quantitatively, not qualitatively, different from those of developing countries in other parts of the world. Africa also offers considerable potential for significant advances in agricultural production through the application of the new technology, and this must be the approach in the short term. In the long term, however, the problem of agricultural production in Africa will require a different kind of production technology for its relatively large areas of lands characterized by moisture and fertility stress. This new technology must be based on efficient techniques of soil and water management, with the agronomists playing a key role supported by soil scientists, water technologists, plant breeders and scientists from other disciplines. The multidisciplinary approach becomes particularly important in this context.
The paper concludes with a brief discussion of ISNAR's collaborative work during the past 6 years with a number of sub-Saharan African countries to strengthen the organization and management of their agricultural research services.
Author's summary

50 88 - 2/30

Farming systems research and development
Farming systems, integrated sytems, land-use planning, permaculture
STRANGE, P.
Permaculture: practical design for town and country in permanent agriculture.
Ecologist, 13 (2/3), 1983, pp. 88-94

Permaculture (permanent agriculture) is an agricultural system that does not depend on limited resources such as water, soil and forests. The principles of permaculture are based on observations of natural ecosystems and on traditional polycultures. It aims to work with, not against, nature, and thus establish a system that will be self-sustaining, a kind of cultivated ecosystem, based on maximum understanding and minimum interference. A sustainable agriculture has four requirements: 1) it must produce more energy than it consumes, 2) it must not destroy its own base, i.e., the soil, 3) it must meet local needs, and 4) it must gain its own nutrients on site. The natural systems which satisfy these requirements are forests and tree systems, lakes and swamps. Basic principles, design, water sector planning for sun and wind; zoning; structures; urban strategies and the political dimensions receive special attention.
Abstract from WAERSA, revised

III INTEGRATED SYSTEMS

51 88 - 3/1

Integrated systems
Asia, Nepal, temperate climate, monsoon rainfall, slopes, anthropologic pressure, ethnic variety, transhumance, animal husbandry systems
SWISS ASSOCIATION FOR TECHNICAL ASSISTANCE
Transhuming animal husbandry systems in the Kalingchowk Region (Central Nepal).
Report of Swiss Association for Technical Assistance Kathmandu: Integrated Hill Development Project, Oct. 1979

Rugged ground, extreme differences in altitude and a temperate climate with monsoon rainfall causing layers of varied vegetation zones, make the region being studied typical of the southern Himalayan slopes. A great ethnic variety and a strong anthropologic pressure on the natural environment are also characteristics of these regions in Nepal.
Animal husbandry is extremely dependent on the outside environment as far as the re-stocking of animals and the sale of the products are concerned. Besides constraining factors influence production factors and processes, leaving the stock farmers with only a limited margin of possible activities.
The production factors are extremely sensitive and can very easily become limiting. The alpine and subalpine grasslands which are used as summer pastures are few in number and have a limited area, so that most of the fodder is obtained when the herds are in the forest. Without being overgrazed, the grazing lands are all being used to their fullest extent, so that any increase in livestock numbers would cause extreme damage to the pasture lands in their present state. Winter fodder is provided only with difficulty and is still insufficient. Capital, available manpower and the right to use the pastures are the decisive elements which have to be taken into account when choosing an animal husbandry strategy. A change in any one of them can affect the running of the animal husbandry system, making it change from one category into another.
The distribution of the different genetic types causes different stock-farming regions to appear, which depend on different geographical zones and bear witness to animal husbandry history: dairy farming prospects in the Bigu region, mainly the production of young bulls and heifers in the Phulbin region, less prosperous dairy farming in the Dolangsa region and, in the south of the study zone, dairy farming which used to be prosperous but it is now on the decline as the animals have aged.
The annual movements of the herds allow the animals to use the different vegetation levels, the forests in particular; stock farmers (usually related) who have banded their herds together follow the same route from year to year. The ovine flocks are moved separately.
The dairy technology is identical to that in the main animal husbandry regions of Nepal (Khumbu, Langtang etc.) During the lacta-

tion period, it requires constant work, which is done exclusively by the women. During the winter, however, it is the men who do the hardest work, which mainly consists in lopping oak branches.
The sale of products (animals, butter, cheese, milk) can bring a substantial income to the stock-farming families.

