

## Integrated systems

Africa, Cameroon, land use, sustainability, highlands, ecology, economics, integrated plant nutrition, draught oxen, erosion control, soil management, farming systems, bushes, trees  
PRINZ, D. and RAUCH, F.

The Bamenda model: development of a sustainable land-use system in the highlands of West Cameroon.

Agroforestry Systems, 5, 1987, pp. 463-474

The city of Bamenda, which is located in a wide valley at an altitude of 1,450 m above sea level, is the administrative center of Cameroon's North-West Province. With its population of ca. 70,000 inhabitants, it is also the economic center of this region, which borders on Nigeria.

The characteristic vegetation found in this highland is that of a savanna, or grasslands, that pushed back the forest generations ago as a result of the activities and interference of man. As in the case of many tropical highlands, the Bamenda Plateau is relatively densely populated.

The cropping periods have been prolonged, the periods in which the land is left fallow have been reduced, and steeper areas are being used for cropping. A reduction in soil fertility and increases in soil erosion will be inevitable unless it is possible to develop sustainable agricultural systems suited to the region that will allow semipermanent or permanent cultivation of the land.

The climate in Bamenda highlands is strongly influenced by a rainy season that lasts, on average, 7 months with an annual precipitation between 1,300 and 2,300 mm.

In the past, labor was divided among the Bantu according to sex: all the tasks involved in food production were carried out almost exclusively by the women, the men helping only when new fields had to be cleared as well as during the harvest. Crops were grown on mounds that were cultivating according to old tradition dating back hundreds of years. The men contributed their share by hunting, fishing, collecting fruits etc. Only after cash crops such as coffee were introduced did the men eventually become more involved in agricultural production.

German engagement in the agricultural development of Cameroon's North-West Province dates back nearly 20 years. The project is being carried out by the Wum Area Development Authority (WADA) and the German Agency for Technical Cooperation (GTZ).

The farming system based on integrated animal keeping and autochthonous experience is called the 'Bamenda model'. The main aim of this model is to make optimum use of local resources in order to develop permanent farming systems that are practicable under the local conditions and that allow the farmers to harvest reasonable yields. Key elements are the introduction of draught oxen, the implementation of integrated plant nutrition systems, erosion control with contour bunds, avoidance of soil-turning plowing, and the integration of trees and bushes into the farming system.

The Bamenda model uses the autochthonous experiences of the population, leads to the integration of the male population into food production, and alleviates the work load through the emphasis on animal traction.

## Integrated systems

Africa, drylands, problems, experiences, guidelines  
KOTSCHI, J. et al.

Towards control of desertification in African drylands.

Sonderpublikation der GTZ, No. 168, 1987, 241 pp., ISBN 3-88085-290-1; Distributor: TZ-Verlagsgesellschaft mbH, Postfach 36, D-6101 Roßdorf 1, FRG

Arid and semiarid regions constitute more than 50% of tropical Africa and support more than 35% of its population. These drylands are severely affected by various forms of desertification which arise out of interactions between man and his environment, and which first become visible as patchy degradation in numerous different areas rather than being confined to a clearly defined zone. Population increase, in combination with various other factors, has caused social and ecological imbalances in land-use systems, leading to a decline in productivity of the land. Studies of human population and land resources claim that actual population already exceeds the carrying capacity of the drylands, but that intensification of land use could raise carrying capacity considerably. Pressure on the resources is particularly great in the intermediate zone (350-900 mm annual rainfall), where livestock keeping and rainfed farming compete most for land but availability of fuelwood is the factor most limiting to human support capacity. The data presented in these studies are based on numerous assumptions and are highly aggregated; they poorly reflect the situations in specific areas but they do indicate a trend which appears to be widespread.

Only recently has the realization dawned both inside and outside development institutions that measures of resource protection and desertification control must be seen in the context of existing land-use systems, rather than being focused on specialized sectors, e.g. forestry. The major land-use systems involved are agrosylvicultural, sylvopastoral and agrosylvopastoral. Most attempts thus far to control desertification have been based on single technical measures thought to be a solution to the problem and have been planned and implemented on a high decision-making level remote from the farms and villages directly affected by desertification. This technology-based, 'top-down' development approach has largely failed. The need for holistic design and a participatory, 'bottom-up' approach is gradually being recognized. Promising in this respect are some small-scale projects, mainly supported by non-governmental organizations. Although governmental and international organizations have acknowledged the success of these small projects, their own involvement in this type of development has been extremely limited. This may be due to organiza-

tional constraints, which often preclude small-scale projects, and the obligation to cooperate with governments rather than with self-help organizations.

Development activities to date have not only placed little emphasis on desertification control objectives as such; they have also seriously neglected those sectors most threatened by desertification, i.e. rainfed farming, livestock and range management, and integrated rural development. Forestry - a fairly new field of development - has been given increasing attention in recent years, but still receives only a small share of total project aid and is predominantly sector-oriented. The authors of this report recommend that future support be given primarily to development of land-use systems which involve rainfed farming, the backbone of the rural economy. Systems involving livestock and range management should be next in importance. Forestry must be considered as complementary to both, as trees are integral elements of dryland farming and pastoral systems. Irrigation has played a large role in official project aid, but the authors feel that it does not merit high priority in fund allocation. Development efforts should not be restricted to maintaining still productive land; rehabilitation of degraded land is becoming increasingly necessary as such areas rapidly become more widespread. The call for a comprehensive and system-oriented, 'bottom-up' approach implies that all target groups participate in desertification control programs. Participation consists of joint problem analysis by rural families, village communities, and national and foreign institutions, including efforts to raise general consciousness of the problem, followed by joint planning of activities with clearly defined roles for the different groups in implementing the measures, and joint evaluation of the results achieved. Such participatory processes can only function in small entities. A truly 'bottom-up' strategy can be pursued by aggregating numerous small projects of this type into a regional or even national plan of action.

