622 90 - 4/101

Cropping systems
Africa, Nigeria, tropical rainforest zone, land equivalent ratio, cocoa, kola, intercropping, farming systems, relative yield

OLADOKUN, M.A.O. and N.E. EGBE

Yields of cocoa/kola intercrops in Nigeria.

Agroforestry Systems, 10, 1990, pp. 153-160

Surveys have revealed that most cocoa, *Theobroma cacao* L., plots in southwestern Nigeria are intercropped with food and/or other tree crops. It has been observed that, on the average, 55% of kola farms in Ogun State of Nigeria were intercropped with cocoa alone while 16% were intercropped with both cocoa and robusta coffee, *Coffea canephora* L. Only 29% of the kola farms were under monoculture.
Cocoa and kola are two of the prominent nigerian cash crops. In 1986, Nigeria exported 2.860 metric tons of cocoa beans at a total value of 5,450,000 US dollars as income from the crop. Kola enjoys a substantial amount of both internal and external trade. Kolanut is used in several ways both for consumption (chewing) and in the preparation of several pharmaceutical drugs, wine, liqueurs and confectioneries.
The yields of two intercropped cocoa/kola plots at the Cocoa Research Institute of Nigeria, Ibadan, were compared with the yields of monoculture plots. It was found that 1.75 ha of monoculture plot gave the same crop yield (kg/ha) as 1.00 ha of mixed crop. The cocoa component started fruiting earlier than kola and also continued to yield annually so there was no crop failure in any year.
Cocoa/kola mixed culture is both practicable and economical. The climatic and growth requirements of both crops make them compatible as intercrops. When both are grown together, each benefits from the maintenance and care given to the other, thus maximising the use of farm inputs and labour. Soil conservation and management are additional advantages given by the mixture. The LER for the mixed culture is 1.75. There is, however, a need to increase research to solve the inevitable attendant problems of intercropping the two species.

V AGROECOLOGY

623 90 - 5/58

Agroecology
Review, book, proceedings, symposium, Australia, sustainable agriculture, soil assessment, farming systems, crops, conventional agriculture, organic farming, economic comparison

WYNEN, E.

Sustainable agriculture: a new direction.

National Association for Sustainable Agriculture, Australia Ltd., Sydney South P.O.B. A 366, Sydney 2000, ISBN 0-7316-3698-8, 1988, 42 pp. price per copy AD 7 (postage included)

Soil quality is one of the reasons why the National Association for Sustainable Agriculture, Australia (NASAA) was formed in March 1986.
This organization defines sustainable agriculture as follows:
A system of agriculture able to balance productivity with low vulnerability to problems such as pest infestation and environmental degradation while maintaining the quality of land for future generations.
In practice this involves a system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, livestock feed additives and other harmful or potentially harmful substances. It includes the use of technologies such as crop rotations, mechanical cultivation and biological pest control; and such materials as legumes, crop residues, animal manures, green manures, other organic wastes and mineral bearing rocks.
A symposium was held for farmers at Dookie College (Victoria), to discuss long-term sustainability of agriculture. This Symposium was organized by Dookie College and the National Association for Sustainable Agriculture, Australia (NASAA).
Issues related to sustainable farming are the topic of the papers in the proceedings:

- Soil assessment for the farmer — by Chris Alenson
- The effect of different farming systems on crops — by Peter Abetz
- A farmer's experience with a sustainable agricultural system — by Alfred Haupt
- An economic comparison of sustainable and conventional farms in south-eastern Australia — by Els Wynen
- Two organic farms in the United States — by Sandy Fritz

All papers in this second edition are reproduced unchanged from the first edition, with the exception of Els Wynen's. Her paper has been updated to include revised estimates of the farm survey.

622 90 - 4/101

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623 90 - 5/58

Agroecology
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624 90 - 5/59

Agroecology
Review, book, organic farming, holistic approach, soil, plant nutrition, pests and diseases, crop rotation, grassland management, animal husbandry, food quality, energy utilization, pollution, labour usage

WIDDOWSON, R.W.

Towards holistic agriculture - a scientific approach.

Pergammon Press, Headington Hill Hall, Oxford OX 30 BW, U.K., ISBN 0-08-034211-6, 1987, 183 pp.

In the introduction the term holism is defined as the tendency in nature to form wholes that are more than the sum of the parts by creative evolution. Holistic agriculture is concerned in obtaining a correct grouping in farming systems which are in themselves sustainable; the organization to give this grouping within the farm and on a national basis and, it would be hoped, one day on an international basis, is of great importance.
Opposed to holism is reductionism, a belief that complex phenomena can be explained in terms of something simple. This view is generally held by chemical farmers.
There is no argument between holistic agriculture and conventional agriculture about established scientific facts. For instance, an agriculturalist understands the plant's need for nitrogen, but the method by which the plant is to obtain that nitrogen is fundamentally different. The holistic farmer will consider all the units, and do his utmost to ensure that none is damaged in his search for that nitrogen.
This book analyses the relationship between soil, plant, animal and man. The author discusses the components, grassland management and the most efficient use of crops to maximize yield, food quality and profitability without the extensive use of chemicals and without damaging the ecology.
The book covers animal farming, the welfare and health of poultry, cattle, sheep and goats, their nutritional needs of and the best way to balance their diets. It is for all those interested in organic farming and its applications in modern agriculture.
The contents of the book are:
Introduction. Soil and Cultivations - Mineral fraction; Organic matter; Symbiotic fixation; Conversion of organic nitrogen to nitrate; Ethylene cycle; Bulk density of soil; Soil reconditioning tools; Keyline cultivation. Sources of Plant Nutrients - Fertilizers; Macro-nutrients; Micro-nutrients; Organic fertilizers; Mineral fertilizers; Plant nutrient loss. Pests and Diseases - Weeds; Pests, Plant diseases; Animal diseases; Fungicides and pesticides; Pesticides, Rotations and Crops. Grassland Management - General considerations; Establishment of grassland; Subsequent management; Seeds mixtures; Grassland improvement. Animal Husbandry - Monogastrics; Ruminants. Animal Nutrition - Diets for monogastrics; Diets for ruminants. Some

Other Considerations - Yield; Profitability; Food quality; Energy utilization; Finite resources; Pollution and animal welfare; Labour usage. Epilogue. Appendix II; Appendix III. Index.

This book is intended for teachers in alternative agriculture, for students in agriculture, horticulture, forestry and land-use generally.
Much of the material can be found in standard text books on conventional agriculture.
The chapter on animal nutrition for example consists simply of standard, conventional information on ration formulation for different types of livestock.

625 90 - 5/60

Agroecology
Asia, Philippines, IRRI, DSE, review, low-input technology, rice production, sustainable agriculture, green manure, fertilizer management, rotary weeder, fish, duck, water buffalo, bio-intensive garden, azolla, azospirilla, technology transfer

IBUSNO, A.C. and M.D.G.G. PETIL

Low-input rice production: toward a sustainable rice farming technology.

In: Proc. of Int. Training Course on Sustainable Agriculture (Ecofarming) and On-Farm Experimentation; SEARCA, Los Baños, Philippines, 1988, pp. 143-149

In the Philippines the planting of high-yielding varieties (HYV's) of rice and the intensive use of chemical fertilizers and pesticides were promoted nationwide. Farmer's production doubled and, in some cases, even tripled. These dramatic results have convinced farmers that high chemical inputs mean high yield. Results have proved that high yields do not always imply high income.
The use of chemicals created a major drawback, especially to small farmers. The steep rise in the price of soil and gas increased the prices of fertilizers and doubled the prices of pesticides. Price of gasoline for hand tractors, treshers, and mills rose also. Small rice farmers using high-input technology were hit the hardest; having no capital resource of their own, they were driven to credit dependence.
The use of chemicals resulted in the degradation of soil, the emergence of new pests, and danger to the health of farmers.
Excessive fertilizer application destroys the soil structure, organic matter levels have dropped, soil acidity has increased, micronutrients have become unavailable, and useful soil microorganisms are destroyed.
The International Rice Research Institute (IRRI) in the Philippines has identified rice pests that emerged owing to indiscriminate chemical spraying. Through continuous exposure to chemicals, some insects have also developed the ability to tolerate heavy doses.
Moreover a survey conducted showed that 28 out of 32 user-respondents experienced symptoms of low-level poisoning. Chemical residues on food products also pose a hazard to consumers.
These developments have made it increasingly clear that the prospect of increased food production with the use of high chemical inputs is not as bright as it once appeared to be.
The negative effects of high chemical input food production resulted in the development of alternative technologies. IIRR initiated the Low-Input Rice Production Project (LIRPP).
Through this project, IIRR promotes low-cost, ecologically sound, and sustainable rice-based production technologies. LIRPP aims to verify, adapt, and demonstrate a farming system using reduced

levels of chemical inputs, diversification of farm enterprises, and integration of livestock, fish, and biofertilizers into conventional rice cropping systems.
The objective of the project is not to establish a "model farm" but to offer a variety of technological options to interested users. The target beneficiaries are the small farmers who have limited financial resources.
This paper further describes the technologies tested and further technologies to be examined.
The authors conclude that a labor-intensive technology is preferable to a capital-intensive one. More importantly, the technology should not lead to the destruction of the farmer's basic wealth, which is a healthy, fertile soil.

626 90 - 5/61

Agroecology
Review, book, Latin America, Asia, alternative agriculture, farming systems research, agroecosystems, production systems, theoretical basis, diseases and pests, sustainable agriculture

ALTIERI, M.A.

Agroecologia: bases cientificas de la agricultura alternativa. (Agroecology: the scientific basis of alternative agriculture.)