52 88 - 3/2

Integrated systems
Latin America, Amazonia, agricultural development, ecology, aquatic macrophytes, appropriate technology, indigenous plants, floodplains
JUNK, W.J.
Aquatic macrophytes: ecology and use in Amazonia agriculture.
Tropical Ecology and Development, 1980, pp. 763-770

In the Amazon basin there are enormous floodplains, the so-called Varzeas, located along whitewater rivers. The soil of these floodplains are deposits of recent sediments of Andean origin and are relatively rich in nutrients.
The floodplains of the Amazon River cover about 64,400 km² and possess an enormous potential for agriculture. Although the Varzea around Manaus (State of Amazonas) is relatively well populated, agricultural production is inadequate to satisfy the basic food demand of the urban population.
Most of the food deficit is covered through imports from southern Brazil. The population is increasing about 3% per year, while the agricultural production of many sectors remains stagnant. One reason for this is that agricultural methods used so far are not adapted sufficiently to the periodical inundations of the Varzeas. With few exceptions, the plants cultivated in the Varzeas cannot tolerate flooding. The period suitable for planting is only during the low water level. This creates a big deficit of production (for example vegetables) during the high water period. Also, damages caused by flooding have to be repaired, which leads to an increase in prices of the products. Cattle farming suffers severely during high water due to the lack of food and, when the water subsides, the banks are muddy and grassless.
It is not possible to exploit fully the agricultural potential of the Varzea for the above reasons. One of the possibilities of increasing agroproduction seems to be appropriate use, for agricultural purposes, of aquatic and semiaquatic macrophytes occurring in the Varzeas.
The periodic change in the water level (which oscillates about 10 m per year near Manaus) induces the development of two different plant communities in the area: one developing during high water, the other during low water on the mud-flats. These plants exhibit various morphological and physiological adaptations which enable them to survive during the unfavorable periods.
Of the many species present, the grasses are most common and show the highest rate of production. In spite of their high nutrient levels, such plants have been insufficiently utilized because adequate harvesting techniques are not available. The use of aquatic

macrophytes as organic manure in the Amazon has only recently been tested, and the results with wing-beans (Psophocarpus tetragonolobus) are excellent, especially if additional limestone is added. Wild rice (Oryza perennis) is common on the floodplains but it is not harvested. Domesticated rice species are now being used in the Jari Development Project on the lower Amazon with good results.

53 88 - 3/3

Integrated systems
West Africa, book, review, humid/subhumid ecozone, agrosilvopastoralism, mixed farming, crop residues
FAO
Integrating crops and livestock in West Africa.
Animal Production and Health Paper, No. 41; Distribution and Sales Section, FAO, Via Delle Terme di Caracalla, 00100 Rome, Italy, 112 pp.

This publication, aimed at senior professionals and technical administrators, discusses the dynamics of traditional agricultural systems and the prospects for increasing the integration of crop and livestock production. It is based primarily on experience gained through Farming System Research in the humid and subhumid zones of West Africa. The focus is on Nigeria, the most populous country in this region, where the pressure to intensify land use while preserving the natural resource base is particularly great.
The book has 3 main sections:
- R. von Kaufmann: The progression from pastoralism to integrated crop and livestock production. Describes interactions between Fulani cattlekeeping and cropping by non-Fulani (e.g. crop-residue grazing, manuring), as well as crop-livestock integration within agropastoral systems.
- B.N. Okigbo: The progression from arable cropping to integrated crop and livestock production. Describes crop-livestock interactions from the farmers' point of view as opposed to the pastoralists' point of view, and the increased importance of livestock on farms as human population density increases and permanent cropping replaces fallowing systems.
- E.N.N. Oppong: Integrating livestock production and tree crops. Describes the advantages for both tree crop and livestock production when these are combined, by either grazing legume pastures in plantations, or by feeding tree by-products to livestock. Refers mainly to Ghana, where most of the plantations are owned by smallholders. Mostly technical aspects are covered, but some consideration is also given to socioeconomic issues.

