Abstracts on Sustainable Agriculture

Compiled by Jürgen Carls

VOLUME 2

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Deutsches Zentrum für Entwicklungstechnologien – GATE

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PREFACE

This is the second GTZ publication to bear the title "Abstracts on Sustainable Agriculture".

These abstracts are more comprehensive than the usual type of annotated bibliography but they cannot substitute the original publication. For details we advise the reader to refer to the original.

We hope that the abstracts have a valuable role to play as part of the external input in the drafting of extension programmes. They make no claim however to offer tailor-made solutions. The responsibility for adapting the abstracts to suit local conditions rests with the reader.

Readers interested in the abstracts are asked to address their request to:

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Eschborn, June 1990

Jürgen Carls
Editor

Contents

GUIDE TO READERS

Selection of literature for the abstracts has been based on the following criteria:

- Ecological Aspects
  - . Sustainability
  - . Resource stability
  - . Soil fertility
  - . Diversity

- Socioeconomic Factors
  - . Promotion of smallholders
  - . Integrated systems (Animal-Man-Plant)
  - . Transfer of knowledge
  - . Low-external-input agriculture
  - . Sociocultural aspects

- Locational Factors
  - . Regional- and site-specific
  - . Practice-oriented
  - . Alternative uses

The abstracts are set up in the following way:

(1) Abstract number.

(2) Principal key-word: traditional land-use systems, cropping systems, agroecology, agroforestry, farming systems research and development etc.

(3) Key-words: if relevant, the geographical demarcation (continent, country) or the agroecological zone is given; the key words "review", "field trial", "field study" or "farm survey" indicate the nature of the paper; common names of field crops, soil fertility, pests, diseases, socioeconomic aspects etc. are used.

(4) Author's name.

(5) Title in the original language.

The subject index, based on the key-words, and the geographical indices are intended to help the reader to quickly find abstracts on specific aspects or areas of sustainable agriculture. The index of authors is intended to help the reader to find all publications by a particular author.

I. TRADITIONAL LAND-USE SYSTEMS

251 89 - 1/21

Traditional land-use systems
Review, traditional agriculture, sustainability, ecology, farming practices, appraisal
WOLF, E.C.
Mimicking nature.

Ceres No. 115, 20, 1, 1987, 20-24

Over the next 13 years, the world's population will increase from today's 5 billion to over 6 billion. Few analysts expect a significant increase in cultivated land by then. Merely maintaining current consumption levels will require a 26 per cent increase in the world's average grain yields. And by 2020, feeding the projected population of 7,8 billion will require grain yields 56 per cent higher than 1985 levels. Unlike past spectacular yield increases achieved under favourable cropping conditions, future improvements in average yields must come from raising the productivity of traditional farmers who cultivate unimproved crops under marginal conditions perhaps the most demanding challenge that national governments and the international development community have faced.
Subsistence farms around the world have certain common features. Farmers often mix different crops in the same fields to reduce the risk if a particular crop fails; they grow a variety of staple crops and vegetables to meet family food needs; and they rarely purchase artificial fertilizers or pesticides. It is not surprising that highyielding varieties of wheat and rice have been introduced to less than a third of the 423 million hectares planted to cereal grains in the Third World. For members of the 230 million rural households in Africa, Asia, and Latin America who use farming methods little different from those of their ancestors, green-revolution approaches will only be part of the answer.
Few researchers recognized the ecological and agronomic strenghts of traditional pratices that had allowed farmers over the centuries to maintain their land's fertility. In pursuit of higher productivity, many agricultural scientists overlooked the need for long-term sustainability.
Agricultural scientists have recently begun to recognize that many farming systems that have persisted for millennia exemplify careful management of soil, water, and nutrients, precisely the methods required to make high-input farming practices sustainable. This overdue reappraisal stems in part from the need to use inputs more efficiently, and in part from the growing interest in biological technologies. The complex challenge of Africa's food crisis in the early 1980s forced scientists to reexamine what peasant farmers were already doing. Many researchers today seek to improve existing farming systems rather than attempting to transform them in a major way.

Traditional farming systems face real agronomic limits and can rarely compete with high-input modern methods. It is important to recognize these limitations, in order to determine both how traditional practices can be modified and what such practices can contribute to the effort to raise agricultural productivity.
Traditional agriculture practised under biological and physical limitations often breaks down under growing population pressure. As rural populations grow, farmers try to squeeze more production from existing fields, often accelerating the loss of fertility. Or they may cultivate new, often marginal or sloping, land that is vulnerable to soil erosion and unsuited to farming.
None the less, traditional methods can make an important contribution to efforts to raise agricultural productivity. They use few external inputs, accumulate and cycle natural nutrients effectively, protect soils, and rely on genetic diversity.
The challenge for agricultural research is to improve agriculture in ways that retain the strenghts of traditional agriculture while meeting the needs of changing times.
Intercropping, agroforestry, shifting cultivation, and other traditional farming methods mimic natural ecological processes, and the sustainability of many traditional practices lies in the ecological models they follow. This use of natural analogies suggests principles for the design of agricultural systems to make the most of sunlight, soil nutrients, and rainfall.

252 89 - 1/22

Traditional land-use systems
Central America, Mexico, lowlands, traditional agriculture, ecology, subsistence farming, shifting cultivation, development
ALTIERI, M.A.
The modular systems in the Tabaşcan lowlands.

In: Agroecology - The Scientific Basis of Alternative Agriculture; Agroecology, 1050 San Pablo Ave., Albany, CA 94706, 1986, pp. 56-59

Various forms of subsistence farming are known to have been employed by the original Indian inhabitants of Tabasco, Mexico, and are thought to have achieved highly productive levels. Slash and burn agriculture was used for basic grain production (corn, beans), whereas extensive use of kitchen gardens (huertos familiares), composed primarily of tree crops and their associated understorey herbs, shrubs and vines, added great variety to the local diet. Cacao was produced as an understorey element in these kitchen garden systems and this crop has been expanded considerably using a plantation system which makes extensive use of legume shade trees.
In recent years the emphasis in agriculture in the Tabascan lowlands has been away from subsistence agriculture and towards commercial farming and stock-raising. Accompanying this shift towards commercial activities, a gradual abandonment of, traditional agricultural practices and varieties has taken place.

As part of a program to attempt once again to achieve the diversity and stability of productivity originally characteristic of the traditional agroecosystems of the region, production units were installed, referred to here as modular systems, whose primary focus centers around the application of ecological principles to agriculture with the incorporation of considerable empirical knowledge present in the region.
Each production unit consists of 5-15 ha controlled by several family units as part of their other agriculture activities. Depending on the social structure of the community, the families may actually live within each module or in a nearby community (ejido) and work in the module during the day. Thus production from each module would either be consumed directly by the families living there, or the products would be distributed to the members of the ejido. Any excess in production would be available for sale or exchange.
Each production unit has as part of its basic structural design an outermost band of vegetation consisting primarily of second growth species present naturally in the region. This band serves simultaneously as a windbreak, a source of natural predators and parasites for biological control, as well as a source of firewood and building materials. At the same time these shelter belts serve as biological reserves or germplasm banks for part of the great diversity of plants and animals normally present in tropical ecosystems. By selective species enrichment with forest and fruit tree species, it is possible to apply agro-silvicultural management practices, increasing the long term value of the shelter belt.
The interior part of each modular unit is constructed on the basis of the topographic diversity existent at each site. In cases where the lowest part of the module can be centrally located, large tanks are constructed which serve as catchments for all runoff from the production unit to collect dissolved nutrients and particles of soil and organic matter. Fish, ducks, and other aquatic animals are being produced in the tanks, with the aquatic plants and sediments being used as fertilizer in other parts of the module. Frequently small canals are built, radiating out from the central tank in order to further aid in the capture of excessive runoff. To avoid total inundation of the site, a principal canal can be built to eliminate excess water from the site, or in some cases, serve as a means of adding water in times of low rainfall.
Located around the central tank or along the edges of the water courses raised platforms (from 2,5 to 10 m wide and up to 100 m long) are constructed, often with the same material extracted from the catchment basins, forming a system of "tropical chinampas" for intensive vegetable production. The "chinampa" ist an ancient food production system extensively used by the Aztecs in the Valley of Mexico and by the Mayans in Southeast Mexico to exploit the swamplands bordering the local lakes. These systems still exist in many parts of Mexico. The Aztecs built chinampas up to a height of 0,5-0,7 m above water level and they reinforced the sides by posts interwoven with branches and by willow trees planted along the edges. The soil of the chinampas ist constantly enriched with

organic matter from the bottom of the reservoirs. Animals kept in small corrals, such as pigs, chickens, or ducks, are fed the excess or waste produce from the chinampas, as well as from other parts of the module, in order that manures can be incorporated back into the platforms for added productivity.
Around the areas of chinampas, the major part of the production of basic food crops traditional in the region is concentrated. According to the distribution of soil types, drainage, topography, and other physical characteristics of each site, a wide variety of annual and perennial crops are planted following the planting methods and combinations recommended by the peasants. This includes such systems as the local corn/bean/squash polyculture, cassava/corn/papaya, and fruit trees associated with various cover crops, shrubs, or vines.

