of labour on small farms. It is easier to take decision on what is to be done. It may also be difficult for the extension and marketing agents to transmit knowledge since most farmers are on their own and are not organized into cooperatives. In Africa, experiences have shown that small farms could be more productive than large ones in the long run. As a result of small farm size, the use of tractor and their maintenance could be quite expensive. There is high cost of tractor equipment in Africa than in Europe because of shorter life span due to lack of spare parts and unskilled maintenance manpower.

b) Predominance of hand labour

Small scale farming is largely dependent on hand labour to about 60-80%. Animal power is about 20% while use of tractor is negligible. On most soils in the tropics water infiltration and low level of microorganisms are problems. With increased cultivation yield decreases from hand hoe > oxen > tractor. Tools utilized are usually inexpensive and readily available and the skill required are already there. There is no need for special training unlike in use of machines. Disadvantages include problem of efficient utilization of the labour force. Timeliness of operation is a problem since the use of hand labour is time consuming. It also brings about drudgery.

c) Predominance of mixed cropping or intercropping

Mixed cropping or intercropping is a widespread cropping practice in the tropics. It is only flooded rice and wheat that are not grown in crop mixture. The advantages include efficient utilization of environmental resources particularly when crops of different maturity cycle complement each other. Provision of favourable microclimate through shading. Stability of yield as it minimizes risk against crop failure. It reduces erosion as well as preventing the spread of diseases and pests. It has high labour requirement than for sole crop and labour utilization is spread through the season. A major disadvantage is difficulty in mechanization of operations like weeding and harvesting. Spraying of the lower growing component crop in the mixture is often difficult.

d) Priority for subsistence food crops

It is characteristic to produce first food for home consumption before any consideration for cash crop. A food crop can become cash crop when produced in surplus

Topic 4

Nomadic farming, Shifting Cultivation, Fallow Rotation, permanent Cultivation, Ley farming etc.

Nomadic farming

- Definition
- Types of nomadic farming and geographic distribution
- General characteristics
- Examples
- Development path

Shifting Cultivation

- Definition
- Types of shifting cultivation and geographic distribution
- General characteristics
- Examples
- Development path

Fallow systems

- Definition
- Types of fallow systems and geographic distribution
- General characteristics
- Examples
- Development path

Ley systems

- Definition
- Types of shifting cultivation and geographic distribution
- General characteristics
- Examples
- Problem of the system
- Development path

Permanent cultivation

- Definition
- Types of shifting cultivation and geographic distribution
- General characteristics
- Examples
- Development path

Topic 5

Intercropping, Sole Cropping, Sequential Cropping, Relay Cropping, Strip Cropping etc.

Intercropping - The cultivation of two or more crops simultaneously in the same field.

Sole cropping – Growing one crop alone in pure stand, either as a single crop or as a sequence of single crops within the year.

Sequential cropping – Growing two or more crops in a sequence, planting the succeeding crop after the harvesting of the previous one.

Relay cropping – Growing two or more crops in a sequence , planting the succeeding crop after the flowering but before the harvesting of the preceding crop.

Strip cropping - Growing two or more crops simultaneously in alternative plots arranged in strips that can be independently cultivated

Adaptive research - research designed to adjust new technologies to specific set of environmental conditions

Basic research - research undertaken to generate new understanding of systems and processes

Commodity research – research focused on the improvement of a particular commodity

Component technology research – disciplinary oriented research on specific physical and biological production factors.

Cropping pattern – the yearly sequence and special arrangement of crops on a given land area

Crop rotation – the practice of following the crop located on a particular site with a different crop the following season

Farm - any tract of land or waste consisting of one or two parcels devoted to the cultivation of plants and animals under the management of the owner or tenant. The cultivation of aquatic life forms can also be included in this definition. A farm is a productive unit whose primary objective is to increase productivity, profit and the well being of the farm household.

Interdisciplinary – is a multidisciplinary team whose members work jointly on a set of problems within a common framework and expected to cross disciplinary boundaries.