Centro de Estudios Tecnologiás Apropiadas para America Latina (CETAL) Casilla 197-V, Valparaiso, Chile; Intelectual No. 63641, 1985, 169 pp.

This book describes methods for developing technologies tailored to the needs and the ecological and socioeconomic circumstances affecting low-resource farmers. 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 production methods.
Part 5 demonstrates the ecological basis for managing insect pests, pathogens and weeds.
Part 6 describes how to manage the "fauna silvestre" in ecosystems.
Part 7 depicts the necessary conditions for the adoption of a sustainable agriculture.
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.

627 90 - 5/62

Agroecology
Review, Africa, SubSahara, sustainability, agricultural development, rural sector, external sector, international environment, political environment, World Bank

IDACHABA, F.S.

Sustainability issues in agriculture development.

In: Sustainability Issues in Agricultural Development; Proc. of the 7th Agric. Sector Symposium; Eds. T.J. Davis and I.A. Schirmer; The World Bank, 1818 H Street, N.W. Washington, D.C. 20433, USA; ISBN 0-8213-0909-9, 1987, pp. 18-53

The failure of agriculture in SubSaharan Africa to attain sustained growth performance in the last two decades is well documented (World Bank, 1981, 1984, 1986). The virtual collapse of export crop production has not been accompanied by a corresponding increase in food production.
This paper focuses on sustainability policy issues in agriculture, with particular focus on African agriculture. The concentration on Africa and Nigeria in particular stems from the enormity of the food and agriculture problem of the region and from the author's relatively greater familiarity with it.
First, the problem of sustainability under three sets of factors, as well as the interactions between these factors are discussed. Then the policy issues for sustainability are examined. At the end, some conclusions are drawn.
According to the Oxford Advanced Learners' English Dictionary, sustainability refers to "keeping an effort going continuously, the ability to last out and keep from falling." Sustainability in agricultural development therefore refers to the ability of agricultural systems to keep production and distribution going continuously without falling. It refers to how agricultural growth and development can be sustained into the future.
National agricultural systems lose sustainability from several sources. Four classes of sources of discontinuity are identified: the national macroeconomic and political environment; the world economy (the external sector); the agricultural sector; and the interaction between the particularly agricultural sector, the macroeconomy and the world economy. The treatment in this paper implies a certain order of priorities of sources of nonsustainability in developing agriculture, especially in SubSaharan Africa.
Discussions of sustainability issues must indicate some sense of order so as to aid the process of setting priorities in the allocation of resources to attain sustainable growth and development performance. Four classes of issues are treated in decreasing order as source of nonsustainability: institutional arrangements and the policy environment, macroeconomic policies, agriculture and the rural sector and the external sector.

Interactions between these classes are also important for sustainability.
The author concludes that the traditional approach to a discussion of sustainability issues in agricultural development focuses on supply-side considerations. This view emphasizes the constraints that define the limits of technology, the policy process and institutional arrangements in attaining sustainable agricultural growth and development performance. Such an approach however fails to explain the persistence of nonsustainable agricultural performance in SubSaharan Africa, twenty-five years after independence. This paper examined the demand side, identifying the sources of demand for programmes, projects and institutional arrangements to ensure sustainable agricultural sector performance. The supply- demand- approach to sustainability provides greater insight into the perennial problem of lack of sustainability in agricultural development.
The discussion implies that the core of the sustainability problem is to be found in the inadequacies in domestic policies, programmes and projects as well as the structural elements in national economies and societies which hamper the articulation of the effective demand of the rural majority for sustained sector performance. Though external factors also play an important role in sustainability, they are considered secondary to the domestic factors.
Political instability has adversely affected consistent public programming for agricultural and rural development. The challenge is to attain a minimally acceptable level of sustainable agricultural sector growth and development performance in the face of largely exogenous political instability.

628 90 - 5/63

Agroecology
Africa, agricultural development, analysis, socio-political model, land holding systems, demographic aspects, housing, food, land exploitation, education, extension, research, administration, social integration, CTA

KAVADIAS, G.V.

Dimensions sociales et humaines du développement agricole de l'Afrique dans la perspective de l'an 2000. (Social and human dimensions of agricultural development in Africa in the perspective of the year 2000.)

In: Agriculture in the Year 2000 - The Case of ACP-Countries; Proc. of an Int. Forum: Green Government and CTA, Netherlands, ISBN 92-9081-0440, 1990, pp 99-104

A theoretical analysis of this phenomenon has already shown that the economic - technological approach to development is insufficient if there is no concurrent reference to the socio-political framework, because development efforts are essentially social actions geared to a certain type of society which they are trying to change.
Experience has shown how important the above mentioned dimensions are since they are decisive for development, particularly in agricultural regions of a traditional nature, as is the case in Africa.
With other words, in every development effort in sub-Saharan countries, the social and, more generally, the human dimensions of the undertaking constitute a fundamental problem. In agricultural areas, and taking into account the specific local context, these aspects constitute a key problem.
And yet, the social and human factors are always more or less neglected, at the same time, nearly all the attention is focused on the financial, technological and technocratic factors.
The author explains that it is thus impossible to speak specifically about social and human dimensions of agricultural development as evidenced by the historical reality of each African country.
The only thing that is attempted, is to try to approach the problem within the context of an abstract socio-political model of a qualitative nature elaborated in stages and based on common or related features of the countries in question. The practical utility of such a model lies in the fact that it represents a reference value. By comparing the model with the situation prevailing in a given country differences and similarities to the model enables observations on the fabric and internal dynamics of the social structures of the country. Furthermore by comparing the existing social structures of the society in question with the social infrastructure dictated by the chosen type of development, it is possible to ascertain discrepancies and identify the necessary measures to be taken in order to reconcile the two.

Such an attempt calls for a multi-dimensioned analysis.
The levels of observation and analysis necessary to the construction of an integrated rural development model in Africa are described.
This model emphasizes the distance between North and South which is increasing. If this gap is not closed, not only will the misery of poor nations persist, but there will be greater danger for world peace through new wars.
The theoretical sociological model of their current development conditions which has been described allows:
- a description of their deficiencies and needs which have to be faced, from the sociological angle,
- the formulation of a series of measures which are required by social and human considerations and which can contribute to the general effort in connection with economic, organizational and technological measures.
- the confirmation that action for development must follow efficient planning.

The planning must prescribe measures for the development of every sector of life, as well as measures for the appropriate combination of their dynamics.
This paper is rather theoretical and the whole effort described above is not easy to accomplish.

629 90 - 5/64

Agroecology
Europe, Sweden, study, environmental protection, agriculture, economics

KUMM, K.I.

Några ekonomiska studier inom jordbrukets miljövård. (Economic studies of environment protection in agriculture).

Institutionen för Ökonomi och Statistik, Uppsala, Sweden; ISBN 91-576-2850-5, 1986, 4 pp.

This note summarizes five recent Swedish studies, the aim of which was to identify economic problems encountered in protecting water and natural grazing resources in agriculture, as well as to test the usefulness of different economic tools in analyzing and solving the problems identified. Problem identification is based on different empirical studies and comprises different steps in the process of environment-political decision making and accomplishment. The methods tested are taken from different sectors of economics. The problems identified are strongly associated with cooperation, searching and learning, for example, how environment protection authorities cooperate with farmers in searching for economically profitable or, at least cheap, measures of improving the environment or how an evaluation of the measures taken can be used to learn more about the relationship between corrective measure and the result. In these processes of cooperation, searching and learning, it is found that approaches and methods used in service management and cybernetics can be used. Different economic control measures can also be used to increase the number of environmental measures that are profitable to the firm. Another important problem area is the analysis and comparison of different alternative measures. Cost benefit analysis can be used to assess the profitability to society of, for example, extension programmes aimed at linking a better environment with better profitability for farmers. Such analyses are important when market imperfections lead to differences between profitability for the firms and profitability for society. Positional analysis is a suitable alternative of complement to cost-benefit analysis in cases of complicated conflicts between different interests.
Abstract from WAERSA

630

90 - 5/65

Agroecology
Review, book, tropics, Latin America, Africa, Asia, tropical forests, deforestation, projects, case studies, forest conservation, sustainable agriculture, natural forest management, DESFIL

GRADWOHL, J. and R. GREENBERG

Saving the tropical forests.

Earthscan Publication, London, U.K., 1988, 207 pp., USD 12.95

A lot of books and articles have been published in recent years deploring the loss of tropical forests. "Saving the Tropical Forests" is one of the few publications, however, that offers tangible suggestions for mitigating the problem.
The introductory sections of the book provide a brief but accurate sketch of tropical deforestation, its causes, and its potential consequences. But the real value of the publication lies in the presentation of 38 project case studies that provide examples of positive approaches to tropical forest conservation. An underlying theme of the case studies is that, to survive, forests must be used for the benefit of people. Discussion centers on project activities in the lowland, humid tropics, with a primary focus on Latin America (two-thirds of the case studies are from the tropics of the New World). Addresses of individuals familiar with each case study and lists of recommended references are provided for readers who want to learn more about specific efforts.
The case studies are arranged in four categories: management of forest reserves, sustainable agriculture, natural forest management, and tropical forest restoration. Each section includes a summary of the elements of each project's success. These summaries indicate that nearly every project emphasizes early and direct economic benefits for local people (even in forest reserves), small-scale initiatives, and active local participation in planning and implementation.
The book presents a wide range of project activities, but several important strategies for saving tropical forests are neglected. The authors recognize, for example, that misguided government policies are a principal cause of deforestation, yet the book fails to discuss any ongoing effort to bring about reform of forest policy (for example, the Tropical Forestry Action Plan or the efforts of the International Tropical Timber Organization). Another strategy that deserves greater attention is environmental education. Although some case studies highlighted in the book have small components on environmental education, none of the broad-based campaigns of public awareness initiated by nongovernmental organizations in tropical countries is discussed. In addition, almost no attention is given to forest plantations that are intensively managed, even though this strategy may be one of the best for relieving pressure on remaining natural forests.

