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SUSTAINABLE AGRICULTURE IN DEVELOPMENT ASSISTANCE

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ACRONYMS

CIAT	Centro de investigaciones de Agricultura Tropical (Colombia)
CIRED	Centre International pour le Recherche et le Developpement (Paris)
CGIAR	Consultative Group on International Agricultural Research (Washington, DC)
FAC	French Foreign Assistance Program
GTZ	West German Foreign Assistance Program
IARC	International Agricultural Research Center
IBSNAT	International Benchmark Soils Network for Agrotechnology Transfer
ICRAF	International Center for Agroforestry Research (Kenya)
ICRISAT	International Center for Research in the Semi-Arid Tropics
IDRC	International Development Research Center (Ottawa)
IFOAM	International Federation of Organic Agriculture Movements
IRRI	International Rice Research Institute (Philippines)
IUCN	International Union for the Conservation of Nature and Natural Resources (Switzerland)
MSU	Michigan State University, Lansing, Michigan

OVERVIEW

An exploration of the idea of sustainable agriculture as a focus for international development assistance is reported in this paper. It is the result of a 23-day consultancy carried out during June through August, 1984, during which key literature was reviewed, a number of agricultural development workers and practioners or advocates of sustainable agriculture were interviewed, and a conference on Sustainable Agriculture and Integrated Farming Systems was attended at Michigan State University. The exploration was undertaken in response to a suggestion from A.I.D.'s Office of Environment and Natural Resources, Bureau for Science and Technology. Also it is connected with IIED's efforts to advance the goal of sustainable development, upon which is founded the World Conservation Strategy.

Dr. Stuart Hill of McGill University's Ecological Agricultural Projects program recently observed (Hill, 1984):

> "There is something seriously wrong with a society that requires one to argue for sustainability."

Few would find fault with the goal of sustainability. The crucial questions are: How is sustainability defined?, How is it to be attained?, and specifically speaking to the subject of this paper, How can agriculture in developing countries be made sustainable?

This exploration revealed that sustainability of agriculture can be or already is a concern of virtually every agricultural development worker, no matter what aspect of the agricultural endeavor is involved: the agroecosystem or resource base, traditional and modern production technologies, research and development efforts, the supply and distribution of inputs, technical assistance and financing, storage, distribution and marketing. Can these various aspects be made sustainable? The answer would tend to be "Yes", or "They must be made to be sustainable."

The sustainability of the agricultural development effort as well as the agricultural activity are co-mingled in the Third World context. Two basic questions emerge:

How can the progress of the Green Revolution be sustained?

How can the productivity of the resource base be sustained?

Thus, sustainability of agriculture, and implicitly agricultural development, in the developing countries resolves ultimately into a consideration of means. Nevertheless, it appears that the overall goal of sustainability could serve to synthesize and bring into concert the often competing or mutually exclusive goals of economically viable agricultural production, social equity, and ecological or environmental soundness (and their respective methods of design and evaluation). The feasibility test has not proven suitable in this regard, nor has the broader goal of "economic development". Also, sustainability explicity introduces the time dimension for judging effort and results, albeit into an as yet undefined period of years. But "sustainability" could be made to accommodate a time frame meaningful to such processes as land regeneration or rehabilitation as well as financial amortization.

The production techniques and principles involved in sustainable agriculture are those of biological or organic farming. They emphasize the use of biological capital and ecological processes in the management of soil fertility, weeds, pests and diseases. Although presently optional in developed nations, these techniques have developed by trial and error among traditional farmers around the world, and are still practiced by millions of people in the tropics.

Marginal, or fragile, environments and their resource-poor farmers could well be the arena where a synthesis of efforts aimed at achieving sustainable agriculture may be most readily attained. The scientific application of ecological and biological knowledge to the agricultural development problems of marginal environments is already being pursued by various individuals or by exceptional development projects. The techniques of biological or organic agriculture may prove to be the best for resource-poor farmers in such environments, which so far have not benefitted from the Green Revolution.

A number of constraints appear to handicap the idea of sustainable agriculture as a development focus:

- misperceptions and lack of communication
- the lack of sustainable agricultural systems for Third World farmers in all environmental situations
- apparent absence of interest among agronomists
- difficulty in attaining the needed inter-disciplinarity and integration of development efforts
- temperate zone technical bias

These constraints are not insurmountable, as research and development efforts in sustainable agricultural techniques demonstrate. Nor can one assume that constraints must be overcome solely by investment in effort or persuasive power. An irresistable trend of integration of disciplines, development expertise and institutional effort is evident which is creating a favorable context for sustainable agriculture. Sustainable agriculture comprises a synthesis of many techniques and concerns which depends as much upon a proper historical context as it does on technical and conceptual solidity. That context appears to be taking form.

SUSTAINABLE AGRICULTURE IN DEVELOPMENT ASSISTANCE
An Exploration

Peter H. Freeman*

A. INTRODUCTION

The International Institute for Environment and Development has embarked on an examination of sustainable development, in support of the World Conservation Strategy's long term goal of sustainable development. This paper explores the idea of sustainable agriculture as a worthwhile goal articulation and as a possible programmatic focus in development assistance, in particular assistance provided by the Agency for International Development. The Office of Forestry and Natural Resources of A.I.D.'s Bureau for Science and Technology suggested that IIED explore this theme in the context of efforts in A.I.D. to more fully integrate the concerns of environmental conservation and agricultural development.

Thus, this exploration of sustainable agriculture tests both the conceptual and technical appropriateness of this way of looking at agricultural development. IIED will be employing the result in its forthcoming 1985 conference on sustainable development (to be held in London, 1985). In Washington, IIED will further explore the possibilities for A.I.D.'s agricultural development work emerging from this exploration, in the context of the Environmental Planning and Management Cooperative Agreement between IIED and A.I.D.

The present exploratory review is based upon a 23-day consultancy carried out during June, July and August, 1984. Interviews (See list) and reviews of literature and documents were the principal means of research on the subject. In addition, Mr. Freeman attended a June 11-13 conference on Sustainable Agriculture and Integrated Farming Systems at Michigan State University. On June 20, a tour of Rodale's Research Center in Kutztown, PA, was made by Mssrs. Berwick, Freeman and Runnalls and Mrs. Phillips of

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IIED, and Ms. Ivory of A.I.D.'s Office of Forestry and Natural Resources, Bureau for Science and Technology.

A search for literature on sustainable agriculture was performed by AID's Development Information Utilization Office, Center for Information and Evaluation. The DIALOG network was used to search CAB abstracts and AGRICOLA (USDA). The IDRC data bases were also searched. A first search for "sustainable agriculture" yielded nothing. An expanded search for the following key words yielded virtually nothing: resource-conserving/resource-limited/regenerative agriculture; biological agriculture; biodynamic agriculture; and non-chemical agriculture. No references applicable to the Third World came up (personal communication with Daniel Westrick, USAID's Center for Development Information and Evaluation). On the other hand, at Rodale's Center there is a good collection of literature on the above topics. Also there have been a number of books and conference proceedings recently published on sustainable agriculture which are reviewed in this paper. Until the key words are employed in computerized data bases, information on sustainable agriculture will remain "fugitive" from these information systems.

B. BACKGROUND AND DEFINITIONS

Sustainable agriculture has been the theme of a number of conferences and books in the last five years, and is the goal of the International Alliance for Sustainable Agriculture, formed in 1982. It is serving as an over-arching term whose goal orientation easily accommodates a wide range of concerns and initiatives in agriculture around the world. Although readily suited to the context of development in the Third World, sustainable agriculture has evolved from a synthesis of thinking in North America and Europe on organic farming, biological agriculture, agroecology, integrated pest management, and Third World agricultural development problems, to mention the main elements. These terms are defined below.

The intellectual leadership that is likely to influence agricultural development agencies in favor of sustainable agriculture resides largely, though by no means exclusively, in Europe and North America. The task of advocating sustainable agriculture therefore entails an accurate and fair depiction of this development thrust, a good grasp of its diverse historical and philosophical origins, and a sensitivity to the present and near term requirements for advancing this potentially powerful focus for agricultural development.

Because sustainable agriculture and related approaches to farming have evolved outside the mainstream of agricultural research, education and conventional farming, one encounters an array of terms that are confusing at first exposure. The terms were mostly identified with the individuals who conceived and developed the different approaches. At their roots, however, all share the mentality of cooperation, accommodation, and co-evolution with nature.

In the recently published book Agricultural Sustainability in a Changing World Order, the editor advances three possible definitions (Douglass, 1984):

(1) sustaining the growth in food production to satisfy the demands of increasing numbers of people,

(2) sustaining the ecological balance of natural systems, the requirements for which would dictate acceptable levels of agricultural exploitation and by extension of population levels, and

(3) sustaining agricultural society and culture -- advocated by the 'alternative agriculturalists' who decry the destruction of the American farm, viewed by many as the foundation of our democratic society.

The International Alliance for Sustainable Agriculture focuses largely but not exclusively on the Third World and seeks "to develop economically viable, ecologically sound, socially just and humane agricultural systems around the world." The four criteria in IASA's goal serve to delineate the wide scope of a meaningful definition of agricultural sustainability.

From an historical viewpoint sustainable agriculture is an extension of the biological or organic farming schools, enriched by the sciences of ecology and entomology, and with its scope widened so as to embrace the social and economic elements that are considered essential to sustaining agricultural endeavour.*

Vogtman subsumes under the term biological agriculture the bio-dynamic school (Rudolph Steiner's lectures in 1924), the Le Maire-Boucher School of France, and organic-biological agriculture of continental Europe (H.P. Rusch's lectures, 1955).

Soil fertility management through biological means and a regard for the "living" soil are the historical point of departure, and continue to be the foundation of this kind of agriculture. A key operational concept in soil fertility is the management of the carbon and nitrogen.

Features of biological agriculture as understood by the Europeans are (H. Vogtmann, personal communication):

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*A succinct historical review is presented by Richard Harwood in "International review of regenerative agriculture" in the Proceedings of a Workshop on Resource Efficient Farming Methods for Tanzania (Harwood, 1984).

1. The soil is fed through soil life
2. Plant nutrients are supplied indirectly
3. Tillage is appropriate
4. Extensive crop rotations
5. Permanent green soil cover
6. Manure and slurry are treated (before application)
7. No chemical biocides

Biological husbandry, a term used in the U.K., is synonymous with biological agriculture.

The USDA defines organic farming as a production system which:

1. largely excludes the use of synthetic agricultural chemicals, and
2. relies upon crop rotations, organic matter, ground rock, mechanical cultivation, and biological pest control to maintain soil productivity and tilth, supply plant nutrients and to control insects, weeds and other pests.

In the USA, regenerative agriculture is a philosophy proposed by Robert Rodale that subsumes organic agriculture, which was pioneered by his father J.I. Rodale, who in turn was influenced by various European approaches and ideas. Regenerative agriculture is one that "at increasingly high levels of productivity, increases our land and soil biological production base. It has a high level of built-in economic and biological stability. It has minimal to no impact on the environment beyond the farm or field boundaries,...produces foodstuffs free from biocides...provides for the productive contribution of increasingly large numbers of people during a transition to minimal reliance on non-renewable resources" (Harwood, 1984).

Agroecology or ecological agriculture, identify the work of a handful of influential university-based researchers, working independently and outside of established agricultural teaching and research institutions. They are plant ecologists or entomologists. Only a few, however, are working on Third World problems.

At the UC Santa Cruz, agroecology taught by Dr. Stephen Gliessman takes inspiration from traditional agriculture around the world, in the study of how agroecosystems can be sustainable and productive without inputs of chemicals and non-renewable energy. (Appendix). At McDonald Campus of McGill University, ecologically defined strategies for agriculture are being conceptualized, researched and taught by Dr. Stuart Hill and his colleagues. The ecological sciences are being brought to bear on how to create agricultural systems that do not poison and squander non-renewable resources. At the Imperial College of Science and Technology, U. of London, Gordon Conway teaches and does research on "agroecosystem analysis" as an approach to research and development in agriculture; especially in Tropical Asia. (Conway, 1983).

C. WORK IN PROGRESS

Agronomic and economic research on biological or organic farming has been going on in Europe almost continuously since its inception in the early part of the century, whereas only recently in the USA have similar efforts been undertaken, principally at the Rodale Research Center and on a modest scale in several land grant colleges in recent years as well (e.g., MSU, Nebraska SU). Two trained agronomists with experience in the International Agricultural Research Centers now work at Rodale's Center--Richard Harwood, formerly with IRRI, and Charles Frances, formerly with CIAT.

In the U.S. there are no public sector initiatives concerning sustainable agriculture or related approaches. The land grant colleges depend upon the federal government or agribusiness for research support and there is virtually no support. In fact, USDA has seconded two scientists (Drs. G. Radke and K. Showers) to work at Robert Rodale's privately financed Research Center in Kutztown, PA.

In Europe, intellectual, academic, and research leadership in sustainable agriculture is centered at the U. of Kassel in the person of Hartmut Vogtman. The focus is, however, on European agriculture exclusively.*

International leadership for sustainable agriculture is being exerted by the International Federation of Organic Farming Movements (IFOAM), in terms of the scientific and technical aspects, and by the two-year-old International Alliance for Sustainable Agriculture (IASA). IFOAM and IASA work in close coordination. IFOAM is reported to have made a policy decision to delegate its former functions of advocacy and networking to IASA, so as to concentrate on winning scientific credibility for biological farming. Both IFOAM and IASA publish periodically (see Appendix).

A considerable outpouring of intellectual effort, conferences and publications on sustainable agriculture has occured in the last six years, largely outside of the mainstream of agricultural research, education and development efforts. It is best captured by a review of a number of conferences and new organizations.

With the creation of the International Federation of Organic Farming Movements in 1972, a worldwide forum for the concerns of sustainable agriculture was born, and a number of fruitful international conferences have been organized. "Towards a Sustainable Agriculture" was the theme of IFOAM's first international conference (Besson & Vogtmann, 1978). It was followed by two symposia: "Basic Techniques in Ecological Farming" (Montreal, 1978) and "The Maintenance of Soil Fertility" (Bruxelles, 1980), both edited as a single volume by S. Hill and published in 1982 (Hill and Ott, 1982). Twenty papers in this volume treat Third World agricultural development (see Appendix).

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*French, Swiss and Belgian efforts were not reviewed but are reported to be substantial.

IFOAM scientists from Europe were well represented at a recent conference (June 11-13, 1984) hosted by Michigan State University on "Sustainable Agriculture and Integrated Farming Systems". The conference, sponsored by Michigan Coop. Extension Service, the Michigan Agricultural Experiment Station, Rodale Press and IFOAM, aimed at introducing biological, or organic farming, to "conventional" agricultural scientists from Michigan State U. and from other land grant colleges and initiating a dialogue. A follow-up working session by IFOAM drafted standards for comparative studies and research (Conference program appended).