This increased participation of target groups has implications for the project cycle. Project identification and preparation, which should be treated as a single phase, will gain in importance. This must commence on the micro level, with close cooperation between rural families/local groups and outside professionals in a form of a dialogue which promotes learning processes on both sides. The phase of project implementation and monitoring will remain much the same as hitherto, but external support will have to be increased within the hierarchy from the farm level up to activities beyond the village level. The phase of long-term operation and maintenance of activities, which has previously been given insufficient attention, must be regarded as a vital stage if resource protection is to be continued. Here, the principle should be that rural families and local groups accept a higher share of inputs (above all, labor) for resource protection, while the share of government institutions should be kept as low as possible.

This strategy also implies a change in attitude by donor institutions towards questions of economic feasibility, the assessment of which is usually based on alternative uses of capital. For a given location, the only alternative to projects of desertification control is to allow desertification to proceed. To work out the costs

of this alternative would be meaningless, since the disastrous nature of the results is obvious and regarded as intolerable, in view of the vital necessity for long-term overall ecological balance.

Increases in production gained by individual families or village communities as a result of desertification control measures will first be directed towards meeting subsistence needs; only later may further benefits become visible in the form of cash. Therefore, funds will not become readily available for servicing of debts, and credit cannot be expected to play an important role in such projects. This applies on both the micro and macro level. Desertification control measures require a very large share of non-repayable funding.

Extension services can actively promote the idea of local participation only if they themselves have a good understanding of the causes of desertification and the role of participation in programs to combat it. These aspects of staff training require urgent attention. There should also be closer links between research and extension, with more importance being placed on socioeconomic aspects and on a better understanding of the process of innovation. adoption by farmers. Participatory and on-farm research would contribute to this.

With regard to administrative structures in the countries concerned, there is an urgent need for decentralization. As long as the different services (e.g. agriculture, forestry) on the district level operate in isolation and rely on instructions solely from their respective national ministries, there will be little chance for these services to support systems-oriented and small-scale development activities.

Also agricultural policy has a strong influence on project success, mainly through prices of outputs, maintenance of price levels, and storage and marketing policies. Attractive prices for agricultural products should stimulate farmers not only to participate but also to assume a higher share of investment in resource protection, and would also provide incentives to remain in the rural areas rather than migrate to urban centres.

The consequences for development cooperation can be summarized as follows:

- a greater effort must be made to support as many small-scale activities as possible (macro programs for micro projects);
- the share of external finance should be small in relation to total investment and should be provided as grants;
- the feedback from evaluation to planning and implementation should be fast;
- 'round tables' and joint committees should concentrate their coordination efforts, apart from financing, on actual project work and exchange of project experiences;
- donor organizations should allocate funds for desertification control without prior identification of single activities;
- decisions as to whether to fund individual projects should be made in the country concerned.

For the proposed strategy of desertification control, three immediate measures are recommended:

- increasing the total budget for small-scale activities and aggregating these activities in a frame finance plan,
- preparing and implementing a 'model plan of action on the local level', and
- designing a program of applied research that includes a farming systems approach with the ultimate goal of working out decision-making aids for rural families.

In assessing prospects for desertification control in the foreseeable future, it must be kept in mind that the strategies can be effective only with the willing participation of the rural people directly concerned. Therefore, it is meaningless for planners to set time horizons. The only way of assessing what can be achieved is to aggregate the effects of on-going projects and to apply the results to specific plans of action designed for individual project regions.

Authors' summary

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#### Integrated systems

Review, handbook, low-cost farming, humid tropics  
SOMMERS, P.

Low-cost farming in the humid tropics: an illustrated handbook.  
Island Publishing House, Inc. Sta. Mesa, P.O.B. 406, Metro Manila, Philippines, 1983, 37 pp.

Low-cost farming is an intensive multistoreyed farming system involving 30-50 compatible crops of varying height. The low-cost farm provides most farming operations and inputs - fertilizer, weed and pest management, irrigation, and storage - from the local environment at practically no cost. The materials required may be produced on the farm site, may be by-products of farm operations, or may be bartered items. Unpaid family labor, on a casual basis, is usually sufficient for farm maintenance. The low-cost farm provides efficient use of natural resources and appropriate technology for low-income tropical areas.

A successful farming system must reflect the socioeconomic situation of a particular area. A small-scale farmer in the tropics needs a system that is inexpensive, efficient, simple, and that relies on locally available inputs. This handbook, born of experience both in farming in the tropics and in tropical agricultural research, explains that system.

A main theme in low-cost farming is to use inexpensive, easily obtainable local materials. The goal is to produce, through a multistoreyed mixed cropping system of varied plant species and small livestock, an abundant supply of nutritious food items, building materials, and any farm products that are essential for the well-being of a farm household in the tropics.

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A low-cost farming system:

- provides daily food requirements for the household,
- is agronomically sound by producing different crops all year round to minimize the risk of an overall crop failure, and
- provides a steady source of income.

The farming system is mixed, involving several storeys of plant canopies. Under each canopy, the farmer plants crops that grow well under that particular level of sunlight. Similarly, plants are grown with varying root depths to take advantage of soil types and moisture levels. Coconut trees form the top canopy layer, under which may grow avocado, breadfruit, guava, jackfruit and citrus. Coffee, cacao or similar crops grow below that canopy. Legumes and gourds are trained to climb the tree trunks. Pineapple, trailing plants and annual plants cover the soil.

Arranging plants to complement each other:

- provides a self-sustaining system of crop production,
- maintains soil fertility, structure and moisture,
- prevents erosion, and
- reduces pest build-up.