The emphasis in the concluding chapter "Strategies and action" is on evolutionary development in the traditional sector, to enhance existing trends toward integration of crop and livestock production.
Abstract from Agrecol/ILEIA

54 88 - 3/4

Integrated systems
Asia, Sri Lanka, study, agroecological zones, cattle, buffalos, distribution, government, livestock farms, smallholders, milk producers
AGRAWAL, R.C. et al.
Impact of cattle distribution from government livestock farms on smallholders in Sri Lanka.
Schriftenreihe des Fachbereichs Internationale Agrarentwicklung, No. 110, SLE, Berlin, 1988, 172 pp. + C1-C6, ISBN 3-924333-67-X; distributor: J. Margraf, Postf. 105, D-6992 Weikersheim, FRG, DM 19.00

The study examines the impact of distribution of meat cattle and buffalos from government livestock farms (GLSFs) on small-scale milk producers in four agroecological zones of Sri Lanka: Coconut Triangle (CT), Dry Zone (DZ), Mid-Country (MC) and Up-Country (UC). The results are based on interviews with more than 160 farmers and landless estate laborers in Kandy, Kurunegalla and Nuwara Eliya Districts and visits to livestock farms. The data from farmers was collected for the year 1986. To evaluate the impact, the respondents were divided into "target" (recipient) farmers who received improved cattle from a livestock farm between 1979 and 1984 and "control" farmers having either no cattle or only local cattle. The major findings and proposals deal with aspects of production (including breeding); socioeconomy; target groups; and distribution policy and channels and related sevices, such as the follow-up (especially with regard to animal health, artificial insemination services, extension and training), credit, milk collection, marketing and prices. The focus is on meat-dairy cattle.
It is proposed that the overall strategy for upgrading of the Sri Lankan (local) breed of meat cattle should be bull-oriented, i.e. through artificial insemination and issuing improved bulls. Distribution of improved cows should play only a peripheral role to help the small dairy producer obtain some income. Emphasis on the distribution of improved cows from the GLSFs for quick upgrading of the national herd has not proved effective as yet, especially because of the small number of animals available for the purpose. Retention of pure-bred female cattle on the GLSFs is the key to producing elite bulls for development of the national herd. All the heifers needed for progeny testing should be retained on the GLSFs and not distributed. Detailed proposals are made with regard to the breeding strategy of the GLSFs, the definition of the target groups, the policy and procedures of distribution and related services, e.g. credit and subsidies, extension and training, feed production and supply, collection of milk etc.
Many of the farmers prefer cash crops and other more paying propositions over dairying for increasing their incomes, mainly due to unfavorable returns from dairying. A number of farmers mentioned low prices of milk in relation to high feed prices as the major reason for this.

Farmers who would like to increase their incomes by expanding dairying but cannot do so, mentioned lack of money/credit, lack of feed and unavailability of the right type of animals from GLSFs as major constraints in all regions and lack of land and labor in the UC and MC.

