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Integrated systems  
Review, animal welfare, socio-economics, livestock farming,  
alternative methods

Mc INERNEY, J.

**Socio-economic perspective on animal welfare.**

Outlook on Agriculture, 20, 1991, pp. 51-56

There is a growing presumption that environmental and animal welfare issues will be the most important influences on farming developments over the coming years.

Agricultural science can no longer pursue technologies that simply confer what were previously viewed as greater productivity and efficiency. Good farm management implies more than just achieving profit levels which are adequate for income and reinvestment, and the economic success of the agricultural sector is no longer defined solely in terms of secure and stable food supplies at reasonable prices.

The change in agricultural outlook brings with it a shift towards targets that are far more qualitative than quantitative.

Welfare issues are now considered among the principal problems that agriculture must confront in the future. The central theme is that, notwithstanding the objective assessments of the animal scientist, animal welfare is primarily a subjective matter of human perceptions; further, because people's preferences determine action, in practice it will be treated as a subset of human welfare. The inherent conflict between animal and human interest is captured in the relationship between welfare and livestock productivity, highlighting the fact that higher welfare standards in modern farming would inevitably raise the price of food. In the light of this, the paper considers both the legal imposition of welfare codes and an approach which allows food consumers to determine the socially appropriate standards via conventional market processes.

The basic message of this paper is that animal welfare is really about people, not animals; therefore it is social scientists, not animal scientists, who should be at the centre of the debate. However, although the economic aspects are crucial this does not imply that economists should be responsible for any policy decisions that are made.

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Integrated systems  
Asia, Malaysia, study, agricultural wastes, algae production,  
culture systems, integrated livestock-fish system

SIEW-MOI PHANG

**Algae production from agro-industrial and agricultural wastes in Malaysia.**

AMBIO, 19, 1990, pp. 415-418

This article describes the efforts and the results achieved in the development of a bioconversion system using palm-oil mill effluent (POME), rubber effluent and farm-animal manure for algae production.

Malaysia is basically an agricultural country, its main revenue earners being palm oil and rubber. Major pollution problems have arisen from the agro-industries based on these two major crops, as well as increased farm-animal wastes.

The combined wastewater discharges from the oil palm and rubber industries contribute an organic load of 0.5 million kg biochemical oxygen demand (BOD) per day. Various treatment methods, including biological, chemical and mechanical treatments, have been developed over the last two decades with some being successfully implemented. Anaerobic tank digestion with biogas production and anaerobic-aerobic ponds are the most cost-effective methods. Farm animal wastes are washed into drains or dried to be sold as fertilizers. Wastes are now regarded as valuable resources to be recovered, and bioconversion systems for the generation of microbial biomass are being developed.

Research at the University of Malaya and other government institutions have shown the feasibility of using microalgae to treat agro-industrial wastewaters. Combining microalgae production and wastewater treatment offers an attractive option to the present treatment systems.

Utilization of the effluents for algae production can transform the nutrients into a beneficial product. Algae generated in high-rate algae ponds can be used as protein and vitamin-rich animal feed. Local algae are screened for growth in the various wastes as well as for valuable chemicals. Optimization of growth and product formation in various culture systems are discussed.

Farm-animal wastes rich in nitrogen and phosphorus have traditionally been used to enrich fish ponds, both serving directly as feed as well as increasing the natural food (mainly algae) in the pond for the fish.

Before a full-scale system can be developed several areas of research have to be studied:

- Improvements in the pond design and operation.
- Use of biogas generated from anaerobic digestion of the wastes.
- Algae species selection and strain improvement through genetic manipulation.

- Improvement in harvesting and processing techniques of the algae.
- Nutritional and toxicological testing of the algae product.

The biotechnology of algae production in Malaysia is still in its infancy. Given the local technical and economic environment, the high-rate algae pond system for production of high-quality animal feed is most suitable. The extraction of chemicals like proteins and pigments may be possible from the waste-grown algae, but for other valuable fine chemicals like lipids and carotenoids, their high value may allow for the more expensive clean-water systems using enclosed bioreactors. The integration of fish culture with both agro-industrial and farm-animal waste treatment is especially suitable for rural application.

Integrated systems  
Review, book, livestock production, small-scale projects, farming systems, ecosystems, ecological balance, biological diversity, carrying capacity, food production, livestock management, community participation, environmental guidelines, nutrient cycles, fodder production, management of wastes, health, husbandry, NGO's

JACOBS, L.

**Environmentally sound small-scale livestock projects - guidelines for planning.**

Publ. of CODEL, Inc., New York; Heifer Project International, Arkansas; Winrock International, Arkansas and VITA, Virginia, USA; ISBN 0-86619-245-X, 1986, 147 p.

This manual is the fifth volume in the Guidelines for Planning series. The series was developed in response to needs of private development agency field and counterpart staff for simplified technical information in order to plan environmentally sound small-scale projects in Third World countries.

The preparation of this volume has been a collaborative effort of coordination in development, Inc. (CODEL), Heifer Project International (HPI), and Winrock International Institute for Agricultural Development.

This manual is designed for development assistance workers and others who are planning or managing small-scale livestock projects. Although aimed specifically at those working in less-developed areas of the tropics and subtropics, these environmental guidelines apply to almost any region of the world. The guidelines stress:

- ecological principles that relate to livestock production
- the role of livestock in the farming system and local environment
- environmental factors that affect the success of a livestock project
- environmentally sound livestock management practices.

This manual emphasizes the environmental factors that affect livestock and livestock interactions. Standard livestock texts should be consulted for detailed management practices. The bibliography lists some of the more comprehensive of these, especially those that are most appropriate for tropical latitudes. Traditional livestock texts cover the common domesticated animals, such as the cow, sheep, goat, and chicken. This manual also deals with animals that are unique to certain areas. The intent here is to stimulate thinking about possible options and to stress the uniqueness of local environments in tropical areas. In other words, there may be a local but relatively unknown or overlooked animal that has great potential for development as a livestock project.

Many references are made to the goal of developing a farming system that is compatible with the environment.

An integrated farming system is characterized by strong interconnections among various farming activities that serve to conserve resources and labour and to reduce the need for imported feeds and fertilizers.

One goal of livestock management is to increase production per animal, which at the same time increases total production on a given area of land. Although this may be the goal of a project, a broader view places livestock production in juxtaposition with local environments, local agricultural systems, and community traditions.

Thus this manual emphasizes the following key concepts:

- maintenance of environmental balance through recycling, regeneration and knowledge of interactions in natural systems
- active involvement of local people in planning, decision-making, and management
- preference for traditional agricultural techniques that have a sound ecological basis
- integration of livestock, cropping, and other land-use systems

Small-scale livestock projects are developed at the local level and are designed primarily for the benefit of local people. Such projects may involve a few small farmers or herders, or an entire rural community working in a cooperative effort.

A good small-scale livestock project:

- involves local people in planning, decision-making, and management
- respects the organization of the community
- encourages regular communication among participants
- addresses common problems and needs
- uses technology appropriate to the region
- includes practical and relevant training for participants
- enhances personal and community self-reliance, takes advantage of local production and consumption patterns
- contributes to overall community well-being

An environmentally sound livestock project works with natural cycles and against environmental degradation. Because all parts of the environment are interrelated, such a project avoids the introduction of substances with unknown properties that might contaminate the soil and water or harm plants and animals. An environmentally sound project uses local resources wisely, works with livestock that are appropriate to the environment, and recycles nutrients back to the soil. Such a project actually may enhance the environment by encouraging beneficial changes that contribute to environmental health. The overall goal is to contribute to a sustainable agricultural system.