The farm is inexpensive to maintain because it revolves around local plant materials and fertilizers produced in and around the farm. The labor requirement is low because most of the crops are simple to plant and harvest. Low cash inputs lead to high economic returns. The variety of crops harvested year-round generates a constant source of extra income. Low-cost farms tend to produce surplus crops.

Low-cost farming is economical because:

- it intensifies land use by growing a mixture of crops on the same plot of land, thus increasing the range of crops for marketing and home consumption;
- it reduces dependence on purchases of items that can be produced on the farm; the low-cost farm can provide most of the daily food needs for a family of four with extra produce for year-round marketing;
- planting is done to accommodate changes in family and market demands; small quantities of a variety of crops are produced, thus eliminating large single crop surpluses.

This handbook describes and illustrates proven farming techniques that will minimize or eliminate dependence on costly purchased inputs. Although individual crop requirements - and the crops themselves - will vary from region to region, individual farmers in the humid tropics can apply the general principles outlined in this book to their particular farm environments.

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#### Integrated systems

Review, book, livestock, camel, potential, dry zones, located resources

WILSON, R.T.

The camel.

Longman Group UK Ltd., 1984, ISBN 0-582-77512-4, £ 25.00

Even the most casual observer will know that from India to the Atlantic Coast the one-humped camel, or dromedary, has long held a position of great economic significance in the lives of the people living in arid and semiarid regions. It therefore seems quite remarkable that Trevor Wilson's book should be the only authoritative, interdisciplinary work ever to have been published on the "ship of the desert".

There is an excellent book about the camel. It is intended to help anyone who is trying to improve the utilization of dryland resources, livestock production specialists and extension workers. The author argues that the camel is worthy of further study and improvement in view of its ability to provide milk, meat, hair and hide in addition to being a means of transport and provider of power. He convincingly argues that it is quite wrong to think of the camel as an animal of the past, without a future. The chapter on the camel's physiology, which has only been studied in detail for some 30 years, is particularly fascinating: this is hardly surprising in view of the animal's extraordinary ability to tolerate heat (it manages not to lose water from the blood stream) to go without water for up to 10 days (it doesn't store water - it has highly adapted kidneys). Camel can even survive by drinking seawater.

Every day the 15 million camels of Africa and Asia collectively provide some 370 tonnes of meat and 20 million litres of milk. The author considered that if attention was now turned to improving the camel's nutrition and management it could become an even more important provider of human food.

Abstract from SPORE

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#### Integrated systems

Africa, sub-Saharan, snails, human consumption, potential, reproductive performance, growth capacity, market system  
KORN, S. von, WAIKUWEIT, E. and PETERS, K.J.  
Nutzungsmöglichkeiten der afrikanischen Riesenschnecke.  
entwicklung+ländlicher raum, 21 (5), 1987, pp. 3-6

The great number of genera and species of Achat snail are distributed over large parts of sub-Saharan Africa. The most important ones among them which are used for human consumption are the species Achatina and some species in the genus Archachatina, both indigenous to West Africa, as well as the species Achatina fulica, indigenous to East Africa. In the present report the reproductive performance and growth capacity, which are strongly influenced by environment, are described for various species and genera. Achat snails, which are in great demand, are only gathered in the natural range. The Ivory Coast snail market system is described. It reaches many levels, from the gatherer over intermediate markets up to metropolitan markets. During the wet season much greater quantities of snails are sold at lower prices than during the dry season. To protect the wild snail population, it is imperative because of the strong demand, mainly by the urban population, to

develop some rules for controlled snail use in the future. In this context open and closed production systems are discussed. Snail production deserves to receive particular notice, since the snail as a typical niche animal is able to convert feed resources efficiently into a high-quality animal product.  
Authors' summary

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#### Integrated systems

Developing countries, ACP-countries, nutrition, game ranching, wild animals, animals protein

#### SPORE

A taste for the wild.

SPORE, 10, 1987, pp. 1-3

According to recent research, game ranching and the raising of small wild animals that are both prolific and adapted to the local environment offer considerable potential. In many regions of the world, particularly in Africa, hunting provides an important part of the meat consumed by local people. In some isolated areas, it often provides all of the meat. In Zaire, for example, 87% of the animal protein consumed comes from hunting or fishing, with people eating on average more than 200 g of game meat per day. This gives an idea of the importance of this sector, which tends to be underestimated, if not totally ignored, by official statistics. A major consideration, however, is that hunting is illegal in most ACP countries, including many in Africa where a widespread poaching industry has developed. When done with traditional techniques and limited to provisioning local needs, poaching generally poses little threat to wildlife.

With better management it is possible to increase the production of wildlife in order to supply more meat to local people and encourage rural development. Because local wildlife is perfectly adapted to local conditions, it has many advantages over domesticated animals. Wild herbivores, for example, can withstand prolonged droughts because their concentrated urine and faeces, as well as high body temperatures, enable them to reduce transpiration and thus retain body moisture. Some of them can literally survive, if not flourish, by consuming only the morning dew. Such animals are able to live on marginal lands, where domesticated animals cannot, because the mixture of species enable a more efficient use of local resources. Some feed only on grasses, others on shrubs or litter, while still others prefer to forage on roots that they uncover. Under normal conditions, therefore, they do not contribute to overgrazing but actually help to maintain an ecological balance. Furthermore, with high birth and growth rates, they have a high production capacity. Last but not least, wild animals are highly resistant to local diseases, particularly trypanosomiasis which decimates cattle in humid areas. The protection and systematic hunting of wildlife can thus make substantial contributions to the development of marginal lands. Such "game ranching" basically consists of improving wildlife habitat and control-

ling hunting. By ensuring an ecological balance between species, especially large carnivores, one can increase the numbers of wild herbivores such as antelopes, buffalos or zebras whose natural bodyweight outshines that of famished looking cattle.