"Agricultural Sustainability in a Changing World Order" was the theme of a 1982 conference and the title of its proceedings (Gordon Douglass, 1984). The conference was funded by the Kellog Foundation, within a program designed to stimulate dialogue among colleges of liberal arts and agricultural sciences. However, it was not until the recent conference on Sustainable Agriculture at MSU in Lansing, Michigan, that the subjects of organic or biological farming in the U.S. and Europe and agroecology in the Third World were seriously considered within the bosom of a leading land grant university. It was considered by the conference organizers and participants to be a signal advance in developing intellectual rapprochement between organic/biological farming practitioners or advocates and the researchers and teachers of conventional agriculture in the USA. A similar interchange took place at the Rodale Research Center during a two day "field day" for USDA personnel, at the end of July, 1984.

Lastly, at the end of August this year IFOAM convened its Fifth International Scientific Congress on "The Importance of Biological Agriculture in a World of Diminishing Resources" (held at the U. of Kassel, FDR, August 27-30). (program appended).

The spate of conferences and publications on sustainable agriculture (and its synonyms) during the last 5 years constitutes an unusual burst of activity, and we may well be witnessing the birth of a major conceptual paradigm in agriculture -- or a temporary slogan which will be succeeded by more precise operational terminology. However, sustainability of agriculture as an overall goal seems virtually unassailable and carries a philosophical and moral strength that compels consideration.

D. SUSTAINABLE AGRICULTURE IN INTERNATIONAL DEVELOPMENT

The requirements for sustainability of agriculture in developing countries are vastly different from those of developed countries. In the developed countries, agriculture is a complex sector of the economy. Its various functions -- production (i.e. farming per se), storage, processing, transport, marketing, and consumption -- are discrete, specialized activities linked to each other and to the larger social and economic matrix. The notion of sustainability

Table 1. Biological (organic) Farming in the DC's and LDC's: a Comparison

North America and Europe	In LDC's
A farming technique of choice	A farming technique of tradition or necessity
A reaction to environmental pollution, soil erosion, health problems suffered by farm operators and farm animals, and high production costs, all related to energy and agro-chemical-intensive production techniques.	A search for agricultural production techniques and systems appropriate to the limited resources and marginal environments typical of Third World farmers in the tropics and subtropics.
In the USA, coincident with the resurgence of small farms.	Farms in the Third World increasingly smaller in size.
Driven in part by demand for organically produced foods.	Driven by the imperative of subsistence and the goal of food self sufficiency.
A continuation and elaboration of organic farming and gardening techniques which have endured in Europe, North America, and Australia largely without government support, in co-existence with modern farming. Research very modest in scale and being carried out largely outside of governmental programs and with no agri-business support; main support from individuals.	The scientific extension of traditional farming techniques developed over centuries, and still in use.
Research is identifiable as organic or biological agriculture; or at Rodale regenerative agriculture; or agroecology or biodynamic agriculture.	Current research not identifiable as "biological" or "organic" or "sustainable" agricultural research. Diverse kinds of research being undertaken in search of biological or ecologically structured strategies in fertility maintenance, pest and disease control and weed control.

would extend to each of these specializations and their respective financial, economic and technological aspects. However, to date discussion of sustainable agriculture in the developed nations has focussed almost exclusively on the production or farming activity. Its practitioners express an explicit concern for the health of the farm family, of farm animals, and of the farm environment. Only Rodale's regenerative agriculture embraces the larger socio-economic context.

It is useful to recall here that in the developed countries the production side of the agricultural sector does not take place solely within their territories. Many products (e.g. bananas, pineapples, coffee, tea, spices, sugar, cacao) are imported from developing tropical nations.

Most farmers in developing countries are engaged in subsistence or near subsistence agriculture, rather than the production of export crops. Some small farmers do both but they are in the minority. Subsistence farmers use few if any agro-chemicals and are "organic farmers" by necessity and tradition, not by choice. All the functions of agriculture are carried out within the subsistence farm family, family grouping or village, i.e. production, storage, processing, marketing and consumption. The need for a sustainable agriculture among subsistence agriculturalists can be readily appreciated and comprehended -- all functions are observably integrated into a more or less self-reliant food system (Table 1).

A statistical review of subsistence agriculture in the LDC's was not possible within the scope of this limited exploratory effort. Denevan (1980) cites a survey showing that in Mexico 52% of all farms are "traditional subsistence" and 40% are "traditional semi-commercial". A recent compilation of agricultural development indicators (IADS, 1981), which summarizes data at the nation state level, provides clues as to the extent of subsistence agriculture in the Third World through data such as cereal production and consumption and cropped land/person ratios. In Asia and the Pacific the median of cropped land per person in 1978 was 0.2 ha; in Africa it is 0.4; in Mexico, Central and South America it is 0.2. (Table 2).

Sustainable agriculture does not yet explicitly figure in international development programs. However, the work of certain individuals or exceptional projects that seek sustainable agriculture has been noticed by the development agencies, and even sponsored by them.

Among these individuals are Robert Mazibuko of S. Africa who has developed a trench composting technique suited to that environment; the Dutchman Van der Meulen who advocates his "ecological methods" for land restoration and fertility maintenance in the wet tropics; Prof. Soemarwoto of Indonesia who has unravelled the ecological rationale of Javanese kitchen gardens or Pekarangan; and Stephen Gliessman of UC, Santa Cruz, who worked many years in Mexico researching and seeking to improve traditional farming techniques of

Table 2. Agricultural indicators in selected "crisis" countries.
(Source: IADS, 1981)

	% people in agric. 1979	Cropped land per person 1978 (ha)	Cereal production, kg per person 1977-79	Cereal consumption per person kg
Asia & Pacific				
Afghanistan	78	0.5	256	237
Pakistan	54	0.3	174	205
Nepal	93	0.2	264	269
Bangladesh	84	0.1	222	247
Sri Lanka	54	0.2	120	213
Philippines	47	0.2	208	235
Africa				
Sudan	77	0.4	157	187
Chad	84	0.5	133	153
Niger	89	0.6	290	319
Upper Volta	82	0.9	159	184
Mali	87	0.3	181	191
Mauritania	83	0.1	18	122
Senegal	75	0.4	122	210
Botswana	81	1.9	125	151
Lesotho	84	0.2	153	247
Tanzania	82	0.3	84	103
Rwanda	90	0.2	39	57
America				
Guatemala	56	0.3	142	171
Honduras	63	0.6	131	200
El Salvador	51	0.2	145	184
Haiti	67	0.2	103	151

the Mexican tropics (Freeman and Fricke, 1980). The influence of the English gardener Alan Chadwick, who introduced French biodynamic agricultural techniques to the United States in the 1960's, extends to the Third World through John Jeavons' advocacy of this technique of intensive horticulture and its adaptation by U.S. Peace Corps (Vickery, 1978).

Except for the World Bank, no development agency appears to have formally explored sustainable agriculture.

1. World Bank

In 1980 the World Bank's Science Advisor commissioned a paper on "ecologically-oriented agriculture" which was prepared by Peter Freeman and Tomas Fricke (Freeman & Fricke, 1980). This followed Dr. Robert Goodland's unsuccessful in-house attempt to gain approval in the Bank for his environmental guidelines for agricultural projects.* The Freeman & Fricke paper generated considerable and heated debate in the Bank, mostly "con" but some qualified "pro's". In the follow-up, the World Bank's Science Advisor, Charles Weiss, visited a number of the experiences cited as case studies in the Freeman-Fricke paper (Chinampas or floating gardens in Mexico, the Projet Agro-Pastoral in Rwanda, and the Wau Ecological Institute in Papua New Guinea). Also, GTZ's Irmfried Neumann was invited to make a presentation at the World Bank of the Projet Agro-Pastoral.

Following the recommendations of the Freeman-Fricke paper, the World Bank commissioned a more thorough review of sustainable agriculture from Walter Kock, former project manager for the above-mentioned Projet Agro-Pastoral in Rwanda. Kock's paper, developed over a 6-week consultancy, faired worse than the Freeman-Fricke effort and was not deemed suitable for Bank endorsement as a technical paper. The paper "Principles and Technologies of Sustainable Agriculture in Tropical Areas; a Preliminary Assessment" is being edited by Robert Rodale at his expense for publication by Rodale Press.

Kock's paper will surely become a milestone contribution to the literature on sustainable agriculture in the developing countries within the framework of international development. At the same time, it falls short of being a comprehensive review of experience.

2. A.I.D.

It is not widely known, even within A.I.D., that A.I.D. has been involved in directly supporting sustainable agriculture and organic farming methods. The A.I.D. Mission in Tanzania financed a technical assistance effort by a number of individuals from the Rodale Center to the Tanzanian government in 1982/83. It is not altogether uncharacteristic of A.I.D. that this came about by coincidence and through a direct interest of the U.S. Ambassador rather than as a consequence of a major policy directive emanating from A.I.D.'s Washington offices. In fact, it was the Ambassador's wife, Mollie Miller, who was familiar with Rodale's operation, who initiated a

*Published by Westview Press (Goodland et al. 1984)

series of events that led to the A.I.D.-financed technical assistance effort. It resulted in a workshop attended by President Nyere, the proceedings of which are now published and available ("Proceedings of a Workshop on Resource-Efficient Farming Methods for Tanzania") (See Appendix). This A.I.D. effort was still-borne, however, since the State Department has decided to close the A.I.D. mission in Tanzania in 1986, and no new projects will be undertaken. Nevertheless, the workshop proceedings could have a large impact among the English speaking nations of East Africa, if they are distributed with care. Further, Rodale is seeking other funding sources that would permit a continued effort in Tanzania.

Since USAID relies heavily on the land grant colleges for intellectual innovation, as well as direct participation in its agricultural development efforts, it's exposure to the various facets and concerns of sustainable agriculture has been minimal. However, Richard Harwood, from Rodale's Center, has made presentations to A.I.D. in Washington (and to the World Bank). Also the integrated pest management services project, managed by A.I.D.'s Science and Technology Bureau in Washington is a notable innovation (which nevertheless is viewed askance by some entomologists who see it merely as pesticides application training for Third World governmental services).

Several projects funded under A.I.D.'s Office of Agriculture in the Bureau of Science and Technology support the development of techniques characteristic of biological farming, namely work in support of nitrogen fixation (four projects), the Dryland Management Synthesis project, and the Soil Management Collaborative Research Support Program (See Appendix). The Farming Systems Support Project could afford a vehicle for researching biological farming systems.

A recent reordering of research priorities in A.I.D. also presents possibilities. A determination in 1983 of priorities in food and agricultural research by A.I.D. recommended the following areas be given increased A.I.D. support (Cummings and Robins, 1983).

1. Sustained high productivity in relatively favorable natural resource areas.

2. Sustained production in less favorable environments (too much or too little rain, steeply sloping).

3. Minimum purchased input production systems.

4. Crop and animal protection by the most cost-effective and environmentally acceptable means.

5. Livestock in mixed farming systems, ones which include crops, livestock, and sometimes agroforestry. (The report notes that relatively little research has been done in the livestock component of farming systems.)

6. Food and agriculture policy.

7. Institutional capability to generate technologies.

All of these research priorities are entirely compatible with biological farming approaches, and vice versa, it may be noted. However, biological approaches offer special potentials in pursuing priorities numbers 2, 3, 4, and 5.

In a meeting on July 6 with Dr. Anson Bertrand and Dr. Tejpal Gil of A.I.D.'s Office of Agriculture in which the subjects of sustainable agriculture and the more effective cooperation of environmental and agricultural sciences within A.I.D. were discussed, these research priorities were suggested by Dr. Bertrand as good possibilities for developing such cooperation. Minimum purchased input systems were singled out as an especially good prospect.

3. Low-Input Agriculture

In recognition of the small amounts of land and capital possessed by most Third World farmers, as well as the constraints on farm labor, agricultural development workers are seeking ways to aid these farmers without resorting to expensive and potentially risky technologies, namely through low input technologies. The reference is to purchased inputs, such as fertilizers and pesticides.

Resource poor farmers (short on land, labor or capital) are usually found in over-populated agro-ecosystems -- over-populated in terms of their climate and their productivity under traditional production technologies. These also tend to be rainfed farming regions, considered to be marginal due to excessive or insufficient rainfall. Biological resources and ecologically based strategies of crop production and protection may be the only way that such farmers can be assisted. Biological farming by definition uses few purchased inputs; however, there are high internal inputs of management expertise (i.e. information) and labor.

The information input will have to be developed through appropriately designed research and trials. Labor saving devices may also be needed — better tools for animals as well as people, including women of course.

The conversion of organic waste to compost and its timely application is an example. There may be required certain capital investments needed to manage manure and other organic matter, especially carts and tools for collection and distribution, and perhaps special materials such as concrete for lining manure or compost pits.

E. SUSTAINABLE AGRICULTURE AS A USEFUL TERM

Sustainable agriculture is a term that has gained currency through its employment as a theme in conferences and publications and its use as the focus of an organizational program — namely the International Alliance for Sustainable Agriculture. As such it cannot be dismissed. Could it be a useful focus in established international development institutions? This question was asked throughout the interviews, together with a related question, How can the environmental sciences contribute more to agricultural development?

The reactions of most of those interviewed indicate that "sustainable agriculture" is an agreeable idea, entirely consistent with development thinking. The exceptions were university-based researchers and development workers (at Cornell), who preferred ecological agriculture or agroecology, responding, it is clear, to the imperative in the university environment to clearly delineate disciplinary territory, as well as the greater demand for semantic precision than is the case in non-university settings.

Because sustainable agriculture communicates a goal rather than a technology or discipline (even though these are implied), its power as an organizing concept in development is perhaps greatest in the arena of policy and programs. At the same time the technological flexibility needed to foster sustainable agriculture in the diverse environmental and socio-economic contexts of agriculture in the Third World, calls for a programmatic goal that accomodates diversity. "Sustainable agriculture" seems to satisfy this requirement as effectively or more so than "agricultural development" or the more limited notion of "feasibility."

Sustainable agriculture is a goal with which few would take issue. It is a logical ancillary of the more broadly stated goal of sustainable development, on which the World Conservation Strategy fixes its sights. Although used as a conference theme, sustainable agriculture has not yet been objectified with measurable criteria or methods for their measurement. An agriculture which is "economically viable, ecologically sound, socially just and humane" -- the goal of the International Alliance for Sustainable Agriculture -- is the most precise definition to date. Economic viability is certainly a measurable criterion; the others are less so, at least by quantitative means.

The criterion of ecological soundness is of fundamental importance, to the idea of sustainable agriculture. Important research and development experiences, some noted in this paper, are accumulating and should be synthesized so as to achieve a clear delineation of ecological soundness.

Explicit in the idea of sustainability is the time dimension. A working definition of sustainable agriculture which includes both economic and ecological criteria will be faced with the Solomonic task of reconciling their differing time frames. To date economic theory has not accounted for the biological and ecological imperatives of sustainable resource management and has employed the shorter time frame that seems to govern the economic choices of most people. In other words, economic theory is generally in accord with individual human behavior in industrialized societies with regard to economic decisions.

The biological and ecological principles in sustainable agriculture which orient and drive production technologies (and associated farm structures and organization) may generate some controversy among agronomists as well as policy analysts, who may dismiss these technologies if they result in a lowering of production. The technical context of their objections would be successful Green Revolution experience. The policy context would be the imperative to feed growing, especially urban, populations in the Third World.