55 88 - 3/5

Integrated systems
Western Australia, agrosilvopastoral trials, management procedures, biology, economics, pine timber, livestock production, environmental benefits, planting patterns
ANDERSON, G.W. et al.
The integration of pasture, livestock and widely spaced pines in South Western Australia.
Agroforestry Systems, 6, 1988, pp. 195-211

In the mid 1970s, Western Australian scientists became interested in the potential of pine agroforestry for the region in the south-west, which lies between longitudes 115 and 122° E and latitudes 31 and 35° S. The climate of the area is mediterranean with cool wet winters and hot dry summers. Winter months have average minimum temperatures of 8-10° C. In summer, maximum temperatures average 25-32° C. Average annual rainfall varies from 600 to 1300 mm per year depending on latitude and distance from the coast. Growing pine at wide spacing was seen as a way to produce sawlogs in the shortest possible time to meet a declining availability of indigenous hardwoods. Pine agroforestry would also reduce losses due to drought, which were a serious concern in conventional plantations, particularly on lower rainfall sites. It was considered that the increased soil fertility expected from the combination of legume-based pasture, application of fertilizer and grazing animals, would improve the health and vigor of pine on marginal sites.
In parts of Western Australia, the replacement of native perennial vegetation by annual pastures or crops has allowed saline ground waters to rise, increasing the salinity of both streams and soils. The possibility that integrating pine with agriculture could alleviate this problem, was another major reason for establishing trials in Western Australia.
The integration of pine, pasture and grazing has been extensively studied in Western Australia. Since 1973, trials have been established at a number of localities, including Mundaring (60 km east of Perth), Busselton, (230 km south of Perth), and Esperance (700 km southeast of Perth).
Pinus radiata is the preferred species because of its superior growth rate. However, it is more demanding for nutrients than Pinus pinaster (Ait) and requires more fertile soils. P. pinaster is grown mainly on infertile coastal sands and in drier areas.
This paper outlines methods of managing an agroforestry system, summarizes data from trials in Western Australia and presents the major findings of the economic analysis.
Data on timber and agricultural yields were used in an economic study of agroforestry in the Manjimup District of Western

Australia. This study found that the long-term profitability of agroforestry was similar to that of plantation forestry. However, it was considered that agroforestry could be a more attractive option for farmers because it provides returns while the trees grow. Compared with grazing enterprise, agroforestry would be substantially more profitable. These results apply to pastured sites with well-drained, fertile soils and rainfall of at least 800 mm per year.
Agroforestry was also found to be more profitable in the long term than a grazing enterprise, the distribution of income is less favorable in the short term and there is a higher labor requirement. The cost of establishing and tending trees must be met at a time when income from grazing is declining. The demands for labor and capital can be evened out by spreading planting over many years rather than by planting all at once. Financial assistance from Government during the first rotation would also help ease farmers into agroforestry. For example, subsidizing the cost of establishing and tending trees would help. For planting which could help to alleviate salinity problems, an extra subsidy would be logical.
Once log sales commence, a cash flow can be maintained. The timing of harvesting is flexible, as trees can be used any time between 20 and 40 years. Growers can time harvesting to suit their financial needs. Logs from agroforestry stands should compete well on the market because of their high quality (clearwood can be used in many ways and large diameters improve timber recovery).
Agroforestry may be more suitable than plantation forestry for the farmer who is a long way from markets because it is more economic to transport higher quality logs.
Management requires close attention to detail during tree establishment, frequent inspection for tree damage during early grazing and strict adherence to silvicultural schedules. Professional advice is recommended in the planning phase to ensure that the design and schedule are appropriate to the objectives of the project and that the management requirements are understood.

Integrated systems
Review, book, tropics, subtropics, sheep production, developing countries, production systems, geographical distribution, economics, physiology, sociology
GATENBY, R.M.
Sheep production in the tropics and sub-tropics.
Tropical Agricultural Series, 1986, 351 pp., Longman Group UK Ltd., ISBN 0582-40404-5, £ 27.50