To be successful, wildlife management must not only inform local people but involve them in such activities to ensure that they benefit from them. In this way, they have an investment to protect, be it a better food supply or the income generated directly or indirectly by tourism.

These projects are being planned in many countries, notably in the Sahel, in order to reduce environmental degradation, desertification and migration to the cities.

Game ranching is already practised in some African countries. Antelopes, for example, are now being studied in Côte d'Ivoire and Zaire in order to determine the most appropriate techniques for raising such animals. Both their behavior and the slaughtering methods used differ from those of cattle and require people who have been well trained for such activities. According to the results of initial research, it seems that game ranches involving several species are more cost-effective than standard cattle ranching.

Game ranching need not be limited to animals designed to replace cattle. Crocodiles, for example, produce not only their highly valued skin but also an edible meat. Contrary to their image, they are more lethargic than vicious and are excellent producers, transforming 2 kg of feed into 1 kg of meat.

Research has now begun on "mini-livestock" and the initial results are promising. This concerns small, native animals that are already quite familiar to many African hunters. Rodents, for example, are particularly favored by some people who consume considerable numbers. Some are already domesticated, like the guinea pigs that are commonly kept and fed with kitchen wastes.

Another non-conventional protein source worthy of attention are snails, particularly giant snails which can be up to 30 cm long and weigh over 500 g. Well known to local people who appreciate such luxuries (it is estimated that 500 tonnes of fresh snails are consumed per year in Abijan in addition to smoked snails), these creatures are relatively easy to raise as they can be fed on wastes, by-products and leaves.

By providing a complementary food source for an often protein-deficient diet, while increasing supplies to the cities and thus the incomes of rural residents, game ranching or mini-livestock can improve both food self-sufficiency and rural employment. To exploit this opportunity, researchers and development workers must get off the beaten track and propose simple solutions from which local people can really benefit.

#### Integrated systems

South America, Amazonia, floodplains, várzea ecosystem, water buffalo husbandry, pasture formation, ecology, agronomy, research activities, working capacity, meat, milk

OHLY, J.J.

Die Wasserbüffelwirtschaft am Amazonas aus der Sicht der jüngsten Entwicklungen. (Aspects of the recent development of water buffalo husbandry in the Central Amazon region).

Max-Planck-Institut für Limnologie, AG Tropenökologie, Plön/and Instituto Nacional de Pesquisas da Amazônia, Manaus, 1985, pp. 441-457

The paper deals with the status and recent development of water buffalo husbandry on the floodplains (várzea) in the Central Amazon region, in the vicinity of Manaus. A short introduction is given about pasture formation on the so-called terra firme in the Amazon basin, in connection with the highly controversial discussion about agronomical and ecological implications, as well as a review of the history of water buffalos in Brazil and the on-going research activities. Five recently established water buffalo ranches near Manaus are discussed with respect to animal husbandry and pasture management. It is clearly shown that extensively managed "prestige" farms underutilize the known potential of water buffalos in meat and milk production and working capacity. It is very unlikely that this kind of buffalo ranching will play a substantial role in the further development of water buffalo husbandry in the region. There is a gap between the promising results achieved in research trials and the reality on the farm level. Recent research at the practical level of an existing farm indicates high production parameters. In order to better utilize the animal's potential and to prevent any future ecological damage of the várzea ecosystem by large-scale land clearing for area-extensive establishments, research should focus on smallholder mixed farms.

Author's summary

#### Integrated systems

Africa, Nigeria, humid zone program, ILCA, crops, livestock, *Gliricidia sepium*, germplasm, evaluation, production systems, soil fertility, fodder, alley farming, feed gardens

ATTA-KRAH, A.N. and SUMBERG, J.E.

Studies with *Gliricidia sepium* for crop/livestock production systems in West Africa.

Agroforestry Systems, 6, 1988, pp. 97-118

The Humid Zone Programme (HZP) of the International Livestock Centre for Africa (ILCA) is based at Ibadan in southwest Nigeria, and is charged with conducting research for the improvement of livestock production area largely because of the presence of the tsetse fly and the disease trypanosomiasis that it transmits.

Sheep and goats are the major ruminant livestock species in the zone and their production is generally sub-intensive with minimum investments in health, feed or housing. The major constraints to the production of these animals in the zone are health and feed, and these two therefore receive priority attention in ILCA's work in the zone. Forage research at ILCA concentrates very heavily on the identification, selection and improvement of fodder trees and their development and integration into farming systems of the zone. The emphasis on fodder trees is a result of the general potential of trees, and their common occurrence in farms, fallow lands and compounds in the tropics. Their relative ease of establishment and the management (compared to that of herbaceous legumes) and potential of their integration into local farming systems make fodder trees, rather than forage legumes and grasses, the base for developing integrated fodder production systems for small farmers in the zone.

Since 1982 the HZP of ILCA has concentrated on two leguminous tree species *Leucaena* (*Leucaena leucocephala* (Lam) de Wit) and *Gliricidia* (*Gliricidia sepium* (Jacq) Steud) in its fodder tree research. Whereas the former has benefited from considerable research attention in the past and has had several improved strains cultivars developed, the latter is generally unstudied and unimproved. Furthermore, its multipurpose nature is grossly under-exploited, largely through ignorance of its potential.

In the southern belts of the coastal countries of West Africa, for example, where *Gliricidia* is commonly found, the tree is used for nothing more than fencing and shade. In fact, it is believed to have been introduced into the zone as a shade crop for export-oriented plantation crops such as cocoa and coffee. It is thus commonly found in the cocoa-growing areas of West Africa. Among the Yorubas of southwest Nigeria, *Gliricidia* is known locally as 'agun mo niye', meaning 'it grows for nothing'. Its potential for soil fertility maintenance and its fodder value are unrecognized. There is need therefore to promote the multipurpose quality of the species and enhance its utilization in the zone.