On the other hand, in the case of the resource-poor farmer in marginal, degraded, and even relatively favored physical environments -- namely those A.I.D. is attempting to assist -- the techniques of sustainable agriculture easily accommodate current thinking on how to approach this development problem, i.e. low-input or minimum-input farming, and add an important ecological and socio-economic overview that will be critical to effective assistance.

F. PRINCIPAL CONSTRAINTS TO THE USE OF SUSTAINABLE AGRICULTURE AS A PROGRAM GOAL IN DEVELOPMENT

Although the organizing focus of sustainable agriculture and its techniques could in principle resolve many problems that have held back agricultural development in the tropics, sustainable agriculture is hampered by a number of constraints. Five are singled out here.

1. The first problem is one of communication and perceptions. SA is an amalgam of influences, techniques, philosophies, and concerns that have on the one hand developed independently of mainstream thinking in the agricultural sciences and in international development assistance, and on the other hand have found their identity in an antagonistic polarity with conventional agriculture.

   The communication of sustainable agriculture, and its organic or biological techniques, inevitably triggers the biases and antagonisms that developed between advocates of organic farming and conventional farming during the past 20 years, approximately. Some of the agricultural scientists and administrators of this

period are involved in defining directions in international agricultural development assistance, in A.I.D., World Bank, CGIAR, and others. It is especially hazardous to use the term organic farming at this moment in time, since it conjures up visions of the independently-minded "crack-pot" farmers in the U.S.A. who resisted the heavy use of agro-chemicals during the 50's, 60's, and early 70's when these were at the technological frontier of agricultural development, along with plant breeding.

This attitude seemed to flavor the reactions within the World Bank to the two papers commissioned on the subjects of ecologically oriented agriculture (Freeman & Fricke, 1980) and sustainable agriculture (Kock, 1982). The poor reception given these papers was no doubt aggravated by the fact that they were commissioned not by the agricultural development professionals of the World Bank, but instead, by the Science Advisor, who now has been absorbed into the Office of Environmental and Health Affairs.

2. A second constraint concerns the lack of fully developed systems for all environments, especially in the Third World.

   There is no single technology indentified with sustainable agriculture, except perhaps for the preparation of compost whose techniques vary widely throughout the world. The "technical package" that development agencies seek does not yet exist for most ecosystems. This "package", once it is devised is not likely to resemble the package associated with the production of high yield varieties, since it will focus on information, methods of nutrient cycling, and the related organization of labor and land use, with minimum purchased inputs. Although information that will be relevant to a sustainable agriculture in various environments exists, it is not yet assembled in a single compendium, or as a management model. In this regard the development of sustainable agricultural systems is faced with information problems and needs very similar to those confronted by farming systems researchers. (See p. 18)

3. A third constraint is the relative absence to date of interest among agronomists and soils scientists (at least in North America) in the subject. In terms of scientific and political acceptance, advocates of sustainable agriculture see Europe as 10 years ahead of the USA, and the USA 10 years ahead of Canada.

4. Fourth, the difficulty of achieving interdisciplinarity essential to programmatic development of sustainable agriculture, involving the fields of pedology, agronomy, entomology, plant and animal ecology, nutritional sciences, sociology, anthropology, and economics, is a constraint that is familiar to development workers, researchers and academicians who seek in one context or another to organize inter-disciplinary effort.

In this regard, it appears that Australia and the United Kingdom have made greater advances than the USA and Canada, at least in academia and in research institutions (Gordon Conway, pers. comm.).

The difficulties experienced in farming systems research are particularly instructive. The subject has been recently reviewed for CGIAR by Simmonds (1984). This experience is relevant not only for the methodological similarities, but also because farming systems research and development are a most obvious way of introducing the precepts and techniques of sustainable agriculture into "conventional" agricultural research.

None of the individuals interviewed in the course of this exploration had insights on how to achieve the bureaucratic integration in development that is the corollary of inter-disciplinary research involving a wide range of pure and applied sciences. Team research on interdisciplinary problems, e.g. farming systems, is in its methodological infancy, especially with respect to the human interactions entailed in bringing together scientists in different branches. All recognized nevertheless, the pressing need for ways to synthesize or integrate human effort in various institutional settings.

5. Temperate zone technical bias. This constraint hampers the transfer to the Third World of virtually all technologies, and it almost goes without saying. However, the ecological sensitivity and the biological imperatives that characterize sustainable agriculture render it especially vulnerable to the hazards of the temperate zone bias. For instance, composted organic matter treated in special bins or pits and later added to the soil is a key element in the management of the carbon and nitrogen cycles on organic or biological farms in Europe and North America. Manure and crop residues are principal sources of compost. The integration of livestock into the farming operation, with allowance for land uses devoted to forage, is implicit in this system, as is the idea of annual crops and pastures. Intensive horticulture and tree crops play only a minor or complementary role in this mixed livestock-cereals-pasture farming system.

In the humid or wet tropics, tree crops, semi-perennial crops (e.g. manioc), and intensive horticulture (kitchen gardens) are key rather than complementary elements to the small farms. Cattle may be absent. In the semi-arid to arid tropics, in Africa, livestock cannot be managed conveniently so as to collect and compost manure. Herds are nomadic or semi-nomadic, grazing in common or state-owned areas, rather than in farm owned pastures or being stable-fed. Some stall feeding is being introduced, however, where crop residues are available, but only for draft animals or special fattening programs.

Plant ecologists and foresters have been able to readily appreciate these differences in the tropics and their implications for agriculture, on the one hand due to their breadth of vision and analytical methods, and on the other because in general they are not professionally committed to agricultural development (or food production) as strongly or as single-mindedly as are agronomists.

It is noteworthy, in this regard, that the International Council for Research in Agroforestry is not formally part of the International Agricultural Research Centers. Even the term agroforestry betrays the temperate zone bias in scientific epistemology. It conveys incompletely and imprecisely the reality that trees (or woody perennials) have many more functions in tropical agriculture than in temperate agriculture and consequently compel a longer term and more intricate view of tropical farming systems. It is also worth observing that the great diversity of crops that can be grown in the tropics, and the continuous growing season (in the humid tropics, at least) makes the goal of complete food self-sufficiency more easily attainable than in the temperate zone.

These rather superficial comments are meant to underline what should be obvious: Sustainable agricultural technologies will have to be devised for many different ecological circumstances. It is likely that agro-ecology and the agroecosystems approach to field problems are the most appropriate way to formally study and design sustainable agricultural technologies. The additional skills of anthropology and sociology will be needed, however, to uncover and exploit the potential paradigms in traditional farming systems, whose ecological logic may be implicit or observed by custom rather than by reasoned choice (Freeman & Fricke, 1980).

G. SUSTAINABLE AGRICULTURE AS A UNIFYING CONCEPT

It has been possible in this brief exploration to detect an emerging pattern of ideas and development paradigms, which are converging on sustainable agriculture and its technologies.
This discernible pattern is focussed on a hitherto unsolved agricultural development problem in the tropics. Extraordinarily diverse points of view, from all parts of the world, from developed and developing countries, from academia, agricultural research centers, and agricultural development institutions are converging on the special dilemma of the small, poor farmer in the problematical environments (too wet, too dry, too steep) of the tropical latitudes -- the farmer who was "passed up by the Green Revolution", who represents perhaps 50% of the Third World's rural population, and who is slowly destroying his habitat in the process of survival, sometimes abetted by misguided development efforts. The plight of this individual, (or more accurately farm or multi-family group) has

captured the attention and energies of scholars, researchers and development workers as well as the development assistance agencies, both public and non-governmental workers.

There is an uneasy recognition that there is no miracle grain or easy technological fix for this segment of the world's rural people. For them commercial farming is a dim prospect, food self reliance is paramount, and food and energy sufficiency are inter-dependent. Development has not worked well for them, especially development premised upon commercialized production surpluses which would pay for farm inputs and consumer goods.

The various development solutions proposed by scholars and development workers for the resource-poor farmer, when taken together, virtually amount to a profile of biological farming. These solutions include:

- o use of manure and crop residues to restore organic matter to the soil.
- o no-till and alley cropping.
- o bench terracing
- o better integration of livestock into the farming system.
- o integration of fish culture into the farming system.
- o use of woody perennials, such as legumes, to modify the micro-climate and supply N-rich green matter.
- o use of N-fixing annuals to supply soil nitrogen and as companion crops.
- o polyculture, crop associations, relay cropping, and other plant husbandry techniques to better exploit growing potentials, control weeds, minimize insect pests and diseases, and provide a more continuous supply of food.
- o use of biogas digestors to generate fuel and nutrient-rich slurry.
- o better use of solar energy for crop drying, preservation.
- o greater fuel self reliance through plantings of fuelwood trees and improved cookstoves.

Further, the adoption of such techniques requires a favorable social and economic context, requiring, among other changes:

- o land reform (tenure and tenancy)
- o agricultural policy reform.

There is as yet no conceptual and programmatic framework which synthesizes these responses at the farm or agroecosystem level, either technically or in terms of the integration of development assistance effort carried out by national and international agencies. Nevertheless, there is an irresistible trend towards integration of effort, evidenced most visibly in analysis and research efforts. Some examples follow:

Analysis and diagnosis

Macro	Agro-ecological zonation (FAO, 1978)
	Dynamic systems analysis, energy modeling (*a la* Odum)
	IBSNAT (A.I.D.) (See Appendix)
Micro	Farming systems analysis (CGIAR)
	Diagnosis and Design (agroforestry)

Research and development

Farming systems approach (crops and livestock) (CGIAR)
Agro-ecosystem analysis (Conway)
Agroforestry (woody perennials and annual crops/livestock (ICRAF)
Integrated pest management

Trials

Unite experimental (Francophone Africa) (FAC)

Design

Farming systems approach and related approaches (CGIAR) (especially Chambers' work; see Chambers, 1984)

Development

"Integrated" development approach (various donors) (Usually refers to the integration of various sectors, e.g. agriculture, forestry, energy, or various governmental services corresponding to these sectors.)

Ecodevelopment (I. Sachs, CIRED, Paris)

Eco-farming (K. Egger, U. of Heidelberg)

Agro-ecosystem management (D. Janzen, 1973)

It seems inevitable that the conceptual context offered by sustainable agriculture will eventually be called into play in efforts to assist the resource-poor farmer in marginal environments. Sustainability as ecological soundness articulates both an obvious need

and an approach required to realistically work with marginal environments. The ecological modelling, conceptual and formal, which illuminates biological solutions to soils, crop, animal, energy, weed and pest management can provide the framework for the integration of on-farm interventions, as well as for the diagnosis and design of research and development. Sustainability as social equity speaks to the numerous policy, land tenure and institutional changes needed to give the resource-poor farmer his place in society. Sustainability as economic viability speaks to both the common sense of farm finances as well as the need for appropriate pricing and other economic policies in support of the resource-poor farmer. Finally, a humane agriculture implies a respect for people and domestic animals that all cultures share, but that may be lost when they become "human resources" and "live" stock.

It also seems obvious that a programmatic framework is required to orchestrate and integrate the various elements that bear on the development of agriculture in marginal environments and among resource-poor farmers. Sustainable agriculture could furnish that framework, and a program goal as well.

The various elements discussed so far can be summarized as follows:

- o Sustainable agriculture is both the goal and the concept.
- o Agroecology is the intellectual approach to understanding and defining research.
- o Farming systems is the way of research and developing.
- o Biological farming is the production technique.
- o Appropriate technology supplies the means of doing. (includes "biotechnology", energy technologies, and other resource-conserving/resource-optimizing technologies.)
- o Cooperation with nature and its forces is the philosophical context.
- o Social equity and active respect for human and animal welfare are the moral context.

H. RECOMMENDATIONS

Recommendations were drafted for IIED, in terms of what it should or could do to advance the goal of sustainable agriculture, as well as for A.I.D. The various constraints are indicative of a fairly broad strategy agenda. Briefly they are:

1. Mis-perceptions and the need for communication.

2. The lack of (or ignorance of) sustainable agricultural systems for Third World farmers in different environments.

3. The relative absence of interest among agronomists and soils scientists.

4. The difficulty of attaining the needed inter-disciplinarity and integration of development effort.

5. Temperate Zone technical bias.

IIED and Sustainable Agriculture

What course should IIED follow in promoting or advancing sustainable agriculture? Implicitly, IIED is committed to this goal, through its association with the implementation of the World Conservation Strategy, whose goal is sustainable development.

1. Sustainable Agriculture and the World Conservation Strategy

IIED can and should facilitate interaction and dialog between practitioners, researchers, and spokespersons of sustainable agriculture, and the individuals or organizations involved in developing national conservation strategies.

2. Advocacy and Diffusion

IIED should prepare a publication on sustainable agriculture aimed at development agency planners, both international and national, which sets forth clearly and succintly the background, evolution, principles and techniques of sustainable agriculture, and the promises and problems it holds.

3. Facilitating Dialog

To help overcome the communication and perception constraint, IIED should organize and host meetings, presentations and seminars which bring together development officials in the donor community and IARC researchers together with the spokespersons and practitioners of sustainable agriculture. Both governmental and non-governmental organizations involved in the Third World should be approached.

Secondly, IIED could compile an anthology of sustainable agricultural experiences in different parts of the world. These experiences could take the form of case studies, including those which are to be presented at the 1985 IIED conference on sustainable development. This should be a "technical working document" rather than an overly-summarized, slick publication.

4. Interdisciplinarity and Integration

IIED could catalyze an effort to bring the principles and techniques of sustainable agriculture into the format of farming systems research by (1) bringing together the respective researchers into an exploratory working session, (2) further elaborating the dynamic systems model of the Mahaweli project so as to include the goals and methods of sustainable agriculture, (3) sponsoring a seminar on farming systems and sustainable agriculture, and (4) publishing or otherwise diffusing the results of this work to the development community as well as the network of sustainable agricultural workers.

5. Sustainable Agriculture in the EPM Project

IIED could ask A.I.D. to consider and refine the strategy recommendations that follow on how A.I.D. can pursue sustainable agriculture. This can be accomplished through the Joint Advisory Services and the Information and Analysis component of the EPM agreement as well as through additional contracts (PIO/T's) with A.I.D.

A.I.D. and Sustainable Agriculture

The concept, goal, principles and some techniques involved in sustainable agriculture are common to many elements of A.I.D.'s efforts in agricultural development. They are not radical departures from on-going work, as noted in the section on sustainable agriculture as a unifying concept and goal. However, these various on-going efforts appear unconnected and uncoordinated, having no unifying institutional purpose that reinforces their impact. Extraordinary difficulties, due to political and institutional factors, affect the conduct of A.I.D.'s work, and it is particularly difficult to achieve (1) integration of policy, programs and projects, (2) integration of technical resources bearing on agricultural development, and (3) a long-term commitment of human and financial resources. As one interviewee pungently stated:

> "A.I.D. tries to solve 20-year problems with four-year people and one-year budgets."

The development of agricultural systems is a long term endeavor. No one would disagree. Indeed, the development of sustainable agricultural systems fostered through development assistance is probably a 20-year proposition, taking into account the research and institutional policy and program efforts required to effectively evolve and diffuse appropriate development interventions.