Author's summary.

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Integrated systems

Review, book, tropics, foddercrops, natural grasslands, pasture management, pasture establishment, soil fertility, fertilizer needs, pasture productivity

HUMPHREYS, L.R.

#### Tropical pastures and fodder crops.

Intermediate Tropical Agriculture Series; Longman Scientific & Technical, Longman Group, Ltd., UK, 2nd edition, ISBN 0-582-77523-X, 1987, 148 p. + indexes

About half of the world's grazing animals are in the tropics. Great scientific progress has been made in understanding the limitations to production from animals at pasture in the tropics, and in understanding how these limitations may be overcome. The first two sections introduce the main themes of the book. These are pasture and forage crop species adaptation, pasture establishment, fertilizer needs, and pasture management. Part 1 discusses the factors which control the development of natural grassland in the tropics and outlines the limitations of natural grasslands which may lead to their replacement with selected planted species or to the incorporation of additional species with them. Part 2 summarizes methods of pasture improvement, which depends upon the pasture manager deciding on his production aims. Part 3 then discusses what plant qualities the pasture manager looks for in improved species. The book also illustrates the characteristics of many of the commercially used tropical pasture and crop plants. The suitability of plants for different climatic and soil conditions is outlined, and the principles of seed production described. Part 4 discusses pasture seed quality and the environmental factors which limit successful pasture environment. Agronomic techniques of sowing and planting are described, both for fully-prepared seed bed situations and for establishment in natural pastures or with companion crops. The function of plant nutrients in pasture production, the fixation of atmospheric nitrogen by pasture legumes, the role of the animal in cycling nutrients back to the pasture, and fertilizer practice are discussed in part 5.

The final section outlines the response of the pasture to grazing and cutting, the factors which influence the optimum number of animals pastured, and the way these may be controlled on different pastures. The possibilities of maintaining continuity of feed supply through fodder conservation or through the development of year-round pasture grazing systems are enumerated.

The material of the first edition has been revised to include some current research concepts, recent farm experience, and new references for further reading. More field examples which illustrate the principles of pasture improvement have been drawn from work in tropical America, Africa, south-east Asia and the Pacific.

Tropical pastures and fodder crops outlines a philosophy for pasture improvement and examines various improved grass and legume species. It describes the establishment and continued management of pastures and provides information about the animals which graze them.

The book is designed for students and extension workers. All chapters of the book are well written, documented and the conclusions drawn are verified by the text, graphs and tables. The book is recommended for all working in tropical countries in livestock production.

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Integrated systems  
Review, book, Africa, Sahel, case study, grazing systems, ecosystems, livestock, biomass, stocking rates, breeds, herd structure, production parameters, productivity, diseases, herd management, agroforestry

LE HOUÉROU, H.N.

#### The grazing land ecosystems of the African Sahel.

Ecological Studies 75; Berlin: Springer Verlag, ISBN, 3-540-50791-4, 1989, 292 p., price DM 168,-

This book provides a comprehensive survey of Sahelian ecosystems with a good bibliography review. The Sahelian zone is defined as the area stretching across Africa that receives 200 to 400 millimetres annual rainfall, with a vegetation dominated by Mimosaceae and annual grasses.

The discussion begins with the environmental characteristics of the grazingland ecosystems and analyses climatic and edaphic factors, illustrated with numerous figures. This is followed by a long section on vegetation, including the following points on browse:

- There are about 100 important browse species in the Sahel.
- The mean crude protein (C.P.) of Sahelian browse species is 12.5%, the mean mineral content is 10.9%, and the mean phosphorus content is 0.15%.
- The best-quality browse is provided amongst others by the LEGUMINOSAE.
- Annual browse production varies from 0.1 to 1.0 kilogrammes dry matter per plant, depending on the species and local conditions.
- Leafy material accounts for about 45% of total aerial production and woody biomass the other 55%.
- Underground biomass is nearly equal to aerial biomass; growth of fugacious roots and large roots is approximately equal.
- Half of the productivity of browse species is available to livestock.

Annual wood production was estimated at 0.30 m<sup>3</sup> or 200 kilogrammes dry matter per hectare.

The chapter on livestock provides information on animal numbers, stocking rates, breeds, herd and flock structure and demography, production parameters, productivity, diseases, production systems, and herd management. Two agroforestry systems are mentioned: the *Acacia senegal* fallow-cropping system in Sudan and the *Faidherbia albida* (*Acacia albida*) system. The author recommends better integration of animal production with agroforestry in order to increase draught power and to restore soil fertility without reducing the area cropped.

Chapter seven presents a detailed case study from northern Senegal. Many useful details are offered on the evaluation of green herbaceous biomass by orbital remote sensing, on the

evaluation of range production from ground sampling, and on low-altitude systematic reconnaissance flights. Complementary information on ecological monitoring has recently been published by the United Nations Sudano-Sahelian Office (UNSO) the first report in its Technical Publication Series. The book discussed here closes with a subject index and two indices of scientific names, one for animals and one for plants. A few small errors, particularly in the spelling of scientific names, do not detract from the book's considerable value for anyone working on research or development problems in the Sahel or other arid lands.

Abstract by Michel Baumer, altered

Integrated systems  
Pacific, Samoa, tropics, proceedings, review, smallholder, livestock development, technical papers, country papers, recommendations

CTA/IRETA

**Seminar on smallholder livestock development.**

Proceedings of the Seminar on Smallholder Livestock Development, Alafua, Western Samoa; Techn. Center for Agric. and Rural Cooperation (CTA), Wageningen-Ede, Netherlands and Inst. f. Research, Extension and Training in Agriculture (IRETA), Alafua, Western Samoa; 1985, 155 p. + Appendices

In the South Pacific region, livestock development has not kept pace with agricultural development in general, and, in particular, the development of smallholder livestock production has lagged behind.

In recognition of this fact and after an inventory had been made of smallholder livestock production problems in the region, a Training Workshop on Smallholder Livestock Development, was held in the region.

In recognition of the great relevance of smallholder livestock development for food and agricultural development in the island states in the region, the Technical Centre for Agricultural and Rural Cooperation (CTA) agreed to sponsor a follow-up training workshop.

This meeting took place 1985 at the Institute for Research, Extension and Training in Agriculture, University of the South Pacific - Alafua Campus, Apia, Western Samoa.

The objective of the meeting was to evaluate progress made during the past and to consider new guidelines for future smallholder livestock development.

This publication contains the country reports presented at the meeting, and the addresses made by several speakers.

The meeting identified three broad areas, namely:

- Feeding and breeding
- Animal health
- Extension and training

It was recommended amongst others:

**- Feeding and breeding:**

- . Imported feeds be substituted by local by-products as far as possible.
- . Investigation be made into the availability of by-products, taking into consideration the cost of production.
- . Investigation be undertaken into the use of fibrous by-products as seasonal feed supplements for ruminant livestock.
- . Ruminant livestock production be integrated to a far larger extent with coconut production.

The introduction of improved breeds be done with great care, taking into consideration attainable levels of nutrition and management.

Pure-bred poultry breeds be given preference in distribution to smallholders whilst hybrids be used by larger commercial enterprises

**- Animal health:**

- Although the South Pacific countries are free of the more serious diseases of livestock, due to their geographical isolation and strict quarantine measures, greater vigilance should be called for in view of the increasing volume of air traffic particularly of the traffic originating in countries with more serious livestock diseases.
- Livestock management problems pose greater constraints to the livestock industry than do problems of animal health.
- Funds be solicited from FAO to equip small laboratories with basic equipment and, if warranted, to upgrade existing laboratories thus increasing their efficiency and their diagnostic capabilities.
- In order to facilitate animal treatment, encouragement be given to the construction of basic animal handling facilities using local materials.
- CTA be requested to assist with the publication of booklets, technical bulletins and manuals aimed at continuously educating farmers and animal health staff through the dissemination of information on animal problems, disease out-breaks, etc.