This paper gives a broad discussion of the potential of *Gliricidia* and describes research conducted on it by ILCA in the development of fodder tree-based production systems for the improvement and integration of crop and livestock production in humid and subhumid West Africa. Relevant research on the species by some other workers in the zone is also cited.

It examines the biological characteristics of the species with respect to growth, flowering and seed production, and analyses its potential for improving crop production (through soil fertility maintenance) and livestock production (through production of improved fodder). Integration of *Gliricidia* into cropping systems is necessary for optimum realization of its crop improvement quality. The alley farming system is presented in the paper as one means of achieving sustainability in crop production through integration of trees, such as *Gliricidia*, into cropping systems. The use of *Gliricidia* and intensive feed gardens for production of leguminous fodder is also described as an alternative production system. Finally, the paper reports on experiences with local farmers in on-farm research and development for the integration of *Gliricidia*

and *Leucaena* into local farming systems. It ends with a suggestion for more research, targeted specifically at improvement of the species and their utilization.

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#### Integrated systems

Asia, Sri Lanka, wet and intermediate zone, smallholder, integration of livestock and crops

ESSERS, S.

Integration of livestock and crops in a smallholding: a project in Sri Lanka.

ILEIA Newsletter, 3 (4), 1987, pp. 10-11

A smallholder usually manages to attain a fairly high productivity. But with still decreasing units of land, it becomes more difficult to survive on farming alone. The Mid-Country Livestock Development Centre (MLDC) searches to increase productivity within the possibilities of the smallholder and to disseminate these experiences. Main focus is on the importance of integrating livestock and crops.

The project is situated in the wet and intermediate zone of the Mid-Country in Sri Lanka. Most of the region comprises highlands. The common cropping system sustains a profusion of tree crops with root crops and herbs stratified into overlapping layers of foliage canopies. The most common crops are coconut, jackfruit, breadfruit, nutmeg, kitul, areca nut, coffee, pepper and banana. In terms of output and returns from land, productivity is at a very low level. Most of the farmers have one or two crossbred cows with their followers. The roughage is obtained mostly from outside their homesteads. The average yield is 3 liters of milk/cow/day. Farming is becoming more and more a part-time activity for the rural population: on average, only 25% of their income is derived from agriculture.

In the MLDC three demonstration farms of 2, 1 and 0.5 acre(s), respectively, were established from 1982 onward. The aim is to find out what kind of production activities would fit best into a certain area of land with an average family labor capacity and to show small farmers how to optimize rentability of their holding and to train them in these practices.

The demonstration farms combine livestock with perennials, vegetables and pastures. As an example, a description of the 1-acre farm will be given as well as differences compared with the 0.5-acre and the 2-acre farm.

All farms have more or less the same infrastructure: dwelling, cattle shed, biogas plant and, on the 0.5- and 2-acre farm, a poultry shed on about 330 m<sup>2</sup> of land.

In June 1986 an early evaluation was made, based on the existing data and extrapolations into the future. The following general trends could be discerned:

Perennial crops are capable of giving higher returns on land and labor than dairying, particularly in the case of the minor export crops, pepper and coffee. The problem with these crops, however,

is that they start producing only after about 3 years. Meanwhile, the farmer also has to live and be able to pay back the (interest on the) loans made for the capital investment. Furthermore, these crops require high inputs and involve more risks. Dairying, as a source of moderate but steady flow of income, can partially bridge this gap, and the vegetables and semi-perennials like bananas may make up for the other part. In the meanwhile, by utilizing the excreta of the animals, soil fertility is being built up on the farm. (Still, up to 40% of the calculated need of fertilizer for the minor export crops is supplied in the form of commercial fertilizer). Economically all three units are viable.

This means that, measured over a longer period, a farmer's household can sustain a reasonable life on it, while the loans necessary for starting the farm can be paid back. Internal (economic) rates of return were forecast to be 15%, 23% and 18%, respectively, for the 0.5-, 1- and 2-acre farms, and will be higher if not all capital investments are required.

On the basis of the data from the three units, a cost-benefit analysis was made for three hypothetical 1-acre farms: a 'dairy model', a 'crop model' and a 'dairy-mix model'. It was calculated that the 'dairy-mix model' generates the highest net returns on land and capital, and makes optimal use of the family labor. A physical explanation may be that, through the combination of crops and livestock, the flow of nutrients, energy and to some extent water, are kept cycling and remain largely within the farm. It has been shown that through intensification and optimizing a family can have a reasonable livelihood from 1 acre, whereas in traditional farming 3-5 acres used to be required.

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#### Integrated systems

Review, book, developing countries, fishing technology  
BOSTID

Fisheries technology for developing countries.

National Academy Press, 2101 Constitution Ave. NW, Washington, D.C. 20418, USA, 1988, 168 pp., ISBN 0-309-03788-8

Traditional fishermen in developing countries catch around 20 million t of fish every year, about a quarter of the world's total catch. This is landed by an estimated 15 million full and part-time fishermen and processed and marketed by a further 15 million people. Assuming an average family size of six, then some 200 million people are directly dependent on small-scale fisheries. Many more people depend on fishing as their principal source of protein and, in Africa, over 80% of the available fish is caught by artisanal fishermen.

This book is based on a report by the US Board of Science and Technology for International Development (BOSTID) and addresses itself to the needs of small-scale fisheries in developing countries. Contributions to the report have been drawn from all around the world, giving a wide ranging and informed assessment of the current situation and possibilities for the future.

However, the book is entirely practical in its outlook, acknowledging that "Artisanal fishermen will only embrace and continue to use new technologies that satisfy their own economic interest. Any increased capital, or operating or maintenance costs, must be balanced by an increased catch which translates into increased profit. Careful cost-benefit analyses, feasibility studies and pilot projects must be undertaken to ensure that this is indeed the case".