Readers intimately familiar with specific projects presented in the book will discover some inaccuracies in the descriptions and some embellishment of project accomplishments. The authors acknowledge that the project descriptions are not intended to be exhaustive studies; rather, they are meant to spark debate and further research. In that respect, the book is likely to be highly successful. It is not a blueprint for halting the destruction of tropical forests, but it does an excellent job of stimulating readers to think about solutions and opportunities.

631 90 - 5/66

Agroecology
Latin America, Africa, Asia, Pacific, humid tropics, hillsides, savannas, sustainable agriculture, cassava, erosion control, pastures, beans, low-input technology

CIAT

CIAT and sustainable agricultural production.

CIAT International, 8, 1, ISSN 0120-4084, 1989, pp. 3-5

In the Andean region of South America quite a bit of the cassava production is done on steep hillsides.
CIAT, has been conducting farm-level studies to determine what farming practices will reduce soil erosion when cassava is grown under these conditions. It was found that while cassava has a reputation of causing erosion, this is only true in the initial phase of the plant's establishment and during its harvest. The soil loss is determined more by the way the crop is managed than by the crop itself.
It was found that adding fertilizers is ecologically and economically justifiable. It reduces soil erosion by making the plants grow faster thus producing leaves which shield the soil from rainfall. It also increases yields two- or three-fold. Using adapted varieties of cassava, selecting healthy planting material, and controlling weeds will also make plants grow quickly and vigorously.
Practices as minimum or zero tillage, covering the soil with crop residues, and planting in contours are some of the best and cheapest ways to reduce erosion.
Based on these findings, it is advocated that farmers plant cassava intercropped with grass barriers, such as *Brachiaria humidicola*, with some tree crops and with some forage legumes, such as kudzu (*Pueraria phaseoloides*).
In Central America, many hillsides have eroded because of overgrazing. Overgrazing is caused largely by the inability of traditional pastures to maintain forage during the six-month dry season prevalent in many areas. During this period the only forage available is maize stubble, perhaps supplemented by sugar cane. New pasture grasses being introduced with deeper roots and greater drought tolerance, could effectively alleviate this problem. Many of the grasses are even capable of regrowth during the dry season.
In the humid tropics, erosion is caused by migration and settlement forced by socioeconomic pressures. Settlers invade and clear land and establish crops that later are replaced by pastures which do well temporarily but degrade when the fertility declines. It is estimated that there are already close to ten million hectares of pasture land in this condition in the humid tropics. CIAT is developing new germplasm and technology to restore these degraded pastures, which can help slow the clearing of virgin or primary forest.

In Peru grasses and forage legumes have been identified that are much better adapted to the acid, infertile soils of the humid tropics than the more demanding pasture grasses currently used. These adapted species, with a high soil-cover capability, thrive in low-fertility soils and put down deep roots in the acid ones, contributing to nutrient recycling.
Aggressive pastures of *Brachiaria dictyoneura* in association with *Centrosema macrocarpum* and *C. acutifolium* can compete with weeds to restore deteriorated pastures. *Arachis pintoi*, a wild relative of the peanut, shows great promise in this ecosystem, and is able to withstand shade, making it a viable candidate for silvipastoral systems.
A less fragile ecosystem than the rainforest is represented by the 300 million hectares of savannas in Latin America. These savannas are equally made of acid and infertile soils, but while the rainforests provide poor settlers with a superficial and temporary fertility when they burn them, the savannas need a lot of inputs to become agriculturally productive. This is why the savannas are typically colonized by medium-size farmers with access to capital who extensively use the native savanna as a forage resource.
The potential of the savannas greatly increases when grass-legume pastures are established. These pastures are more productive than the native grasses and more than double the annual weight gains of an animal. Even a few strips of legumes sown into the native grasses can provide enough protein for cattles to make the fibrous savanna grass more digestible. Animal and land productivity is increased too. Stocking rates can be increased more than five-fold with the new pastures, doubling animal gains and increasing productivity more than ten-fold for the entire system.
The new pasture technology induces an intensification of savanna production systems. Food crops adapted to this ecosystem could be integrated to the pasture systems, with a high potential for sustainability. Attention has been given to rotating pastures with crops, such as rice, which can be tolerant to acid soils. Rotation with rice appears more feasible with the development of lines with high tolerance to very acid soils and rice blast, the main disease affecting it in the savannas. These lines are now in their final stages of field testing in several countries.
A low-input philosophy has been developed, that is not overly dependent on chemical inputs. Whenever possible, a biological solution to disease and insect constraints is sought.
Biological solutions, such as genetic resistance to insects and pests, lower the cost and risk to farmers. They reduce the need for pesticides, thus reducing environmental contamination and the danger of induced resistance and destruction of natural enemies. When pesticides must be used, integrated pest management is recommended.
The low-input philosophy has important implications for more efficiently using non-renewable natural resources. Developments in nitrogen fixation in beans and pastures minimize the need for nitrogen fertilizers. Scientists are looking for beans with a lower need for phosphorus, or pastures that can be established and maintained with less fertilizer.

90 - 5/67

632

Agroecology
Review, book, Africa, sustainable agriculture, traditional methods, traditional society, ecology, land tenure, agrarian revolution, education, farming systems

LOWE, R.G.

Agricultural revolution in Africa?

MacMillan Publishers Ltd., London, ISBN 0-333-42455-7, 1986, 295 pp.

In many countries of West and East Africa, food production is insufficient to meet the needs of the populations.
One of the main reasons for these difficulties is biological, attributable to the soil characteristics of the humid tropics.
Peasant agriculture was adapted to these constraints, but shifting cultivation and related fallowing systems have recently been described as 'outmoded farming systems'.
These farming systems are ecologically sound for subsistence agriculture under low population densities and long-term fallows, but under various socioeconomic pressures they are now breaking down.
Short-term fallows and extended periods of cultivation are resulting in erosion, soil degradation and loss of productivity.
In any case agriculture is in a state of change in Africa. The need is to put men, land, capital and know-how together in the right proportions. At present the main deficiency is know-how.
The author has spent most of his working life in West Africa, and much of it in various parts of Nigeria. Emphasis is laid on his personal experience.
Nigeria contains a considerable range of the land types that typify tropical Africa, from arid savanna to equatorial rain forest.
There are lessons to be learned by other tropical African countries.
This book has evolved from a series of lectures on multiple land-use given at the University of Ibadan.
The book contains the following chapters:
1 The problem
2 The social impediment
3 The biological impediment
4 The land tenure impediment
5 Agrarian revolution
6 The implication for farming
7 The implications for education
8 The implication for society

It is a textbook for land use and land tenure courses especially in University departments of agriculture, forestry and land management.

It considers the biological, the social and the land tenure implications to modernize Africa's agriculture.
The nature of agrarian revolution is discussed, together with its implications for farming, for education, and for society.
Especially the book considers land tenure aspects, African farming systems and discusses the contribution cooperatives make to progress in agriculture.
This book is recommended for students and practitioners of agriculture forestry, economics, sociology and political science of rural development in Africa.

633 90 - 5/68

Agroecology
Review, book, world population, statistics, food requirement, economic systems, tribalism, nationalism, colonial history, land tenure, peasant farming, social security, poverty, starvation

BLAXTER, K.

People, food and resources.

Cambridge University Press, UK.; - The R M Jones Lectures in the development of ideas - ; ISBN 0-521-32300-2, 1986, 118 pp., price £15.00

This little book derives from a series of public lectures, concerned with the development of ideas, given at the University of Belfast, under an endowment of the late Robert Millar Jones. Its subject matter is well defined in the title and the whole range of problems and offered solutions which together make up the world food problem is brought together in an erudite, objective and balanced fashion. It should be in the hands, not only of every agricultural scientist and developer, but also of politicians and decision makers, world wide.
An early pivotal chapter is devoted to discussion of the numbers of people in the world, beginning with the writings of T.R. Malthus. It is a refreshingly clear exposition. Malthus's ideas and those of later workers are evaluated in mathematical terms which are readily comprehensible by those with only a smattering of algebra. A background of statistics is also provided to illustrate the underlying potential of population growth for explosion and catastrophe, and the pressures, natural or imposed, which may slow or halt such growth. The nutritional requirements of this burgeoning world population and the ways of estimating them are then discussed. Nutritional needs are translated into estimates of world food demands and of the agricultural production to satisfy them. The problem which is at first agricultural is soon shown to be wider and to encompass demand for other material and physical world resources.
The kernel of the book is a clear exposition of the balance sheet of world population and its requirement for food, but the most exciting part is the last three chapters where the problems, previously dealt with descriptively and dispassionately, are now posed in terms of human frailty and the imperfect economic systems of society. Here the author touches on the impediments to economic and agricultural solutions resulting from tribalism, nationalism and the colonial legacy. He discusses the problems arising from land ownership and tenure under different regimes, the growth of towns, peasant farming and the extended family. The countervailing value of the last two of these as a form of social security and an alternative to unemployment is explored.
In the final chapter, where possible solutions to the great problems are considered, the human dilemma is sketched with a sure and skilful hand; so too is the antithesis between the views of

those who believe that the solution to the problems of poverty, starvation and expanding population, in developing countries lies in a 'hands off' approach (to allow natural forces of starvation and disease to check the population and bring it into balance with its environment, and to eschew any form of technological interference as exacerbating the situation) and those who believe that technological advance and sensible planning can be brought to the aid of poor countries without accompanying distortion or destruction. At the end of the book the author reveals himself to be a cautious optimist with a belief in the human spirit and in the technological benefits that science can confer.
If there are criticisms (and they must be few) they derive from the compressed nature of the material which leaves some tantalizing questions for the reader to pursue for himself. Some of the anecdotal support, too, suffers from the enforced brevity. One is left curious to know more about the author's personal views on the way forward. Many of the problems are moral or political in the final analysis, and although a scientist must remain dispassionate when weighing evidence, it would be interesting to see in greater depth how one man with very appropriate experience would meet the challenge.
It is too much to hope that a larger book will follow this one to serve as a reference source for those who have to grapple with world food problems? If so Sir Kenneth Blaxter's text could well provide the framework (perhaps with the help of other authors) on which it could be built. In the meantime the arguments in this slim volume are developed with power and economy to give a valuable distillation of evidence and views. We owe Sir Kenneth, The University of Belfast and the late R.M. Jones a debt of gratitude.
Abstract by N.F. Robertson, UK.