**- Extension and training:**

- It was concluded that at present in almost all Pacific island countries smallholders receive very limited assistance from extension services.
- Factual information be sought regarding smallholder income and the economics of the smallholder enterprise. This information could serve as a sound base for promotion, through financial assistance, of smallholder livestock production.
- Extension officers be trained.
- Links be developed between extension services and non-governmental organizations involved in training livestock smallholders. Training in extension methods be made available to personnel of these organizations.
- Paraveterinary training courses be strengthened and up-grades and training courses in meat inspection be offered.
- Farmers' training include familiarization with proper management of traditional as well as new species of livestock.

A follow-up technical meeting on extension problems, including those in smallholder production, will be held in the future.

Integrated systems  
Asia, Sri Lanka, Buffalo, grazing systems, tethering draught power, comparative analysis, IFOAM, DSE

ULLUWISHEWA, R.

**Buffalo management for draught power under the free-grazing system and tethering system in Sri Lanka: a comparative analysis.**

In: Proc. of the 8th Int. IFOAM Conf., Budapest, Hungary, 1990, pp. 175-176

Buffalo husbandry, which is highly significant to low-income small farmers as an appropriate source of draught power, nutrition, and organic manure, is conducted under two different management systems viz, free grazing and tethering. Under the free grazing system which is widely practised in the dry zone where density of population is low, animals are allowed to move freely in jungles, scrublands, grasslands irrigation tank beds, and fallow paddy fields. Under the tethering system which is practised in the densely populated wet zone and intermediate zone where uncultivated lands are scarce, animals are tethered in home gardens, road sides, fallow paddy fields and coconut plantations during the day time, and tied to a post in the owners' homegardens at night.

Under the free grazing system, animal feeding is exclusively dependent on the naturally occurring grasses and weeds in uncultivated lands and uncultivated patches of cultivated lands whereas under the tethering system, in addition to the feeding on naturally available fodder, occasional feeding on straw is not uncommon. However, under both systems, cost of feeding is almost nil. Labour and cash inputs required per animal are considerably lower under the free grazing system, and it was found that this system has scale economies where the cost and labour requirement per animal are reduced with increasing size of herd. Therefore, herd size under this system is considerably larger, and buffalo owners place their animals in the care of professional herdsmen at the end of the cultivation period during which the animals had been used for draught power. In this case, animals are driven from the village to distant locations where uncultivated lands are available. In terms of mortality rate, animal health and nutritional status herd quality is found to be better under the tethering system. However, herd profitability is higher under the free grazing system which is undertaken as a profit making business. The tethering system is, however, practised by subsistence farmers to help their farm work whereas free grazing is normally practised by farmers who keep buffaloes to hire out. Under both management systems, buffalo husbandry is becoming less practical and economically less viable, because the uncultivated land on which animals are fed on is becoming scarce due to increasing pressure on land. This study suggests that if buffalo

husbandry is to be revived, a shift is necessary from both the traditional free grazing system and the tethering system to the all feeding system which relies on crop residues, tree fodder, and cut-grass. However, since such a system involves extra labour cost, it would be unacceptable to farmers without an improvement in the income generating capacity of buffalo husbandry. Programmes aimed at such improvement are essential. Measures which would increase the income generating capacity of buffalo husbandry include diversification of the use of buffaloes, improvement of milk production, and improvement of their draught power capacity.

#### Integrated systems

Review, book, tropics, milk production, dairy production systems, cattle husbandry, indigenous cattle, dairy crossbreeds, nutrition, feedstuff, forage quality, reproduction, health, disease, water buffalo, camel, sheep, goats

CHAMBERLAIN, A.

#### Milk production in the tropics.

Longman Scientific and Technical, UK, ISBN 0-582-77513-2, 1989, price £7.00 (Pbk.)

This book is long overdue. It must be welcomed by all those who have an active interest in milk production in the tropics. The text, which is divided into four parts, is well written and easy to read, and is amply supplied with photographic illustrations and tables. Part 1 describes the potential and prerequisites for the development of dairy production systems in the tropics. Part 2 consists of a series of chapters devoted to dairy cattle husbandry. It contains, in addition to an excellent chapter on the role of indigenous cattle, dairy crossbreeds, and European type stock, valuable information on nutrition, available feedstuffs and practical advice on methods for improving forage quality which is highlighted as a major constraint for increased productivity.

Further chapters deal with management factors such as reproduction, health and disease, and handling facilities on the dairy farm. While these chapters contain much sound practical advice some may think that the coverage of health and disease is somewhat superficial. Milking procedures are described and the problems connected with the production of clean milk, and the subsequent difficulties associated with its collection, transportation, processing and eventual distribution are covered on Part 3.

The final part of the book will provide the student of tropical agriculture with a sound introduction to the role of water buffalo, camels, sheep and goats in milk production in the tropics. Although this is an excellent book that will be widely read by students, extension workers, researchers and planners alike, the author has failed to look forward and speculate on the numerous ways in which biotechnology could be applied to and might revolutionize milk production in the tropics.

Abstract by R.H. Phipps.

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## Integrated systems

Review, Europe, developing countries, goats, milk production, breeding systems, nutrition, lactation cycle, energy requirements, protein, feeding

SUTTON, J.D. and A. MOWLEM

## Milk production by dairy goats.

Outlook on Agriculture, 20, 1991, pp. 45-49

Goats are rarely used for milk production where there are cows but in many areas the environment is too hostile for cattle, and goats are often the only domesticated stock to be found.

Goats were one of the first animals to be domesticated by man. They are now found in almost every country and in many parts of the world they are the main source of animal protein.

The total world population is around 490 million with 75% of these in the developing nations.

In Europe the largest goat population is in Greece where there are over five million goats. There are almost three million in Spain and over one million in France.

The current trend throughout the world is for a decrease in goat meat production, to a present level of around 1.75 million tons, but an increase in goat milk production, to a current level of around 7.5 million tons.

Most the milk in Greece is used for cheese and/or yoghurt production. Virtually all goat milk produced in France and Spain is used for cheese production. In the UK milk consumption is relatively more important and accounts for some 40% of total production.

Some of this increase in milk production is almost certainly due to increased performance from goats in developing countries resulting from genetic improvement through more selective breeding.

In France, the UK and to some extent in Spain, dairy goats are usually kept intensively in zero-grazed systems. The main reason for this is to control internal parasite infestations which can be the cause of reduced production in goats that have access to pasture.

The paper deals specifically with the following subjects:

- Dairy goats in the UK
- Breeding systems
- Nutrition of goats
- Rearing and pregnancy
- Lactation cycle
- Energy and protein requirements
- Feeding lactating goats

The authors conclude that interest in improvements in goat production throughout the rest of the world, particularly in developing countries, has increased considerably in recent years. The goat is now recognized as an important source of animal

protein in many countries particularly in environments that will not support other species. Until recently very little has been done to increase the productivity of goats in these countries and, using goats from developed countries as models, it is obvious that with selective breeding and improved feeding management there is potential for considerable progress.