In this context, the authors point out that the average artisanal catch may be low but, in terms of fish catch per ton of fuel, it is much higher than in the industrial sector. This reflects the overall view of the book that fish catches and thus the quality of life of many coastal dwellers could be much enhanced by providing access to modest technical and financial resources and by ensuring protection of fishing grounds. For this reason, transfer of existing technology between developing regions is accorded a high priority.

The book itself makes a significant contribution to this process by outlining possible improvements in fishing boats and gear, methods of creating artificial reefs and deploying fish aggregating devices, techniques for developing coastal mariculture, and ways of improving fish processing and preservation. The geographical spread of the book is wide, from algal turf mariculture in Antigua, fish aggregating devices in Trinidad and Tobago, to new boat designs in Western Samoa. The book uses such examples to provide a comprehensive view of the technologies that can be deployed to improve fish harvesting and processing in the developing world. Its clear text presents the drawbacks as well as the advantages and, in all cases, the emphasis is on enduring improvements. As the authors point out, the advantages of outboard motors for fishing boats are obvious, but in West Africa the lack of foreign exchange to purchase spare parts, replacement motors and fuel has resulted in a decrease in the percentage of motorized small-scale fishing boats.

Abstract from SPORE

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#### Integrated systems

Review, developing countries, livestock management, ecology, improvement, small farms, economy, non-economic returns

ILEIA

Environmentally sound improvement of livestock management.

ILEIA Newsletter, 3 (4), 1987, pp. 3-5

The majority of small farms maintain animals. Except a few of the developing countries, 85% or more of the ruminants (buffalos, cattle, goats, sheep) and even higher proportions of the donkeys and horses are on small farms. Animals play both economic and non-economic roles in small-farm systems. Economic returns are derived from meat, milk, eggs, manure, traction, transport, investment, insurance, fuel, by-products, skins and hides. The proportion of income derived from livestock can be substantial and of existen-

tial importance in the off-season period, a fact too often overlooked.

In addition to numerous economic uses of livestock in small farm systems, animals are an element in complex cultural patterns. Animals are a source of identity and prestige for the families and a means of forming social ties through gifts and exchange with others. Another non-economic return characteristic of many animals is companionship.

Integration of crop and animal enterprises can increase the total productivity of the small-farm resources and improve welfare; e.g., about 60% of the digestible non-protein nitrogen nutrients produced would have little value if they were not passed through animals. Animals can graze on land that is unsuitable for cultivation or of little agricultural value. They can eat surplus human foods that would otherwise spoil and can provide a reserve food and/or cash supply. Furthermore, such integration is important in ensuring sustained productivity and stability in most ecosystems. Because of the diversity of agroecosystems, livestock improvement methodology varies widely. New information and new ideas for livestock management will develop from a renewed awareness and appreciation of natural systems. Successful application of these ideas of livestock systems will depend largely on local conditions.

The development of a new farming system or the improvement of an existing system should be based on identified community needs. Because many breeds and types of animals are now domesticated, it is usually possible to find one that is adapted to the local environment, available at reasonable cost and socially acceptable. Thus, the planner seeks to identify livestock with food, water and labor requirements that fit the local environment. Livestock that can be easily controlled and are within the financial reach of participants can best serve the needs of the community.

Improved livestock production should take advantage of local animals and local situations. Objective study of a specific environment can be more rewarding than taking the ideas of another location and/or culture and trying to force them to work. Often, the value of local breeding stock and its adaptation to local environmental conditions is underestimated. They may be resistant to local diseases, have developed ways of coping with droughts or extreme heat, or may have unusual characteristics that are of value to local people. In contrast, a new breed of cattle may adjust poorly to environmental stresses, or may not have the type of hump on its neck that fits the local draft harness.

Effective livestock management systems must be integrated into the total agricultural and social system. A major consideration in the integration of livestock into the farming system is the availability of labor. In many small farm systems, labor is scarce during certain seasons. An animal project that competes for labor during this time has little chance of success. In addition, livestock production may demand greater management skills for a reasonable return on money, labor and land investment. New skills may have to be learned.

Feed and range management, animal health care and breeding programs are discussed in the article.

#### Integrated systems

Review, book, tropics, rabbit production, nutrition, meat production, self-reliance

SCHLOLAUT, W. et al.

A compendium of rabbit production,

GTZ Publication, No. 169, 1985, ISBN 3-88085-256-1, engl+french, DM 30.00; TZ-Verlagsgesellschaft mbH, Postfach 36, D-6101 Roßdorf 1, FRG

Rabbits must surely be one of the most underexploited sources of meat amongst the poorer groups of people living in the tropics. The ability of rabbits to convert otherwise inedible vegetation into high quality food fit for human consumption is well known throughout the world, yet relatively few people keep them in developing countries.

But the picture is changing as the importance of self reliance is more widely appreciated. To accelerate this change, the German Agency for Technical Cooperation (GTZ) has produced a new compendium on rabbit production. This practical handbook explains in simple terms how to select suitable breeds, how to house, rear and feed rabbits, and how to cope with the problems that may arise, such as disease. The economic aspects of keeping rabbits are explained and there are accounts of the importance of by-products, such as rabbits skins and angora wool, which can support local industries and give the rabbit farmer an additional cash income. Rabbits grow quickly, reproduce quickly, require little space, do not produce an unpleasant odor, do not compete with man for food, and will eat a wide range of food plants; their meat is widely acceptable, easily digestible and generally commands a good price. If this book encourages more people to keep them, it will have provided a valuable service to both rural and urban development.

#### Integrated systems

Review, USA, farming practices, sustainability, crop rotation, contour plowing, tillage practices, pest control, water conservation, market influence

BOYD, S. and McGRATH, C.

Sustainable farming practices.