A.I.D. would need a major policy commitment to sustain such an endeavor, especially given the vissicitudes of development priorities and funding.

1. Policy Implications

The possibility of preparing a policy directive on sustainable agriculture should be explored by A.I.D. Initially it is suggested that the present exploratory paper be sent to the appropriate sector councils, and that a meeting or meetings be convened to discuss its policy implications.

2. Research on Sustainable Agriculture

A number of specific suggestions can be made.

(1) A.I.D. research priorities in food and agriculture could be linked to constitute an effort to develop sustainable agricultural systems. This would basically insure that the various facets of the so-called minimum, or low-input, agriculture would be appropriately and systematically linked. Specifically the following A.I.D. research priorities should be brought under a systematic research effort:

- o Sustained production in less favorable environments
- o Minimum purchased input production systems
- o Crop and animal protection by the most cost-effective and environmentally acceptable means
- o Livestock in mixed farming systems

(2) A.I.D. should consider funding short to medium term advisors, on a trial basis, in the subjects of plant ecology and systems (agrosystems) analysis to one or more of the International Agriculture Research Centers, including ICRISAT, ICRISAT/Sahel, CIAT and IITA. The purpose would be to bring the ecological and closed system perspective of sustainable agriculture to the definition of research hypotheses and programs, both for on-farm research and on-station research. These advisors could be supplied through the EPM project. A.I.D. missions would probably be interested in such advice being given to on-going farming systems research in the various A.I.D. portfolios as well.

(3) A.I.D.'s Office of Agriculture in the Bureau of Science and Technology should commission an analysis with recommendations of the possibilities for a research and development program in sustainable agriculture.

3. Training

Practitioners and researchers of sustainable agriculture in the LDC's should be invited to address various A.I.D. training fora: the development studies program, the annual training seminar for agricultural development officers, and other training events.

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LOG OF INTERVIEWS AND VISITS

June 8, 1984	Chuck Haynes S&T/Ag (livestock)	Telcom, Freeman
June 8	James F. Parr Agricultural Research Service, USDA	Telcom, Freeman
June 8	Garth Youngberg Institute for Alternative Agriculture 445-4095	Telcom, Freeman
June 11-13	Conference: Sustainable Agriculture & Integrated Farming Systems, at MSU. Persons interviewed: Hartmut Vogtmann Englehard Boehncke Elliot Coleman Steven Gliessman William Lockeretz Stephen Kafka Kenneth Dalhberg Patricia Barnes McConnell Miguel Altieri Warren Sahs Terry Gipts	Freeman attended, & interviewed a number of participants. See attached conference program
June 14	Terry Gipts, Executive Director International Alliance for Sustainable Agriculture	Interview/presentation at IIED
June 20	Rodale Research Center Kutztown, PA Richard Harwood Nancy Bailey Heather Danton Steve Van Gorder Rick Engel	Visit & interviews Freeman Runnalls Berwick Phillips Ivory
June 22	USDA, Grad School AID ag. studies	Freeman, attended brown bag seminar on agroforestry; presentations by Spears & Harcharik
June 26	Tomas Fricke ATI	Interview. Freeman & Berwick
June 27	Ray Dasmann UC, Santa Cruz	Telcom, Freeman

June 29	Charles Antholt ASIA Bureau/TR	Interview Freeman & Berwick
July 2	Tom Edens Dept. of Resource Development & Entomology, MSU	Telcom. Freeman
July 3	Curt Farrar, Exec. Dir. CGIAR	Interview. Freeman & Berwick
	Charles Weiss Office of Environ. & Health Affairs World Bank	Interview Freeman & Berwick
July 6	Anson Bertrand, Director S&T/Ag Tej Gil, Head S&T/Ag/Nat. Resources	Interview Freeman & Berwick
July 9	Tony Pryor, REDSO/EA Bert Printz Mark Ward, Africa Bureau Harlan Davis, Africa Bureau and others from AID	Participate in discussion following Pyror's presentation on the workshop in Nairobi
July 12	Donald Plucknett CGIAR 1825 K St. NW Washington, DC	Interview, Freeman
July 13	Albert Brown, head Rural Development Office Bureau for Latin America & Caribbean USAID	Interview, Freeman & Berwick
July 17	Gordon Douglass Dept. of Economics Pomona College, Claremont, CA	Telcom Editor of proceedings of the April, 1982 conference on "Agricultural Sustainability in a Changing World" (Westview Press, 1984).
July 17	Gordon Conway Imperial College Centre for Environmental Technology Imperial College of Science and Technology, London.	Meeting in office of IIED, with Runnalls & Berwick

July 18	Robert Cook, Director Cornell Plantations Susan J. Riha, agronomist Dept. of Agronomy David R. Bouldin, soils Dept. of Agronomy W. Ronnie Coffman, plant breeder Dept. of Plant Breeding David Pimentel, Entomologist Entomology & Agricultural Sciences Richard J. McNeil Dept. of Natural Resources Larry Zeidema, Assoc. Dir. International Agriculture	Two-hour group meeting at Cornell University
July 19	Jack Ewel Dept. of Botany University of Florida Gainesville, FL	Interview, Berwick
July 30	Wayne Nilsestuen Ag. economist LAC/RD USAID	Telcom, Freeman

APPENDICES

APPENDIX A.

Terms of Reference

JES
JOINT ENVIRONMENTAL SERVICE
IIED

North American Headquarters: IIED, 1717 Massachusetts Avenue, N.W., Washington, D.C. 20036 Telephone (202) 462-0900 Telex: 64414
European Headquarters: IUCN, Avenue du Mont-Blanc, 1196 Gland, Switzerland Telephone 022/64 7181 Telegrams: iucnature Gland Telex: 22818
London Office: IIED, 10 Percy Street, London, W1P 0DR Telephone 01-580 7656-7 01-580 9796-7 Cable: Earthscan London W1 Telex: 261681

Information and Analysis #2
June 18, 1984

Mr. Peter Freeman
619 Upland Place
Alexandria, VA 22301

Dear Peter,

The International Institute for Environment and Development (IIED), on behalf of the Joint Environmental Service (JES) of IIED and IUCN would like to contract with you for your services in support of the development of a strategy to examine the current thinking, practice and application of sustainable agriculture in the context of agricultural development assistance to LDC's. The purpose of this examination are:

1. to define an approach or strategy appropriate to IIED that would pursue the goal of sustainable agriculture within its EPM project as well as its support for sustainable development;

2. to document current thinking, practices, and applications of sustainable agriculture;

3. to review actual or potential obstacles to the adoption of sustainable agriculture in agricultural development assistance;

4. to identify initiatives related to sustainable agriculture (e.g. research, surveys, projects, etc.) that may be appropriate for development assistance;

5. to recommend follow-up work on sustainable agriculture (or other appropriate label) that could be supported by IIED through the EPM project.

These objectives will be approached in this project by

- Defining major practices and trends in the subset of agricultural sciences most germane to third world agricultural development projects

- o defining the particular practices which could benefit from the "environmental sciences" -- either through the application of existing technology or indicated research. (This may also dictate a follow-on review of such projects -- their characteristics, goals, flaws, successes, failures, conduct, etc. with an eye to identifying the points of entry for environmental sciences which could benefit such projects.) The particular environmental inputs should be reviewed.

- o interviews of knowledgeable agricultural scientists and agricultural program directors to solicit opinions and data which speak to (among others)

  - where areas of friction between environmental scientists and agricultural scientists have existed;

  - where areas ripe for environmental inputs exist;

  - cases illustrative of costs to agricultural projects traceable to a lack of environmental inputs;

  - cases illustrative of benefits to agricultural projets of environmental interventions;

  - a self examination of the particular biases which environmental and agricultural scientists are perceived to incorporate into projects which might constitute problem areas.

The manuscript which you will produce for IIED will accommodate these objectives and incorporate the responses of experts to such issues as are raised above. Please note that this manuscript will constitute the primary material for review by other agricultural and environmental scientists who may be asked to contribute to the final manuscript envisioned by IIED as both a critical review and programmatic initiative to address the broader topic of sustainable agriculture.

You should note that JES is not a legal entity but a service operated by IIED and IUCN. Both organizations conduct work under its style and title. The IIED is responsible in law for the fulfillment of this contract and all difficulties arising from it should be referred to me.

SCOPE OF WORK AND SCHEDULING

As developed in our communications, your scope of work will consist of the following tasks and deliverables with the due date parenthetically noted.

Task 1.

Review the agricultural literature for practices, trends and opportunities to incorporate specific interventions provided by environmental science.

Task 2.

Interview agricultural scientists and managers. An initial list of potential interviewees follows:

- Fred Bentley - Univ. Alta
- Christian de Laet - Univ. Regina
- Charles Antholt - USAID-ASIA/TR
- Tej Gill - USAID-S&T
- Swaminathan - IRRI
- Robert Goodland - World Bank
- John Spears - World Bank
- Charles Weiss - World Bank
- Jack Ewel - Univ. Florida
- Gordon Conway - Imperial College
- David Pimentel - Cornell
- Richard Harwood - Rodale
- Charles Francis - Rodale
- William Liebhart - Rodale
- Gary Toenissen - Rockerfeller Foundation
- Ned Raum - Winrock
- Stephen Gleissman - Univ. Calif.-SC
- Thomas Fricke - ATI
- Don Plucknett - World Bank (CGIAR)

and those at such institutions as Univ. Calif. Davis, BIFAD, Texas A&M, etc. As noted in my letter to you of May 25, 1984, we should attempt to sample a cross section of operative strata in this business -- e.g. practicing agricultural scientists, project managers, academicians, NGO experimentalists, experienced consultants, and concerned legislators.

Task 3.

Develop an outline of the report arising from data collected in Tasks 1 and 2 and discuss with IIED and USAID.

Task 4.

Produce draft report and suggestions for follow on activities with attendant estimated requirements (e.g. level-of-effort, travel, etc.)

APPENDIX B.

Table of Contents,
Basic Techniques in Ecological Farming
and the Maintenance of Soil Fertility

Basic Technics in Ecological Farming
Techniques de Base en Agriculture Biologique
Grundsätzliche Verfahren der ökologischen Landwirtschaft

Papers · Exposés · Referate
Presented at the 2nd International Conference held by IFOAM,
Montreal, October 1–5, 1978

Le Maintien de la Fertilité des Sols
The Maintenance of Soil Fertility
Die Erhaltung der Bodenfruchtbarkeit

Exposés · Papers · Referate
Présentés à la 3ème Conférence internationale organisée par IFOAM.
Bruxelles, du 3 au 5 septembre, 1980

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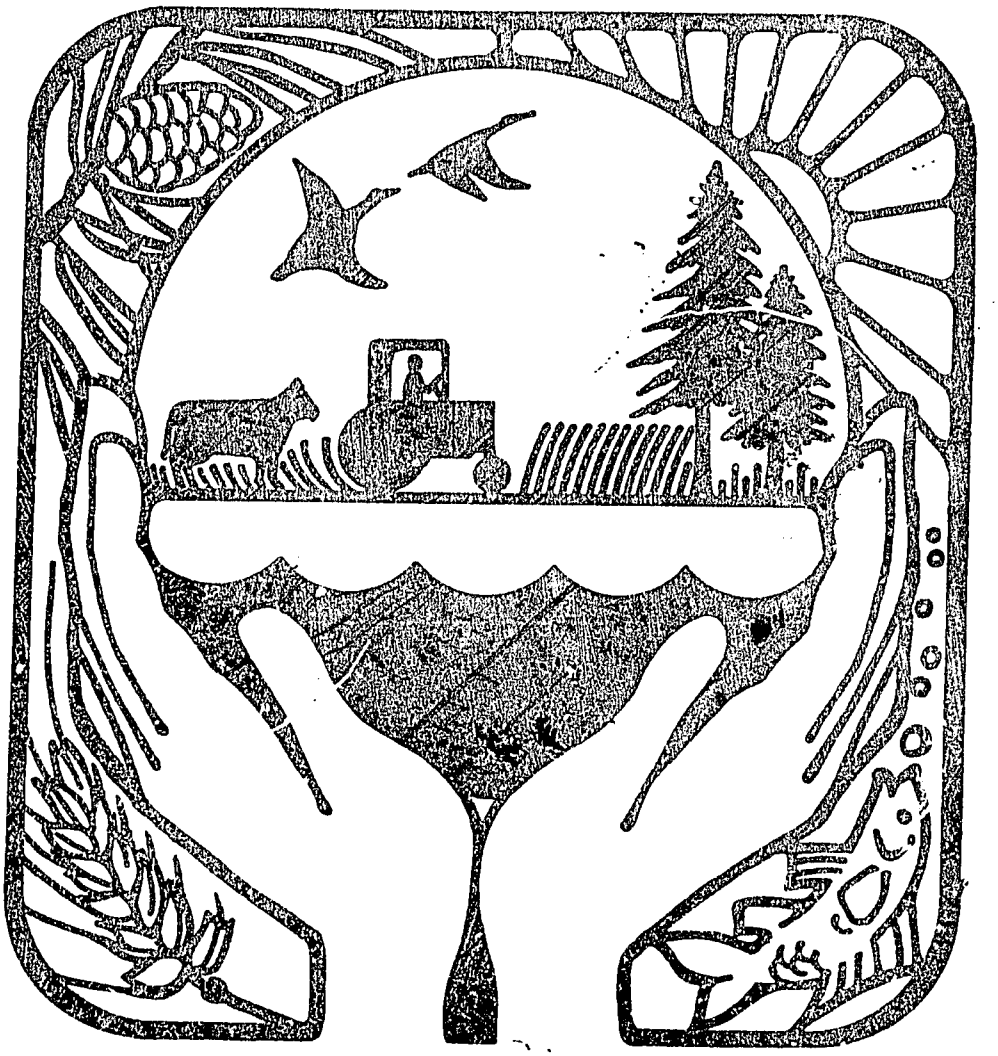
CONTENT - TABLE DES MATIERES - INHALTSVERZEICHNIS

APPENDIX C.