This book represents an important effort in putting into perspective the role of sheep in the economy of developing countries of the tropics and subtropics. It is of particular interest for discussion on sheep breeds and production systems in Africa and the Near East. The examples and the illustrations have been drawn from the author's first-hand experience in India, Australia, Kenya, Fiji etc. The book contains black and white as well as

color photographs. Anyone with a general interest for sheep will find this a refreshing and stimulating account of sheep production in Africa, Asia, South America and other tropical areas.
The different systems, flock structures, ownership patterns and management methods are described and, later in the book, pasture management and integration with crop production are discussed.
The introductory chapter briefly covers the geographical distribution of sheep, breeds and environmental physiology. The latter should have included a brief discussion on alleviation of thermal stress. The following chapters prepare the reader well for the practice of sheep production in the tropics and subtropics.
However, information on housing of sheep under humid conditions should have been included. The author has included several examples on economics of production from various countries including India, Ghana and Kenya. The discussion on sociological factors affecting sheep production, particularly in North Africa, focuses attention on the complex patterns of ownership, exchange and marketing of sheep, migration over thousands of kilometres, and on the reasons for which Bedouins keep sheep. These sociological factors and their impact on sheep production must be properly understood by international aid agencies if sheep development projects are to succeed.
The chapters on health, nutrition, reproduction, growth, and wool and milk production are presented with very effective use of tabulated data to cover information on antihelmintics, feedstuffs, nutrients, tropical grasses and legumes, breed reproductive rates, lamb growth and milk yields. Novel aspects include details of water requirements, grazing behavior, poisons, drought feeding, artificial insemination and a comprehensive discussion on wool characteristics. The information is technically advanced and up-to-date, yet presented clearly and readably. There are particularly useful reviews of the literature on wool studies in countries such as India, Pakistan, Nigeria, South Africa, Mexico and Brazil, and on milk production.
A detailed appendix completes the work with a technical glossary and brief description of over 200 breeds.
The publication of books of agriculture in a wider context should be welcomed at this time of world food problems and international awareness. This is a very useful book for anyone interested in sheep production in the tropics.

Integrated systems
Africa, Zambia, rural development, migration, subsistence agriculture, agricultural productivity, small-scale industry, trade, extension project results
GTZ
Integrated rural development programme in North-Western Province of Zambia.
GTZ Documentation Country Brochure No. 2, 1988, pp. 11-13

Migration from rural areas to urban centres is a problem affecting many developing countries. In Zambia, the rural exodus has long since reached a critical level. With an urbanization rate of almost 45%, Zambia continues to be the most urbanized African country south of the Sahara. The population is concentrated in a few centres such as Lusaka and a few towns in Copperbelt Province. To increase welfare in these regions and to support the Zambian Government in its efforts to create decentralized growth centres, comprehensive measures are needed. In 1978 the GTZ launched a project supporting the Zambian Integrated Rural Development Programme (IRDP) in North-Western Province. With a population density of 2.6 inhabitants/km², this region is the most sparsely populated province of Zambia. The depopulation is mainly the result of labor migration to the mining industry in the Copperbelt. 90% of the remaining inhabitants are subsistence farmers. Climate and soils are favorable for extensive agricultural production, especially as this largest province offers ample land. In addition, there is great potential for timber utilization and honey production.
However, "integrated development" not only includes activities aimed at an increase of agricultural productivity. It also includes rural small-scale industry, trade in local agricultural and rural products and in commodities required for agricultural, and rural industry and services. Integrated Rural Development must mobilize the rural poor and integrate them into a social, political and economic process.
The project is based on intensive utilization of local resources and appropriate technologies. It comprises 19 sector components. The main component is the Zambian Lima programme, which focuses on small-scale farmers cultivating areas up to one ha, Lima being a measurement unit equivalent to 0.25 ha.
Groups of farmers are assisted through input supply and marketing strategies and are advised on the production of surplus maize. The nationwide Lima programme has adopted a rather conventional approach, focusing to a large extent on maize as the staple food with particular concentration on hybrid maize.
A major achievement was the introduction of draft oxen. Most of the local population had hardly any experience with cattle, but the demand grew as the advantages of using oxen for ploughing and transport became evident. To date 300 farmers have received a pair of trained oxen with plough and locally produced ox-carts under a loan agreement. 5,000 farmers have joined the transport system. They brought about 80% of the total marketable surplus to the North-Western Cooperative Union depots on ox-carts.
The ox-carts were developed in the Small-Scale Equipment Section which conducted trials and trained carpenters to produce these. It has been integrated into the National Engineering Service since mid-1987.
The promotion of rural crafts and rural industry covers some 400 pit sawyers and about 100 village carpenters who were not working to capacity before the project started. They are producing furniture, wooden building materials, school desks and ox-carts for the local demand with a minimum of external inputs.
Beekeeping is a traditional activity in North-Western Province, but due to lack of equipment, storage and marketing facilities, it

