

ping. A little advantage was also observed in soybean. Groundnut, sorghum and cowpea had rather low yields in intercropping. The overall result was by far the best in the case of cassava/maize intercropping. Maize/sorghum intercropping seems to be interesting on account of the retarded sorghum development, assuring a good moisture supply to maize during critical stages.

## V AGROECOLOGY

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### Agroecology

Review, sustainable agriculture, definitions, principles, economics, social justice, ecology, traditional agriculture, GIPS, T.

What is a sustainable agriculture?

In: Proc. of the 6th Int. Sc. Conf. IFOAM, UC, Santa Cruz, California, USA, 1986, pp. 63-72

The importance of sustainability as a necessary, fundamental goal has received increasing attention worldwide, ranging from discussions of how to create a sustainable society to a focus by the World Bank, the United Nations and other agencies on sustainable development. The need for sustainable agriculture has been understood as environmental contamination has grown, health hazards have mounted, pest control practices have faltered, rural economies have deteriorated and hunger has spread. As the use of the term sustainable agriculture has become widespread, it has become important to have a clear definition. To "sustain" means "to keep in existence; keep up; maintain or prolong; to provide sustenance or nourishment for". Various definitions have been provided for what constitutes a sustainable agriculture, ranging from a narrow focus on economics or production to the incorporation of culture and ecology. One of the earliest definitions stated eight basic components for sustainability: systemic dynamism, harmony with nature, diversity, renewable resources, personal involvement, nutrition, community, and aesthetics. Quite often, "sustainability" has been focused only on the ongoing, productive capacity of a system. The German Agency for Technical Cooperation has sought to create a "self-sustaining agriculture" with the aim of "establishing high and lasting soil productivity and thereby conserving or re-establishing a well-balanced ecological environment". Over time, a definition has emerged that unifies these diverse elements into a widely adopted, comprehensive, working definition: a sustainable agriculture is ecologically sound, economically viable, socially just, and humane. This definition is used by an increasing number of researchers, farmers, policy makers and organizations worldwide. This paper provides a widely accepted working definition for sustainable agriculture, discusses its essential components, examines the sustainability of traditional and conventional systems, and mentions several sustainable approaches.

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## Agroecology

Review, book, alternative agriculture, science, farming systems, research, agroecosystems

ALTIERI, M.

Agroecology: the scientific basis of alternative agriculture. Westview Press, Boulder; Intermediate Technology Publications, 9 King Street, London WC2E 8HW, UK, 1987, ISBN 0-8133-7284-4, £ 12.95

This book describes methods for developing technologies tailored to the needs and the ecological and socioeconomic circumstances affecting low-resource farmers in the Third World and the US. The book is divided into five parts: Part 1 describes the historical and theoretical framework of agricultural ecology. Part 2 deals with the ecological considerations necessary in designing sustainable agroecosystems and suggests a methodology for evaluating farming systems for the purpose of designing technologies adapted to the needs and resources of alternative farmers. Part 3 describes the ecological features of various traditional and organic farming systems throughout the world, showing that there are many living models to learn from, both for researchers and farmers. Part 4 shows the ecological basis for managing insect pests, pathogens and weeds. Part 5 depicts the necessary conditions for the adoption of a sustainable agriculture worldwide. The purpose of this book is to provide a simple synthesis of the research on agroecosystems and technologies and an analysis of ecologically based technology development, for the purpose of establishing the scientific basis of alternative agriculture. This book is an interesting combination of theory and practice, with emphasis on the practical side, and is highly recommended for all interested in sustainable agriculture.

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## Agroecology

Asia, Japan, review, book, ecology, philosophy, natural farming, perception of nature, tillage, soil fertility, pest management, weeding, pruning, cropping systems, nutrition

FUKUODA, M.

The natural way of farming: the theory and practice of green philosophy.

Japan Publications Trading Co. Ltd., 1-2-1, Sarugaku-cho, Chiyoda-ku, Tokyo 101, Japan, 273 pp., ISBN 0-87040613-2; Dfl. 39.00

Natural farming is based on five principles: no tillage, no fertilizer, no pesticides, no weeding and no pruning. It is farming in step with nature, where farmers have to question and reject scientific thinking and allow nature and natural processes to guide how they farm. In this book, Fukuoka shares his interpretation of the development of agriculture and the principles of natural farming, and gives much specific information and techniques that can be

used by natural farmers. A great deal of specific technical information is presented, intermixed with a critique of scientific agriculture, all presented within a world view that seeks to 're-green' the globe. Very interesting for people who are seeking new pathways in agriculture.  
Abstract by Agrecol/ILEIA

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## Agroecology

Tropics, review, experiments, sustainable agriculture, GTZ, farming practices, smallholder farming systems, interdisciplinary approach, adaptive research, green manure, integrated approach  
KOTSCHI, J. and ADELHELM, R.