253 89 - 1/23

Traditional land-use systems
South America, Chile, land-use, traditional farming systems, small scale systems, semi-commercial systems, crops, integrated systems
ALTIERI, M.A.
Traditional farming systems of Mediterranean Chile.

In: Agroecology - The Scientific Basis of Alternative Agriculture; Agroecology, 1050 San Pablo Ave., Albany, CA 94706, 1986,pp. 52-55

The farming systems of the small farmers (campesinos) of Mediterranean Chile are diversified systems. In these systems, the critical factor in the efficient use of scarce resources is diversity. Thus, campesinos assemble crops, animals and other farm resources to optimize production efficiency, nutrient cycling, crop protection, etc.
Although the manner in which campesinos assemble a particular set of farm resources varies from site to site, farming systems can be divided into two major groups: 1) small-scale intensive systems und 2) more extensive semi-commercial enterprises.
Small Scale Intensive Systems:
These systems rarely exceed 1 ha in size and the limited land area generally does not provide for all the food family requires. All items produced tend to be used for on-farm consumption. Missing resources have to be purchased with earnings from off-farm work. On these farms, campesinos typically produce a great variety of crops and animals, and it is not unusual to find as many as 10 tree crops, 10-15 annual crops and 3 to 4 animal species on a single farm.
The physical layout of these farms varies, but often they include, in addition to the tree and annual food crops, a sort of grapes ("parron") to provide shade, and fruit, herbs, medicinal plants and flowers. The typical animals of these farms are free ranging chickens and ducks, rabbits and occasionally a few pigs feeding on kitchen waste and crop residue. Intensified annual cropping usually involves the use of simple crop patterns (i.e., growing a set of annual crops only during the spring and summer), or more

typically crop sequencing (planting a second crop after the harvest of the first). In both crop patterns, campesinos may practice intercropping. Common intercropping systems include corn and beans, garlic and/or onion mixed with lettuce und cabbage, and corn-potatoes.
Extensive Semi-Commercial Systems:
The farms range between 5-20 ha in size. These systems are also diversified, but the crop and animal combinations are designed to increase production to yield a marketable surplus. With a larger area of land to work with, the campesino devotes much of it to more extensive activities such as pasture for livestock and grain cultivation. The additional land also affords more space for wood producing trees. In this way, nearly all of the household requirements are provided for on the farm.
Typically, the campesino grows crops preferred by the local community for commercial purposes. These crops, however, may entail relatively high risks. He hedges against this risk by growing several less valued and/or risky crops. Growing of beans, squash, potato or corn between rows of high value fruit trees (peaches, cherries, apples, etc.) is a good example.
The design of a 12 hectare farm about 10 km east of Temuco, in south Chile, is discussed where the campesino balanced his farm enterprises to provide for the needs of food, clothing, housing and capital. The farm consisted of an interplanted area of annual crops and fruit trees, a mixed orchard of fruit trees with rows of bee hives between the trees, approximately 5 ha of pasture, 2-3 ha of wheat and a stand of pine. From 26 bee hives he harvested 280 kg of honey/year, obtained 10-12 liters of milk per day from 3 cows, collected 10-11 eggs per day from his chickens, and from the wheat, supplied all of his flour for making bread. Pine trees were planted to provide for his wood requirements. The fast-burning wood was made into charcoal for cooking and heating and was also used in the construction of the house and barns. Guano from his animals and crop residues were collected in a compost pile for later use in crop fertilization.

254 89 - 1/24

Traditional land-use systems
Africa, review, traditional farming systems, Food plant
OKIGBO, B.N.
Broadening the food base in Africa: The potential of traditional food plants.

Food and Nutrition, 12, No.1, 1986, pp. 5-17

This paper reviews the potential for exploitation of African traditional food plants, in the context of traditional farming systems, the changes they have undergone, means to increase food production and appropriate measures to be taken, including international cooperation.
One important and widely accepted idea is that Africa developed two agricultural complexes: a seed agricultural complex,

characteristic of the savanna and involving the cultivation of grains and seed-bearing crops in open-field systems; and a "vegecultural" complex, peculiar to the forest regions and involving the growing of roots, tubers and cuttings in gardens rather than in fields.

Most tropical African livestock species were domesticated elsewhere or were introduced from North Africa and South-Eastern Asia. They include goats, sheep, chickens, pigs and ducks. Certain animals became adapted to specific ecological zones.

A simplistic model of traditional farms in tropical Africa consists of a pattern of fields at different distances and in different directions from the compound and/or homestead garden. Different methods of soil management and fertility maintenance are practised on each of the fields and in the homestead garden. The methods usually include fallows, clearance systems and production systems for varying numbers of crops and/or livestock according to prevailing practices, customs and the needs of the farmer. Each traditional farm is a complex of units or subsystems differentiated according to characteristic aspects of the production process.

The farm may be an enterprise and provide a livelihood for one or more individuals, but it usually supports a family unit in which some or all members may participate part or most of the time in farm work.

Farms are small: over 60 per cent range in size between 0.10 and 3.00 hectares. Farm size in savanna areas is usually larger than in the rainforest zone, perhaps as a result of high labour requirements in the latter for clearing, weeding and related tasks.

A diversity of farming systems exists, ranging from true shifting cultivation and nomadic herding to permanent settlement and intensive livestock production, such as modern poultry and dairy production.

In general, most of the traditional and transitional farming systems consist of shifting cultivation and related forest, secondary bush, woodland, thick and grassland fallows in respect of which varying periods of cultivation (two to five years) are followed by equally variable periods of fallow.

The second half of this paper discusses those changes which adversely affect food security and nutritional status in terms of increasing malnutrition in Sub-Saharan Africa. It also considers strategies for attaining meaningful levels of food self-sufficiency which should help to minimize that proportion of the food requirements that must be met through purchase with farm and/or non-farm incomes or through food aid.

Broadening the food base through greater utilization of indigenous food crops is one of the promising ways of increasing agricultural and food production in Africa within the strategies of increasing production per unit area and efficiency in the utilization of forest products and resources. Some indigenous food crops with developmental potential in the context of this paper are listed in a accompanying panel.

255 89 - 1/25

Traditional land-use systems
Central America, Mexico, sandy pits, study, traditional cultivation system

DEL AMO, R.S. et al.

The Tecallis: A traditional cultivation system.
In: Global Perspectives on Agroecology and Sustainable Agricultural Systems, Proc. of the 6th Int. Sc. Conf. of the Int. Fed. of Org. Agric. Movements, Univ of California, Santa Cruz, USA, 1988, pp. 433-443

As the sustainability of modern agriculture being increasingly questioned, studying and analyzing traditional cultivation systems has become more important. This paper describes a newly discovered cultivation system used along the banks of the middle Balsas River (Mezcala). Known as the Tecallis System (which means "holes" or Arenales (which means "sand culture"), this method is based upon efficient soil and water management, organic fertilizer, and intensive labour. The Tecallis System is an agriculture strategy developed for the dry season. The system is based on a high percentage of hand labour and represents a highly productive type of intensive agriculture.