In the UK and other developed countries a more discerning interest in food and food sources plus an increasing demand for variety have created markets for good quality goat milk products. Goat milk is also used by many of those who are allergic to cow milk. This alone represents a significant demand. Five major retail multiple stores currently account for sales of more than half a million litres of goat milk per annum and all report a continuing rise in sales of this and other goat milk products.

As agricultural production becomes less intensified in Europe, it is likely that goats will make an increasing contribution to food production.



Integrated systems  
Africa, Nigeria, survey, poultry husbandry, smallholders, flock size, flock structure, culling pattern, production system, free range system, backyard system, intensive system, management practices

SONAIYA, E.B.

**Poultry husbandry in small rural farms.**

entwicklung + ländlicher raum, 24, 4, 1990, pp. 3-6

There is very little information available in the literature about flock size, composition and structure of small rural poultry farms.

Such data are beginning to be accumulated for Nigeria.

Poultry is an ideal livestock for small farms because of the small individual requirement for feed, water and other production inputs. While every household in the rural and semi-urban areas keeps an average of about eight chickens in Nigeria and while more than 80 percent of total poultry population is found in the rural households, there is very little management intervention in the life cycle of the birds. The situation varies with species; while there is more intervention with chickens, guinea fowls, ducks, geese and turkeys which are regarded as domesticated, there is much less, if any, intervention with pheasant, quail and pigeons which are still harvested.

The major intervention in poultry husbandry is in the areas of feed and water supplementation, overnight housing, and to much lesser degree, health management. The area of reproduction - selection, mating, incubation, brooding - are strictly left to the birds.

In surveys of small rural poultry farms in Nigeria conducted in ten representative states, flock composition was found to be heavily skewed towards chickens. The three major poultry species on small rural farms are chicken, guinea fowl and duck. The composition differs depending on location. While mixed poultry flocks occur throughout the country, there is a greater tendency toward mixing in the north while in the south the emphasis is on chickens.

In this paper the following aspects are discussed:

- Flock structure and foundation
- Culling pattern
- The production system
- Management systems
- Management practices.

Finally the author discusses the productivity of small scale poultry as follows:

The productive performance and productivity of small scale poultry is very low. The system uses minimal investment and does not interfere with the natural cycle of the birds. Egg production is usually in two to three clutches per year with about ten eggs per

clutch. Hatchability is good (40 to 60 percent). It would appear that the events occurring immediately around hatching are the most crucial. Production of eggs in clutches reduces the total number of eggs produced while brooding further reduces the number of hen-days available for egg production. Modern, automatic incubators are simply too big and complex for small scale producers. There are small kerosine or gas-powered incubators that can serve the needs of cooperatives of small scale producers. Such a "mini-hatchery" can also undertake to vaccinate the birds and raise them to four weeks before selling to producers. In turn, producers can sell their fertile eggs and slaughter chickens to the mini-hatchery or "mini-integrator" for further merchandising. Such a scheme should be able to become self financing and serve as a learning process for future medium and large scale producers. Summarizing it is stated that the bulk of poultry products consumed in most African countries is produced by small rural farms. Their flock structure, management system and production inputs are all tied closely to the climatic, physical, economic and social environment. This is an advantage which should not be set aside. To improve productivity, innovations are needed in housing, feeding, health, reproduction and marketing. As a vehicle for such innovations, a "mini-integrator" system is suggested. Rural poultry co-operatives should buy eggs and chickens from producers and pay for them in young growers, feed and vaccines. Such a scheme can either be introduced as a pilot project and later regularized, or as a component part of community development plans.

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Integrated systems  
Europe, UK, review, cashmere production, goat fibre, nutrition,  
breeding, management

RUSSEL, A.J.F.

**Cashmere production - the viable alternative.**

Outlook on Agriculture, 20, 1991, pp. 39-43

Cashmere production is one of the more promising of the novel forms of animal enterprise currently being tested under commercial conditions in the UK.

Cashmere has the great advantage over many other novel forms of production that a strong market already exists. The UK, and particularly Scotland, is famous throughout the world for its very high quality cashmere knitwear manufactured wholly from imported raw material.

Most goats produce two types of fibre: a coarse outer coat of 'guard' hair from the primary follicles and a fine undercoat from the secondaries. The guard hair has a mean fibre diameter of around 80  $\mu\text{m}$  or more and is of little or no commercial value. Whether or not the fine undercoat can be classified as cashmere depends on the buyer, as there is no internationally agreed definition of this product.

In the UK, goat hair growing from secondary follicles and having an approximately normal distribution of fibre diameter with a mean value of less than 18.5  $\mu\text{m}$  would generally be regarded as cashmere. In other countries the definition is less precise. The undercoat from dairy goats probably conforms to the strictest definition of cashmere, but the quantity produced per animal is negligible and the length of the fibre too short for it to have any commercial value.

Mohair is produced only by Angora goats. Angora is probably unique in growing fibres of approximately the same diameter from both primary and secondary follicles. Some primaries may produce coarser medullated fibres which are regarded as a fault and which downgrade the value of the fleece. The Angora is thus to all intents and purposes a single-coated goat. Unlike cashmere goats, the Angora's fibre grows continuously throughout the year. Mohair is coarser than cashmere, ranging in mean fibre diameter from 23  $\mu\text{m}$  or less in super-fine kid mohair to 34  $\mu\text{m}$  and more in strong adult mohair.

After this introductory definitions and observations the author discusses the following aspects of cashmere production:

- Nutrition
- Breeding for cashmere production
- Fibre growth and harvesting
- Management.

Concluding the author states that the establishment of a quality cashmere production industry in the UK will, in time, be of benefit nationally in that it will effect substantial import

savings. It is also an attractive enterprise to the individual farmer. Cashmere goats are truly dual-purpose, if not triple-purpose animals, as in addition to the production of a high value luxury fibre for which a ready market already exists, they also produce a low-fat carcass for which there is an increasing demand. The returns from these two sources are estimated to give gross margins at least as high as those from sheep, despite the fact that the goats do not attract the financial support currently enjoyed by sheep. The third purpose in farming cashmere goats is the benefit which their grazing preferences can bring, through pasture improvement, to sheep and cattle production. These attributes might make cashmere production also an attractive and viable alternative enterprise for developing countries.

Integrated systems  
 Review, book, tropics, subtropics, ruminant production systems,  
 resource utilisation, technology transfer, livestock management,  
 socio-economic aspects, development tools, physiology of  
 ruminants, metabolism, feeding systems, agro-industrial  
 byproducts, pasture systems, parasites, nutrition, ILCA, CTA

PRESTON, T.R. and R.A. LENG

**Matching ruminant production systems with available resources in the tropics and sub-tropics.**

PENAMBUL Books: ARMIDALE, P.O.B. 512, Armidale, New South Wales 2350, Australia in cooperation with CTA, Wageningen, Netherlands; ISBN 0-9588290-1-2, 1987, 232 p. + index.

There is an increasing realization that livestock play a fundamental, often catalytic role in development processes. In most developing countries, the main source of cash income of most subsistence farmers and all pastoral groups arises from the sale of livestock and livestock products. Livestock are also a source of credit. They provide draught-power for crop production and provide milk, meat and hides. Within the existing farming systems there is considerable scope for increasing animal productivity and reducing costs by making more efficient use of locally available resources.