90 - 5/69

634

Agroecology
Review, booklet, glossary of terms, sustainable agriculture, IIED, SIDA

McCRACKEN, J. and J.N. PRETTY

Glossary of selected terms in sustainable agriculture.

GATEKEEPER Series No. SA6; International Institute for Environment and Development - Sustainable Agriculture Programme , 3 Endsleigh Street, London WC 1H ODD, UK, 1988, 20 pp.; price £1.50 incl. p. and p.

This Gatekeeper Series is produced by the International Institute for Environment and Development to highlight key topics in the field of sustainable agriculture. This glossary of thirty-five entries covers a variety of terms commonly used in sustainable agriculture literature:

- Agroecological zoning
- Agroecosystem
- Agroecosystem Analysis (AA)
- Agroecosystem zoning
- Agroforestry
- Alley cropping (Avenue cropping, hedgerow cropping)
- Appropriate technology and intermediate technology
- Bioenergy (Biomass energy)
- Carrying capacity
- Cash crops, food crops, export crops
- Common property resources
- Community forestry (Social forestry)
- Conservation farming (Regenerative farming)
- Desertification
- Farmer Participatory Research (FPR)
- Farming Systems Research (FSR)
- Genetic preservation
- Integrated Pest Management (IPM)
- Integrated Rural Development (IRD)
- Land degradation
- Minimum tillage
- Multiple cropping
- Multipurpose trees
- Open access resources
- Pastoralism
- Range management
- Rapid Rural Appraisal (RRA)
- Remote Sensing
- Share cropping
- Shifting Cultivation (Swidden)
- Subsistence agriculture
- Sustainable development
- Sustainable livelihood security
- Tragedy of the commons

- Transhumance

Each entry includes a brief description and references for further information on the subject. Cross references to other terms are indicated. References are provided to important sources and background material.

As an example the term sustainable development is presented here in full length:

Sustainable development:

"Two interpretations of sustainable development are now emerging: a wider concept concerned with sustainable economic, ecological and social development and a more narrowly defined concept largely concerned with 'environmentally sustainable development' i.e. with optimal resource and environmental management over time. The former interpretation has been endorsed by the World Commission on Environment and Development (WCED, 1987) who define the concepts as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". More specifically, a sustainable development approach "argues that real improvement cannot occur in developing countries unless the strategies which are being formulated and implemented are environmentally sustainable over the long-term, are consistent with social values and institutions, and encourage 'grassroots' participation in the development process... In general terms, the primary objective is reducing the absolute poverty of the world's poor through providing lasting and secure livelihoods that minimize resource depletion, environmental degradation, cultural disruption, and social instability" (Barbier, 1987b).

In contrast, a more narrowly defined concept of environmentally sustainable economic development is:

Sustainable economic development involves maximizing the net benefits of economic development, subject to maintaining the services and quality of natural resources over time.

"Maintaining the services and quality of the stock of natural resources over time" implies, as far as is practicable:

a) utilising renewable resources at rates less than or equal to the natural or managed rate at which they can be continuously generated;
b) emitting wastes at rates less than or equal to the rates at which they can be absorbed by the assimilative capacities of the environment; and
c) optimizing the efficiency with which exhaustible resources are used, subject to substitutability among resources and technological progress.

Copies of this paper are available from the Sustainable Agriculture Programme, IIED, London (£1.50 incl. p. and p.)

635

90 - 5/70

Agroecology
Review, book, policy study, developing countries, poverty, hunger, food, security, food supply, definition of terms, food prices, household, purchasing power, national measures, international trade, food aid

WORLD BANK

Poverty and hunger: Issues and options for food security in developing countries.

The World Bank, 1818 H Street, N.W. Washington, D.C. 20433, USA, 1986, 69 + xi pp., USD 7.50 (softcover)

A publication as important as this by the World Bank has to be viewed in the context of the Bank's shift over the last six years to a much more conservative outlook. A lot has been heard from the Bank about "getting prices right", allowing market forces to have a freer hand and so on, and much less of the talk heard during the 1970s about direct measures to eradicate poverty. Given the political climate in the Bank, this is an exceptional document; given what needs to be done about reducing poverty and hunger by improved food security, this document still falls short of what is required.
Such chapter headings as "National measures to reduce chronic food insecurity" and "International support for food security" create the impression that insufficient attention has been given to household and community level factors and how those should be taken into consideration in designing food security policy. This impression is confirmed in the reading: household level factors are relegated in the main to "boxes". That said, the document is one which can form the basis for promoting the argument that issues of national economic growth and equity can and do overlap in improving food security.
The policy study is essentially split into three parts. After a definition of terms and an overview, there is a discussion of whether food security is a problem of supply or purchasing power. That is reviewed by reference to two aspects - chronic and transitory food insecurity. The former is defined as continuously inadequate diet caused by the inability to acquire food; the latter is a temporary decline in a household's access to enough food, resulting from instability in food prices, food production or household incomes - famine in its worst form. Inadequate production, household purchasing power and unstable world and domestic prices are all reviewed as causative factors.
The second part discusses national measures to reduce both chronic and transitory food insecurity. The former includes increasing the food supply (by trade interventions, production subsidies), subsidizing food prices (by targeted subsidies, marketwide subsidies) and augmenting incomes. The national measures to reduce transitory food insecurity are given as stabilizing domestic food supply (production, buffer stocks, trade), stabilizing domestic

demand and protecting vulnerable population groups. The third section concentrates on international measures: external finance including food aid and international trade.
With those two tiers included, why would household-level factors not have been discussed: to start with, the different means by which poor people acquire food and then to build linkages up to national level and further. There is a huge gap in planning between household and nation and this report has not helped to close the gap. We should try to take household characteristics and priorities and see how those can be built up into national programmes that are technically, and politically, feasible. Many a project and policy has failed because inadequate attention was paid to the target group itself.
Abstract by Richard Longhurst, U.K.

636 90 - 5/71

Agroecology
Canada, sustainable agriculture, review, history, events, organic farming, sustainable agricultural organizations, food certification, extension agents, supermarket chains, farmer markets, direct marketing systems, training

HILL, S.B.

L'Agriculture écologique au Canada. (Sustainable agriculture in Canada.)

Publ. of the Departm. of Entomology and Ecological Agriculture Projects; MacDonald College, Ste-Anne-de-Bellevue, Quebec, H9X 1C0, Canada, 1989, 10 pp.

In this paper sustainable agriculture is defined, some of the key individuals and events involved in this development in Canada are noted, the studies done by Canadian government departments reviewed, the present situation described, the forces involved are noted, some future predictions, and what needs to be done now in order for progress to continue.
Indications of the present state of sustainable agriculture in Canada are:
- Most provinces have one or more organic food certification agencies. These groups together with the Department of Consumer & Corporate Affairs have arrived at an agreement upon definition of organic food and farming.
- Several provinces have appointed extension agents with special responsibilities for organic farming and have issued bulletins relating to organic and sustainable systems of agriculture. Some are also establishing special subsidy and crop insurance program. There are also a growing number of independent consultants providing products and services to organic farmers.
- Most of the major supermarket chains are considering or have established organic sections in one or more of their outlets, and some mail-order organic retailers have become established. Much food, however, continues to be sold through farmers markets and other direct marketing systems, and through health food stores.
- Although organic foods' share of the retail market is only 0.3%, it is increasing at 15-20% each year, and demand for such produce exceeds supply in most regions (in Quebec it is 10 times the supply); 25% of urban Canadians stated that they would buy primarily organic vegetables if they were available and no more than 25% more expensive.
- Courses in sustainable agriculture are only available in Universities (Laval and MacDonald College of McGill) and Colleges (La Pocatière, St-Hyacinthe and Victoriaville) in Quebec. Several regional societies occasionally offer short courses.

- Stories on sustainable agriculture in the media are now common. (Farm broadcasts, Food Show, Country Canada, Semaine Verte, Ideas Series, W5, Sunday Morning, etc.)
- Internationally, Canada is expanding its involvement in the development of sustainable food systems.