In: Farmland: a community issue, 1987, pp. 7-9, Concern, Inc., 1794 Columbia Road, N.W., Washington, D.C. 20009; US\$ 3.00

Many US farmers are finding it possible to farm profitably while producing food which is free of pesticides. At the same time, they are reducing soil erosion, surface water and groundwater contamination, and energy consumption. They are using a blend of time-tested and new techniques of pest control, intercropping, ground covers, and new crop varieties based on an educated understanding of the interlocking needs of agriculture and the environment.



These constantly evolving, resource-conserving techniques, variously called organic, regenerative or sustainable farming, are gaining popularity not only among farmers, but also among consumers concerned about the quality of their food and drinking water. Farmers are rediscovering the following practices that have proven successful in the past and integrating them with the advances of modern science:

- crop rotation
- contour plowing
- planting of windbreaks, shelterbelts and buffer zones
- integrated pest control
- water conservation methods etc.

These techniques are briefly discussed.

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88 - 3/24

#### Integrated systems

Review, book, tropics, poultry production, nutrition, farming techniques

CTA/CAB

Manual of poultry production in the tropics.

CTA/CAB International, Oxon, 1987, 118 pp., ISBN 0-85198-590-4;

Distributor: CTA Technical Division, Postbus 380, 6700 AJ

Wageningen, Netherlands

Poultry products are a very rich source of highly nutritious substances indispensable in the human diet. Raising chickens can be a good way to bring in some revenue for farming communities in the tropics. Poultry farming is also attractive because it can produce quick results and does not require much capital investment. Farming techniques are relatively simple and the products have a market because they can be sold in small quantities such as a few eggs or birds.

In spite of these advantages, there has been little increase over the last few years in poultry production in Africa. One of the reasons for this is the predominance of traditional production methods. More modern, large-scale production is expected, however, in view of high population growth and the sharp rise in the price of other meat products, especially in urban areas. It has also been observed that there is a high preference for poultry in these regions.

The publication of this manual on poultry farming is therefore well-timed. It is a handy guide to all aspects of poultry farming in the tropics. The book includes a thorough study of the anatomy and physiology of poultry as well as information on how to choose strains and produce hybrids. Considering the damage caused by epidemics such as Newcastle disease, which is capable of wiping out whole flocks of birds in a few days or even hours, the section on diseases looks at prevention and treatment, including hygiene and vaccination programs. A table of the main microbial infections, with the causes, principal symptoms and treatments, is a special bonus.

In poultry keeping as in other enterprises, good management is crucial. The final chapters of this book therefore give detailed advice on how to manage a poultry farm. There is also a section on rearing guinea fowl and ducks, which includes a part on integrated duck/fish production.

This book is written in textbook style with clear illustrations and is suitable for agricultural students and extension workers as well as those directly involved in tropical poultry farming. The manual was originally published in 1983 by the Institute d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, and the English version is a joint CTA/CAB International publication.

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88 - 3/25

#### Integrated systems

USA, book, review, sustainable agriculture, soil fertility, manure weeds, insects, pastures, crops, innovations

GRANATSTEIN, D.

Reshaping the bottom line: on-farm strategies for a sustainable agriculture.

Publ. of Land Stewardship Project, SE Minnesota Field Office,

P.O.B. 412, Lewiston, Minnesota 55952, ISBN 507-523-3366, US\$ 9.00

The Land Stewardship Project urges farmers to experiment with new ideas, including practices mentioned in this book, on a small scale for several years before adopting them for the entire farming operation. This small-scale experimentation will avoid putting the entire farm at economic risk. Adapting practices to local conditions and to the individual farm management needs is also an important step.

The Land Stewardship Project is a private, non-profit organization founded in 1982 to address critical rural resource questions in the Midwest. The organization is rooted in the ethics of wise land use and in an understanding of the importance of a healthy rural community. The long-term goal toward which the Land Stewardship Project is working is that the nation will come to cherish the farmlands as a precious, finite resource, and that, as individuals, everyone owning and/or working the land will strive to leave it in better condition than when he or she received it. This publication is intended to provide conservation-minded farmers in the upper Midwest with a collection of ideas, already being tried on working farms, which make farming more economically and environmentally sustainable. New ideas are constantly merging and are ripe for adaptation. It is hoped that the wide range of innovations and experiments already being undertaken by farmers committed to conserving soil, protecting groundwater from contamination, and saving money by reducing off-farm purchased inputs will provoke increased research of these practices by public research institutions.

For the past six years, the Land Stewardship Project has worked extensively in southeastern Minnesota. Most of the examples of sustainable practices identified in this book come from this

specific geographic area. However, many of the concepts described here should be of interest to farmers throughout the Midwest.

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88 - 3/26

#### Integrated systems

Asia, Papua New Guinea, review, book, integrated systems, extension, husbandry, crops, appropriate technology, self-help technology, resources, rural development

HALE, P.R. and WILLIAMS, B.D.

Liklik Buk: a rural development handbook catalogue for Papua New Guinea.

Melanesian Council of Churches, 1978, 274 pp., ISBN 0-86935-0244; Distributor: Liklik Buk Information Centre, P.O.B. 1920, Lae, Papua New Guinea

Liklik Buk gives community-level leaders and trainers in Papua New Guinea better access to rural development information sources, with the goal of village self-help action. It includes short, rich articles on crops, livestock, processes, designs, health and animating rural development; references to books, pamphlets and organizations; plus comments and editorials from a broad range of contributors. Information given on particular topics is not complete, but it is basic, technically sound, and helps the reader define an interest and find further information.

Some basic information can be found in each of the major sections, but since many problems have several aspects to a solution, additional information is also found in other sections.

Liklik Buk is for the direct use of village people; it is meant to be for their benefit. It is primarily a support for those who have dedicated themselves to working with village people: teachers, business development officers, pastors, university students, overseas volunteers, or village leaders. It gives inspiration, new ideas and helpful information.