The contribution of animal science to livestock production in Third World countries is meagre. The basic reason for the poor performance of livestock in the Third World lies in the seasonal inadequacy of the quantity and quality of feed available. These feed deficiencies are rarely tackled by conservation and supplementation, while mineral deficiencies are often undiagnosed. The utilization of the feed that is available is commonly constrained by a failure to use management practices that can help animal output. There are many components in the development strategy that are needed to overcome the constraints. Some of the more important features are:

- Matching livestock production systems to available resources
- Selecting crops and cropping systems that will maximize biomass production and nitrogen fixation and minimize the use of imported inputs
- Recycling of livestock wastes
- Making more efficient and widespread use of agricultural byproducts and crop residues as sources of ruminant feeds or directly for fuel
- Using multipurpose animals such as cattle and buffalo that work, provide milk and meat and, in addition, fuel and fertilizer from their excreta
- Incorporating into the production system appropriate non-ruminant species that are well adapted to tropical resources, byproducts and wastes (e.g. ducks, rabbits and fish).

The book is subdivided as follows:

- the recent, and more relevant developments in ruminant digestion and metabolism (Chapters 3 and 4).
- the ways of manipulating both the feed and the rumen ecosystem, in order to improve the balance of nutrients made available for productive purposes (Chapter 5).
- the factors controlling feed intake (Chapter 6).
- the guidelines which aim to facilitate the development of feeding systems using available resources.
- the information that has become available during the development of feeding systems utilizing the feed resources typically available in the tropics (Chapters 8 and 9).
- the interactions between nutrition and parasitism in view of the importance of this topic in the tropics (Chapter 10).
- the role of technical innovations that satisfy the more demanding socio-economic constraints inherent in the application of technologies at the level of the smallholder farmers.
- the gaps in knowledge, and the inconsistencies of the data (Chapter 12).

The book is intended to be a reference used with other suitable texts by graduates to assist in their appreciation of the variables that apply to animal production.

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Integrated systems Caribbean, Jamaica, case study, livestock production, agro-industrial wastes, poultry industry, citrus pulp, brewer grains, green bananas, rice bran, yellow corn, soybean meal, beef production, feeding programmes, organic fertilizer, feed ingredients, CTA

WILDISH, A.A.

**A practical approach to the utilization of agro-industrial wastes for livestock production in Jamaica.**

In: Proc. of a Seminar on "Forage Legumes and Other Local Protein Sources as Substitutes for Imported Protein Meals", Kingston/Jamaica, 1987, pp. 143-153

Jamaica Broilers is a vertically integrated company with its own breeder flocks, hatchery, 250 contract broiler farms, processing plant, feed mill and marketing organization. These operations produce by-products containing nutrients which have the potential of recycling to produce other value added products. These byproducts are:

- By-products of the poultry industry.
  - . Broiler litter
  - . Poultry offal, feather, blood
  - . Hatchery waste
- By-products of agro-industries
  - . Citrus pulp
  - . Brewers grains
  - . Reject green bananas
  - . Molasses
- Dry by-products of industry
  - . Wheat middlings
  - . Rice bran
- Traditional animal feed ingredients
  - . Yellow com
  - . Soyabean meal.

The company introduced some new technology called biofermentation. This is a method of biologically processing organic waste material by promoting ideal conditions for the aerobic thermophilic groups of bacteria and fungi to digest the material into simpler forms and structures. Provided the mixtures of materials have a carbon to nitrogen ratio in the range of 25-30: 1 and moisture levels of between 35-45 per cent, the process produces high temperatures of 60-77°C. These temperatures are sustained for a minimum of 72 hours and can then be rapidly terminated by unloading the biofermenter. At these temperatures after 72 hours the pathogenic organisms have been destroyed, no weed seeds survive and the materials have been changed into a homogeneous biomass by the tremendous bacterial digestion process of controlled composting. At the same time, most of the nutrients are preserved. Some energy is consumed in the process but highly degradable material such as

hatchery waste, chicken offal and feathers, fish waste, degradable vegetable waste, condemned meat or vegetable products or other similar materials can be stabilized and made safe for animal nutrition by the process.

Operations were based on three products:

- Production of top quality beef
- Production of a 100 per cent organic fertilizer called "Bioganic".
- Production of feed ingredients for sale to the animal feed mills.

The biofermentation process has proven to be very efficient and repetitive. It is a natural process with no additions of organisms or enzymes to promote the biodigestion. It is very energy efficient, requiring only the intermittent operation of a 5 HP electric motor for less than one hour every 24 hours. Once properly organized, it does not require highly trained personnel for operating the systems.

The company has expanded the facilities and produces cattle in feed lots in quite a big number.

The facility produces over 200 tonnes of "Bioganic" fertilizer a week and over 100 tonnes of "Bioferm" feed ingredients a week.

The integrated technology that is being developed has tremendous potential to be applied in other developing countries as well.

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91 - 3/105

Integrated systems  
Review, study, Brazil, Amazon, developing countries,  
ethnopharmacology, indigenous knowledge

ELISABETSKY, E. and D.S. NUNES

**Ethnopharmacology and its role in Third World countries.**

Ambio, 19, 1990, pp. 419-421

This paper aims to call attention to the several roles that ethnopharmacological research can play in underdeveloped countries in general and the Amazon region in particular. To exemplify the results achieved through this research approach, the paper describes preliminary results obtained with *Dorstenia asaroides*.

It stresses the adequacy of the ethnopharmacological approach as a research strategy for underdeveloped countries, as well as presenting research results that may have significant impacts on the health-care systems of these countries.

Ethnopharmacology can be broadly defined as of an ethnically defined group's medicine, which is usually comprised of plant and animal-based remedies. For the past 25 years, 25% of all prescriptions in the USA have contained active principles that are still extracted from higher plants, most of which have been used for centuries by traditional healers all over the world. Since plant-based pharmaceuticals account for USD 43 billion of the estimated worldwide drug market of USD 150 billion (retail price 1985), the importance of traditional medical practices as sources of remedies in modern western medicine should not be underestimated.

At the other extreme, ethnopharmacology can be regarded as an instrument for technological development in countries that heavily depend on imported pharmaceuticals. This dependence on imports causes major problems, including difficulties in establishing their own health policies as well as important drains on hard currency. The ethnopharmacological approach to identifying medically useful compounds in plants can contribute to minimizing such problems by directing research to specific relevant diseases and by pointing to alternative sources of compounds currently imported by underdeveloped countries.

Indigenous knowledge becomes a crucial point, since it provides the clues by means of which one can focus the study upon a particular therapeutical action, leading to a significant reduction of investments in terms of time and money.

Underdeveloped countries should concentrate efforts on indigenous resources, e.g. flora and culture. In fact, retrospective analysis has shown that 74% of the chemical compounds currently used in drugs in the industrialized countries have the same or related uses in traditional medical systems. By cutting research and development investments, ethnopharmacology can contribute to the development of low-cost pharmaceuticals. This goal might, in fact,

be even more important for the bulk of the world population than the discovery of a new prototype drug.

It has been claimed that the development of renewable plant-based products in the Amazon could form the basis of new economic activities in the region.

Ethnopharmacology can be important in this context by selecting species to be introduced in extractive reserves and introducing commercially viable native species.

It could be argued that within the Amazonian context, the development of plant-based drugs will contribute to: the conservation of Brazilian flora and its culturally-based traditions; appraise traditional knowledge by recognizing it as true "know-how"; rational management of the Amazon by developing renewable plant-based medicines; the promotion of the national pharmaceutical industry; the provision of specific solutions for local health problems and the discovery of prototype drugs.

In summary, ethnopharmacological research can lead to several beneficial outcomes at world, national, and local levels. It must be sure that indigenous populations do indeed benefit, financially and otherwise, from the results of this research strategy since their traditional knowledge is the basis of this research approach.