Some predictions for the state of sustainable agriculture in Canada in the year 2000 (under ideal conditions of change) are given:
- 40% of Quebec's farmers are organic farmers by 2004.
- Supports for transition to sustainable agriculture and crop insurance in the absence of pesticides available in all provinces.
- 50% reduction in pesticide use in Ontario (Program 2002 goal).
- Degree programs in sustainable agriculture available in all major agricultural colleges, and related programs universally available at other levels.
- Marketing Boards having special categories for organic food.
- Sustainable agriculture demonstration farms established in all major regions of Canada.
- Extension agents specializing in sustainable agriculture available in all regions.
- Access to appropriate supplies, services and markets available in all regions.
- "Certified" organic/sustainable food universally available and purchased preferentially by most governmental and para-governmental institutions, and bought by over 25% of Canadians.
- Farmer-researcher participatory research being the norm.
- All agricultural Canadian aid to meet sustainability criteria.
- Strict pollution/environmental degradation taxes in place and supported by comprehensive monitoring systems.
- Research focussing on design and management of optimally functioning agroecosystems and prevention of problems will be emphasized rather than the search for curative solutions.

Finally the author considers some things that need to be done to facilitate a smooth transition to a sustainable agriculture in Canada:
- Support and funded training programs for farmers in transition.
- Removal of barriers to full participation by organic farmers in government programs.
- Administrative and financial support for farmer-researcher participatory, long-term research, and for other supportive research.
- Promotion and protection of certified organic standards by government regulations.
- Support for the establishment of degree and training programs in sustainable agriculture.

Despite encouraging trends, many barriers remain, and much work needs to be done if a smooth transition to a truly sustainable food system (and lifestyle) for Canadians is to be achieved in an efficient manner.
Author's summary, shortened

637 90 - 5/72

Agroecology
Review, book, wildlands, protection, management, economic development, World Bank

LEDEC, G. and R. GOODLAND

Wildlands: their protection and management in economic development.

The World Bank, H Street, N.W. Washington, D.C. 20433, USA, 1988, 278 pp. USD 17.95

This study contents that wildlands in their natural state play a significant part in meeting human needs, and, as the complex ecological interactions that permit life to survive and flourish on this planet become better understood, so does the critical role played by wildlands in human well-being. This is not the first book to challenge the belief that wildlands in their natural state are only marginally useful to people and that the choice is between meeting human needs and preserving wildlands. The support and publication of the book by the World Bank testifies to a growing consciousness that "wildlands.... in their natural state can also contribute significantly to economic development."
The authors summarize the experience of the World Bank with wildland management. Discussion includes the lessons learned, the benefits that have accrued to projects in which wildland management has been successfully implemented, the ecological and wildland issues that should be considered in project development, the Bank's new wildlands policy, the way wildland management can be incorporated into the project cycle, the types of wildland management components that may be inserted into projects, and wildland management in sector planning and economic analysis.
Wildlands is intended as a brief overview for development professionals not necessarily familiar with the topic. Readers looking for comprehensive, technical explanations may be disappointed. Moreover, to stem the loss of wildlands, the book focuses almost exclusively on careful project siting and the creation and strengthening of parks and reserves as components of traditional development projects. Although mention is made of ensuring sustainability and promoting bio-diversity, the book does not discuss conservation alternatives to traditional development.
This study is, however, a clear synopsis and handy reference for planners. Over half of its length is devoted to useful appendices. These include a list of wildland management projects supported by the World Bank; a compilation of directories of protected areas and significant natural areas; a list of regions with exceptionally endangered wildlands; guidance for the appropriate siting, size, and shape of a protected area.

638 90 - 5/73

Agroecology
Review, book, Africa, climate, socio-economy, natural disaster, drought, education, population growth, price policy, poverty, world trade, interest rate, debt, cash crops, colonialism, case studies, ILCA, IITA, ICRISAT

GLANTZ, M.H.

Drought and hunger in Africa.

Cambridge University Press, U.K., ISBN 0-521-32679-6, 1987, 457 pp., price £37.50; this book is based on presentations at a colloquium entitled "Drought and Hunger in Africa": Denying Famine a Future, held in Boulder, Colorado, USA, 1985

This book is based on papers presented at a colloquium in Boulder, Colorado in 1985 which was held as part of the 25th anniversary celebrations of the US National Centre for Atmospheric Research. There are four parts concerned respectively with the physical and social aspects of drought and hunger in Africa; internal and external factors affecting food production; case studies from various parts of Africa; and lessons for the future from countries which have had a measure of success in dealing with the problems of drought and famine. Each chapter contains a list of references, and some have footnotes. There is also a useful index.
In a thoughtful preface, Bradford Morse of the United Nations Development Programme emphasises that the Green Revolution, successful in Asia and Latin America, and based mainly on the modification of the environment to meet the needs of the plant, is less relevant to Africa than a Gene Revolution, aimed at modifying the plant to suit the environment. In view of this statement it is a pity that there is relatively little emphasis throughout the book on the biological research efforts of the international agricultural research centres and national research programmes. Although ILCA (International Livestock Centre for Africa) is mentioned in one chapter, the research programmes in Africa of ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) and IITA (International Institute of Tropical Agriculture) are neglected. Perhaps the book is best read in conjunction with the Commonwealth Agricultural Bureaux publication Advancing Agricultural Production in Africa (D.L. Hawksworth (ed.), 1984.
The first section begins with a chapter which describes the nature of African drought and reviews the meteorological factors, global and regional, influencing its variability. Rain distribution rather than total rainfall is shown to be more critical for food production. It is followed by a case study of the history and meteorological aspects of drought in Ethiopia. In the third chapter, contributed by the book's editor, the effect of drought on economic development in sub-Saharan Africa is discussed and we are reminded that drought, although irregular, is a recurring phenomenon. The need is stressed for efficient national and

regional networks of meteorological services to help improve decision-making processes for agricultural development and early famine-warning systems. Chapter 4 deals with the role and plight of pastoralists in Africa's arid and semi-arid rangelands, with strong arguments for a fairer deal for impoverished herders and for the recognition that alternatives to pastoral production in range areas are unlikely to be economically, socially or ecologically cost effective.
Part 2 contains four contributions on the complex interacting effects on African development of inefficient domestic agrarian and industrial policies and a difficult international economic climate; these add to the adverse legacies of a colonial past, and to difficulties arising from population growth and a frightening debt burden. The general message is clear: increased and sustained agricultural productivity, particularly of food crops, holds the key to progress. Despite an occasional note of optimism, this section of the book leaves one with the feeling that Africa's difficulties are such that, despite many of the radical changes advocated for prevention, hunger will continue for a long time to wreak havoc among the poor of Africa's arid and semi-arid regions.
The first chapter in Part 3 paints a more optimistic picture, however, highlighting the flexible approach of drought-affected farmers and pastoral groups in the Sahel to adapt their systems to accommodate the vicissitudes imposed by erratic rainfall and high rates of evaporation.
A paper on the evolution of food rationing systems stresses that state-organised emergency food-rationing systems are more efficient and fair in combating famine than are primitive rationing systems in stateless societies. Group farming schemes, which have weakness even in times of favorable climatic conditions, are seen to exacerbate the problems of families outside such schemes during drought. Part 4 looks to the future and seeks to draw on experiences in Malawi, India and China in avoiding or overcoming famine. The concluding chapter stresses that hunger in Africa is more the result of human interventions than of climatic fluctuations.
The publication of this book is timely, coming in the aftermath of horrific famine episodes on the African continent. Although the options of different authors vary as to the best ways and means of solving Africa's problems, there is general consensus on the need for pressing action, not only to avoid the repetition of such episodes but also to ensure that agricultural productivity is raised to levels that will provide higher living standards for all Africa's people. It should appeal most to international aid agencies, political scientists, agricultural planners, economists and sociologists. Its greatest value could well lie in its being read by the politicians/ruling class and civil servants of those African countries most ravaged in recent years by drought and famine.
Abstract by N.L. Innes, U.K.

639 90 - 5/74

Agroecology
Asia, Indonesia, project, case study, environmental management, donor assistance, training and education, environmental sector reviews, IIED, UNDP, World Bank, UNEP, USAID

HANSON, A.

Environmental management development, Indonesia.

In: The Greening of Aid - Sustainable Livelihoods in Practice -; Eds. C. Conroy and M. Litvinoff; Earthscan Publ. Ltd. in association with The Int. Inst. for Environment and Development, London; ISBN 1-85383-016-X, 1988, pp. 235-239

In Indonesia the need for a sustainable, equitable basis of resource and environmental use has long been recognized.
Under the 1982 Environmental Management Act, roles and responsibilities are recognized or designated.
Environmental management should become a responsibility shared between governmental and non-governmental elements within a society.
Co-ordination has been provided by the Ministry for Population and Environment, charged with expanding the level of awareness regarding environmental issues.
The most difficult aspect of environmental issues is the costal zone and watershed management, forest land development, industrial hazardous waste disposal, agricultural chemical use and environmental aspects of energy.
Sustainable development strategies must be intersectoral, although taking into account sectoral interests.
In the field environmental management, foreign donor assistance is directly channeled into development projects and into appraisal, while far larger sums are committed to sectorial projects which ought to create changes in environment.
UNDP provided funds for an international team to develop an overview of the activities.
The review produced several priority issues/policy matters and suggestions for action, many of which have been acted upon through the national five-year-plan.
One example of donor-assisted efforts is the ongoing effort to upgrade and expand technical skills within the environmental study centre network and, through these university-based units, provide education and training to others, particularly government personnel.
The project provides inputs, including buildings, books, journals and field sampling equipment.
A serious constraint was the limited inputs set aside specifically for enhancing administrative and management capability.
Concluding, the author points out that the necessity of devising better economic approaches to environment and development has proven a tough topic to bring into focus. Unless the point can be brought home to decision-makers that the issues of resource

depletion and environmental protection represent significant losses, or additional burdens on the economy, then environmental management will be constrained.
The need for structural shifts in Indonesia's economy as a consequence of introducing sustainable development and environmental planning concepts is far from threatening. There will be true beneficiaries, among them the poorest people, urban dwellers, coastal fishermen and families relying on sustainable access to forest products. More work needs to be done on the identification of target groups and the quantification of benefits they may receive.
Now public, corporate and government attitudes towards environment are gradually shifting, although not at the desired rate and not always consistently. There is a need for continued education efforts and for expanded use of traditional and modern media to spread the message. Belief in environment is linked to a broader set of concerns: harmony with humanity, with nature and with God. This spiritual linkage is essential for the emergence of a national environmental ethic.
Donor assistance in support of environmental management, modest in relation to overall needs although and in comparison to other sectors, has been effectively used in Indonesia. Further expansion of assistance will be required over the next decade for full institutional development and to provide for transfer of expertise.