In traditional Mesoamerican agriculture, two kinds of irrigation systems can be distinguished: those which require a hydraulic infrastructure and those which do not (the latter are termed "humidity cultivation" systems). In humidity cultivation, irrigation is accomplished through ditches and canal systems.

The basis of the agriculture system described in this study is the exploitation of the sandy soils that remain when the Balsas River level drops in the dry season (November to April). This system complements the other agricultural systems of these people in the following ways:

- During the rainy season, farmers cultivate maize and sesame seed fields on higher ground
- During the dry season communities carry out the arenales cultivation, which offers a subsistence base completely different from the maize-sesame seed system and includes vegetables, fruit, and flowers.
- Fruit tree orchards are tended in some sandy areas on the river bank.
- Tierra de sereno (night-dew culture), which uses moisture condensed during the night, is practiced during the months of September and October. This is developed on the lowlands of the river banks with maize sown for a second crop and watermelons grown between the maize plants.

The Tecallis System is ecologically sound because it efficiently uses water, natural fertilizers, space, and time; it does not rely on external inputs, and is based on diversity. The system facilitates intensive use of the environment through diversification in production and the profitable use of a seasonally specific and previously unexploited habitat. Diversity, soil protection, water conservation, and combination of species with different life cycles and from different habitats are

characteristics of the Tecallis System which integrate effectively into the natural ecosystem.
The Tecallis System has several socioeconomic advantages: farming occurs in the dry season when no other agricultural work is ongoing; certain crop species yield two or three harvests in one season; the system is highly appropriate for populations living in marginal river areas; while most food produced is consumed by the farmer's household, some surplus production is generated for barter or cash; and finally, this system provides food during the dry season, contributing to a stable year-round food supply in a region which is isolated from commercial large-scale food distribution.
Tecallis cultivation can be seen as a hydroponic system in that plants are cultivated in sand containing few nutrients to which natural fertilizers are applied. The rediscovery of techniques such as tecallis, a historical antecedent of hydroponics in ancient Mexico, is thus of great importance. Moreover, this system's advantage over modern and commercial hydroponics is that it does not entail any initial investment cost.

256 89 -1/26

Traditional land-use-systems
Africa, Nigeria, survey, agroforestry, homegarden, compound farm, germplasm conservation, tree improvement, land-use
OKAFOR, J.C. and E.C.M. FERNANDES
Compound farms of southeastern Nigeria: A predominant agroforestry homegarden system with crops and small livestock

Agroforestry Systems, 5, 1987, 153-168

This paper identifies the major components of compound farms and describes their uses, environmental variation, interactions and management practices. Prospects for and the implications of improvements to the system are examined.
Compound farms are a traditional land-use system that appear to have evolved with the shifting cultivation and bush fallow systems. Recent observations indicate the spontaneous establishment of compound farms by shifting cultivation seeking to establish land tenure alongside new roads.
Compound farms are found within the vicinity of homesteads and comprise numerous multipurpose woody species in intimate multistoried associations with annual crops and small livestock. The multistoried structure and species diversity allow almost complete coverage of the soil by plant canopies, thereby promoting soil conservation. Soil fertility is maintained by the use of household refuse, crop residues and animal manures.
The system has been recognized as a potentially sustainable form of land-use with possible applications for the entire humid tropics.
Several trees and shrubs are deliberately planted and managed on the compound farms for a variety of products or functions.

Goats, sheep and poultry are commonly kept for meat for sale or home consumption. Other animals occasionally kept include cattle and pigs. Livestock is fed with fodder from trees and shrubs, crop residues, grasses and herbaceous species growing in the compound farms or near fields. The animals are either confined in pens and stall-fed or tethered in fields. Trypanosomiasis is a major constraint to livestock rearing.
The number of crops decreases as the distance from the house increases. The highest diversity occurs on the compound farms and the lowest on the outlying fields. This minimizes the time spent visiting distant fields.
Vertically, several relatively distinct strata (canopy layers) can be distinguished in the compound farms. The lowest zone (0-1,5 m) comprises food crops like cocoyam, beans, cucurbits, okra and regeneration of overstorey trees and shrubs. The next zone (1,5-3 m) consists of cassava, maize, yams (on stakes) and castor. Next is the plantain/banana layer (3-6 m). Above this comes the fruit/vegetable tree layer (6-30 m +) comprising species for timber, fuelwood and cultural uses.
Due to different maturity periods, crop species are invariably planted and harvested at different times. Yams, for example, are planted before the onset of the rains, while maize and millet are planted a few months after the rainy season has begun. Cassava ist planted about four weeks after maize and harvested the following year. This diversified and continuous production of food is important not only nutritionally, but also because storage is difficult and post-harvest losses are high.
Numerous advantages are inherent in the multispecies, multistoried cropping systems like the compound farms. These include diversified production, risk minimization, enhanced labour efficiency, continuous production thereby minimizing post-harvest losses due to poor storage facilities, better nutrient cycling and nutrient use efficiency than in monocropping systems and good soil conservation due to continuous ground cover.
The biggest constraint of the compound farm or homegarden type of system is that it is perceived as a primitive form of subsistence land use. These view is common both on international and local levels of landuse policy and decision making and has resulted in little, if any, resources being devoted to the study and improvement of the system as a whole.
It is important that a well co-ordinated and systematic research programme is undertaken to obtain information relevant to enhancing the productivity and sustainability of the compound farms.

257 89 - 1/27

Traditional land-use systems
Africa, Rwanda, land-use, ecological farming, sustainability, gross margins, comparative study, economics
BENNETT, J. and R. PREISSLER
Traditioneller und Standortgerechter Landbau im Gebiet des Projet Agro-Pastoral Nyabisindu. Ein betriebswirtschaftlicher Vergleich der beiden Systeme.
(Traditional cropping and ecological farming in the area of the Agro-Pastoral Project of Nyabisindu. An economic comparison of the two systems.)

Projet Agro-Pastoral de Nyabisindu; Etudes et Experiences No. 10; GTZ Projet Agro-Pastoral de Nyabisindu, B.P. 70, Nyabisindu, Rwanda, 1987

The shortage of resources in many developing countries as well as the problems of a "high external input" agriculture, have led to an intensive search for ecologically sound land-use systems.
A model of land-use has been developed in the Agro-Pastoral Project of Nyabisindu, Rwanda which is more recognized not only within Rwanda but world-wide. In search for an alternative to the conventional European agriculture, methods of self-sustaining autochthon land-use systems have been combined with results of agricultural economy-research and adjusted to the local conditions of Rwanda.
Most important elements of methods are:
- Land contouring by integration of hedges, forage grasses and trees against erosion.
- Crop rotation with periodically returning green manuring,
- Manuring with compost, manure and mulch,
- Mixed cropping and
- Integrated livestock raising with fodder growing.

The activities have been tested on the experimental fields ("fermettes") of Nyabisindu and in model farms in the project area. First results and successes in the realization by the extension service give reason to believe that the way taken is the correct one.
The results of these tests accentuate the importance of a more intensive occupation with the economic aspects of ecological farming.
The present work tries to demonstrate the essential points for the economic evaluation of ecological farming by means of case studies received hitherto in Nyabisindu. The methodical main point of this work is to be seen in the expression and comparative interpretation of gross margins for traditional production methods as well as for those of ecological farming.
The data and calculating results used could serve as guide-lines for individual farm planning until the basis of research for ecological farming has been broadened.

258 89 - 1/28

Traditional land-use systems
Review, agriculture, sustainability, concept, traditional land-use, ecological farming, low-input systems, integrated pest management, alternative agriculture, environment, research needs
CARTER, H.O.
The agricultural sustainability issue: an overview and research assessment.