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91 - 3/106

Integrated systems  
Latin America, Paraguay, Asia, Israel, semi-arid zone,  
agricultural production, review, book, proceedings, natural  
resources, farming systems, plant production, irrigation, plant  
diseases, pest control, fodder production, animal husbandry,  
regional development, research station, appropriate technologies,  
DSE, GTZ

KLENNERT, K.

**Agricultural production under semi-arid conditions with special  
reference to the Paraguayan Chaco: strategies and appropriate  
technologies.**

Publ. of Deutsche Stiftung für internationale Entwicklung (DSE)-  
ZEL, Weillinger Str. 52, D-8133 Feldafing, 1988, 278 p.

This review refers to the results of an international workshop  
held in Israel.

Paraguay is interested in further agricultural development of its  
large semi-arid region of the Chaco. In particular, to increase  
the production with careful use of its natural resources became a  
rising concern of the local farming community and the national  
authorities. But the practised methods of agricultural production  
need further improvement to reach this goal.

Israel is known for its efficient and ecological adapted  
technologies for agricultural production in semi-arid and arid  
regions. The use of these technologies could be of great value for  
developing countries.

The establishment of a research station in the Central Chaco to  
help solve significant problems of agricultural development and  
ecology is of interest for the Paraguayan Ministry of Agriculture  
and Livestock (MAG) and local farming communities.  
Specific priorities as they were recommended by the working groups  
relate to the subjects

- integrated rural development:

- . The activities should include an appraisal of the impact of  
changes that the project can bring to the economic situation  
of the farmers, strategic market research, development of  
support services and product processing as well.

- soil, water, and fertilization:

- . The initial plans for the experimental station should focus  
on natural drainage, soil survey, installation of a  
meteorological station, and collection of rain water.
- . The objectives for the first five-year phase of research  
should be to improve soil and water management, to sustain and  
improve soil fertility, to find ways to prevent soil  
salinization, to control wind erosion, to test various kinds  
of water qualities, and to improve irrigation methods suitable  
for small farmers.

- field crops, industrial crops, fruits and vegetables:

- . As a principle, cropping has to be managed so as to assure  
sustainability of crop production and soil fertility.
- . Peanuts, cotton, grain and forage sorghum, castor beans, and  
cassava were declared first-priority crops.
- . Long-term priorities should be to optimize fertilization, to  
develop integrated pest and disease control systems and post-  
harvest protection.

- animal production:

- . An economic analysis of the animal husbandry system, including  
management aspects, in the central Chaco should be carried  
out.
- . Fodder production in pastures and weed and pest control should  
be initial stages to improve existing pastures.
- . Fodder should be produced on arable land as a rotation crop.

- technology transfer:

- . A sustained extension service for peasants and small farmers  
should be established with well trained extension officers.
- . A monitoring and evaluation system should be established as  
well as an endowment fund.
- . Paraguayan scientists have to be well qualified for the  
research station.

Cultivation of the Chaco, with widespread poor soil fertility,  
poor distribution of rainfall, saline groundwater, and a generally  
rather precarious ecosystem, is not easy. Inappropriate methods of  
cultivation can very easily damage natural resources in a way  
which is difficult to regulate. The alarming rate of  
deforestation, the increasing need for systems of cultivation  
which are both, appropriate to the location and generate better  
incomes, are reasons enough to tackle the question of appropriate  
land use for ecologically fragile regions.

844

91 - 3/107

Integrated systems  
Central America, El Salvador, concept paper, natural resource  
management, national strategy, DESFIL, NGO's

DAUGHERTY, H.E. and D. SHERRILL

**Toward a national strategy for natural resource management in El Salvador: a concept paper.**

Publ. of Development Strategies for Fragile Lands (DESFIL), 7250  
Woodmont Avenue, Suite 200, Bethesda, Maryland 20814, USA, 1990,  
29 p.

This paper was prepared at the request of the U.S. Agency for International Development in El Salvador. The objective was to lay the groundwork for a detailed National Strategy on Natural Resource Management. It sets forth how a strategy should be prepared, data and information requirements, the kinds of people and institutions necessary to complete it, and other factors that should be in place before success can be achieved.

This concept paper serves as a guide to both the El Salvador USAID Mission and the Government of El Salvador in developing long-range plans for the stabilization, regeneration, and management of El Salvador's dwindling natural resources.

El Salvador is the smallest and most densely populated country on the mainland of the Western Hemisphere. It has a long and unfortunate history of misuse of its environmental resources. This history long precedes the current civil conflict that has exacerbated the condition. National problems of environmental degradation and natural resource depletion are severe, and directly affect the economy and the quality of life of the majority of Salvadorians.

The military conflict has also had an important indirect ecological impact on the landscape and the people, largely through the displacement of large numbers of the rural population and the disruption of natural resource management programs.

There are critical problems with respect to data and information systems. Data collection and environmental monitoring have been seriously interrupted by the civil strife of the last decade. Data gaps now exist and preclude time series analyses so important in forecasting and decision taking.

In spite of the persistent political/military situation in El Salvador, a large number of projects programs are underway in the country that have environmental or natural resource management components. These are being carried out by a host of national and international institutions. Most of the projects are isolated, and are being concluded without a co-operational framework and, without a cohesive national strategy that could integrate various elements and activities.

The preparation of a National Strategy for Natural Resource Management in El Salvador can proceed on the basis of already established foundations. The Salvadorean government appears to be

firmly committed to undertaking concrete action to strengthen resource productivity and sustainability. There are several environmental NGO's that are young and dynamic, with qualified leadership and personnel, and there is a groundswell of public opinion spearheaded by the mass media regarding rapidly deteriorating environmental quality.

The National Strategy must consider the environmental and natural resource problems in the country, including deforestation, soil erosion, loss of soil fertility, water supply, environmental contamination, pesticide abuse, loss of wildlife habitat, and data collection and environmental monitoring. The plan proposed to address these problems consists of a number of steps to be taken, some simultaneously, over a two-year period. These steps are: establish an office within the Fundación Ecológica Salvadoreña, a Presidential Commission on Natural Resources and Environment, a national technical team, and an external support team; install a geographic information system; create a national data directory, a centralized library, and an information bank; hold workshops on the information bank; define priority areas for action; design, implement, and evaluate initial projects; prepare an issues paper; hold national congresses on the strategy; define and implement subsequent projects; and elaborate the strategy.

What is lacking in El Salvador, specifically, is a catalyst to mobilize and channel the human resources of the country along a new path to sustainable development focusing on human needs, sustainable natural resource management, and ecological recovery.

845

91 - 3/108

Integrated systems  
Africa, Nigeria, humid zone, compound farms, homegarden system,  
agroforestry, crops, livestock, trees, multistorey cropping, IITA,  
ILCA

OKAFOR, J.C. and E.C.M. FERNANDES

**The compound farms of south-eastern Nigeria: a predominant agroforestry homegarden system with crops and small livestock.**

In: Agroforestry Systems in the Tropics; Ed. P.K.R. Nair; publ. by  
Kluwer Academic Publishers, P.O.B. 17, 3300 AA Dordrecht,  
Netherlands; ISBN 9024737907, 1989, pp. 411-426

This paper identifies the major components of compound farms in Nigeria and describes their uses, environmental variation, interactions and management practices. The prospects for and the implications of improvements to the system are examined. South-eastern Nigeria is a region with a population density approaching 500 people per square kilometre.

This high population pressure on the limited land resources led to a breakdown of the traditional land-use practices of shifting cultivation and bush fallow which would need periods of up to 15 years to maintain stability.

Compound farms are a traditional land-use system that appears to have evolved with the shifting cultivation and bush-fallow systems.