Development and introduction of self-sustaining agricultural practices in tropical smallholder farms.

In: Proc. of the 5th IFOAM Conf., University of Kassel, 1986, pp. 211-221, ISBN 3-926059-01-X, Verlagsgruppe Wieland, Happ, Burkhard; Witzenhausen, FRG.

The need for sustainable agriculture and its general principles are recognized worldwide. However, attempts to improve practices already used and to define new ones are in most cases insufficient or even completely lacking. This applies particularly to tropical regions for two main reasons: experimental work in this field started only recently, and the wide variability of sites makes it rather difficult to transfer methods and experiences from one situation to another.

The German Agency for Technical Cooperation (GTZ) works worldwide in rural development and is increasingly endeavouring to improve farming practices toward long-term sustainability and higher intensity under low-external-input conditions.

The most important measures to reach a self-sustaining agriculture with low external inputs on tropical smallholder farms are:

- agroforestry or multistorey farming
- multicropping (sequential cropping and intercropping)
- intensive gardening and vegetable growing
- green manuring
- biological nitrogen fixation (cultivation of legumes, blue algae, azolla etc.)
- manure and compost application
- mulching
- integration of animal husbandry and crop husbandry into a farming system (e.g. forage cropping, to stall cattle, to use trees and shrubs for fodder, to grow pastures under plantation)
- biological and integrated plant protection
- pond aquaculture.

This list of measures is not complete nor does it reflect a hierarchy, but the GTZ identifies these as key elements to achieve the above-mentioned objectives. They are considered to be of primary importance because all of them either contribute to a higher production of biomass and/or an increase of inorganic matter content in the soil. Both the production of biomass and organic matter are

most important parameters in a system designed to sustain soil-fertility and to make most efficient use of basic resources like nutrients, water and light.

These measures have already proven to be successful in GTZ projects on rural development and will be even more relevant in the future. In most cases, however, before these measures can be propagated, experimental work is required, because they have to be adapted or improved according to the specific site. In certain fields, even new methods have to be developed.

A framework has been designed which may serve as a decision-making aid to optimize smallholder farming systems with an interdisciplinary approach. The family and its decision-making process is considered the key factor for accepting innovations. Relevant experimental questions are identified from the family's limitations and potentials; they are implemented primarily in simple field trials either "on farm" or on village demonstration plots.

This does not exclude research under controlled conditions but helps limit it to the most relevant research questions. The result of these experiments at the "grassroot level" should turn out to be highly applicable and practical.

In the second part of the paper, several examples of adaptive research concerning green manuring are given in which applied experimental work and extension form an integrated approach to development.

Authors' summary

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#### Agroecology

USA, California, review, experiments, sustainable agriculture, agroecosystem model, agroecological research, crops, pests, farm management, ecological framework

GLIESSMAN, S.R.

The ecological element in farm management.

Proc. Symposium on the Sustainability of Californian Agriculture, Sacramento, California, 1986, 10 pp.

The long-term sustainability of conventional agriculture has become the topic of considerable discussion and concern among a broad spectrum of people involved in the multiple components of the production, processing and distribution of food, feed and fiber in California and elsewhere. An economic model of analysis points to serious problems in the balance of cash flow and the rising costs of production. Increases continue on the input side of the model, but the value received on the output side does not seem to be rising accordingly. At the same time, the awareness of serious problems of environmental degradation of air, water, soil and biotic resources as a direct consequence of present-day farming practices has increased. An approach to managing agricultural resources needs to be developed that both reduces dependence on costly, non-renewable inputs, and ameliorates the impacts that current practices are having on the environment. By introducing an ecological element into the design and management of farming

systems, major steps towards ensuring the long-term sustainability of farmland can be achieved.

The ecosystem concept is a basic element of ecology, and serves both as an important means of defining the unit of study as well as a way of approaching the system in an integrated and holistic fashion. The ecosystem concept permits the study of inputs and outputs, and how materials are transported or transformed within the system. By comparing different agricultural ecosystems, the impacts of different practices, technologies or even natural events can be estimated in terms of how they affect the sustained use of resources. More recently, the development of the agroecosystem concept has emerged as an important tool for integrating the great diversity of factors which affect farm systems.

Extensive research is currently in progress through the Agroecology Program at UC Santa Cruz with a focus on gaining an agroecological understanding of different agroecosystem designs and management strategies. These studies are aimed at establishing a basis for learning how sustainable agroecosystems function. Many of the studies are examining ecological interactions in mixed crop or intercrop systems, nutrient cycling problems and habitat management for pest control. Various research examples are discussed.