Program
Sustainable Agriculture and
Integrated Farming Systems conference at MSU

SUSTAINABLE AGRICULTURE & INTEGRATED FARMING SYSTEMS:



A Conference in Support of the Future

JUNE 11-13

The Kellogg Center Auditorium Michigan State University

CONFERENCE SPONSORS
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SUSTAINABLE AGRICULTURE & INTEGRATED FARMING SYSTEMS:

A Conference in Support of the Future

MONDAY

8:00 a.m. **Welcome & Introduction**
Thomas Edens (Departments of Resource Development and Entomology, MSU)

8:30 **Conference Goals & Objectives**
Cynthia Fridgen (Cooperative Extension Service, MSU)
Richard Harwood (Rodale Research Center)

9:30 Coffee Break

10:00 **SESSION I: AGRICULTURAL SUSTAINABILITY AND FARMING SYSTEMS INTEGRATION**
Coordinator: Herman Koenig (Assistant Vice President for Research and Development, MSU)

Speakers:
Gordon Douglass (Department of Economics, Pomona College) ***The Meanings of Agricultural Sustainability***
Englehard Boehncke (University of Kassel, West Germany) ***The Role of Animals in a Biological Farming System***
Herbert Koepf (Emerson College, Great Britain) ***Integrating Animals into a Production System***

Respondents:
Roger Black (Department of Agricultural Engineering, MSU)
Bernard Zandstra (Department of Horticulture, MSU)
Hans Sundemeier (Department of Agricultural Economics, University of Keil)

12:00 Lunch

1:00 p.m. **SESSION II: THE STRUCTURE, MANAGEMENT AND ECONOMICS OF ALTERNATIVE AGRICULTURAL SYSTEMS**
Coordinators: George Bird (Department of Entomology and Office of Integrated Pest Management Programs, MSU) and Lawrence Libby (Department of Agricultural Economics, MSU)

Speakers:
Elliot Coleman (Director of Agricultural Education, Mountain School, Vermont) ***Towards a New McDonalds Farm***
Steven Gliesman (Agroecology Program, University of Southern California) ***Relationships Between Economic and Ecological Factors in the Design and Management of Sustainable Agroecosystems***
Richard Harwood (Rodale Research Center) ***The Integration Efficiencies of Cropping Systems***
Helene Hollander (Cornucopia Project) ***Developing More Local Markets for Farmers: The Southern Alleghanies Story***
Nicholas Lampkin (University of Kassel, West Germany)
William Lockeretz (School of Nutrition, Tufts University) ***United States Organic Farming: What We Can and Cannot Learn From On-Farm Research***
Robert Miller (Department of Soil Science, North Carolina State University)

Respondents:
Fred Tschirley (Department of Botany and Plant Pathology, MSU)
Larry Connor (Department Agricultural Economics, MSU)

TUESDAY

8:00 a.m. **SESSION III: EXPANDED APPROACH FOR AGRICULTURAL RESEARCH: THE EUROPEAN MODEL**

Coordinator: Bernard Knezek (Michigan Agricultural Experiment Station and Department of Crops and Soil Science, MSU)

Speakers:
Peter Vereijken (Director of National Research Center, Netherlands)
Hartmut Vogtmann (Chair of Biological Agriculture, University of Kassel, West Germany)
Stephen Kaffka (Department of Agronomy, Cornell University) ***Patterns of Energy Use, Nutrient Cycling and Yields Over a Thirty-Year Period on a Self-Reliant Dairy Farm***

Respondents:
Margaret Bubolz (Department of Family and Child Ecology, MSU)
Dale Harpstead (Department of Crop and Soil Science, MSU)
Donald Isleib (Institute of International Agriculture, MSU)

10:00 Coffee Break

10:30 **SESSION IV: ALTERNATIVE AGRICULTURAL SYSTEMS: ECOLOGICAL IMPACTS**

Coordinator: Dean Haynes (Department of Entomology, MSU)

Speakers:
Miguel Altieri (Department of Entomology, University of California, Berkeley) ***Diversification of Agricultural Landscapes. A Vital Element for Pest Control in Sustainable Agroecosystems***
Terry Cacek (United States Department of the Interior—Fisheries and Wildlife, Denver) ***Impacts of Organic Farming and Reduced Tillage on Fish and Wildlife***
Maureen Hinkel (Audubon Society)
Gunter Kahnt (Institute of Plant Production, University of Hoheneim, West Germany)

Respondents
Mark Whalon (Department of Entomology, MSU)
Eleanor Groden (Department of Plant Pathology and Entomology, University of Rhode Island)
James Miller (Department of Entomology, MSU)
John Schweitzer (Urban Affairs Program, MSU)

12:30 Lunch

1:30 p.m. **SESSION V: THE ROLE OF ETHICS AND VALUES IN AGRICULTURE**

Coordinator: Jon Bartholic (Department of Resource Development, MSU)

Speakers:
Kenneth Dahlberg (Department of Political Science, Western Michigan University) ***Ethical and Value Dimensions of Agricultural Systems and Agricultural Research***
Maynard Kaufman (Department of Religion, Western Michigan University) ***The Pastoral Ideal and Sustainable Agriculture***
Robert Bealer (Department of Rural Sociology, The Pennsylvania State University) ***Regenerative Agriculture: One More River to Cross***
Philip Shepard (Department of Philosophy, Lyman Briggs College, MSU) ***Value Clarification and Moral Responsibility in Agriculture***

Respondents:
Patricia Barnes-McConnell (Cowpea Research Institute, MSU)
Harold Schwartzweller (Department of Sociology, MSU)
Craig Harris (Department of Sociology, MSU)

3:30 Coffee Break

4:00 **SESSION VI: TECHNOLOGY TRANSFER**
Coordinator: Mary Andrews (Program Leader and Extension Administrator, MSU)

Speakers:
Edwin French (Department of Agronomy, University of Florida) ***Appropriate Technology as an Appropriate First Step***
Patrick Madden (Department of Agricultural Economics, The Pennsylvania State University) ***Regenerative Agriculture and the Technological Delivery System***
Gerhard Plakholm (Austrian Ministry of Agriculture, Austria)
Lawrence Woodward (Elm Farm Research Centre, Great Britain)

Respondents:
Garth Youngberg (Executive Director, Institute for Alternative Agriculture)
David Merck (Cooperative Extension Service, MSU)
John Houdek (Western Michigan University)

WEDNESDAY

8:00 a.m. **CONFERENCE SESSION SUMMARIES**
Facilitator: Charles Laughlin (Associate Director, Georgia Agricultural Experimental Station, University of Georgia)
Summaries by Session Coordinators

9:30 Coffee Break

10:30 Discussion

12:00 Lunch

1:30 p.m. **Open Forum: Question & Answer Session**

4:30 Adjourn

5:00 **Reception—Big Ten Room**

5:45 **Dinner—Big Ten Room**

6:45 **Welcome and Reception Remarks**
James Anderson (Dean, College of Agriculture and Natural Resources, MSU)
Robert Gast (Director, Michigan Agricultural Experiment Station, MSU)
Gordon Guyer (Director, Cooperative Extension Service, MSU)
Lawrence Woodward (Director, Elm Farm Research Centre, Great Britain)

KEYNOTE ADDRESSES
Great Hall, Wharton Center for the Performing Arts

8:00 Harold Breimyer (Department of Agricultural Economics, University of Missouri) ***Sustainability in the Context of Political and Economic Realities***

9:00 Robert Rodale (President, Rodale Press) ***The Past & Future of Regenerative Agriculture***

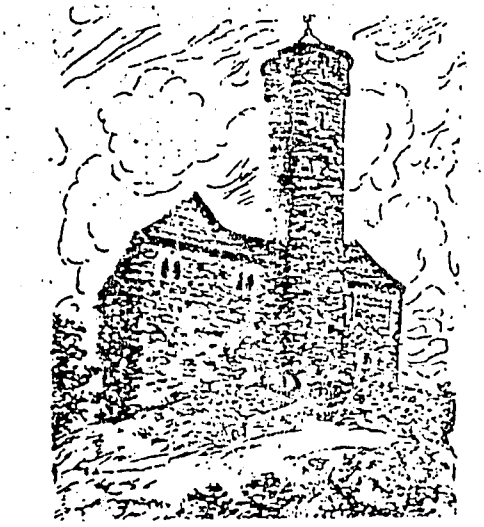
APPENDIX D.

Program
The Importance of Biological Agriculture
in a World of Diminishing Resources

INTERNATIONAL
FEDERATION of
ORGANIC
AGRICULTURE
MOVEMENTS

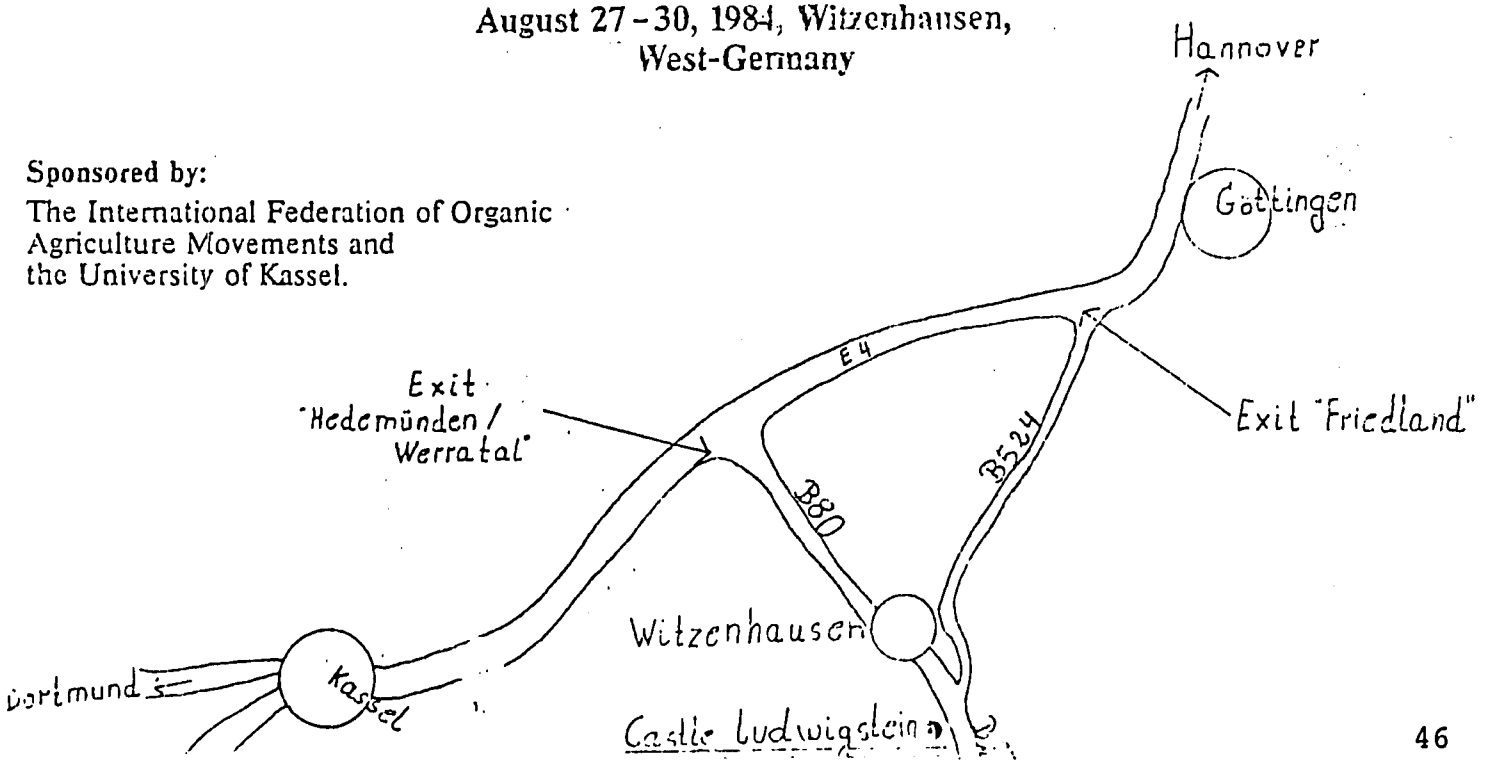
The importance of biological agriculture in a world of diminishing resources

The Fifth IFOAM International Scientific Conference at the University of Kassel (Germany)



Schloss-Castle-Ludwigstein,
August 27 - 30, 1984, Witzenhausen,
West-Germany

Sponsored by:
The International Federation of Organic Agriculture Movements and the University of Kassel.



APPENDIX E.

"Self Reliance: a New National Policy"

Self-Reliance: A New National Policy

Editor's Note: The following is the text of Tanzanian President Julius K. Nyerere's opening address at the *Workshop on Resource-Efficient Farming Methods*, a joint project involving Tanzanian government and scientific leaders at all levels, the U.S. Agency for International Development, and Rodale Press. For details on the events leading up to this historic conference, see Robert Rodale's article "The Road to Morogoro."

JULIUS K. NYERERE,
President of Tanzania

MOROGORO, Tanzania—About 80 percent of our people now get their living from the land, and almost all the rest of us are the children of peasant farmers. We often have a plot of land of our own. I do, and so we do not need to be told that our lives and our future depend on the land, and on its output. But I think we may be guilty of taking the land for granted. Except in a few areas like Kilimanjaro and parts of the Kagera region, there is and always has been plenty of land for anyone who wanted to farm. We have used it, and when it began to produce less, we have abandoned a plot and moved elsewhere. If we left it long enough, natural regeneration occurred before we came back to the same plot.

But this practice of shifting agriculture is no longer feasible. Our population is increasing very fast, so there will not always be "plenty of land." Also, we have abandoned the practice of living like permanent refugees in temporary huts scattered throughout the countryside. Now, we live in villages and are gradually building permanent houses; our farms also have to be permanent, and reasonably near where we live. The same piece of soil has to go on for year after year, producing the food and export crops we need for our survival. It is, therefore, vital that we should recognize—and recognize quickly—the need to adapt our traditional farming practices to these new conditions. The soil of Tanzania is a valuable and irreplaceable natural resource, which belongs to our descendants, as well as to the present generation, and we have to treat it accordingly.

> "This workshop is an example of the most altruistic kind of assistance; we shall not buy a single extra ton of American fertilizer or machines as a result of this week's activities . . ."
>
> **From President Nyerere's opening remarks at the *Workshop on Composting and Organic Farming* for Tanzanian agriculture leaders, May 16, 1983**

Growing crops use energy. They take goodness out of the land. But fortunately, we now know that different kinds of crops take different elements from the soil, and some crops even put particular substances back into it. Without realizing what has happened, and why it has happened, our peasants have traditionally recognized this scientific fact in practice. They knew that after growing maize, or millet on a plot for a year or two, it became less productive. But they also knew that by leaving that plot to be recaptured by the bush, they could later come back to it and use it for grain a second time. They also knew that the ash from burning crop residue on the plot was a good thing, although few, if any, of our tribal languages had any scientific terms to describe what was happening. By such practices, our peasants were fertilizing the soil, albeit very crudely and inefficiently. Their methods, however, are no longer appropriate, sufficient, or, indeed, possible for us, at least as a program for the medium- or longer-term future.

We now live in villages. We have more and more people to feed from our land. Our farmers now have to feed and support a much larger number of people who do not cultivate for themselves. It is in these new circumstances that we have three tasks to fulfill. First, we have to maintain the existing fertility of our soil. Secondly, we have to improve that fertility. And thirdly, we have to do this economically on the basis of self-reliance, and in a sustainable manner.