640 90 - 5/75

Agroecology
Review, book, developing countries, human nutrition, food production, international trade, international cooperation, prospects, UNESCO, CTA

SASSON, A.

Feeding tomorrow's world.

UNESCO/CTA Publication, Paris/Wageningen, ISBN 92-3-102083-8, 1990, 761 pp. + Bibliography; available from UNESCO, 7 Place de Fontenay, 75700 Paris, France.

A number of developing countries, in particular in sub-Saharan Africa, are still suffering from acute food shortage due to various causes and from malnutrition. At the same time the silos of the industrialized countries are overflowing with excess agricultural foodstuffs, in spite of recent setbacks in global output.
The significance of such a contrasting situation can only be seen in relation to the fluctuations which have taken place in the production of agricultural commodities during the last decades and to the changes occuring in the world economic situation.
The demographic, nutritional and epidemiological problems of human populations touch the frontiers of several disciplines, such as biology, economics, sociology and physiology, and their solution demands co-operation between these disciplines and those of the technologies offered by medicine, pharmacy, agronomy and food science.
The author takes a multidisciplinary approach to human nutrition and food production and, in this way, attempts to answer these and other pressing questions.
This comprehensive work, written to appeal to a wide public, particularly teachers and students, provides relevant scientific and technical information on human nutrition and food. The problems dealt with here belong to several fields of knowledge, and are related to values and constraints that are closely linked to the socio-cultural environment.
This book provides a scientific, economic, socio-economic and environmental overview of nutrition throughout the world.
A study of issues relating to human demography, nutrition and epidemiology requires not only an examination of the relevant scientific and technical facts, but these must be placed in the varied economic, cultural and social settings of the populations concerned.
This book is intended to make available to teachers and to the general public the basic and most recent information relating to the current state of food and nutrition of human populations. Through its multidisciplinary approach and its global coverage, it contributes to the substantial existing documentation in this field.

Unesco's association with the ACP-EEC Technical Centre for Agricultural and Rural Co-operation (CTA) in this copublication emphasizes the co-operation Unesco has developed and extended with the institutions involved in disseminating scientific and technical information.
In particular, CTA's aim is to assist the ACP countries towards sustainable development and self-sufficiency in food production. Copublishing this work with Unesco is one of the examples to transfer knowledge to developing countries.

641 90 - 5/76

Agroecology
Latin America, Honduras, DESFIL, management of environment, case study

VALENCIA, I.

Managing the Honduran environment.

A Publication of the Development Strategies for Fragile Lands Project (DESFIL), III, No. 4, 1989/90, pp. 4-7

Local participation in SECPLAN (Department of Environment of the Territorial Planning Division of the Honduran Ministry of Planning) has been substantial. About 100 professionals from all government institutions involved in environmental management participated in the process: all of them attended the general workshops, a multidisciplinary team conducted the case study discussed below, most participated in the elaboration of the 1989 Environmental Profile, and teams participated in the field practices. In addition, an environmental education meeting brought together semi-independent private and government groups that collectively have the power to effect significant changes. The guidelines and policies document will be elaborated by SECPLAN with assistance from several governmental institutions, and will be presented by SECPLAN to the new government.
Concerning the case study, selection of a large and complex geographic area, which contained critical environmental management conflicts, dictated the implementation of a single case study, rather than the three separate studies originally planned. The case study consisted of an environmental assessment of the Southern Zone (Choluteca and Valle Departments), and was carried out over three weeks by a team of government and DESFIL professionals. The Southern Zone is a politically sensitive region due to its position between Nicaragua and El Salvador. In addition, sandy soils, steep slopes, high population density, and favorable climate with abundant rainfall have brought about extreme erosion and deforestation.
Intensive agriculture has polluted the streams and reduced the volume flowing into the estuaries, and valuable coastal resources are being destroyed by potentially violent competition between shrimp and fishing groups. The purpose of the case study was to identify the causes of the conflicts and to suggest alternatives to alleviate them and to arrest degradation.
The study, in Spanish, presents alternative solutions for institutional organization, land use management, water rights, agricultural system improvement, estuarine management, land concessions, mariculture, and pollution control, all of which have been incorporated into the Strategy for Management of the Southern Zone, prepared by SECPLAN.
The Honduras Environmental Profile is nearing completion. Teams of Honduran professionals from 23 government and nongovernment institutions, with participation of DESFIL specialists, have

compiled and edited the document. It contains information on population, agricultural activity, forestry management, wildlife and wildland management, hydrology and watersheds, coastal resources, the residue and contaminant situation, human resource development, and the institutional and legal framework for natural resource management in Honduras. Final printing is scheduled for spring 1990. The Profile will be particularly valuable to the new government team, inaugurated in March.

Environmental education has played an important role in SECPLAN. At the First National Meeting of Environmental Educators, held in September 1989, 62 environmental educators and decision makers from 27 Honduran institutions worked for five days on a strategy for environmental education. DESFIL was assisted by the USAID Forestry Support Program and the U.S. Forest Service. The Honduran Association of Ecology was responsible for all conference preparations and for printing the proceedings.

There were excellent presentations on local activities in environmental education. Those from teachers' groups, such as MAPROMA (Maestros para la Promoción del Medio Ambiente), and private and voluntary organizations, such as Compañeros de las Americas and U.S. Peace Corps, were outstanding, demonstrating that there is enormous talent and motivation in Honduras in the area of environmental education. The objective of the meeting was fully met by promoting strong cooperative action, and providing direction and common objectives. The exchange of ideas and experience helped identify some important proponents in environmental education within the country. The Ministry of Education, represented at the closing session, declared 1990-2000 the "Decade of Environmental Education in Honduras."

Results of the entire SECPLAN project will be drawn together in the strategy document, which will present guidelines and policies together with proposed institutional responsibilities and specific actions required to correct or arrest the problems identified through the workshops, the case study, the Profile, and the environmental education meeting. The objective is to provide SECPLAN and other Honduran institutions with a document that summarizes the policy and management options consistent with productive development and natural resource sustainability.

Work on the strategy document began in December 1989. A SECPLAN team prepared the framework for a three-day-workshop at which the main problems related to environment were discussed; the institutions with a causal or regulatory role were identified; and policy guidelines were suggested, with the actions needed to correct or improve the problems. Stress was placed on the feasibility and sustainability of the options proposed by the 30 participants, who came from the outgoing government, the new administration, universities, and private institutions. A compilation of the work of the participants is being prepared by SECPLAN for review by DESFIL, which has responsibility for preparation of the final draft.

The original time frame for this project grossly underestimated the requirements imposed by the institution-building approach of the Honduran government and DESFIL. Government and university professionals were seconded on a part-time basis for the activity,

without additional compensation. Despite the difficulties under such pressure, the Honduran professionals dedicated an enormous amount of time and effort to the project.

This entire effort has been most valuable. The number of Honduran personnel involved, the breadth of training, the widespread diffusion of a set of problems and concepts, and the consensus-building process that has taken place have all contributed to the project's success.

Author's Abstract

642 90 - 5/77

Agroecology
Review, book, tropics, developing countries, sustainable development, people, land, soil, vegetation, livestock, wildlife, water resources, erosion, desertification, land degradation, pollution, waste, CTA

DELLERÉ, R.

Terres et vivres. (Land and food.)

CTA-Centre Technique de Cooperation Agricole et Rurale, Postbus 380, 6700 AJ Wageningen, Pays-Bas; French edition ISBN 92-9081-033-5, English edition ISBN 92-9081-0327; 1989, 96 pp.

Environmental resources are often the only resources available to the poor of the rural tropics.
These resources are also the basis for sustainable progress and development.
Therefore increasing food production and protecting the environment are among the greatest tasks facing the developing world today.
The development achieved must not be at the expense of the natural systems on which human existence ultimately depends.
This book has been published, to raise awareness for these questions.
This book is specifically concerned with maintaining a balance between food production and the environment in tropical countries.
It is a combination of aerial photographs and text that support each other.
The aerial photographs were taken by professionals; the texts were written by specialists in ecology and agricultural development.
The book considers the following aspects:

1 People
- Pressure on land resources
- Urbanisation

2 Land, soil and vegetation
- Over-exploitation
- Clearance by fire
- Loss of river bank forests
- Deforestation
- Ill planned development projects
- Monocultures
- Biodiversity

3 Livestock and wildlife
- Overstocking
- Overgrazing
- Wildlife

4 Water resources
- River basins
- Irrigation
- Salinisation
- Large dams

- Flood hazards
- Water-borne pests and diseases
- Groundwater exploitation

5 Erosion, land degradation and desertification
- Soil compaction
- Erosion by water
- Sediment deposition
- Coastal pollution
- Dune invasion

6 Sustainable development
- Terrace farming
- Contour farming
- Oasis farming
- Dune stabilisation

7 Pollution and waste
- Water pollution
- Energy consumption
- Air pollution
- Pesticides and fertilizers

The book was guided and funded by CTA, the Technical Centre for Agricultural and Rural Cooperation.
The role of the Technical Centre for Agricultural and Rural Cooperation is to transfer information to the African, Caribbean and Pacific countries. The main intention is to help these countries develop towards self-sufficiency in food production.