In: The Changing Dynamics of Global Agriculture; A seminar on Res. Policy Impl. for NARS; ISNAR/DSE/CTA, Feldafing, FRG, 1988, pp. 115-135

There is a growing and diverse literature based on agricultural sustainability - concerning its meaning, relevance as a concept in agriculture and development, and applicability for research planning and extension activities. Some confusion comes from the fact that the term has intellectual roots from different disciplines where it is used in a variety of contexts.
The term sustainable has long been used by resource managers with reference to the maximum harvesting of forests or fisheries consistent with the maintenance of a constantly renewable stock. Sustainability is the steady state when what is being used (harvested) is continually replaced.
Sustainability has been defined by some in terms of carrying capacity - the maximum population size that the environment can support on a continuing basis.
Other terms for agricultural sustainability include alternative, regenerative, low-input, ecological, environmentally sound, and organic agriculture. These terms are used by people interested primarily in alternative systems of farming that will feed expanding populations while minimizing potential negative effects, whatever they might be. Defining the negative effects essentially separates or categorizes the various proponents of sustainable agricultural systems. Some groups put primary emphasis on minimizing environmental damage and degradation. Sustainability becomes almost synonymous with stewardship of the earth.
Others want mainly to perpetuate a rural community system; community sustainability or maintaining viable rural communities becomes almost a goal in itself. Still others equate agricultural sustainability with food self-sufficiency while minimizing costs. Many advocate an energy-conservation agriculture - so much so that efficiency of the system is measured exclusively in terms of energy use. People require both safe food and water, which in turn, proponents argue, require an agricultural system that can operate ad infinitum with only meager dependence on external inputs. Thus, just as the term sustainability has differing dimensions in various contexts, the agricultural counterpart has social, ecological, economic, and emotional implications.
Summarizing, the paper discusses several meanings of agricultural sustainability, followed by a look at the current agricultural system and what the impetus is to change it. Then, the state of the art in research on low-input, sustainable farming systems is

discussed, what impediments there are for farmers to change from current agricultural production systems. Finally, change is more likely to be gradual than abrupt.

259 89 - 1/29

Traditional land-use systems
Africa, review, survey, semi-arid zones, natural resource management, forestry, range management, FAO
NIAMIR, M.
Traditional african range managment.

ILEIA, 5, 2, 1989, pp. 28-29

The pastoralist in Africa has developed principles and strategies for managing the natural resources in agreement with his variable physical environment and his social needs. Recently his situation had to face external pressures, such as crop expansion into high quality rangelands, nationalization of land by governments, population increase, indiscriminate water development, and a series of droughts, all of which have contributed to pasture shortages and land degradation.
In many areas the traditional system of management is no longer able to cope with the shortage of pasture, and instead is adding to the problem of land degradation. In addition, the traditional management knowledge is gradually being lost as more of the younger generation of pastoralists are attracted to urban areas. Yet the traditional system has developed an intimate knowledge of the environment and many successful techniques that could still be of use today.
A literature survey was commissioned by the Food and Agriculture Organization (FAO) of the United Nations, to collect details on traditional African natural resource management, and to evaluate the survival of traditional techniques and their potential for development in Africa. The study concentrates on four aspects: 1) the descriptive knwoledge of the physical environment (e.g. names of plants and soil types), 2) daily natural resource management techniques (e.g. which tree or pasture to use, when and why), 3) the social controls and organization of daily management (e.g. grazing controls), and 4) the socio-political structure of resource management (e.g. resource tenure issues). This article covers daily range and herd management techniques and the social controls on daily management.
Today many techniques are still in use, either in the original or a modified form, and can be incorporated into development projects. Development personnel in the field need to first consider whether the traditional techniques are still alive, for which they need the active assistance of the pastoralists in the planning, design and execution of the projects. In addition, these techniques cannot be revived without clarification of national land tenure laws, checks on crop expansion, official recognition of traditional socio-political organizations, greater incentives to young herders to stay on the range, greater sensitivity by

government officials and extension workers to the value of traditional knowledge, and a common, coherent national policy on the decentralization of natural resource management.

260 89 - 1/30

Traditional land-use systems
Latin America, Mexico, traditional farming, highlands, agro-ecosystem, mixed cropping, low-input system, sustainability, modern practices, integrated systems
BOROWITZ, S.
Lessons from a traditional agroecosystem.
The Cultivar, 7, 1, 1989, pp. 1-4

Increasing population pressures led the people of Tlaxcala, Mexico to expand their agricultural fields to include hillsides.
The farmers developed a unique agricultural system - canals associated with the terraced fields. Using this system - which incorporates nutrient cycling, crop diversity, and careful soil management - Tlaxcalan farmers have maintained the agricultural productivity of much of their soil without chemical pesticides or fertilizers.
Despite the long-term success of their traditional practices many Tlaxcalan farmers are abandoning them in favour of modern inputs and techniques, including synthetic pesticides and fertilizers, heavy machinery, and monocropping. This transition from a low-input, regionally adapted system to practices which do not emphasize the maintenance of soil structure and fertility threatens to deplete the area's fragile resource base and diminish the long-term sustainability of the system.
Traditional Practices:
The Tlaxcala region, located in the volcanic highlands 200 kilometers east of Mexico City, features intermittent, heavy rainfall, and alternating layers of clay soils covered by a thin protective layer of topsoil. Stripped of the topsoil, the underlying becomes hard and unworkable.
To control the runoff from the heavy rains Tlaxcalan farmers have developed a carefully designed system of sloping terraced fields, and built canals divided into catchment tanks, or cajetes, at the base of the terraces.
The cajetes, with an average capacity of 168.5 cubic meters per hectare, can trap up to 16.85 mm (0.65 in) of rain. As much as 24 mm (0.95 in) can fall in less than half an hour in this region, but the fields can also absorb some of the moisture.
The cajetes act as compost pits, trapping soil and leaf litter washed from upslope. Each year, the farmers dig out the cajetes and return the captured soil and composted vegetation to the terraced fields. Combined with manure from livestock and humans, as well as rotations of legumes, the soil and compost from the cajetes have provided a good portion of the nutrients and organic matter necessary for the system to remain productive over three thousand years of cultivation.

The diversity of both crop and non-crop plants plays a major role in maintaining the system. To meet their dietary needs, Tlaxcalan farmers traditionally plant intercrops, emphasizing corn/bean/squash. This kind of mixed cropping has been shown to use both soil nutrients and solar energy more efficiently, as well as suppress weeds and discourage pests, leading to a greater total harvest. In addition, farmers plant several seed varieties of each crop to insure success of at least one of each type in the variable climate. Through this traditional practice of seed selection, seeds especially adapted to regional conditions have developed.
The typical practice of leaving the areas around cajetes as permanent border space, where agave, cactus, fruit trees, native shrubs, and a variety of annuals thrive, ensures that regional plant diversity is also maintained.
The border plants provide food, fuelwood, and fodder, and provide food and shelter for beneficial insects that prey on and parasitize harmful insects. Trees along the border also control wind erosion and circulate nutrients from the deeper soil strata; nutrients are transferred to leaves, which eventually decompose and make nutrients available to crop plants.

<u>The Impacts of Modern Practices:</u>

Although the terrace/cajete system has traditionally produced more than enough food for the community, farmers are beginning to abandon it, due in part to pressures from a variety of sources - including government, banks, agribusiness interests, and export organizations - which promote modern high-input methods. To raise national production levels, Mexican agricultural policy encourages standard input-intensive systems using tractors, hybrid seeds, and synthetic chemical fertilizers and pesticides.
The scenario on Tlaxcalan farms has begun to change. To receive government aid and bank loans, farmers must monocrop using seeds produced under "ideal" conditions. These seeds, developed on farms with precise irrigation and fertilizers, and protection from wind and pests, are not appropriate for highland conditions. Monocropping leaves the crops vulnerable. To compensate, farmers begin to rely on government-subsidized pesticides.
To provide fields for the growing population, the government also subsizides the construction of tractor-built terraces. Existing fields are combined into larger plots, and new terraces are created on land that may be inappropriate for long-term agricultural use. Since these new terraces lack cajetes, which would collect nutrients, farmers find they need synthetic fertilizers to maintain soil fertility.
Even though high-input methods are a faster and less labor-intensive way to raise production in the short term, they cost more money, require more energy from fossil fuels, and can degrade the ecosystem.