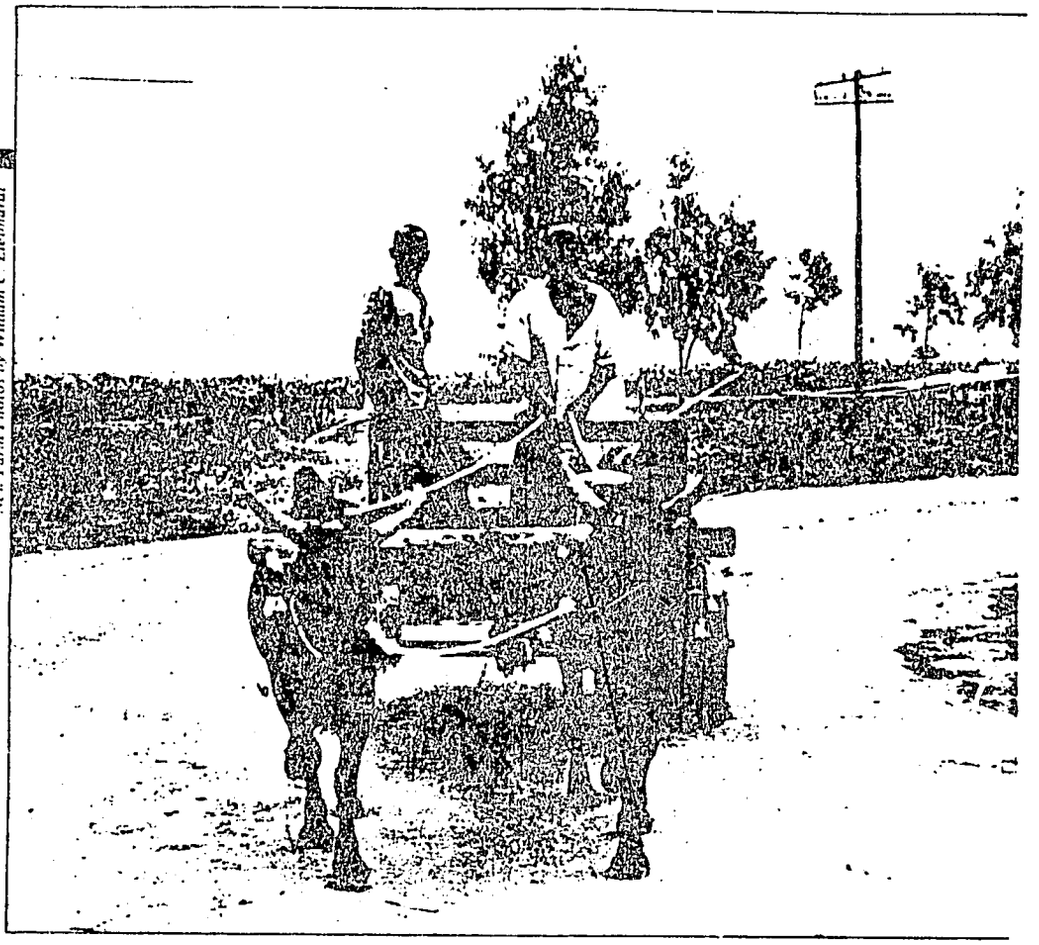
The systems of shifting agriculture, of "burning and slashing," and of moving whole communities to new areas, have, for a long time, been recognized as being inefficient or inappropriate for modern needs. When I was at school, in colonial times, we were taught how to make compost and urged that this was a good thing to do. But few of those who went to school in those days ever went back to work on the land; we became clerks or teachers, and tended to regard this knowledge of compost as an irrelevance. It may be that, at that time, agricultural officers were urging the use of compost upon the farmers—but

the Extension Service did not reach very far. In any case, when our country became independent (in 1961), our ambition was to "modernize" our economy. We did not work this out very thoroughly; but it appeared to us that if you wanted a productive agriculture, you had a mechanized agriculture, and you used chemical fertilizers, chemical insecticides, and—to be completely up to date—even herbicides. That, at least, was our vision of American and Canadian agriculture — and we were often told that America is the most productive agricultural country.

As we are a very poor country, we could not move very fast on mechanizing our agriculture, but we did establish some publicly owned commercial farms, and while we had any foreign exchange, we bought tractors and combine harvesters for them. We taught our peasants also to hanker after those machines. As few could afford to buy them, or had the means to get them maintained if they did, our peasants went on working with the hand-hoe. It is only in very recent years that we have begun to put emphasis on what we can do—that is, to move from the hand-hoe to animal-drawn implements.

We seem, looking back, to have acted in a very similar manner on questions relating to feeding the soil. We urged the use of chemical fertilizers; we established a fertilizer factory—heavily dependent on imported components—and we ensured that chemical fertilizers were used in growing certain of our export crops, especially cotton and tobacco. We also adopted a World Bank-assisted maize program, which depended upon using chemical fertilizers. For the rest, we left our peasants to carry on as before. We even stopped teaching compost-making in our schools, regarding this as a discredited and "old-fashioned" technique, which was irrelevant to our future.

The net result has been that in many places, nothing is done at all to re-fertilize our soil after it has been used, much less to improve the fertility. Our peasants can no longer "move on" after their plot has lost its fertility; they just get less result from their sweat and—legitimately— complain that having told them to use fertilizer, we do not make it available at a price they can afford or when they need it. And sometimes, the continual use of chemical fertilizers makes the soil very acidic, and thus reduces its productivity. We get less cotton per hectare in Sukumaland now than we used to.



New Farm Photos by William C. Lockhardt

Technicians from the University of Dar Es Salaam at Morogoro drive load of equipment back from the fields after a demonstration of composting (compost piles at far right) and tours of test plots comparing chemical and non-chemical farming.

And we also discovered that in Europe, and in America itself, there are now very many people who say that heavy use of chemicals on their soils has done great damage, both to the soil itself and to their water supplies. Heavier and heavier dosages are required year after year to achieve the same result. And in some places, especially when insecticides are being used, both the soil and its produce are being poisoned. I am told that there are some U.S. farmers who use chemicals to get a high output from their commercial crops, but who meet their homestead needs from a separate area where they do not use chemicals at all. There is also a recent Indian report about the environmental effects of the Green Revolution, with its heavy dependence on fertilizer, which has revealed adverse effects on the health of farmers, and of some peasants who do not themselves partake of the benefits of the new methods, but whose soil is affected by water flowing from the Green Revolution areas.

We have not reached this intensity in the use of chemical fertilizers, except possibly in the cotton fields, where the need may be to change the type of chemical fertilizer used. And there is no reason why we should be afraid of chemicals, any more than a man with an occasional headache should refrain from using aspirin because other people use so many that they die.

For I am not one of those, although I know that such people do exist, who are against chemical fertilizers and insecticides on principle. I believe they can be very useful, alone or in combination with natural methods of soil protection, when used in

New Farm Photo by Richard Harwood

During a break in the workshop on composting and organic farming, Tanzanian President Julius K. Nyerere (right) visits with John Haberern, Rodale Press senior vice president (left), and Medard Gabel, director of the Cornucopia Project (center left).

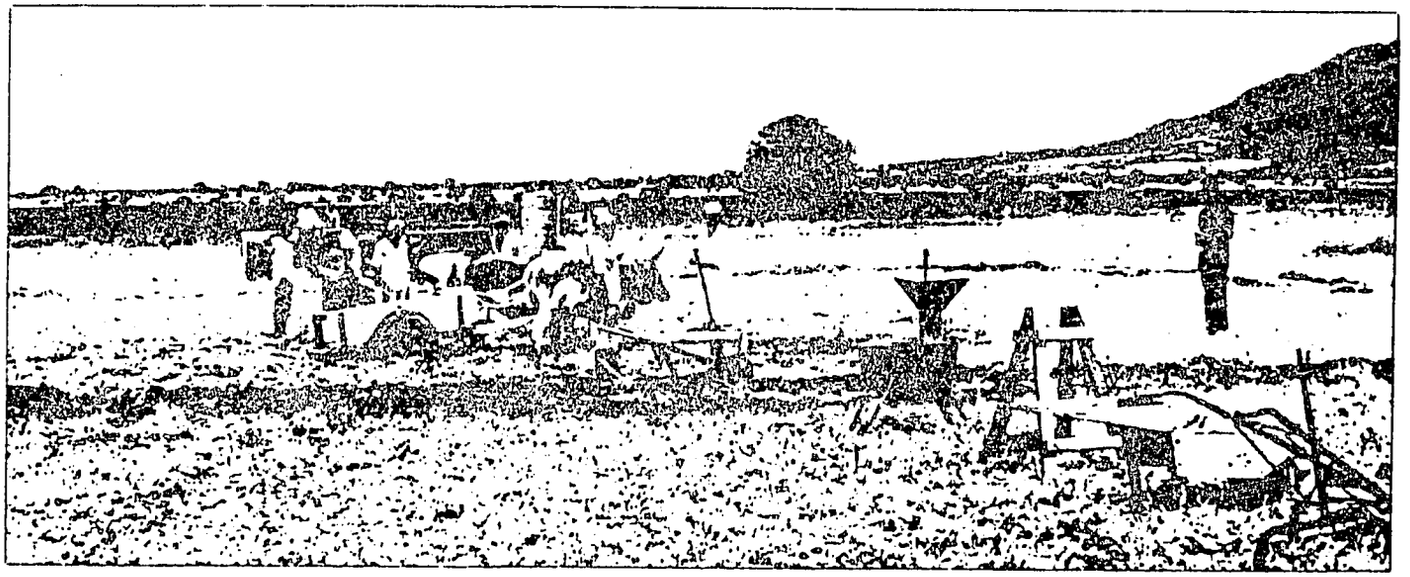
moderation in appropriate circumstances. We do have commercial farms in Tanzania: they should and they must use chemical fertilizers to maintain and improve their soil fertility, even if they also use natural methods of soil enrichment. There are certain crops which seem to grow economically in Tanzania only in tandem with chemical fertilizers. It may be that even for the latter, there are better ways—more self-reliant ways—of fertilization; but until we are sure of that, and know what they are, we must continue to buy or make chemical fertilizers and transport them to the farms and the fields.

For there is the problem: Chemical fertilizers are a manufactured by-product of oil or natural gas, or are minerals which have been treated in a large factory, or both. We have one fertilizer factory in Tanzania, a country of about 360,000 square miles. Until this year, it has been getting its raw phosphate (as well as all of its other chemical inputs) from overseas. In the future, it will get it from a mine just opened some 310 miles away. Inevitably, the fertilizer is expensive. All oil-based products are expensive, and transport, as well as the imported chemicals, depend on oil products. Further, in our case, the foreign exchange shortage means that supplies of fertilizer are sometimes interrupted—the factory closes down because we do not have the foreign money with which to buy its inputs. And there is for us also the physical difficulty of transporting the manufactured fertilizer over hundreds of miles of old railway line with few wagons, and over poor roads with old lorries. Quite frequently, the fertilizer does not arrive at the farm at the time it is needed.

Fortunately, most Tanzanian agriculture does not have to depend upon chemical fertilizers. There are scientific methods of agriculture which preserve soil fertility and use no chemicals at all. It is those, or some of them, which we have come to this workshop to learn about.

In many parts of Tanzania, our peasants traditionally grew a main crop and another crop in the rows between it, or sometimes just scattered among

Standard Tanzanian farm implements on display during field demonstrations. The array includes a rare oxcart and an even rarer working tractor.



the other seeds. In our enthusiasm for the highest output of a particular cr), we were at one time discouraging this practice. It is now clear that, once again, the peasants knew better than the experts, for the total crop output from intercropping systems is frequently higher than that where a plot is reserved for the main crop only. And certainly, labor productivity is often higher, because the need for weeding is reduced and the soil is preserved from being either baked or washed away. Everything depends upon which crops you combine. Scientists can now tell us which combinations are appropriate and why. For example, they can explain why it is good in certain kinds of soils to interplant rows of maize with rows of particular legumes, or banana plants with certain kinds of fodder grasses. Also, they have demonstrated that appropriate interplanting reduces the incidence of some plant diseases, or insect infestation; they can often tell us which kinds of intercropping have those effects. We have such scientists, and such experimental plots in Tanzania. Our trouble is that we do not disseminate that knowledge, and put it into practice.

Again, appropriate crop rotation—planting different crops in a cycle of three or four years—can maintain or improve the fertility of the soil, without the application of fertilizer, or even manure or compost: it depends what your rotation is, and the correct one depends upon your soil. For example, experimental results from Ukiriguru have shown that a fallow period of three to four years has the same effect as six tons of manure per acre—and the three or four years in which a cassava crop is left in the ground in that area produce an effect comparable with a long period of fallow. This principle of crop rotation is very easy for our peasants to understand. It is, in effect, what they have been practicing by their system of shifting agriculture.

Nor is that all. Where the soil fertility has already deteriorated, or where, for economic or other reasons, the peasant does not want to follow an appropriate crop rotation pattern, it is still possible to improve fertility by natural methods. There is the practice of "green manure," digging the crop residue back into the soil. And there is compost. This also amounts to putting back into the soil the goodness which has been taken out of it. Finally, for those areas where domestic animals are part of the peasant culture, there is the use of manure. Again, we have in Tanzania places where this is used to the maximum—with very impressive results. I hope that some of you will have visited such farms; often they are run by our own experimental or training institutions, or by missionaries.

Compost and other methods of fertilization are the subject of this workshop. I have been talking only in general terms, and about the principles; the experts are here with us. Gentlemen, you are very welcome. I know that these farmers from the Rodale Institute will be the first to tell us that neither they nor their country are unique in their knowledge, or their practice of what is sometimes called "organic farming". There are practitioners throughout the world. But it is perhaps appropriate that we should welcome Americans talking on this subject. For if these methods of farming can hold their own in the home of mechanical and chemical farming, then surely people can hardly question their relevance to getting increased output in our own conditions of very much lower agricultural productivity.

And let us remember that our recently published Agricultural Policy Statement gives very great emphasis to improving our peasant agriculture—increasing its output per acre, and per man-hour. The use of compost, manure, crop rotation and intercropping is the answer to the peasants' questions about how they can increase their income, without becoming dependent upon an unreliable supply of expensive fertilizers and other inputs from outside their village a..d farms. Compost can, as I understand it, be made in each field. It certainly does not have to be transported from Tanga. When we talk about village self-reliance as being the foundation of national self-reliance, this is the kind of thing we should be talking about. □

Students from a technical school on the slopes of Mt. Kilimanjaro cultivate crops in a scene typical of rural Tanzania.

APPENDIX F.

Project Descriptions
Office of Agriculture
Bureau for Science and Technology

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON D C 20523

OFFICE OF AGRICULTURE

BUREAU FOR SCIENCE AND TECHNOLOGY

CENTRALLY-FUNDED AGRICULTURAL PROJECTS AND PERSONNEL AVAILABLE TO USAID MISSIONS

Prepared May 1983

PROJECT: Mixed Crop/Livestock Farming Systems, #4133 START: FY 83 / END: FY 88

PURPOSE: To conduct applied research on animal production in mixed farming systems in LDCs.

DESCRIPTION: The project will focus on integrated crop/livestock farming which is the predominate type of agriculture in 60% of the countries where AID operates. Project activities will collaborate and coordinate with the livestock/farming systems programs of International Agricultural Research Centers (IARCs) and extend IARC and regional research networks to national program levels. The project will direct applied research and training to the immediate production needs of LDC small farmers. Results of project activities will also feed into the Farming Systems Support Project.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions	Yes X No___
Information Sources	Yes X No___
Host Country/LDC-Based Training Workshops	Yes X No___
U.S. or Third Country Degree Training	Yes X No___
Research	Yes X No___

Other Project Components:

Examples of Past Activities Under this Project:

GEOGRAPHIC CONCENTRATION: Africa___ Latin America/Caribbean___ Asia ___ Near East___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical___ Arid/Semi-Arid___ Humid X Rainfed___ Irrigated___ Worldwide X

CONTACT AID/W Project Officer: Dr. John P. Bishop, S&T/AGR/AP

PROJECT CONTRACTOR/MANAGEMENT ENTITY:

Not yet contracted - project is in design stage.