643 90 - 5/78

Agroecology
Review, book, world, agriculture, environment, climatic change, sustainable development, pollution, desertification, biotechnology, agronomy, FAO

ALEXANDRATOS, N.

World agriculture toward 2000.

Belhaven Press, 25 Floral Street, London WC2E 9DS, U.K., ISBN 185-293-0578, 1988, 338 pp., price £27.50

Agriculture demands long-term planning but suffers from short-term changes in economic and trade policies as well as in weather and pest status. With the need to feed an extra billion people by the end of this century, taking the right decisions now is crucial. As an aid to planning for the future, the FAO has published a revised and updated edition of "Agriculture Toward 2000".
"AT 2000" was first submitted to the 1979 FAO Conference but this latest edition entitled "World Agriculture Toward 2000" has the benefit of additional information; China's agriculture has been included. The perspective has shortened from 20 to 10 years and there is more recent information on which to draw. The study examines 94 developing countries individually, which account for all but 1.5% of developing country population. Thirty four developed countries are also studied.
Drawing on the economic and technical disciplines and field experience of FAO, the report is an assessment of possible future world and country-group production, trade and nutrition. Attention is also focussed on strategies and policies to check environmental damage in striving for increased production.
However, the report recognizes that in developing countries in particular, environmental protection cannot be left to governments alone; much of the motivation and the resource that will be needed will have to come from the farmers themselves. This requires the introduction of conservation measures into agricultural and agroforestry systems at farm level and hence provides FAO's rationale for promoting a shift away from purely technical approaches towards community and farmer-centred measures.
In his introduction, the Director-General of FAO, Edouard Saouma, stresses that developing countries themselves bear the primary responsibility for bringing about a further strengthening of their productive capacity but at the same time he notes that their efforts alone cannot meet this challenge. The elimination of hunger is a global problem that demands a global solution and the combined efforts of all partners in development.
"World Agriculture Toward 2000" contains detailed information so but it is written in an easy-to-read style and is supported by graphs and statistical tables.
Abstract from SPORE

644 90 - 5/79

Agroecology
Review, book, USA, Europe, organic farming, proceedings, symposium, practices and research, nutrient cycling, tillage, pesticide inputs, energy, economics, public policy

BEZDICEK, D.F. AND J.F. POWER

Organic farming current technology and its role in a sustainable agriculture.

ASA Special Publication No. 46; Proc. of a Symposium, Atlanta, USA; Publ. by the American Soc. of Agronomy et al. 677 South Segoe Road, Madison, WI 53711. ISBN 0-89118-076-1, 1984, 192 pp.

Agricultural production has been intensified through the abundant use of inorganic fertilizers, the practice of monoculture or two-crop rotations, and the use of chemical pesticides. Such a system of production is not sustainable because it leads to degradation of the environment.
A symposium was held at the 1981 American Society of Agronomy annual meetings in Atlanta, Ga. to investigate alternative production methods that might be employed in agriculture to reduce production costs, improve crop quality and reduce potential environmental damages.
This Special Publication is a collection of the papers presented at this symposium on Organic Farming.
The objective of this symposium was to summarize the present state of knowledge of various biological systems of crop production, and to identify subjects for which scientific knowledge is lacking.
In this publication, most aspects of organic farming are discussed. Meeting nutrient needs from organic sources is a major topic of discussion; reducing soil erosion and nutrient loss via rotations and minimal tillage are treated. Minimizing the use of chemical pesticides and decreasing energy inputs are subjects examined. The economic impact and socio-political implications of organic farming are presented.

645 90 - 5/80

Agroecology
Review, green revolution, pesticides, environment

BRAMBLE, B.J.

An environmentalist's view of pest management and the Green Revolution.

Tropical Pest Management, 35, (3), 1989, pp. 228-230

Pest management in the Third World is one of many issues related to the Green Revolution.
Environmentalists are concerned about the problems of Third World pest management.
Human intoxications, poisoning of wildlife and residues result from indiscriminant use of pesticides. Use of Green Revolution technologies have extended social inequities, led to increased reliance on monocultures, destroyed genetic resources and led to environmental degradation.
The magnitude of the problem can be attributed to lack of training in safe use of toxic chemicals, illiteracy, extreme poverty which impels the reuse of pesticide containers, lack of concern for farmworker health by large landowners, and other basic problems.
Environmentalists are also concerned by reports of massive fish kills and contamination of wildlife, especially animals at the top of the food chain. In many areas the natural balance of predators and prey has been upset, particularly in the insect world.
Most of the pesticides applied in developing countries are used on export crops. This is true for Latin America and Africa, though it is much less true in South and Southeast Asia.
The concerns of environmentalists with regard to the misuse of pesticides in developing countries generally overlaps with their concerns about the Green Revolution which is associated primarily with food crop protection, particularly rice and other grains.
The author summarizes some of the serious reservations which many environmentalists have about the results of large-scale conversion to high-yielding varieties, particularly in the developing world.
The author argues:

> "If agriculture is to be increasingly productive over the long term, a turnaround is required. There must be a shift from over-emphasis on export cash crops to promoting domestic supply, and from commercial landholder to small farmer. Policies must include: stable credit and better prices; improved marketing, transport and advisory services; appropriate research; and security of tenure."

One of the centerpieces of sustainable agriculture is Integrated Pest Management. It aims not to eradicate pests but to keep them at tolerable levels through the utilization of a range of 'natural' restraints, including mixed planting, sanitation, introduction of natural enemies, selective baits, releasing sterile males, and use of hormones to interfere with maturation.

Most environmentalists recognize that pesticides are essential elements of most IPM-schemes. The appropriate use of pesticides seeks to minimize the residues in food commodities. By following the principles of IPM and 'good agricultural practice' lower quantities of pesticides will be required.
The kinds of IPM that are appropriate in these circumstances are different. The possibility of intercropping itself, which mimics a diverse ecosystem, is one of the most promising aspects.

VI AGROMETEOROLOGY

646 90 - 6/14

Agrometeorology
Review, book, climate, agriculture, cool temperate zones

PARRY, M.L. et al.

The impact of climate variations on agriculture. I. Assessment in cool temperate and cold region.

Kluwer Academic Publishers, 1988, 876 pp.

In the last years the discussion on climatic changes due on increasing CO_2 and other greenhouse gases has become louder and louder. Climatic models predict a global warming of 3°C to 8°C in the next century, affecting climatological factors like rainfall, frequency of droughts, cloudiness and extreme weather events. All of these have a strong impact on world food production and other activities of our present civilization.
This book reports results from the international project on "The Impact of Climatic Variations on Agriculture" funded by the U.N. Environment Programme and the International Institute for Applied Systems Analyses, Vienna, Austria.
The conference brought together climatologists, agronomists, agricultural economists and regional and national planners.
Volume I is divided into 6 parts, written by 60 reviewers from 12 countries.
The first part describes the choice of models and the development of climatic scenarios for case study experiments. The reviewers discuss the advantages and difficulties of linking biophysical and economic models in attempts to assess the effects of climatic change. At the end they use as an example a case study of the possible effects of CO_2-induced increase of temperature on the productivity of northern biosphere boreal forests. In the last section the economic effects of those productivity changes are quantified.
Volume I contains furthermore the results of case studies for different regions (Province of Saskatchewan, Canada (Part II), Iceland (Part III), Finland (Part IV), Northern European USSR (Part V), and Japan (Part VI). In all studies the different climatic scenarios have been simulated:
- The reference or base line climate, representing present-day climatic conditions.
- A warm period scenario
- A cool period scenario
- A scenario about the impact of a doubled CO_2 concentration in the atmosphere

The climatic conditions for simulating scenarios are mostly taken from historical data of the respective region. In some parts the impact of short and long term climatic anomalies on agriculture has been computed separately.

The results of the studies are similar for the different regions. Warming increases the agricultural production. In some cases warming must coincide with higher precipitation for avoiding summer drought. In other regions precipitation excess, rather than deficit, depresses yields. In general however, a cooler climate leads to decreasing productivity.
In one of the first chapters the editors emphasize that the assessments presented in this volume are preliminary. A list of research requirements in the first chapter shows that much work still needs to be done. One of the greatest difficulties in designing the scenarios is the uncertainty about the parallel development of different climatic factors such as temperature, precipitation, cloudiness, radiation.
Inspite of the work still to be done and of the difficulties in validating the models, the results of the scenarios for the different regions demonstrate, that it is possible to make plausible forecasts about the development of plant primary production and the economic implications as a result of climatic variation.
Such case studies are therefore a good instrument for many people: for scientists, for agricultural and economical planners, for politicians and for others also. In addition this volume contains a lot of data about climatic and other site factors influencing biomass production as well as about economic conditions in the different regions. This volume provides an important basis for ecologists as well as for economists for studying the interaction between climate and plant growth and biomass production in the different regions of the world.
Abstract by Wolf-Ulrich Kriebitzsch, amended.

647 90 - 6/15

Agrometeorology
Africa, Sahel, forestry projects, neem windbreaks, pearl millet,

ICRISAT

Competition between neem windbreaks and pearl millet at ISC.