<u>Integrating Traditional and Modern Practices:</u>

Mexican agricultural policy could promote proven traditional agricultural practices, such as those of the Tlaxcalans', in addition to appropriate "Green Revolution" methods. That's where development projects should begin."

The Mexican government could developed seeds selected for local conditions, and could encourage diversity, rather than monocropping. New terraces could allow for tractor access yet still include cajetes. And instead of subsidizing fertilizers and chemical pesticides, the government could use the same money to buy animals to provide not only manure, but meat and milk.
The Tlaxcalan methods can apply to most slope agriculture where soil and water conservation is essential.
A combination of resource-conserving, traditional methods and current scientific knowledge may provide increased productivity while still protecting the natural resource base.

261 89 - 1/31

Traditional land-use systems
Africa, Sub-Sahara, review, traditional systems, rotations, shifting cultivation, cropping systems, farming systems, ecology, sustainbility
OKIGBO, B.N.
Cropping systems and rotations development for improving shifting cultivation and related intermittent production systems in tropical Africa.
In: Improved Product. Systems as an Alternative to Shifting Cultivation, FAO Soils Bulletin 53, ISBN 92-5-102 121-X, Rome, Italy, 1984, pp. 121-140

This paper considers criteria for selecting suitable farming systems for different ecological zones and suggests more efficient cropping systems and rotations by integrating traditional with new technologies. It also presents examples of improved cropping systems with recommendations for integrating them into planned rational land use supported by research.
Traditionally, Africa has not been a major food importer; the food self-sufficiency ratio was much higher in the 1960s (98%) than in 1981 (88%). Yields per hectare are lower in Sub-Saharan Africa than elsewhere and whereas yields elsewhere have increased during the last decade, in Africa they have generally either been decreasing or have remained constant. It is, therefore, not surprising that studies agree on the poor performance of agriculture and on a gloomy future for food production in Sub-Saharan Africa.
In efforts to solve this problem, traditional farming systems have become increasingly outmoded because of such modernization pressures as rapid population growth, high rates of urbanization, rising incomes, and a demand for convenience foods produced outside Africa.
To overcome these low production rates in tropical Africa the following recommendations are given:
- The highest priority should be given to cooperative international and regional efforts to help African countries develop their own research especially that seeking alternatives to shifting cultivation and related fallow systems.
- Land development and soil management benchmark and technology

transfer activities of the IARCS and other international institutional efforts should be strengthened financially and in their national and regional manpower development programmes.
- Although some improvement is being made in the design and development of management principles for cropping systems in drier areas, progress in solving similar problems in the humid and subhumid tropics has been very slow. Crops there include several species not yet affected by the Green Revolution; more serious effort should be devoted to designing cropping systems and developing management principles for the humid tropics.
- In countries of tropical Africa which are not producing enough food to meet current demand, high priority should be given to: (a) strategies to increase productivity through more efficient cropping systems and rotations, (b) ways to maximize irrigation benefits including watershed development, especially in the drier areas, and (c) significant increases in the use of valley bottoms and hydromorphic soils especially in rice production for which a possible two million hectares is potentially in tropical Africa.
- Most African countries faced with problems in food production are giving priority to achieving self-sufficiency and to producing food commodities that are currently being imported. In all these efforts, primary emphasis should be placed on those resources, crops, soils, etc. which will give maximum returns per unit input; those of medium potential should be developed secondarily and lastly those with low or marginal potential. In tropical Africa this is not the case, where much effort and many resources are being devoted to production in marginal areas.

262 89 - 1/32

Traditional land-use systems
Tropics, developing countries, review, traditional systems, small-scale farmers, diversity, ecology, sustainability, nutrient cycling, diseases, pests, weeds, productivity, agroforestry
ALTIERI, M.A.
The significance of diversity in the maintenance of the sustainability of traditional agroecosystems.

ILEIA, 3, 2, 1987, 3-7

The ethnobotanical knowledge of certain traditional farmers is so elaborate that the Tzeltals, P'urepechas and Yucatan's Mayans of Mexico can recognize more than 1200, 900 and 500 plant species respectively.
Hanunoo swidden cultivators in the Philippines can distinguish over 1600 plant species.
Therefore a striking feature of traditional farming systems is their degree of plant diversity in time and space in the form of polyculture and/or agroforestry patterns.
Peasants knowledge about soils, climates, vegetation, animals and ecosystems usually results in multidimensional productive strategies which generate, within certain ecological and technical

limits, the food self-sufficiency of farmers in a region. For agroecologists interested in the development of sustainable agricultural systems, there are several factors of traditional agriculture as well as aspects of traditional knowledge that are relevant. By understanding the features of traditional agriculture, such as the ability to bear risk, biological folk classifications, the production efficiencies of symbiotic crop mixtures, etc., it is possible to obtain important information which may be used for developing appropriate agricultural strategies more sensitive to the complexities of agroecological and socio-economic processes, tailored to the needs of specific peasant groups and regional agroecosystems. It is difficult to separate the study of traditional agricultural systems from the study of the cultures that feed them. For this reason researchers must deal with both the complexity of the production systems as well as with the sophistication of the knowledge of the people that manage them. Such complex studies require the participation of social scientists interacting with agronomists and other biologists.
In this paper the roles of diversity in agroecosystem function is discussed:
- diversity and nutrient cycling
- diversity and insect populations
- diversity and plant diseases
- diversity and weed populations
- diversity and productivity
- diversity and sustainability

In essence, the performance of the total system is dependent upon the level of interactions between the various farm components. Systemdriving interactions are those direct interactions where products or outputs of one component are used in the production of another component.
The subsidizing of a peasant agricultural system with external resources (pesticides, fertilizers, irrigation water) can bring high levels of productivity through dominance of the production system, but these systems are sustainable only at high external costs and depend on the uninterrupted availability of commercial inputs. An agricultural strategy based on a diversity of plants and cropping systems can bring moderate to high levels of productivity through manipulation and exploitation of the resources internal to the farm and can be sustainable at a much lower cost and for a longer period.

263 89 - 1/33

Traditional land-use systems
Latin America, Mexico, study, agroecosystems, traditional agriculture, productivity, crops, soil fertility, plant protection, sustainable agriculture, ecology, research needs
JIMÉNEZ-OSORNIO and SILVA DEL AMO R.
An intensiive mexican traditional agroecosystem: The Chinampa

In: Proc. of 6th Int. Conf. of IFOAM, California, USA, 1988, pp. 451-462

This paper describes a study of the chinampas in San Andrés Mixquic, Méxcico D.F. The objectives of the study were to: describe the current status of the chinampas; determine changes in the basic elements and practices of the peasants from 1971 (the date of the oldest records) to the present; recover and understand the ecological basis and interactions involved in the chinampa system in order to utilize them in the design of sustainable agroecosystems; and propose research areas necessary to understand the ecological mechanisms and interactions involved in the system.
Traditional agriculture in Mexico has led to the development of complex agroecosystems characterized by high levels of production. The chinampa agricultural system, represents the pinnacle of Pre-Hispanic - technology in Mesoamerica and still functions today. The word chinampa, meaning "net of branches," is derived from the Nahuatl language. Both the Nahua and the chinampas were once part of the Aztec empire.
A chinampa is essentially a long narrow strip of land surrounded on at least three sides by water. The basic elements of the chinampa agricultural system are water, soil fertility, energy cycling, seed beds, and use of noncrop plants. The ample supply of water which characterizes the chinampas is important. Canals are used for transport, and the abundant water enables peasants to cultivate their land all year, instead of only during the rainy season. Chinampa soils have traditionally been managed intensively. Soil fertility is continuously renewed with organic amendments such as canal muck, aquatic plants, crop and weed residues, and animal manure.
The chinampa agricultural system is self-sufficient due to continuous recycling of energy and materials. Human labour is intensive, cultural practices are well adapted to the environment of the chinampas, and external inputs of materials are minimal under ideal conditions. This system is an example of how natural resources can be successfully managed without long-term depletion or destruction.
An essential element in the chinampa system is the technique for preparing the starter seedbeds, which are called almacigos.
Habitat and plot microclimate are controlled with the use of noncrop plants. The willow tree (Salix bomplandiana H.B.K.) is an important element and is planted around the perimeter of the plot at 3- to 5-meter intervals. Tree roots stabilize plot edges and draw moisture directly from the water table, thus enhancing water management in the field. Rows of willow trees reduce wind and are