PROJECT: Pest Management and Related Environmental Protection, #0930 START: FY 80 / END: FY 85

PURPOSE: To provide training and technical assistance in crop protection.
DESCRIPTION: Emphasis is given to the integrated pest management approach (IPM). When pesticides are to be used, assistance is provided to assure that their use is needed and is cost-effective. Training components include pest management seminars/workshops, IPM short courses, chemical pesticide residue analysis training and "train-the-trainer" courses aimed at developing country farmers.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions: Yes X No
(Project design/evaluation; preparation of Initial Environmental Examinations and Environmental Assessments where pesticides are to be used in AID-funded projects)

Information Sources Yes X No
(Proceedings of seminars, workshops and IPM short courses; publications - e.g., "An Agromedical Approach to Pest Management;" training kits in "Safe Use of Pesticides")

Host Country/LDC-Based Training Workshops Yes X No

U.S. or Third Country Degree Training Yes No X

Research Yes No X

Other Project Components:
Training in crop protection, principles of IPM, safe use of pesticides, and pesticide residue analysis.

Examples of Past Activities Under this Project:
(1) Seminar/workshop on pest and pesticide management in the Caribbean, (2) Project Redesign Team : West African Regional Food Crop Protection Project, (3) Environmental Assessment for Use of Pesticides in Tunisian Agricultural Research Project, (4) Assistance to USAID/Niger in the design of crop protection component of its ongoing agricultural research project.

GEOGRAPHIC CONCENTRATION: Africa ___ Latin America/Caribbean ___
Asia ___ Near East ___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate ___ Tropical/Sub-Tropical ___ Arid/Semi-Arid ___
Humid ___ Rainfed ___ Irrigated ___ Worldwide X

CONTACT AID/W Project Officer: Carroll W. Collier, S&T/AGR/AP

PROJECT CONTRACTOR/MANAGEMENT ENTITY:
Dr. Ray F. Smith - Consortium for International Crop Protection (CICP)
2288 Fulton Street, Suite 310 - Berkeley, California 94704

ADDITIONAL CONTACTS:
University of Miami/School of Medicine/Division of Chemical Epidemiology
15655 S.W. 127th Avenue - Miami, Florida 33177

PROJECT: Soil Families (Benchmark Soils), #0582 START: FY 74 / END: FY 83

PURPOSE: To accelerate the adaptation and delivery of appropriate, cost-effective agroproduction technology to the developing countries in the tropics.

DESCRIPTION: This project has successfully tested the hypothesis that agroproduction technology can be transferred from its site of origin to other locations with similar agro-environments in widely separated parts of the world. A system of soil classification called "Soil Taxonomy," developed by the USDA Soil Conservation Service, contains the basis of the hypothesis. The soil families classification under Soil Taxonomy stratifies the agroenvironments into agroproduction niches.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions	Yes___ No X
Information Sources (Publications & communications)	Yes X No___
Host Country/LDC-Based Training Workshops	Yes X No___
U.S. or Third Country Degree Training	Yes X No___
Research	Yes X No___

Other Project Components:

Examples of Past Activities Under this Project:

GEOGRAPHIC CONCENTRATION: Africa___ Latin America/Caribbean___ Asia ___ Near East___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical___ Arid/Semi-Arid___ Humid___ Rainfed___ Irrigated___ Worldwide X

CONTACT AID/W Project Officer: Dr. James L. Walker, S&T/AGR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:

Dr. J. Silva/Dr. G. Tsuji
University of Hawaii/Dept. of Agronomy and Soils
2500 Dole Street, Krauss Hall 22
Honolulu, Hawaii 96822
Tel. 808/948-6604

PROJECT: Soil Management Support Service, #1229 START: FY 79 / END: FY 88

PURPOSE: To develop the prerequisites for soil-based agrotechnology transfer to and among tropical and subtropical countries.

DESCRIPTION: The project provides field support assistance to AID missions and LDCs on programs or problems relating to land use and land use planning for food production. It offers assistance to soil management programs relating to problems in agronomic production systems, soil erosion, and soil and water conservation. Other services provided are technical assistance and training in the use of "Soil Taxonomy" and guides to improving Soil Taxonomy in tropical and subtropical areas.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions (Project design and evaluation; advice on project/program strategies; specific analytical/field-testing services)	Yes X No
Information Sources	Yes X No
Host Country/LDC-Based Training Workshops	Yes X No
U.S. or Third Country Degree Training	Yes No X
Research	Yes No X

Other Project Components:
International committees will be established to deal with specific facets of Soil Taxonomy, and international workshops will be held in LDCs to improve Soil Taxonomy for the tropics.

Examples of Past Activities Under This Project:
Regional training courses have been held to strengthen professional staff in the LDCs. Technical assistance has been provided to 25 countries by 50 professionals. Technical monographs have been published and others are underway.

GEOGRAPHIC CONCENTRATION: Africa ___ Latin America/Caribbean ___
Asia ___ Near East ___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate ___ Tropical/Sub-Tropical ___ Arid/Semi-Arid ___
Humid ___ Rainfed ___ Irrigated ___ Worldwide X

CONTACT AID/W Project Officer. Raymond E. Meyer, S&T/AGR/RIR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:

USDA Soil Conservation Service
P.O. Box 2890
Washington, D.C. 20013
Tel. 202/382-1828

PROJECT: Soil Management Collaborative Research Support Program (CRSP), #1311 START: FY 81 / END: FY 91

PURPOSE: To find economical ways to increase the productivity of tropical soils while protecting them from both short-term and cumulative damage, and to enlarge the pool of scientists working on soil problems in developing countries.

DESCRIPTION: Activities include research on land clearing, soil preparation, fertility maintenance through conservation, rotation, and fertilizer use combined with liming and use of organic residues. Special attention is given to crusting in Sahelian zone soils.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions	Yes X No___
Information Sources	Yes X No___
Host Country/LDC-Based Training Workshops	Yes X No___
U.S. or Third Country Degree Training	Yes X No___
Research	Yes X No___

Other Project Components:
Technical Assistance available at cost (it cannot be furnished from project funds).

Examples of Past Activities Under this Project:
Work incorporated from earlier project has shown that yields can be sustained for 25 crops over a ten-year cycle. External plant nutrient inputs are essential, but some of these requirements can be satisfied by legumes in a rotation, by compost, or by mulch from nearby uncultivated lands. Some fertilizer and lime are required for satisfactory crops.

GEOGRAPHIC CONCENTRATION: Africa X Latin America/Caribbean X
Asia X Near East___ Worldwide___

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical X Arid/Semi-Arid X
Humid X Rainfed X Irrigated___ Worldwide___

CONTACT AID/W Project Officer: John L. Malcolm, S&T/AGR/PMR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:
Charles B. McCants
TROPSOILS Management
North Carolina State University
P.O. Box 5306
Raleigh, North Carolina 27650

ADDITIONAL CONTACTS:

Goro Uehara	Douglas Lathwell	John Nicholaides	Frank Calhoun
Soil Science Dept.	Agronomy Dept	Soil Science Dept	Dept. of Soil
Univ. of Hawaii	Cornell University	N.C. State Univ.	and Crop Sci. Texas A & M

PROJECT: International Benchmark Sites Network (IBSNAT), #4054 START: FY 82 / END: FY 90

PURPOSE: To organize, assemble, store and utilize crop and land resource management data from international and national agricultural centers in data bank(s) for the purpose of transferring cost-effective food production technology among similar agro-ecological regions of the developing world.

DESCRIPTION: The project aims to set up a prototype network that will serve as a model to demonstrate the operation of agro-technology transference systems and provide training ground for more comprehensive operational networks (regional, national and international) to fulfill LDC needs for crop production technology transfer.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions	Yes X No ___
Information Sources (Publications, seminars)	Yes X No ___
Host Country/LDC-Based Training Workshops	Yes X No ___
U.S. or Third Country Degree Training	Yes ___ No X
Research	Yes X No ___

Other Project Components:

Examples of Past Activities Under this Project:
(New project getting underway)

GEOGRAPHIC CONCENTRATION: Africa ___ Latin America/Caribbean ___ Asia ___ Near East ___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate ___ Tropical/Sub-Tropical ___ Arid/Semi-Arid ___ Humid ___ Rainfed ___ Irrigated ___ Worldwide X

CONTACT AID/W Project Officer: Dr. T. S. Gill, S&T/AGR/RNR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:

Dr. G. Uehara/Dr. G. Tsuji
University of Hawaii
Department of Agronomy & Soil Science
2500 Dole Street, Krauss Hall 22
Honolulu, Hawaii 96822
Tel. 808/948-6604

PROJECT: Dryland Management Synthesis, #4135 START: FY 83 / END: FY 88

PURPOSE: To increase host country capabilities to plan and implement dryland agricultural management projects/programs.

DESCRIPTION: The project is concerned with areas where lack of precipitation is the limiting production factor during the crop-growing season. It provides technical assistance and training in dryland technology to host country institutions through missions and conducts special studies. It also disseminates information about dryland agriculture and appropriate dryland technologies for adaptation and adoption. The project emphasizes the soil and water management aspects of dryland agriculture and works to develop linkages among AID missions, host government institutions, and national and international research programs.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions (Project design, evaluation)	Yes X No___
Information Sources (Planning guides, field manuals)	Yes X No___
Host Country/LDC-Based Training Workshops (Also U.S.-based training)	Yes X No___
U.S. or Third Country Degree Training	Yes___ No X
Research	Yes X No___

Other Project Components:
Pilot-testing/case countries involving the selection and testing of technologies to increase dryland production. In exceptional cases, a longer term relationship may be developed between the Dryland Management Synthesis Project and AID missions, International Agricultural Research Centers, and country institutions.

Examples of Past Activities Under this Project:
Technical assistance and training in soil water and agro-climatic aspects of agronomic management. Preliminary outlining of country research strategies in dryland activities. Analysis of rainfed vs. irrigated production potential.

GEOGRAPHIC CONCENTRATION: Africa___ Latin America/Caribbean___
Asia ___ Near East___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical___ Arid/Semi-Arid X
Humid ___ Rainfed X Irrigated__ Worldwide___

CONTACT AID/W Project Officer: Raymond E. Meyer, S&T/AGR/RNR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:

To be determined

PROJECT: World Rhizobium Collection Center, #0095 START: FY 76 /Continuing

PURPOSE: (1) To provide intern-type training for LDC scientists, (2) To distribute requested rhizobial strains and information to researchers worldwide, and (3) To maintain a germ plasm bank of characterized and evaluated nitrogen-fixing microbes of agricultural significance in biological nitrogen fixation (BNF).

DESCRIPTION: Effective use of BNF requires the correct strain of nitrogen-fixing bacteria (Rhizobium) and the correct legume variety. A useful superior strain represents an investment of at least $500,000 due to the necessary collection, screening, characterization and evaluation of inoculant in laboratory and farm trials. Superior strains are available on request for local testing. LDC scientists desiring intern training should apply through AID or directly to USDA.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions (BNF program assessment, project design, evaluation)	Yes X No___
Information Sources (Catalogs, personal correspondence)	Yes X No___
Host Country/LDC-Based Training Workshops	Yes___ No X
U.S. or Third Country Degree Training (Could be arranged through Univ. of Maryland)	Yes X No___
Research	Yes X No___

Other Project Components:
Intern-type training; provision of tested rhizobial strains.

Examples of Past Activities Under this Project:
Intern-type training for scientists from Mali, Tanzania, Egypt and Thailand. Distribution of 450 strains of rhizobia each year to researchers worldwide.

GEOGRAPHIC CONCENTRATION: Africa___ Latin America/Caribbean___ Asia ___ Near East___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical___ Arid/Semi-Arid___ Humid ___ Rainfed___ Irrigated ___ Worldwide___

CONTACT AID/W Project Officer: Lloyd R. Frederick, S&T/AGR/RNR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:
Dr. Deane F. Weber
U.S. Department of Agriculture
Nitrogen Fixation Laboratory
BARC-West. HH19 Range 1
Beltsville, Maryland 20705

PROJECT: Nitrogen Fixation - Limiting Factors, #0610 START: FY 76 / END: FY 89

PURPOSE: To promote the cooperative work of LDC scientists to solve problems limiting biological nitrogen fixation (BNF) and to develop practical ways to improve the contribution of BNF in farming systems.

DESCRIPTION: Biological nitrogen fixation offers an opportunity to reduce the annual multi-billion dollar need for manufactured nitrogen fertilizer. BNF is limited, however, by the absence of appropriate symbiotic bacteria and other factors limiting crop growth. Failures of legume inoculants (both local and imported) are common, signaling the need for improved inoculants to assure reliability. Other problems involve insect larvae, which destroy nodules, and the persistence in the soil of rhizobia for one legume in a cropping system, which may lead to ineffective nodules on succeeding legumes. These and other problems can be attacked by small, discrete grants. Grants are awarded for a three-year period, with priority given to problems identified in developing/ tropical areas and to cooperative work between LDC and U.S. scientists.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions (TDY Technical Assistance to LDC scientists and country programs)	Yes X No___
Information Sources (Scientific articles)	Yes X No___
Host Country/LDC-Based Training Workshops	Yes___ No X
U.S. or Third Country Degree Training	Yes X No___
Research	Yes X No___

Other Project Components: Cooperative research with LDC scientists.

Examples of Past Activities Under this Project:
Twenty-five grants have been made for cooperative research involving scientists in Kenya, Sudan, Panama, Guyana, Morocco, Senegal, Egypt, Thailand, El Salvador, Honduras, Colombia, Venezuela, Brazil, Chile, Nigeria, Mexico, Turkey, Bangladesh and Malaysia.

GEOGRAPHIC CONCENTRATION: Africa___ Latin America/Caribbean___
Asia ___ Near East___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical___ Arid/Semi-Arid___
Humid ___ Rainfed___ Irrigated___ Worldwide X

CONTACT AID/W Project Officer: Lloyd R. Frederick, S&T/AGR/RNR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:
Dr. Charles Smith - USDA/CSRS
Washington, D.C. 20250

ADDITIONAL CONTACTS:
Dr. Gerald Elkan
Dept. of Microbiology - North Carolina State University
Raleigh, North Carolina 27650

PROJECT: Nitrogen Fixation, Symbiotic (NifTAL), #0613 START: FY 75 / END: FY 89

PURPOSE: To develop practical ways to enable tropical root-nodulated crops to capture nitrogen from the air and to increase food production by use of tropical legumes.