has hardly ever been considered a regular source of income. A honey factory has been established in Kabompo with a technical capacity for processing up to 200 tonnes of honey per year to a suitable standard to satisfy international quality standards legislation, and the 1,800 active beekeepers in the programme area can rely on a regular, long-term market for their surplus honey. They still use their established techniques of bark-hive beekeeping, which are the cheapest and most efficient under local conditions.
Although successful in most of its project elements, IRDP also suffered several setbacks resulting from rapid changes in the Zambian agricultural and cooperative policy, from management crises in institutions expected to take over from IRDP, or from IRDP management constraints.
As the usual administrative structures and the procedures of government institutions are not adequate to serve the needs of the masses of underprivileged rural people, and because the most underprivileged population will find it more difficult to become well-organized and self-reliant, the strategy for the future will have to be a careful blend of consolidation, integration and moderate expansion measures.

58 88 - 3/8

Integrated systems
Asia, Peoples' Republic of China, agricultural production, mushroom cultivation, subsistence agriculture, smallholders
AGRICON
Mushroom cultivation in the Peoples' Republic of China.
entwicklung+ländlicher raum, 22 (2), 1988, p. 11

The cultivation and production of mushrooms has for centuries been an integrated part of agricultural production. AGRICON, a Chinese organization within the China International Cooperation Company of Agriculture, Livestock and Fishery (CALF), presents a brief overview of Chinese experience in mushroom growing. Mushroom growing can improve the subsistence and economic base of smallholdings.
China was one of the first countries to recognise the nutritional importance of mushrooms. The cultivation of so-called edible fungi can be traced back to between 533 and 544 AD in an ancient agricultural book entitled "The key techniques for ordinary people", in which white fungi and mushrooms are described as being well-known, delicious dishes. Since that time, attention has been paid to cultivating mushrooms.
Most mushrooms show a high protein and low fat content. The Volvariella volvacea, for example, contains 17 aminoacids. Lentinus edodes and Pleurotus ostreatus contain 19 amino acids, including 8 amino acids which are considered essential for the human body. Lentius edodes also contains vitamin D.
Mushrooms are not only delicious and nutritive food, they also have positive medical qualities. They can stimulate resistance to harmful micro-organisms and regulate the functions of the human body. By eating mushrooms regularly, the colesterol content in the