an excellent habitat for some beneficial organisms such as birds and entomophagous insects. The branches of the willow tree along with other noncrop plants such as grasses and aquatic plants protect seed beds from heavy rains, frosts, and excessive drying. Almost all weeds are used as forage and fertilizer.
Although government projects have been designed to protect the ecology of this area, they have failed to recognize two important factors in the survival of the chinampas: water and the chinamperos. Future government projects need to recognize that water is a major component of the chinampas and that any change to the water supply affects the entire chinampa agroecosystem.
Family and social organization have been important factors in the survival of the chinampas. The decline of the chinampas has affected the social structure and cultural characteristics of the people living on them. Cooperative work on the canals has declined, for instance, as has the tradition of families working together within a chinampa. Younger generations look to the city for employment rather than to farming. The decline of the chinampas signals not only the loss of a production system, but a cultural system as well. Projects aimed at protecting and encouraging the chinampas' production system should protect and utilize its sociocultural attributes.
Since the chinampas are still functioning, studying the ecological mechanisms and interactions involved in the extraordinary and seemingly perpetual productivity of this system could provide useful information in the development of a sustainable agriculture. Research questions should include:
- What are the ecological roles and benefits of the noncrop plants?
- Why is the silt of certain canals incorporated in seedbeds?
- Does the system have mechanisms of pest control built in? If so, what are they?
- What are the allelopathic interactions involved in the system and how important are they?
- Are there plant species in the system that can be managed and incorporated into other agricultural systems?
- What are the nutrient dynamics and how are they affected by fertilizer usage?

Although these questions are focused on ecological factors the chinampa agricultural system includes ecological, technological, and social factors. Multidisciplinary study is therefore required.

264 89 - 1/34

Traditional land-use systems
Africa, tropics, review, book, Terres et Vie, CTA, agriculture, sustainability, sociology, traditional systems, diversification, ecology, farmers, crops, water resources, land managment, agroforestry, trees, soil fertility, cultural practices, economics
DUPRIEZ, H. and P.DE LEENER
Agriculture tropicale en milieu paysan african (Agriculturel in African Rural Communities).

MacMillan Publ. Ltd, London and Terres et Vie, Nivelles, Belgium and CTA, Netherlands; ISBN 0-333-44595-3, 1988, pp. 292 + ix

Agriculture in African Rural Communities is a basic introduction to principles of crop physiology and practices of crop husbandry. The book recognises the realities of traditional subsistence farming but introduces improved methods. As well as details of plant requirements and the importance of soil and water, it describes environmental, climatic, cultural, social, managerial and economic factors.
This book is about tropical agriculture in general, although stockraising and the keeping of poultry and small animals are not covered. The book does not overemphasize how best the grower might improve his or her farming methods. The reader must draw his own conclusions about the practical steps to be taken. It is more important to understand and think over one's farming methods than to imitate. Therefore a careful examination of the illustrations is needed. They show ways of working the land. Whether these ways are appropriate for a particular farmer, only the farmer can decide.
Each of the forty-nine lessons in this book are each on a different subject, but they form an interrelated whole.
This book does not treat agriculture simply as a technical activity which needs only specialists trained in institutes of higher education.
The "Land and Life Series" is aimed at practitioners and students of agriculture and rural development and associated vocational and technical skills. The books in the series treat topics according to appropriate, smallscale and affordable technology taking into account traditional ways but adding relevant modern improvements. For training, they can be used in secondary schools and vocational training centres and colleges up to diploma and degree level, but they are chiefly meant to be used in the field, in practice. They are ideal for self-help, adult education and rural extension projects. They are written in a clear and highly illustrative style and thus can be used equally by those for whom English is a second language and by non-specialists. All the titles in the series are designed and produced as low-cost editions. Although based on African practice, the books are relevant to similar climatic regions in other continents.

265 89 - 1/35

Traditional land-use systems
Africa, Ghana, report, cocoa, traditional practices farming, cropping systems, intercropping
ANABAH, S.
Traditional cocoa farming in Ghana.

IFOAM, 3, 1988, pp. 11

Cocoa is produced in Ghana by traditional organic methods, dating from 1879. It is grown in the tropical rainforest in the southern parts of the country by smallholders using traditional techniques. The recent adoption of intensive farming practices and the establishment of commercial farms in some parts of Ghana has not displaced these smallholders. Their cultural practices have prevented devastation of forests, helped in the maintenance and build-up of humus rich top soils, and prevented landslides and soil erosion on the hill tops and slopes where cocoa is grown.
The establishment of a cocoa farm starts with the clearing of jungle followed by judicious and selective felling of forest trees by axe. Many trees are retained to provide permanent shade for the cocoa plants. Most farm operations are done manually, although some farmers now use chain saws and motorised spraying machines. The debris is burned to open up the area for planting, to sterilise the soil, provide potash and destroy weed seeds. Once established, there is no further burning.
Weeds are clearing by hand twice a year just before the commencement of each of the two rainy seasons. They are left on the soil to decompose and build up the humus.
Artificial fertilizers and herbicides are not applied on the cocoa plants or on the staple food crops (cocoyam, plantain and cassava) intercropping with the young cocoa seedlings. These crops provide shade for the young plants and also biodynamic organic food for the farmer's family. Intercropping ceases when the cocoa overshadows the food crops and starts bearing pods about three years after planting. A well-maintained cocoa farm is always naturally covered with litter of cocoa leaves, which perpetually mulch and preserve soil moisture. This also accelerates the decomposition process.
Cocoa trees infected with swollen shoot disease caused by mealy bugs are cut out to arrest the spread of infection. Black pod fungus is also treated by removing diseased pods; and judicious pruning and reduction of shade brings it under control. Capsid beetles are very often a menace when there are flushes of new growth, and a pyrethrum base insecticide is sprayed twice a year. Another troublesome common pest establishing itself all over Ghana is the grasshopper, which feeds on nearly all green vegetation. Fortunately it perishes with the heavy rains, so is not a major problem.
The golden pods of cocoa are harvested and usually broken open by the communal efforts of neighbouring farmers in order to get the beans ready in time to allow for successful fermentation. The fresh cocoa beans are piled up on banana and plantain leaves and

covered up for a few days to ferment without chemical additives. After this period, the beans are sun-dried and sold.
Traditional cocoa farmers' wives burn sun-dried cocoa husk into potash, and together with palm oil they manufacture organic soap. So the traditional cocoa farmers of Ghana wash with organic soap, eat organic food, cure diseases with medicinal herbs growing around them, and brush their teeth with chewing sticks and sponges gathered from the forest.

266 89 - 1/36

Traditional land-use systems
Latin America, Amazon Basin, humid tropics, traditional agriculture, appropriate technology, migratory agriculture, acid soils, ecology, ecosystem, cropping systems, soil fertility, farmer, economics, low-input system, pasture, agroforestry
NICHOLAIDES, J.J. et al.
From migratory to continuous agriculture in the Amazon Basin.