An ecological framework for analyzing the impact of any particular farming practice offers tools for predicting what the impact of each practice most likely will be. Yet this requires that agriculture be examined for more than just the short-term requirements of the market. The long-term impacts of agricultural practices and technologies on soil, air, water and biotic resource quality and availability need to be examined. An important basis for determining sustainability is thus established.

By researching the ecological basis of alternatives that allow much less dependence on costly outside inputs from non-renewable sources, or much less environmental impact, important tools for farm managers of the future can be developed. Management decisions can then be made in such a way as to maximize the benefits gained from incorporating our knowledge of biological processes, resource conservation and the ability of the agroecosystem to recover from our impact. Much greater emphasis can be focused on productivity as a process, as well as on the end product or yield. At the same time, an ecological approach will need to be tested against the social and economic framework of modern agriculture. With long-term sustainability as an issue, judgements as to the overall structure for proper agroecosystem design and management is much more achievable.

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#### Agroecology

Book, review, Papua New Guinea, subsistence agriculture, traditional agricultural

GOELTENBOTH, F.

Subsistence agriculture improvement manual.

Wau Ecology Institute Handbook, No. 10, 1985, National Library, Papua New Guinea, ISBN 9980-73-001-3

This manual of subsistence agriculture is the end result of consistency and persistence in the development of appropriate techniques in improving subsistence agriculture production. Subsistence agriculture maintains 80% of the 3 million people in Papua New Guinea (PNG). It is the major preoccupation of the bulk of the rural population. It is their way of life. PNG is experiencing a rapid depletion of its forest resources through timbering, agricultural development and traditional agricultural practices in a new context of localized overpopulation. Traditional methods involve the cutting of forests for temporary gardens and repeating this process when the soil becomes depleted. With increasing population growth, this method can result in the elimination of the primary forest and create an impoverished environment, such as a grassland, which has nutrient-depleted soils. On the other hand, primary forests may be transformed to monocultures for export commodities without regard to the villagers' needs and the native flora and fauna. This is particularly true for areas where big timber projects are set up. Since most of the people in PNG still live in villages, some far away from roads and airstrips, subsistence agriculture is very important to their existence. Steps have to be taken through extension of education to modify the practices that result in soil loss and nutrient depletion in subsistence farming throughout PNG. The traditional custom of swidden or slash-burn farming was adequate under the earlier low-population situation, but with current rapid population growth it threatens the forests, especially on slopes. People of the forested and sparsely inhabited areas practise long fallow. In the anthropogenic grasslands, the people fallow their gardens for shorter periods and substitute various soil-enriching techniques for soil regeneration. A great variety of horticultural practices and strains of food plants have accumulated in PNG over the centuries. They are closely adjusted to the local farming and environmental conditions; thus adaptive agricultural structures are all too easily destroyed by population pressure or cash cropping. Recognizing the impact of extensive farming systems on tropical forests and resulting environmental degradation such as a decrease in species diversity, species extinction and erosion, and in order to improve the nutrition of subsistence farmers, the Wau Ecology Institute initiated studies in 1976 toward the transformation, intensification and site-stabilization of shifting agriculture. On the basis of these studies, project activities started in 1982 to combine traditional and improved appropriate gardening techniques and to extend these methods to officials, associations, village groups and the individuals who are expected to do training and extension work. The intended result of this program is to maintain an effective subsistence agriculture system which provides a self-sufficient food supply and supports the villagers socially, economically and nutritionally.

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## Agroecology

Book, review, arid and semiarid lands, sustainable use, management, developing countries

CHILD, R.D. et al.

Arid and semiarid lands: sustainable use and management in developing countries.

Rep. of AID/NPS Project, Washington, D.C. 20240, 1984, 203 pp.

More than half of the earth's land surface is arid or semiarid. These form the major land resources in most developing countries. There is an urgent need for responsible management of the world's arid and semiarid land resources.

The term rangelands includes those uncultivated lands that can be browsed or grazed by wild or domestic animals. Because most arid and semiarid lands are not cultivated, they are considered as rangelands. In different parts of the world, this type of land is known by many names i.e., savanna, veld steppe, dryland, arid and semiarid land, native pasture, grazing land, bush, grassland or pampas.

This book is intended to help development agencies to consider the total ecological and socioeconomic environment as they plan, implement and evaluate projects. The first section of the book is a review of rangeland classifications and a description of the people, livestock and wildlife that share the land. It also contains a discussion of what must be known about developing-country infrastructures before any development project is planned. The second part looks at processes and interventions that can help to meet the long-term needs of the people who depend on rangelands. There is a review of what has been learned about the ecological use and management of developing-country rangeland resources and a documentation of the need for an integrated approach to the development of these resources.