ICRISAT, Ann. Rep. 1988, Patancheru, Andhra Pradesh 502324, India, 1989, pp. 190-191

Neem (*Azadirachta indica*) is a well-adapted exotic tree species in the Sahel, which has been widely sown in forestry projects for avenue shade, and as shelter in towns and on cropped lands. Major, successful windbreak sowings of neem may be found in central Niger (Majjia Valley) and northern Nigeria (Sokoto State). As a result of these projects, enthusiasm for the use of this species in windbreaks is growing.
Neem windbreaks are being proposed for areas with environments very different from the places where they have benefitted crops. In the Majjia Valley, for example, the water table is only 7-10 m deep, whereas at ISC it is 40 m deep. It is likely that in areas with deep water tables and low rainfall, tree roots would have to extend into the cropped fields to obtain sufficient water. In this case, neem trees could be competing with crops grown between them. Such negative effects could obviate any shelter benefit that the trees provide.
In 1987, on the ISC station, ICRISAT began to study these effects utilizing 5-year-old, 5-m tall windbreaks that were sown in north-south lines 100-150 m apart, perpendicular to the damaging winds of the rainy-season storms. It was compared pearl millet yields in the rainy seasons of 1987 (lower than average rainfall, late onset of rains) and 1988 (above average and favorably distributed rainfall) with an irrigated pearl millet crop grown in the off-season, 1987-88.
The irrigated trial examined the effect of drought on the development of 42 pearl millet cultivars. Drought stress was imposed by withholding irrigation after 50% flowering. At the time of harvest, were sampled plants from both irrigated and stressed plots in the study, moving away from the windbreak in 3-m increments. Grain and biomass were markedly reduced within 15 m of the trees in the stressed plots. For fully irrigated plots, competition was noticeable only within about 8 m of the windbreaks. Trends of yield in the poor rainfall year (1987) closely followed those of the stressed plots, while trends in the good rainfall year (1988) followed the irrigated plots.
In areas with deep water tables, neem is slower-growing but more competitive than on land with shallow water tables. There is some competition even when it is 5 years old, and even in relatively good rainfall years. It is likely that the major source of competition is for soil water.

648 90 - 6/16

Agrometeorology
Study, climate, global consideration, grain production

KOGAN, F.N.

Climate constraints and trends in global grain production.

Agric. a. Forest Meteorol. 37, 2, 1986, pp. 89-107

In the past 10 to 15 years, vagaries of weather have caused quite a number of shortfalls in the world grain production and particularly in production of wheat which is the key grain crop. These shortfalls have had a pronounced negative impact on the balance between food supply and demand. Data show that advanced technology continues to make a positive contribution to yield growth in the majority of the world regions. However, in some areas this growth has recently slowed, while other areas have maintained a high rate of yield growth. These different rates arise primarily from the impact of the interaction between climate and technology on yield growth. This paper presents substantiation of the climate-technology interaction phenomenon, and provides an index for expressing the interaction. These indices were calculated and explored for 103 wheat regions in the world, including all major producers of wheat. Analysis indicates that recent climate constraints (mainly the shortage of water) have caused a levelling off of the long term trend of wheat yield in an area which currently produces around 40% of the global wheat production. Unfortunately this process is strengthening and expanding into new areas. Calculations show that in the next 15-25 years, the stagnation in wheat yield growth will probably affect an area producing 55 to 65% of the global wheat output. This trend is of serious concern and suggests that the currently applied technology needs to be considerably modified in order to delay, stop and even reserve the tendency of stagnation in wheat yield growth.
Author's summary

649 90 - 6/17

Agrometeorology
Asia, India, dry zone, microclimate, alley cropping, moisture competition

ICRISAT

Microclimatic modification in alley-cropping system.

ICRISAT Ann. Rep. 1988, Patancheru, Andhra Pradesh 502324, India, 1989, pp. 186-188

Previous studies have demonstrated the severe competition for moisture between leucaena hedgerows and crops in a joint experiment with the Central Research Institute for Dryland Agriculture (CRIDA). In contrast, many workers have suggested that one of the benefits of agroforestry is the beneficial modification of microclimates. Earlier studies at ICRISAT on microclimatic modification in conventional intercropping systems have indicated positive interactions. A study was conducted in 1986 and 1987 with the University of Nottingham, UK, to quantify changes of microclimate in leucaena alley cropping systems. A major emphasis was to develop appropriate analysis methods that relate microclimatic variables to growth and development of associated annual crops.
In the rainy season, pearl millet cv BK 560 as an alley crop was grown between hedges of 1-year-old leucaena spaced at 3.4 m, which were cut to 0.7 m prior to sowing that pearl millet and at 30 DAS. Wind speed, saturation deficit, leaf temperature, soil temperature, and light interception in sole pearl millet and the alley crop at the height of pearl millet was monitored.
To relate the response of the crop developmental processes of leaf production and phenology to temperature, the concept of thermal time was used. When thermal time for each 10-day period was calculated there were no differences in the totals between the sole and alley crops. This is not surprising as mean temperature during the rainy season varies from 24 to 27°C which is ideal for the growth and development of pearl millet.
During the first 35 days, the wind speed above the alley-crop pearl millet was reduced by 50-60% of the value for sole pearl millet because the leucaena hedgerows were higher than the crop, but when the pearl millet started to elongate and exceeded the height of the hedgerow, there was no difference in wind speed. This suggests that the main benefit of the windbreak in such a system would be during the early seedling period when wind speeds are greatest (2-4 m s^{-1}).
Thus, in contrast with the evidence on conventional intercropping, microclimate amelioration for alley cropping is small and relatively insignificant in the environment studied here. The main reason is that the temperature, saturation deficit, and wind speed are already favorable for crop growth during the rainy season and when microclimate modification might be most effective, i.e., in summer, it is too dry for sowing understorey crops.

The discouraging experience with leucaena based alley cropping is consistent with the bulk of the evidence in SAT India. The physical and economic environments in SAT India differ greatly with the conditions that favor alley cropping in Africa and in parts of Asia other than India. The most important factors are the lack of substantial positive interactions such as mulching and crop growth, small environmental improvement, and severe competition for moisture between leucaena and annual crops. Leucaena based alley cropping is successful where lack of rainfall is not a major constraint to crop yield, where inorganic fertilizer is inappropriate, unavailable, or too expensive, and where competition with annual crops is not appreciable. The attention in agroforestry has therefore turned to a nonaggressive species - perennial pigeonpea - which has many of the beneficial characteristics well-known in conventional intercropping systems.

90 - 6/18

650

Agrometeorology
Study, Europe, F.R.G., model, daily mean, soil temperatures

LANGHOLZ, H.

A simple model for predicting daily mean soil temperatures.

J. Agr. & Crop Sc. 163, 1989, pp. 312-318

Based on measurements in 3 different types of soil (clay, sand, peat) linear regression equations between daily air temperature (2 m) and soil temperature (2, 5, 10, 20, 50 cm depth) are calculated for all months of the growing season. The equations show a significant seasonal dependence and the best correlations in the upper 10 cm of soil. Differences depending on the type of soil are relatively small. Correction terms involving cloudiness and thermal inertia of the soil during a sudden warming or cooling period complete the prediction model. Standard deviations between predicted and measured values have been found within 1.5 K in most cases. Lastly a generally applicable method for calculating regression equations at any station is introduced.
The prediction of soil temperatures by regression shows a good accuracy for all sowing depths down to 10 cm and also useful results between 10 and 20 cm. Standard deviations between measured and calculated soil temperatures are mostly below 1.5 K. For the lower layers of soil, the influence of air temperature decreases and the process of heat conduction is mainly dominant so that regression involves larger errors. Especially in spring and autumn, it is very important to calculate regression equations only for a period of 1 month or if possible for 10 or 15 days because of the rapid change of temperature at those times. Differences due to the type of soil are generally small but also included in the model. The water content of soil is very important in regard to heat conduction but not introduced in the model as its influence is mainly restricted to daily fluctuations but less on daily averaged soil temperatures.
For the general application of the regression method only average values of air and soil temperatures and empirical values of the slopes are necessary.
The application of this method to different sites and types of soil in Bavaria and other regions of Germany shows a good agreement with measured values.

90 - 6/19

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Agrometeorology
Latin America, Mexico, field trial, rainfall, water requirements, intercropping, beans, soil moisture, evapotranspiration, dung, green manure, yield, spacing, planting

CAMPOS DE JESUS, S. et al.

Efecto de la captación de lluiva, estiércol y rastrojo sobre la humedad del suelo y producción de la asociación maíz-fríjol. (Effect of rainfall catchment, dung, and stubble on soil moisture and yield of maize/bean intercrops).

Agrociencia (Mexico), 52, 1983, pp. 45-64

Field capacity in maize/bean intercropping was studied in Lomas de San Juan, Chapingo, Mexico, on a sandy, crumb soil with a 3% slope. Precipitation during the crop cycle was 483,3 mm. Runoff of the different drainage channels or field capacity of planting area was also measured and soil MC was recorded with gravimetric samplings. Evapotranspiration was quantified with the water balance and with a dynamic model for estimating daily evapotranspiration. The effect of dung and stubble on field capacity and on intercrop yield was determined. Yield/plant and runoff increased with interrow spacing (113 and 112 additional millimeters of water at interrow spacings of 110 and 130 cm, resp.). The addition of dung increased available moisture and the addition of 5 t stubble/ha conserved available soil moisture more than dung did, maintaining levels of 34-81% available moisture; however, it did not affect grain yield significantly. High plant populations/ha increased yield/plant and per surface area. The optimum economic treatment for maize and bean production was a 110cm interrow spacing and plant populations of 25,900 and 12,900 maize and bean plants, res./ha.