In: FAO Soils Bulletin No. 53, ISBN 92-5-102121-x, 1984, pp. 141-168

Appropriate technologies for changing migratory agriculture to continuous agriculture in some parts of the Amazon Basin have been developed. These agronomically sound, scale-neutral technologies are beginning to be used on some of the Amazon Basin's acid and infertile soils normally subjected to shifting cultivation.
Two types of farmers are involved in the clearing of the Amazon Basin. Shifting cultivators are responsible for most of the clearing in the western part of the Basin, while ranchers trying to develop pastures are the primary cause for the clearing of the seasonal semi-evergreen forest in most of the Brazilian or eastern portions of the Basin.
Acid and infertile soils (Oxisols and Ultisols) occupy almost 75% of the Amazon Basin. These red or yellow soils are deficient in most nutrients, usually welldrained, and have generally favourable physical properties.
Most shifting cultivators in the Basin use the slash and burn technique. In this system, the larger trees and shrubs are cut by axe, machete, or chain saws during periods of low rainfall, are allowed to dry for at least 10-14 days and are then burned either in place or in piles with smaller trees and shrubs. Other shifting cultivators, such as those in the very high rainfall areas of Ecuador's Amazon Basin, practise "slash and mulch" by broadcasting the crop seed in the forest, cutting the undergrowth and using that vegetation as mulch instead of burning. Still yet another variation of shifting cultivation is in the Xingu River Basin in the centre of Brazil's Amazon Basin by the Indians who plant their root crops in the cleared forest prior to burning. Then, with the burn, the root crops lose their green material, but not the vitality of the underground root system which absorbs nutrients leached from the ash when the rains begin.

The Basin's shifting cultivators most commonly plant some combination of rice, bean, maize, cassava, sweet potato, and plantain among the ashed debris using a stick to make the hole into which seed or vegetative portions of the crops are planted. Cassava and banana are often planted before rice in many areas of the Basin and it has been reported that cassava is planted to 90% of the Basin's cultivated fields.
After one or two crops, especially on the acid and infertile soils, yields decline so drastically due to soil fertility depletion and consequent greater weed competition that the land is then abandoned to a forest fallow. This fallow usually lasts for 14-21 years during which the fertility of the soil is regenerated by nutrient cycling of the forest growth and litter. The land is cleared once again, cropped and returned to fallow after one or two more crops.
With the opening of the Trans-Amazon highway and feeder roads, there is consequent increased population pressure, shortening of the forest fallow period and the soil fertility regeneration process, and a subsequent conversion of an ecologically sound cropping system into an unstable, unproductive one which creates ecological disaster. The effect of this shortened fallow is especially pronounced on the more infertile soils which make up three-quarters of the Basin.
In Yurimaguas, Peru, continuous cropping systems for the acid, infertile soils of the Amazon Basin and other similar agro-ecological areas have been developed. The results of these research efforts are felt to offer attractive alternatives for shifting cultivators in the Amazon Basin and in similar soil-crop climatic areas.
Important components of the continuous cropping included determining the most important crops, their nutritional needs, best sequences and changes in soil properties with time of cultivation.
Included in the Yurimaguas research are various rotations and combinations of rice, maize, soybean, groundnut, cassava, cowpea, sweet potato and plantain.
The improved Yurimaguas technologies offer an agronomically, economically and ecologically attractive alternative to that scene for certain areas of the Amazon Basin.

267 89 - 1/37

Traditional land-use systems
Reviev, Africa, Sahel, book, technical notes, land-use, traditional systems, ecological approach
UNESCO
The Sahel: ecological approaches to land-use.

MAB Technical Notes, UNESCO, 7 Place de Fontenoy, 75700 Paris, France, ISBN 92-3-101237-1, 1979, pp. 99

The official reports of MAB published to date in the "MAB Report Series" number some 30 issues. These reports contain the

proceedings of the different types of meetings which have marked the planning phase of the programme. While these reports are above all of a logistic nature, it is evident that they have been established on the basis of the present state of ecological knowledge, as described and summarized in documents prepared by specialists and presented to each meeting.
It has been decided to publish such documents (in English, French and if necessary, Spanish) in a new series, entiled "MAB Technical Notes". These technical notes will provide reviews of scientific knowledge relating to the ecological bases of, and new techniques for the management and exploitation of natural resources. Eventually, the series will contain reviews or the results of the operational phase of the programme.
The present volume is devoted to the Sahel.
After an introduction to the problem, the book contains the following articles:
- The Sahel: climate and soils, by L. Berry
- Remote sensing potentials for ecological research and training in the Sahel, by N.H. MacLeod
- Plant cover and pastures of the Sahel, by H. Gillet
- Pastures and livestock in the Sahel, by G. Boudet
- The improvement of pastoral economy in the Sahel: research trends, by G. Boudet and H. Gillet
- Animal production and health in the Sahelian zone, by H.S.H. Seifert
- Studies on pastoral nomadism in the Sahelian zone: bibliographic review, by E. Bernus
- Human geography in the Sahelian zone, by E. Bernus
- The status of pastoral nomadism in the Sahelian zone, by D.L. Johnson
- Improvement of pasture and livestock exploitation in the Sahel: proposals for management and land use, by G. Boudet

These basic information documents, enriched and amended by discussions, constitute a useful body of information for a larger public, for use in research, planning or teaching.

268 89 - 1/38

Traditional land-use systems
Latin America, Chile, subtropical zone, slopes, survey, interviews, small farmers, agroecology, cropping systems, cultural techniques, sustainability, socioeconomy, productivity, soil conservation, appropriate technology, rapid rural appraisal
RODRIGUEZ, J.A. et al.
Agroecological typification of traditional farming systems in Central Chile.

In: Proc. of the 6th Int. Sc. Conf. of IFOAM, Santa Cruz, California, 1988, pp. 463-468 + Annex

Under prevalent conditions of economic uncertainty in Chile, attempts to improve rural life and income must emerge from rural

development strategies that minimize dependence on purchased inputs and industrial technology, improve the efficiency of the use of local resources are used, emphasize self-sufficiency in production and consumption, and favour the organization of peasants to enhance their capacity for economic and social survival. The approach must be based on people's goals, indigenous knowledge, autochthonous technologies, local resources and social organization, so that it becomes a village-based effort with the active participation of all peasants.
A typical agroecosystem of the described area rarely exceeds 2.5 ha and is composed of the household, a kitchen garden, a chicken house, a mixed fruit orchard, a pasture with grazing animals, and the cropping systems which include tobacco, corn/bean polycultures, potatoes, vegetables and a fallow section. Most farmers devote about 25% of their land to tobacco. Crop growing seasons are concentrated between October and March, with virtually no cropping activities during late spring and winter months.
Tabacco and traditional crops compete during the growing season for the same land, scarce labour, and/or cash resources. At present farmers devote more effort to tobacco because it provides secure cash when grown under contract with the National Tobacco Company of Chile. Although yields of traditional crops exhibit a decreasing trend, farmers still plant them to secure subsistence food. Risk avoidance is expressed through crop diversification and/or early planting to provide an early source of food.
After evaluating the information derived from a survey it has been decided to concentrate the technical efforts in three main areas: reorganization of production space, soil conservation practices, and use of appropriate technologies.
Reorganization of Production Space:
A proposed design of a model farming system deviates from the traditional model in various ways:
- it includes raised beds for biointensive year-round vegetable production using organic residues and wastes; medicinal herbs are also emphasized in these units;
- includes a cow "corral" built close to the compost pile;
- bee hives are placed between the mixed orchard and the annual cropping system area;
- it includes a portable chicken house to distribute manure in otherwise unused spaces; and
- it includes a crop rotation system designed to preserve the soil and to assure constant diversified production by dividing the land into 6 small fields of fairly equal productive capacity. The rotation is designed to produce the minimum variety of a basic crops, including winter crops such as fava beans, lentils, barley, and wheat, taking advantage of the soil-restoring properties of the legumes.

Soil Conservation Practices:
This includes simple recommendations such as plowing in contour, minimal tillage techniques, use of terraces and hedgerows, and cereal/legume rotations as well as improved management of fallow periods. It also involves construction of fences for better grazing rotation and cattle management.

An important technique for marginal areas on the slopes is the design of agroforestry systems.
Use of Appropriate Technologies:
This takes advantage of several techniques and tools like solar drying, greenhouse construction, solar heaters and ovens, basic food cooking recipes, home building techniques, etc., which would enable farmers to conserve energy, food, and other materials.