Compound farms are found within the vicinity of the homesteads and comprise numerous multipurpose woody species in intimate multistoreyed associations with annual crops and small livestock. The multistoreyed 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 manure.

In addition to the advantages of diversified production, risk minimization, improved labour and nutrient-use efficiencies and soil conservation, compound farms represent germplasm banks containing many of the useful tree/shrub species currently disappearing due to indiscriminate clearing of forests and woodlands.

Several trees and shrubs are deliberately planted and managed on the compound farms for a variety of products or functions. A high number of tree and shrub species (at least 60) in the compound farms provide food products, other woody species providing edible products.

Goats, sheep and poultry are commonly kept for meat, for sale and/or home consumption. Other animals occasionally kept include cattle and pigs. Livestock are 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 trees, shrubs and other crops in the compound farm are positioned where they can be protected, watered and harvested with ease.

Trees and shrubs that are regularly used for food, such as *Treulia africana*, *Chrysophyllum albidum*, *Dacryodes edulis*, *Pterocarpus* spp. and *Vernonia amygdalina* Del., occur at a higher frequency within and around the compound farms. Species that are not used regularly or are difficult to harvest occur at a higher frequency in the outlying and distant fields.

The number of crops decreases as the distance from the house increases. The highest diversity occurs on the compound farms and is lowest on the outlying fields. This minimizes the time spent visiting distant fields.

The abundant but seasonal availability of fruits, widespread waste of fruits during seasons of plenty, and lack of storage mean that the effectiveness of production in compound farms could be significantly enhanced by adequate processing and/or preservation methods.

The potential of integrating genera such as *Derris*, *Adhatoda* and *Lonchocarpus* within compound farms for green manuring should be investigated. The species identified are recognized sources of natural insecticide and nematicide compounds and could play an important role in minimizing pre- and post-harvest crops losses due to pests.

Summarizing, the system has been recognized as a potentially sustainable form of land use with possible application for the entire humid tropics.



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91 - 3/109

Integrated systems  
Latin America, Bolivia, Andes, highlands project, migration, life zones, land capability, land-use, watershed management, livestock, forestry, natural area management, biological diversity, agricultural practices, crops, trees, coca production, farm-level approach, training needs, irrigated agriculture, institutions, NGO's, DESFIL

DICKINSON, J.C. et al.

**The associated high valleys project in Cochabamba, Bolivia.**

Publ. of Developm. Strategies for Fragile Lands (DESFIL), 624 9th Street, N.W., 6th Floor, Washington D.C. 2001, 1988, 61 p.

This paper summarizes the background papers prepared for the redesign of the Chapare Regional Development Project, Bolivia. The Chapare Regional Development Project (CRDP) began in the major coca-producing area of the Chapare in 1983. The successful establishment of an alternative agricultural economy required successful control of coca production. The 1986 project evaluation noted factors affecting success, including low agricultural productivity of the area because of high rainfall and leached, nutrient-poor soils, isolation of the region from markets, and problems of security affecting every aspect of development assistance. Farmers have been loath to give up the lucrative cultivation of coca for alternative activities that are less remunerative. In addition, the population of the Chapare exceeds the carrying capacity of the area under present production and land-use strategies. The primary focus of the CRDP has been on income-generating activities, such as irrigated and rainfed agriculture, livestock, and rural industry, for colonists whose presence precedes the coca boom. Most of the population, attracted by coca, is expected to leave the region if this economy is suppressed. As a result of the July 1987 interdiction efforts, many people have temporarily migrated from the Chapare to their home communities. They are unlikely to remain there, however, as the same pressures that prompted previous migrations to the Chapare and elsewhere remain. The reprogramming of the CRDP attempts to address the problems of these migrants. The project represents a formidable challenge to fragile lands management since the area is characterized by overgrazing and fire; soil erosion and loss of plant and animal species diversity; and accelerated runoff, increased sediment transport, and accentuated flood peaks. Migration in search of off-farm employment has traditionally relieved the pressure on lands unable to support the population. The goal of the AHV project is to stimulate balanced economic development and enhanced living standards in the project area. Its

purpose is to modify and improve agricultural and forest production within a sustainable land-use system, and provide farmers with improved marketing opportunities. Within this broad framework, the project will focus on the following, specific objectives:

- Increase sustainable output from crops, livestock, and forests and diversity into new complementary activities;
- Increase local incomes by value added to products through local processing; marketing assistance; and investments in training, energy, and roads; and
- Reduce migration by increasing incomes and the demand for labour.

The mild, semi-arid climate found at an elevation of 2,000 meters and above is suitable for proved, temperate-zone technology in rainfed and irrigated agriculture. The crops, and the management they require, are familiar to both farmers and technicians. The main focus of the project is the family, especially of migrants and potential migrants, and the natural resource base. The project purpose is to improve family well-being and income through sustainable management of this resource base. Activities to be supported include rainfed and irrigated agriculture, animal husbandry, forest and rangelands management, rural industry, and housing improvement.

Essential preliminary activities are the life-zone classification, the land capability assessment, and the hydrological studies needed before investments are made in irrigation systems. Most project activities will be implemented by institutions already working in the subregions or by those that have demonstrated expertise in topical areas related to project needs. The initial beneficiaries will be women, who have sole responsibility for managing households in the absence of their husbands, and those who, because of greater access to productive resources or for other reasons, have not migrated. In the short-term, the project may slow the rate of growth in the number of migrants. Later, a growing portion of potential migrants can be expected to stay at home, depending on the extent to which economic opportunities have been increased.

Integrated systems  
Asia, Malaysia, study, rubber plantation, revenue utilization,  
animal feed, research trials, poultry production, sheep rearing,  
weed control, management aspects, performance evaluation,  
economics, research needs, bee-keeping

ISMAL, T.

#### Integration of animals in rubber plantations.

In: Agroforestry Systems in the Tropics; Ed. P.K.R. Nair; Kluwer Academic Publ., Dordrecht, Netherlands; ISBN 9024737907, 1989, pp. 229-241

This paper describes an agroforestry approach of integrating animals (sheep, poultry and bees) in smallholder rubber plantations. The approach is based on the existence of surplus family labour, utilization of interspaces between the rows of rubber, availability of cheap and nutritious animal feed and the presence of a favourable microclimate for animal growth under rubber. Results of trials carried out by the Rubber Research Institute of Malaysia are presented.

Rubber (*Hevea brasiliensis*) is the most important commercial crop in Malaysia, and Malaysia is the biggest producer of natural rubber in the world.

The size of the rubber production units range from very small holdings of an average of 1.4 ha to large estates of hundreds of hectares. The Government of Malaysia has designated rubber production units of less than 40.4 ha as "smallholdings" and the rest as "estates". The smallholdings account for 1.5 million ha, i.e. 76% of the total area of the country under rubber.