blood can be reduced, and diseases such as myocardial infarction, arteriosclerosis, high blood pressure, coronary disease etc. can be prevented. In the late 1950s, Chinese scientists gradually discovered that most mushrooms described here contain substances which might prevent cancer. Increasing attention has therefore been paid to mushrooms as an important food crop. Agricultural by-products such as straw, wood blocks, cotton seed residue, waste cotton, sugarcane residue, tea residue, corncob powder and other supplements are the principal materials used in mushroom cultivation.
In Agaricus bisporus cultivation, for instance, a mixture of cow dung was traditionally used to cover the mushroom bed (substrate). However, this method was very labor- and cost- intensive and, finally, sufficient quantities of cow dung were no longer available. Nowadays no cow dung is used. It has been replaced mainly by paddy and wheat straw, rice bran and crushed clay.
The unexpected result of this net mixture for the substrate was a slight increase in the mushroom yield, while the number of hours of work and labor costs were reduced by 80% and 40% respectively.
In some of the southern provinces of China, where agricultural production has to be intensive, mushrooms are cultivated in an intercropping system, e.g. Pleurotus ostreatus is intercropped with wheat. The results show that only the autumn yield of the wheat is slightly lower. The net income of the farmers has nevertheless doubled.
In some areas, Pleurotus ostreatus is intercropped with vegetables or with sugarcane. In this way the mushrooms do not occupy land alone, but rather good crops of mushrooms, vegetables and sugar-cane can be achieved simultaneously. There are no geographical limits to cultivating edible fungi, which can be adapted to local conditions, cultivated under artificially controlled climates or in an industrial production system. In all cases, an intercropping method can be used.
Chinese farmers have gained much experience in mushroom growing. The scientific research centers of China have summarized these experiences and research is still being intensified. In 1981 the first Chinese technical workshop on mushrooms was held, at which the latest scientific technologies were reported. China plans to further intensify research on edible fungi with the objective of increasing knowledge on the biological patterns of the different mushroom varieties and finding ways of better utilizing wild mushroom resources as well as of increasing the number of mushroom varieties which can be artificially cultivated.

59 88 -3/9

Integrated systems
Review, sustainable agriculture, agroecosystems, ecology, transition phase
ALTIERI, M.A.
Towards sustainable agriculture.
In: Agroecology: the scientific basis of alternative agriculture, 1987, pp. 195-199; Westview Press, Inc., 5500 Central Avenue, Boulder, Colorado 80301, USA, ISBN 0-8133-7284-4

Dramatic increases in crop productivity in modern agriculture have been accompanied in many instances by environmental degradation (soil erosion, pesticide pollution, salinization), social problems (elimination of the family farm; concentration of land, resources and production; growth of agribusiness and its domination over farm production; change in rural/urban migration patterns).
The problems of modern agriculture may become even worse when conventional western technologies, developed under specific ecological and socioeconomic conditions, are applied to developing countries, as in some Green Revolution programs.
Modern farming has become highly complex, with gains in crop yield dependent on intensive management and the uninterrupted availability of supplemental energy and resources. It is based on the premises that the modern approach is no longer appropriate in an environmentally troubled and energy-poor era; and that progress toward a self-sustaining, resource-conserving, energy-efficient, economically viable and socially aceptable agriculture is warranted.
The challenge for sustainable agriculture research will be to learn how to share innovations and insights between industrial and developing countries and to end the one-way transfer of technology from the industrial world to the Third World.
Realistically, the search for sustainable agricultural models will have to combine elements of both traditional and modern scientific knowledge. Complementing the use of conventional varieties and inputs with ecologically sound technologies will ensure a more affordable and sustainable agricultural production. In the USA and other industrial countries, adopting this approach will require major adjustments in the capital-intensive structure of agriculture. In developing countries it will also require structural changes, mainly to correct inequities in the distribution of resources, but it will also require that governments recognize rural people's knowledge as a major natural resource. The challenge will then be to maximize the use of this resource in autonomous agricultural development strategies.
When examining the problems that confront the development and adoption of sustainable agroecosystems, it is impossible to separate the biological problems of practising "ecological" agriculture from the socioeconomic problems of inadequate credit, technology, education, political support and access to public services. Social complications, rather than technical ones, are likely to be the major barriers to any transition from high-