269 89 - 1/39

Traditional land-use systems
Pacific, Polynesia, Micronesia, review, book, traditional agriculture, subsistence agriculture, environment, ecology, sustainability, sociology, economics, vegetable, food plants, extension, education.
BARRAU, J.
Subsistence Agriculture in Polynesia and Micronesia.
Bernice P. Bishop Museum Bulletin, 223, Publ. Kraus Reprint Co., Millwood, New York, 1976, pp. 85

From a geological viewpoint, roughly three principal types of island are found in the south Pacific: (1) Coral islands, which are atolls or raised reefs. (2) Volcanic islands, whose rock formation may belong to one of two distinct mineralogical types.
(3) Continental islands consisting of plutonic and metamorphic rocks, particularly common in Melanesia but also found in Micronesia, as well as in the Fijian-Tongan group on the fringes of Polynesia.
The deterioration of the vegetation in a number of high islands in both Micronesia and Polynesia is due, at least partially, to the techniques of primitive agricultural systems. Often, such degradation is accompanied by the large-scale development of certain introduced weeds.
Traditionally, the Polynesian family was the owner of the land. The family, in the local and very wide interpretation of the term, included the whole group of descendants of a common ancestor under the authority of the most direct descendant, who was responsible for the administration of family land. Households and even some individuals of the group were entitled to a section of the family property, which was not transferable without the consent of the community and its chief. For instance, in the Samoas, where this traditional system has been retained, the head of the family, or matai, enjoys undeniable authority. It is not unusual for him to receive the wages earned by members of his family from their European employers, as well as the profits obtained from the sale of agricultural produce. The matai, in turn, is expected to provide each of the members of his family with sufficient means for subsistence. This system, intended for a strictly subsistence economy, has been the object of severe criticism in this modern era which began with European colonization. Nowadays, it is accused of paralyzing all personal initiative and retarding economic development.
In regions of the Pacific, the wooden digging stick was the most

frequently used agricultural implement, and it still has considerable use in some of the high islands of Polynesia where taro is grown in low-lying swamps. A variant of the digging stick is an enormous club, which is used for making a wide, regular, cylindrical hole in the mud, thus providing the tuber with a container in which it can develop freely. Nowadays, metal hand tools of European manufacture are increasingly common.
The time when Polynesia and Micronesia had a purely subsistence economy is past. Today, account must be taken of new economic factors resulting from the presence of Europeans, whose influence has varied in degree depending upon the area involved.
This social and economic classification permits the general observation that European influence, although varying in degree from one area to another, is considerable throughout Polynesia and Micronesia. All of the islands have been submitted to missionary activity; all are engaged today in cash-producing enterprises, and all have benefited, with European settlement, from the introduction of food plants. In short, few Polynesian or Micronesian islands have conserved their traditional subsistence economy intact.

270 89 - 1/40

Traditional land-use systems
Africa, Cameroon, survey, traditional farming, postharvest technology, root crop, tubers
NUMFOR, F.A. and S.N. LYONGA
Traditional postharvest technologies of root and tuber crops in Cameroon: Status and prospects for improvement.
In: Proced. of the 3rd Triennial Symp. of the Int. Soc. for Trop. Root Crops, Nigeria, 1986, pp. 135-139

Important tropical root and tuber crops in Cameroon include cassava (*Manihot Esculenta* Crantz), cocoyams (*Xanthosoma sagittifolium and Colocasia esculenta*), yams (*Dioscorea* spp.), and sweet potatoes (*Ipomoea batatas*). *The other* root and tuber crops either have been recently introduced or are of limited, local importance. This survey looks at root and tuber crops as staple foods; those of medicinal or pharmacological importance are excluded.
Postharvest losses of root crops in Cameroon involve losses in the quantity or quality of the produce caused by physical, physiological, and pathological factors. Losses occur at various postharvest stages: harvesting, gathering, transportation, storage, processing, culinary preparation, and consumption.
Traditional African societies have developed simple technologies for reducing postharvest losses. Because of rapid population growth and shortened handling and preparation times, however, these apparently ingenious methods are inadequate for current needs. Consequently, consumers prefer foreign-processed foods.
Available research results on postharvest technologies of root crops in Cameroon are crop specific and do not comprehensively assess traditional postharvest technologies. To fill this gap, the

existing traditional methods of processing and preservation were surveyed. The goal was to formulate future research priorities in the postharvest technology of root and tuber crops in Cameroon.
This survey indicates that postharvest technology research should focus on the following aspects. Simple storage techniques and structures must be developed. The production of root and tuber crops is indirectly constrained by the lack of effective storage techniques and structures. Most farmers are easily discouraged when, after a bumper harvest, most of the crop is lost during storage. With the growth of cities and the higher demand for food in the rural areas, any effective techniques and structures for the storage of root and tuber crops will promote increased production.
Improved handling and processing techniques must be developed with emphasis on nutrition, hygiene, and quality standards. There is a wide range of traditional skill for handling and processing root and tuber crops; however, these techniques need improvement. As people become aware of nutrition, hygiene, and quality standards, traditionally processed foods tend to be less desirable than imported foods. The emphasis, therefore, should be on developing existing local technologies.
Root crops could serve as raw materials for the development of industrial products. Cassava, for example, is a source of good-quality starch for the pharmaceutical, textile, and food industries, and the aroids contain chemicals that are important in medicine.
New, competitive, fast-food products should be developed. Most traditional products require a lot of time to prepare. Therefore, the general tendency is to buy imported foods that are easier to prepare. Root and tuber crops, show good base for the development of fast-food products.
Animal feeds must be developed. Root and tuber crops, particularly their shoots, offer useful material for animal feeds. Traditionally, the shoots of these plants have been used minimally, although they are rich in good-quality proteins and vitamins.
Basic data on root and tuber crops are required. Some information exists on the approximate composition of root crops. More information is needed, however, on the variability of these data with crop variety, environment, age, and storage and processing. Nutritional studies are also needed.

II FARMING SYSTEMS RESEARCH AND DEVELOPMENT

271 89 - 2/31

Farming systems research and development
Africa, Kenya, farming systems, strategies, subsistence, marginal area, beekeeping, livestock, crops
ABELLA, J.C. et al.
The farming system in Tharaka: Strategies for subsistence in a marginal area of Kenya.

ICRA, Bulletin 15, 1984, 55 p.

The study aims to identify and evaluate development options and research recommendations which are likely to meet the objectives of both the farmers and the Government in the Tharaka region.
The study area comprises 80% of the total 370,000 acres 150,000 ha of Tharaka Division, making up the arid and semi-arid parts of the Division.
The physical and natural resources of Tharaka present an unsuitable environment for arable farming, but the density of population makes mixed farming inevitable.
Population growth in Tharaka is around 3,3% per year (1969-1984). If this growth rate continues, it will result in a decrease of landholdings from 20 acres at the moment to 10 acres per household by the year 2005, far too small to support a household if the land is predominantly cultivated under a bush fallow system with fallow lenghts of mainly 2-5 years.
Labour is almost entirely provided by family members. Cash is required in certain periods to buy food and make up for a poor harvest. It is also needed for school fees, especially for secondary education. Small amounts of cash are also required for domestic needs. The economy in Tharaka is still largely run without cash. Sales match purchases in a way that is only a short step from a barter economy. Goats almost function as commodity money.
Cropping is undertaken in a situation of severe erosion and decreasing fertility of soils because the measures undertaken to prevent erosion are very poor. 83% of the cultivated area is devoted to food crops, mainly millet, sorghum, green gram and cowpeas. The remaining 17% is devoted to the cash crops, cotton and sunflower. Some farmers occasionally use ox ploughs but handtools are mainly used in cropping.
Livestock (sheep, goats and cattle) are owned by 85% of the farmers surveyed for a variety of socio-economic reasons. They are regarded as a source of wealth and prestige.
Beekeeping is the most promising way of earning money other than from sale of crops and/or livestock. More sales of honey or wax could provide a significant increase in income for a wide range of farmers. There is very little prospect of charcoal-burning, basket-making or other income-earning activities being able to make a significant impact in Tharaka.