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88 - 3/27

#### Integrated systems

USA, review, book, sustainable agriculture, ecology, communities, farming, agricultural policies, practices

BOYD, S. and McGRATH, C.

Farmland: a community issue.

Publ. of Concern, Inc., 1974 Columbia Road, N.W., Washington, D.C. 20009; US\$ 3.00

Farmland is a national resource. It is as fundamental for survival as air and water, yet not given similar protection. To assure future yields of adequate quantity, this resource must be sustained. It will require support not only from farmers and public officials but from everyone. Farming today is influenced by many factors outside the farming community. Federal agricultural policies based on rewarding increased production have often encouraged the misuse of resources. In the past 40 years, scant attention has been given

to the environmental impact of intensive farming practices. The negative results of this policy are now apparent: synthetic chemical pesticides and fertilizers found in groundwater nationwide; soil eroding at a rate which threatens future harvests; water resources depleted and contaminated. In addition, prime farmland is disappearing through haphazard development of the countryside. To meet high production goals, many farmers have become locked into a cycle of borrowing and a dependence on purchased materials - more land, chemicals, fertilizers; bigger, more expensive machinery and irrigation systems. Now, complex changes in the economy in international markets have produced an unprecedented farming crisis. Although wide publicity has been given to the financial repercussions, the important issues of resource depletion and soil and water contamination have largely been ignored. All of these factors have caused societal disruption. Farming practices and federal policies that do not address conservation of human and environmental resources and the protection of public health will not ensure a sustainable agricultural system.

Ecologically sound and profitable farming methods exist and are being used in many parts of the country. However, far more support is needed from the public and from federal, state, country and local governments.

This booklet provides an introduction to some of the problems faced and to some of the opportunities that exist for positive change.

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88 - 3/28

#### Integrated systems

Asia, Philippines, ICLARM, project, animal-fish, experiments, integrated farming, methods, potential

HOPKINS, K.D. and CRUZ, E.M.

The ICLARM-CSSU integrated animal-fish farming project: final report.

ICLARM Technical Report, No. 5, 1982, 96 pp., ISSN 0115-5547, US\$ 9.70

The methods and potential benefits of combining livestock and fish culture operations need to be better defined before large-scale development efforts are mounted to popularize this form of agriculture and, often, available production methods need to be refined and adapted to the prevailing economic circumstances. With these points in mind, ICLARM and the Freshwater Aquaculture Center (FAC) of the Central Luzon State University (CLSU) began a cooperative research project in 1978 with the ultimate objective of designing a technology for integrated farming appropriate to rural development in the Philippines.

A special 2-ha facility was constructed at the FAC during 1978, and a series of experiments was conducted over the following three years, terminating at the end of 1981. The project was supported by CLSU, ICLARM and the Rockefeller Foundation. Major experiments were conducted with pig/fish, duck/fish and chicken/fish systems. The livestock were grown in houses near the

pond dikes and their manure was added daily to ponds that were 400 or 1,000 m<sup>2</sup> in size. Most of the experiments were factorial designs with livestock numbers and fish-stocking densities as the main variables. The fishes were a polyculture of Nile tilapia (*Oreochromis niloticus*) and *Cyprinus carpio*, with predators, *Channa striata* or *Clarias batrachus*, used in certain experiments to control tilapia recruitment.

Mean net fish yields greater than 15 kg/ha/day of market size tilapia and 4 kg/ha/day of carp were attained with manure loads of approximately 100 kg dry matter/ha/day with pig manure and with chicken manure. Higher manure loads reduced yields. Duck/fish experiments had lower yields than those of pig/fish or chicken/fish experiments.

In addition to fish growth and yields, water chemistry, plankton populations, and livestock and fish parasites were monitored. On average, dissolved oxygen was above 200% saturation in the afternoon and dropped below 1 mg/l in the early morning systems receiving high manure loads. Total ammonia sometimes exceeded 2 mg/l in chicken/fish experiments. The plankton populations were highly variable even between ponds treated identically.

No parasites zoonotic to men were found in the livestock or fish. Preliminary economic analyses showed that livestock/fish systems can be highly profitable and can contribute to increasing rural incomes in addition to utilizing protein in feed stocks more efficiently than livestock systems alone.

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88 - 3/29

#### Integrated systems

Asia, Philippines, ICLARM, SEARCA, integrated systems, agriculture, aquaculture, farming systems

PULLIN, R.S.V. and SHEHADEH, Z.H.

Integrated agriculture-aquaculture-farming systems.

ICLARM Conf. Proc. 4, 1986, 258 pp., ISSN 0115-4389, DM 36.00

Integrated livestock/fish, fowl/fish and rice/fish farming and crop rotation in fishponds have been practised for centuries in Asia. The integration of aquaculture with livestock and crop farming offers greater efficiency in resource utilization, reduces risk by diversifying crops, and provides additional food and income.

The International Center for Living Aquatic Management (ICLARM) began an integrated animal/fish farming research project in 1978, in cooperation with the Freshwater Aquaculture Center of Central Luzon State University, Philippines.

The conference, held 6-9 August 1979 in Manila, Philippines, was called in association with that project, to increase awareness of the effectiveness of integrated agriculture-aquaculture farming systems in increasing production and income for small-scale enterprises; to encourage governments and assistance agencies to initiate research and development programs to document and test these systems; and to stimulate continuing cooperation in this field.

Some of the objectives of the conference were: to provide an overview of integrated agriculture-aquaculture farming systems as currently practised in a number of Southeast Asian countries; to review available experience and technology; to discuss the social and economic aspects of these systems; and to identify research and development requirements.

The proceedings are published jointly by ICLARM, MC P.O. Box 1501, Makati, Metro Manila, and Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Los Banos, Laguna, Philippines.