Land equivalent ratio - the land area needed under sole cropping to produce the same amount of crop yield as from one ha of intercropping. It is computed as:

$$\text{LER} = \frac{\begin{array}{cc} \text{Maize yield in intercrop} & \text{groundnut yield in intercrop} \\ (2.5 \text{ t/ha}) & (1.2 \text{ t/ha}) \end{array}}{\begin{array}{cc} \text{Maize yield in sole crop} & \text{groundnut yield in sole crop} \\ (3.0 \text{ t/ha}) & (1,8 \text{ t/ha}) \end{array}} = 1.50$$

Multidisciplinary – this is where representatives of different disciplines work towards a common goal but within the confines of their own discipline

On-farm research with a farming systems perspective – research based on the assumption that in order to develop appropriate technologies for small farmers, it is necessary to understand the circumstances of the farmers and to test proposed technologies in farmer’s fields.

On-farm trials - experiments carried out in farmer fields or with their livestock.

Rapid rural appraisal – an informal method of rural data gathering selected to be quicker and more cost effective than the traditional survey methods

Recommendation domain – a group of roughly homogenous farmers with similar circumstances for whom we can make more or less the same recommendation

Strategic research – research aimed at solving specific problems of strategic importance

Systems approach – a scientific method which seeks to understand the complexity of systems through studying their interrelationships rather than their constituent components

Topic 6

Important crop based farming systems: lowland rice-based, upland cereal-based, root crop - based , small scale mixed farming, irrigated small-holder farming, small-holder farming with plantation (perennial) crops and agroforestry

Crop based farming system is synonymous with cropping system. It refers to the crop production activity of the farm. It describes all the cropping pattern grown on the farm and their interaction with farm resources, other household enterprises, the physical, biological and socio-economic factors of the environment

Lowland rice-based system

- Main features
- Geographic location
- Crops cultivated
- Socio-economic aspects
- Productivity
- Sustainability
- Future major issues

Upland cereal based

- Main features
- Geographic location
- Crops cultivated
- Socio-economic aspects
- Productivity
- Sustainability
- Future major issues

Small-scale mixed farming

- Main features
- Geographic location
- Crops cultivated
- Socio-economic aspects
- Productivity
- Sustainability

- Future major issues

Irrigated small holder farming

- Main features
- Geographic location
- Crops cultivated
- Socio-economic aspects
- Productivity
- Sustainability
- Future major issues

Small holder farming with plantation and perennial crops

- Main features
- Geographic location
- Crops cultivated
- Socio-economic aspects
- Productivity
- Sustainability
- Future major issues

Agro-forestry

- Definition
- Major practices
- Characteristics of trees
- Socioeconomic characteristics
- Crop and tree management
- Soil fertility management

Alley cropping

- Definition
- Characteristics
- Advantages and disadvantages

Topic 7

Farming systems research: descriptive and prescriptive

History of agricultural research in Nigeria

- Started by colonial government
- Aimed at export cash crops for colonial industry
- Food crops added after independence the 1960's
- Concern about relevance of research to needs of farmers in 1970's
- Research was not strongly linked to extension
- Farming systems research perspective came into being in the early 1980's because farmers were not adopting improved technologies

On-farm adaptive research

- Designed to adjust new technologies to specific environment of farmers
- Allows research results developed on-station to meet objectives of farmers
- It aim at identifying in cooperation with farmers productive and sustainable technologies

Types of on-farm research

- According to research problem
- According to degree of farmer involvement
- According to state of knowledge

Framework for farming systems research

- Descriptive farming systems research or Diagnostic survey
- Prescriptive farming systems research (design, testing and extension stage)

Experimental site selection Types of on-farm research

- Method of choosing experimental sites
- logistics
- Determinant of number of site

Farmer participation

- Working with individual or group
- Communication
- Contacting farmers
- Farmer training
- Farmer's practice

Research team

- Composition
- Tenure