capital/energy production systems to labor-intensive, low energy-consuming agricultural systems.
A strategy to achieve sustained agricultural productivity will have to do more than simply modify traditional techniques. A successful strategy will be the outcome of novel approaches to designing agroecosystems that integrate management with the individual resource base and operate within the framework of environmental conditions. Selections will have to be based on an interaction of factors such as crop species, rotations, row spacing, soil nutrients and moisture, temperature, pests, harvesting and other agronomic procedures, and will have to accommodate the need to conserve energy and resources and protect environmental quality, public health and equitable socioeconomic development. These systems must contribute to rural development and social equality. For this to occur, political mechanisms must encourage substitution of labor for capital, reduce levels of mechanization and farm size, diversify farm production and emphasize worker-controlled enterprises. Social reforms along these lines have the added benefits of increasing employment and reducing farmers' dependence on government, credit and industry. Limitation under the prevailing social conditions to adopt ecological farming are discussed.
The requirements to develop a sustainable agriculture clearly are not just biological or technical, but also social, economic and political, and illustrate the requirements needed to create a sustainable society.
It is inconceivable to promote ecological change in the agricultural sector without advocating comparable changes in all other interrelated areas of society. The final requirement of an ecological agriculture is an evolved, conscious human being whose attitude toward nature is that of coexistence and not exploitation.

60 88 - 3/10

Integrated systems
Review, book, practical guide, rural development, tropics, subtropics, climate, soil, water, management, land improvement, land use, crops, manure, animal production, fisheries, poultry, economics, appraisal of projects, sociology
ILACO, B.Y.
Agricultural compendium.
Elsevier, The Hague, 1981, 740 pp., ISBN 0-444-41952-7, Dfl. 100.00

Written by field workers for field workers, the Agricultural Compendium is a practical guide for all those involved in rural development in tropical and subtropical regions of the world. All the important aspects of rural and agricultural develoment are summarized and integrated with a wealth of information collected from a variety of related disciplines. As it is essential that specialists from these different disciplines be aware of the work of others, an overview of the various principles and methods used is included.

Great care has been taken to give the user easy access to the information provided in this Compendium. A systematic layout, extensive list of contents and detailed subject index make it possible for the reader to find the information he requires quickly and easily. The many tables, figures and graphs that are included will be particularly useful when making basic calculations.
Contents: Chapter 1. Climate: classification of climate; phenomena relevant to agricultural meteorology; data collection. 2. Soil and land classification: parent materials of soils; essential soil properties; soil fertility; soil description; diagnostic nomenclature used in the present US taxonomy; systems of soil classification; field survey; land evaluation. 3. Geodesy: measuring methods; instruments and accessories; adjustment of instruments; the geometry framework; processing, checking and adjusting measurements; aerial photography; maps: types, scales and degrees of accuracy; calculation of surfaces. 4. Water control: hydraulics; surface water hydrology; groundwater hydrology; drainage; irrigation; miscellaneous hydraulic structures; operation and maintenance. 5. Land improvement: land clearing; land leveling; reclamation of saline and alkali soils; soil improvement; soil erosion and soil conservation; rural roads; capacity standards for construction. 6. Agriculture: crops; land use; yields; water requirements; chemical fertilizers; organic manures; pest control; mechanization; storage; seed production; climatic and soil requirements; labor requirements in crop production; nutritional composition of foods. 7. Animal production and fisheries: cattle; water buffalos; sheep and goats; horses, donkeys and mules (equines); camels and llamas; pigs; animal power; poultry; breeding; nutrition and feeding; grasses and legumes; grassland utilization; animal diseases and sanitation; nomadism; housing; marine fisheries; inland fisheries. 8. Farm economics: data collection; data processing and analysis; farm planning; brief guidelines for project studies. 9. Economic and financial appraisal of projects: economic appraisal; financial appraisal; sensitivity and risk analysis; income growth and income distribution; compound interest factors. 10. Sociology and rural development: development as an object of sociological analysis; development and social changes; social aspects of physical planning; settlement and resettlement; reallocation of rights and resources; transfer of knowledge. 11. Tables and supporting data. Index.
This handsome book is well produced and sturdy, allowing an intensive use by fieldworkers as well as by administrators, advisors and others involved in the planning process of rural areas.
Abstract by International Society of Soil Science, Netherlands