Although the rubber-production strategy in both the smallholdings and the estates aims at maximum output of rubber, various types of intercropping and other plant associations are common in smallholdings but not in estates. The rationale for intercropping is that in a monocrop of rubber, which is usually planted at 7.3 x 2.4 m spacing (570 trees/ha), about 75% of the total land area is not effectively occupied by the roots of the main crop when the rubber trees are under three years old, and in smallholdings the farmers take advantage of this using the surplus family labour that they usually have. It is also recommended by government authorities to plant intercrops such as banana, maize, groundnut and vegetables in the smallholdings during the immature growth phase of rubber, whereas leguminous cover crops are recommended if intercropping is not practised. Leguminous cover is a regular aspect of plantation management in estates. However, most intercrops cannot be grown when the rubber canopy closes about three years after planting, and the leguminous cover (except for shade-tolerant species such as *Calopogonium caeruleum*) fades away progressively as the rubber trees grow. Consequently, the inter-row spaces in rubber plantations are infested by weeds. Since

these weeds compete with rubber trees, they have to be controlled, which is usually done by the use of herbicides. Efforts have been made to integrate animal production in rubber plantations, whereby the interspaces in the plantations are utilized to rear animals such as poultry and for bee keeping, while the weeds are used as feed for sheep. The rotational system of broiler production under rubber was found to be technically, socially and economically feasible, providing a net return on family labour of M\$ 370 - M\$ 825 per consignment of 500 birds. Sheep rearing under rubber also appeared to be very attractive and practical; apart from producing meat for sale it also served as a "biological weed control" measure. The cost of controlling the weeds commonly found in rubber plantations could be reduced by about 21% over the usual method by using sheep grazing for weed control. The internal rate of return (IRR) from sheep rearing can be as high as 44%. Details of operation and management aspects of sheep integration under rubber are given. Bees kept under rubber feed on nectar produced by the inflorescence and the tips of young rubber shoots and also on flowers of intercrops and weeds. The *Apis cerana* species was found to be suitable, producing about 3 kg of honey per colony per harvest. The paper discusses the aspects of this new agroforestry approach in detail.

848

Integrated systems  
Africa, Kenya, review, book, proceedings, wildlife, livestock,  
parasites, diseases, range management, policy considerations

MAC MILLAN, S.

**Wildlife/livestock interfaces on rangelands.**

Publ. of Inter-African Bureau for Animal Resources, P.O.B. 307866,  
Nairobi, Kenya, 1986, 209 p.

This book refers to a conference on wildlife/livestock interfaces  
on rangelands in East Africa.

The purpose of the conference, was to bring together information  
and ideas on management and research needs involving wildlife on  
rangelands.

Twenty papers and five discussion sessions at the conference  
considered the following issues:

- Wildlife and livestock relationships
- Parasite and disease inter-relationships among livestock and  
wildlife
- Utilization of wildlife
- Human dimensions in range and wildlife management
- Range management strategies for integrating wildlife and  
livestock production.

The following are strategies and recommendations have been made:

- It was unanimously agreed that there is urgent need to conduct  
scientific research on wildlife/livestock interfaces. Such an  
interdisciplinary research programme must be organized with an  
ecosystem approach. This would ensure that all relevant  
disciplines were considered when developing strategies for  
management of wildlife and livestock on Kenya's rangeland.
- It was pointed out that wildlife and livestock co-exist on  
Kenyan rangelands with few problems from a parasite/disease  
perspective. In many instances, blame for wildlife transmission  
of disease to domestic livestock is unconfirmed by scientific  
fact. Many actions and recommendations have been based on  
emotion and misunderstanding. Disease transmission must be  
documented by scientific research before an extension programme  
can be planned to ensure appropriate field implementation of  
policies that are developed.
- Depredation problems by wild animals must be controlled and  
management strategies developed to decrease losses to farmers  
and ranchers. Crop depredation appeared to be more serious than  
livestock predation.
- The perpetuation of wildlife in Kenya depends on its value to  
Kenyans. Wildlife must be valued in the market-place as a  
renewable resource from Kenyan rangelands. With this in mind,  
most members strongly recommended that non-endangered species of  
wildlife be used not only for game viewing by tourists, but also  
as a product to be produced, harvested and merchandized through  
regulated outlets.

as a product to be produced, harvested and merchandized through  
regulated outlets.

- Range conditions and forage production are declining on many  
Kenyan rangelands. Severe bush infestations of grasslands have  
resulted from fire control and general overgrazing. This  
decreases the potential for cattle production. Conference  
attendees agreed that a change from cattle to small stock as the  
primary livestock-base on such land would permit more  
appropriate use of grazing resources. In situations where an  
adequate fuel base can be maintained, the use of fire is a well-  
documented tool for controlling bush encroachment. It was agreed  
that inadequate managerial skills are often the limiting factor  
for organized ranching schemes.
- It is obvious that before range improvement strategies can be  
successfully implemented, stocking rates will have to be in  
balance with the forage productive capacity of rangeland. The  
recent drought, with its disastrous impact on domestic  
livestock, was grim testimony to what happens when there is an  
imbalance between livestock numbers and forage availability.  
Land-use planning must be used to develop guidelines for  
appropriate use and reclamation of rangelands and abandoned  
fields.
- In addition to declining productivity, the amount of rangeland  
to support wildlife and domestic livestock is declining. This is  
a result of desertification and, even more important, the  
ingress of people. As a result of population pressures, people  
are migrating from high-potential agricultural areas to farm the  
more productive regions of the semi-arid rangelands. Emphasis on  
family planning should, therefore, be included in all programmes  
established to improve resource use and development on  
rangelands.  
To be effective, range and wildlife researchers and extension  
persons as well as land-use planners and ranch managers will  
have to use a systems approach when developing strategies for  
appropriate use of Kenyan rangeland resources.

849

91 - 3/112

Integrated systems  
Study, tropics, sub-tropics, rangeland management, wildlife,  
livestock, carrying capacity

HEADY, H.F.

### Can rangelands be managed for livestock and wildlife?

In: Proc. of a Conference on Wildlife/Livestock Interfaces on Rangelands; Kenya, 1986, pp. 153-158

The purpose of this paper is to deduce from past and present examples of the management of livestock and wildlife.

The abundance of data on population dynamics, off-take, average daily gain, live weights, carcass weights, fat percentages, etc., of single species, domestic and wild, has little relevance to the title of this paper and are not reviewed.

Livestock and wildlife have shared the same areas ever since there was livestock. This is dual existence more often than dual management, or intensive management of one with little attention to the other.

The author discusses various examples of common-use management:

- Colombia black-tailed deer and sheep
- Several rancher examples
- Private land programmes for wildlife
- The George Reserve in Southern Michigan
- Introduction of exotic animals
- Combined production of three cervids
- Capybara (*Hydrochoerus hydrochaeris*) and cattle
- Rangeland management good for domestic animals
- Carrying capacity

Out of these discussions the following conclusions were drawn:

- Many ranchers are undertaking business ventures in dual production of wildlife and livestock. Other ranchers are known to have eliminated livestock in favour of game ranching, mostly for sport hunting. Farming of natives and exotics for meat, skins, trophies and other products is increasing.
- Off-take that maximizes production and income follows the same principles for wild as for domestic animals. The profit motive is foremost in raising livestock and wildlife together or each separately.
- The most important management principle is that females must be harvested so that the herds can be maintained at a carrying capacity that maximizes economic returns.
- The key to maximized production is a high rate of survival and growth, which in turn produces high biomass and better trophies. An objective should be to reduce natural or unplanned mortality.
- Habitat management is a way to increase the productivity of the selected combination of animal species and numbers. The animals themselves may be used in habitat management. Other inputs such as brush control, seeding and fire are valuable techniques.

themselves may be used in habitat management. Other inputs such as brush control, seeding and fire are valuable techniques.

- Multi-species management often increases costs and intensifies problems. Different handling facilities are required for each species; laws do not permit ranching with some species; diseases and parasites may increase; and predation may be troublesome. These are a few of the problems multiplied by adding a second, or more, species to the production system.
- Hunting on private land for a fee is a rapidly increasing and profitable source of income to landowners. This will foster improved management of rangelands as well as wildlife.
- Common-use management will be attractive and a way of management for some, but it is certainly not a system for all. The long-used management of one kind of animal and the existence of others will continue to be practised in most situations.