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## Agroecology

Developing countries, review, discussion, TAC, IARCs, CGIAR, sustainable agriculture, concepts, definitions, proposals

TAC

Sustainable agricultural production: implications for international agricultural research.

Progress Report of CGIAR-TAC (draft), Washington, D.C., 1987, 69 pp.

A dictionary definition of sustainability refers to "keeping an effort going continuously, the ability to last out and keep from falling". Such a definition would suggest that agricultural systems would be sustainable if production could be maintained at current levels. This would be a static concept of sustainability. But sustainability should be treated as a dynamic concept, allowing for the changing needs of a steadily increasing global popula-



tion. In the static sense, many traditional agricultural production systems were sustainable for centuries in terms of their ability to maintain a continuing, stable level of production. However, the needs and increasing aspirations of expanding numbers of people have forced changes in production practices that have imposed excessive demands on the natural resource base. Within this content, sustainable agriculture should involve the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the natural resource base and avoiding environmental degradation. Characterized in this way, sustainability should be considered in the light of past and current trends in agricultural production. In this study of CGIAR priorities for future strategies, TAC recommended that the word "sustainable" be included in the system's goal statement and that greater emphasis be placed on sustainable production systems in future work of the Centers. In this paper, TAC reviews the circumstances threatening sustainability, analyzes areas where international research could contribute more effectively to the development of sustainable agricultural production, and makes recommendations for the future work of the Centers. The discussed draft paper, prepared by CSC II, incorporates the comments and suggestions made at TAC 43, plus some further thinking by the Sub-Committee.

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#### Agroecology

Review, book, food production, sustainability, systems approach, agricultural policy, case studies, socioeconomy, technology  
 PARIKA, K. and RABAR, F.  
 Food for all in a sustainable world.  
 Progress Report of IIASA Food and Agriculture Program, International Institute for Applied Systems Analysis, Laxenburg, Austria, 1981, 250 pp. + xiii.

The Food Agriculture Program (FAP) of the International Institute for Applied Systems Analysis (IIASA) was started in 1977 with the object of examining the production and distribution of food in the variety of economic situations in which the nations of the world found themselves. This book reports the progress that has been made after four years' work. Although the program was originally intended to examine the problems and their causes and to consider policies to alleviate them, and this has been done in most of the individual cases considered, a further dimension has been added: that of providing long-term solutions which have validity in dealing with increasing world population over a horizon of 50 years. A major feature of the program has been the use of a systems' approach which encompasses both national and international relationships. The first three parts of the book set the scene in terms of present policies, the linkages between policies which operate at the national and

international levels, and the data relating to participating countries to which the FAP has access. Part 4 tackles the first task in realizing the objective of the program, that of describing and applying the national agricultural policy models which have either been constructed in participating countries or have been built at IIASA. In Part 5, which together with Part 4 constitutes the largest part of the book, the impact of technological transformation in agriculture is examined as the second task in achieving the objectives of the program. This part also includes a number of case studies. A publication of this kind includes a great diversity of material and it is difficult to comment in general terms. However, the reader will be impressed by the magnitude of the task of linking the socioeconomic with the technological aspects of the program. There is nothing new in this, but the IIASA has established a considerable momentum toward accomplishing this linkage. It is to be hoped that the effort will continue until it is ultimately successful.

Abstract by J.G.W. Jones

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#### Agroecology

Review, agroecology, agroecosystems, social value, cybernetic systems, strategies, productivity, stability, sustainability, agricultural history, Green Revolution, evaluation, development programs  
 CONWAY, G.R.  
 The properties of agroecosystems.  
 Agricultural Systems, 24, 1987, pp. 95-117

Agroecosystems are ecological systems modified by human beings to produce food, fiber or other agricultural products. Agroecosystems are often structurally and dynamically complex but their complexity arises primarily from the interaction between socioeconomic and ecological processes. Studies of agroecosystems have tended to concentrate on the flows and cycles of energy and materials of agroecosystem complexity and have relatively little impact on the theory and practice of agricultural development. Agroecosystems may be regarded as true cybernetic systems whose goal is increased social value. This is achieved through a variety of strategies that combine different levels of productivity, stability, sustainability and equitability. Agricultural development thus involves making trade-offs between these properties. The situation is illustrated by selected examples from agricultural history, including the origins of agriculture, manorial and modern western agriculture, and the Green Revolution in Indonesia. In this paper agroecosystems are characterized by a limited set of dynamic properties that not only describe their essential behavior but can be used normatively as criteria of agroecosystem performance. They can be employed in the design and evaluation of agricultural development projects at all levels of intervention.