DESCRIPTION: The project works to (1) Assess and help develop national biological nitrogen fixation (BNF) programs, (2) Provide short-term, intern and graduate degree training programs for LDC scientists in the use of root nodule bacteria (rhizobia) and the application of BNF in cropping systems, (3) Design and implement systems for legume inoculant production and distribution, (4) Coordinate local scientist participation in legume inoculation trials, (5) Provide selected rhizobial cultures for improved legume seeds, (6) Link scientists through workshops, information exchange and the BNF Bulletin, and (7) Provide technical assistance in the optimum use of legumes in farming systems. The University of Hawaii's NifTAL (Nitrogen Fixation by Tropical Agricultural Legumes) program has developed a central facility for laboratory, greenhouse and field testing of the rhizobia-legume symbiosis for more than 50 tropical legumes used in cropping systems.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions (Project design, evaluation and implementation)	Yes X No ___
Information Sources (Articles, training and extension materials)	Yes X No ___
Host Country/LDC-Based Training Workshops	Yes X No ___
U.S. or Third Country Degree Training	Yes X No ___
Research	Yes X No ___

Other Project Components:

Examples of Past Activities Under this Project: Technical assistance in N-fixing trees in Thailand; inoculant production in Africa and Asia.

GEOGRAPHIC CONCENTRATION: Africa ___ Latin America/Caribbean ___ Asia ___ Near East ___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate ___ Tropical/Sub-Tropical ___ Arid/Semi-Arid ___ Humid ___ Rainfed ___ Irrigated ___ Worldwide X

CONTACT AID/W Project Officer: Lloyd R. Frederick, S&T/AGR/RNR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:
Dr. Jake Halliday
University of Hawaii - NifTAL - P. O. Box "O"
Paia, Hawaii 96779 Tel. 808/579-9578

ADDITIONAL CONTACTS:
Dr. Delane Welsch
Department of Agr. Economics
University of Minnesota
St. Paul, Minnesota 55108

Dr. Donald Munns
Land, Air and Water Resources Dept.
University of California
Davis, California 95616

PROJECT: Nitrogen Fixation, Associative (Non-symbiotic), #1004 START: FY 77 / END: FY 85

PURPOSE: (1) To determine practical ways to enable grasses to capture nitrogen from the air, (2) To improve and manage associative nitrogen (N) fixation in grasses, and (3) To determine the agricultural value of N-fixation in grasses.

DESCRIPTION: Most of the fertilizer N is used on grass crops, such as rice, maize and wheat. If associative N-fixation could provide a significant portion of the N needed by the crop, the economic benefit would be tremendous. More research is needed to establish reliability in the system and to determine the feasibility of relying on the system for improved yields. If successful, this program could greatly increase the productivity of grass cereals in LDCs.

PROJECT ACTIVITIES - The following are available:

TDY Technical Assistance to Missions (BNF program assessment, project design, evaluation, implementation)	Yes X No___
Information Sources (Scientific articles)	Yes X No___
Host Country/LDC-Based Training Workshops	Yes___ No X
U.S. or Third Country Degree Training	Yes X No___
Research	Yes X No___

Other Project Components:
Intern-type training.

Examples of Past Activities Under this Project:
BNF program assessment in Egypt; project design in Mali.

GEOGRAPHIC CONCENTRATION: Africa___ Latin America/Caribbean___ Asia ___ Near East___ Worldwide X

AGRO-ECOLOGICAL ZONES: Temperate___ Tropical/Sub-Tropical___ Arid/Semi-Arid___ Humid ___ Rainfed___ Irrigated___ Worldwide X

CONTACT A.I.D/W Project Officer: Lloyd R. Frederick, S&T/AGR/RNR

PROJECT CONTRACTOR/MANAGEMENT ENTITY:

Dr. S. C. Schank or Dr. S.H. West
Department of Agronomy
University of Florida
Gainesville, Florida 32611

APPENDIX G

Cover Page Manna

MANNA

Vol. 1, No. 2 Newsletter of the International Alliance for Sustainable Agriculture March/Abril

International Alliance Meets: Announces New Initiatives

As featured in the new IASA slide show, Ifugao farmer harvests traditional rice in the Philippine's Banaue Rice Terraces, the Eighth Wonder of the World. Photo: Terry Gips.

April 15-17 marked a joyful productive series of events for the International Alliance. For the first time since the founding a year ago, the entire Board of Directors came together for a retreat, planning session and board meeting. Those present included: Dick Harwood, Director of Rodale Research Center, Thomas Fricke of Appropriate Technology International, and Filipino Nicky Perlas of Vidar Farm.

The mission and goals of the organization were examined and new priorities were established. Summarizing its newly developed mission, Board member Dick Harwood said, "The International Alliance can play a unique leadership role in bringing together diverse groups and providing the movement with much needed information and referral services."

Three projects were chosen which will meet such needs as well as provide a financial base for expanded activities:

•a *Resource Guide to Sustainable Agriculture in the Third World*

•a multi-lingual slide/tape show on "Sustainable Agriculture Around the World" and

•a timely news service on agriculture, *New Directions in Agriculture*.

The *Resource Guide to Sustainable Agriculture in the Third World* will be a comprehensive documentation of individuals and groups in the Third World practicing sustainable agriculture. The guide has been requested and co-sponsored by the International Federation of Organic Agriculture Movements (IFOAM) the Pesticide Action Network (PAN International) and other groups.

A bi-lingual questionnaire will be mailed to Third World sustainable agricultural groups and farmers covering agricultural practices, productivity, areas of expertise and specific needs. The completed questionnaires will be compiled by computer and a sheet on each respondent will be printed. Several indices will be prepared including: alphabetical, country and crop. The information will be packaged in a loose leaf form so that it can be expanded and updated over time. Once a substantial number of groups is listed a bound copy will be prepared for use by libraries and policymakers. This could then become the basis for a computerized information system.

The second project, the slide show, will be a dynamic educational vehicle emphasizing the role sustainable agriculture can play in ending hunger and pesticide abuse around the world. The show will draw on over 8,000 slides and highlight outstanding projects everywhere from Nicaragua to Rwanda and China to the Netherlands. A preliminary version has been shown in Europe and the United States, and sixty groups have requested the purchase of a finalized version complete with multi-lingual tape and educational packet.

The third project, "New Directions in Agriculture," is an easy-to-read, bound, monthly news information service drawing on articles from 700 worldwide periodicals. The service will provide a fore-sighted, comprehensive overview of information essential to policymakers in government, business and non-profit organizations. The cost is $25 for one issue and $250 for a full year. Subscribers can save $40 through a special introductory offer good until July 15. Satisfaction is guaranteed or the cost will be refunded.

Preliminary funding is urgently needed to further develop all three projects. Any groups interested in supporting these efforts should contact the International Alliance.

PAN International Conference in Holland

Representatives from 21 countries met in Utrecht, the Netherlands, February 8-11 for the first global meeting of the Pesticide Action Network International (PAN International). They called for a halt to the unregulated export of hazardous pesticides to Third World countries which have resulted in 400,000 annual poisonings and widespread environmental harm. The conference, supported by the Dutch government, also urged actions to implement sustainable agricultural systems.

Founded in Penang, Malaysia, in May, 1982, PAN International has rapidly expanded from 30 to more than 300 environmental, agricultural, consumer, religious, labor, health and development organizations representing millions of people in 49 countries in every continent.

At the conference members reported on pesticide misuse that resulted in the death of 12 Indonesian villagers from DDT contaminated food, the poisoning of 20 children by paraquat spray drift in Tubarao, Brazil, and the environmental crisis in Sudan's one million hectare (2.5 million acres) Gezira cotton scheme caused by a 600 percent increase in pesticide use in just nine seasons.

"Such unnecessary widespread suffering and destruction could have been avoided if proper safeguards were in place and available alternatives implemented, including biological control and integrated pest management," said Dr. Prayoon Deema, Inspector General of the Ministry of Agriculture in Thailand and member of the IASA International Advisory Board.

PAN members charged that chemical companies did not take responsibility for agrochemical misuse. "Pesticides are often sold in empty coke bottles with no warning labels and empty pesticide drums are used to collect rainwater for drinking," said Dr. Elsa Nivia, Chemistry professor at the National University of Palmira, Colombia.

In order to bring about long-term solutions to the problems of pesticide use and mis-use, PAN International committed itself to the development of ecologically sound, economically viable and socially just agricultural systems. As a first step, PAN will support the efforts of ecological agriculture groups and the creation of documentation centers to gather and disseminate practical in-

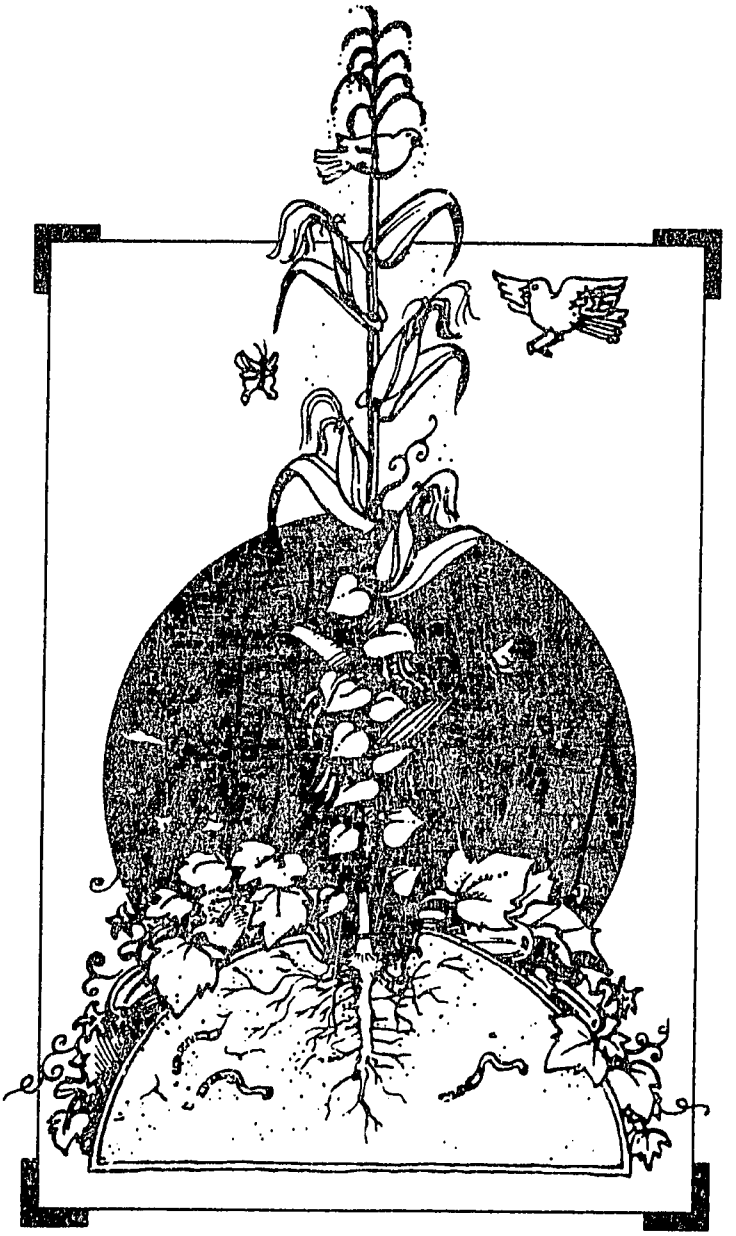
PAN Conference continued on page 6

APPENDIX H.

Cover
"Agroecology at the University of California, Santa Cruz"

AGROECOLOGY

at the
University
of California,
Santa Cruz



What is the Agroecology Program at UC Santa Cruz?

Instruction

Undergraduate Education: Students participate in the Agroecology Program as part of the environmental studies major at UC Santa Cruz. Both of these programs are located within College Eight—the "College of Environment and Society"—which is one of the eight colleges that make up UC Santa Cruz. Agroecology students examine the practical and theoretical aspects of agriculture in the United States and other parts of the world, study ecological interactions between plants and their environment, and learn about the social, biotic, and physical factors that influence agroecosystems. Students complement their agroecology courses with courses in many other disciplines. The anthropology, biology, economics, and sociology programs offer courses that focus on agriculture, as do community studies and Latin American studies.

Besides enrolling in regular courses, students also take advantage of individual studies and internships that give them the opportunity to get hands-on experience in testing agroecology techniques.

Graduate Education: Currently students pursue graduate studies in agroecology through the Biology Board or as limited status students through the Environmental Studies Board.

Apprentice Program: About twenty apprentices live and work at the UCSC Farm and Garden for six-month periods each year through enrollment in a University of California Extension certificate program. Since 1975, these apprentices have maintained and strengthened the Farm and Garden, the primary teaching and research facilities for the Agroecology Program. Their years of hard work have created successful models of how agriculture and horticulture can be managed ecologically. Through a rigorous combination of course work and practical training in farming methods, apprentices gain a firm understanding of the cultural, ecological, and economic dimensions of small-scale agriculture.

Research Activities

Faculty, graduate students, and undergraduates all participate in research projects through the Agroecology Program. Here are some examples:

- Studies of how allelopathy, the ability of plants to produce chemicals that inhibit the growth of certain other plant species, can be used in an agroecosystem as a biological means of weed control.
- Projects in which insect interactions are monitored in mixed cropping systems, with the aim of using this information to design agricultural systems that take advantage of biological pest control.
- Studies of how nitrogen inputs can be increased by planting leguminous cover crops or including legumes in polycultures.
- Projects involving the design and testing of solar crop dryers, which reduce the need for expensive natural gas or fossil fuels.

Facilities

The UC Santa Cruz campus offers a variety of habitats which differ in topography, climate, and soil types. This diversity creates an ideal laboratory for experimenting with agricultural methods. The UCSC Farm and Garden are particularly valuable resources for research. The Garden was founded in 1967 by Alan Chadwick, master gardener and creator of what he called the biodynamic French-intensive method of horticulture. Chadwick's method includes close spacing of plants in raised beds, maximum aeration and drainage, careful use of organic fertilizers, and labor intensive—rather than mechanized—crop care. These methods result in high yield from a small area.

The four-acre Garden is situated on a steep hillside, once covered with poison oak and blackberry brambles. Now it is a showcase for small-scale intensive horticulture and also serves as a preserve for a diverse plant collection, including ornamentals, food crops, and native California plants. The many different microclimates of the Garden also allow for useful comparative studies.

The seventeen-acre Farm is located on a lower meadow of the UC Santa Cruz campus. Founded in 1972, the Farm is a mosaic of vegetable beds, market gardens, orchards, compost areas, barns, outbuildings, hay meadows, and areas for draft animals and small livestock. The Farm has also been the site of many projects on resource-conserving technologies, such as a large greenhouse that is heated by solar energy rather than natural gas, and an aquaculture wastewater treatment system.

Outreach

The Friends of the UCSC Farm and Garden, a community-based support group, now boasts more than three hundred members, publishes a quarterly newsletter, sponsors a lecture series, and organizes community events to benefit the Farm and Garden.

The Agroecology Program offers guided tours for school groups and community organizations, as well as workshops on various horticultural techniques. Also, a resource library is being developed on campus to offer public access to a wide range of information on agroecology and related topics.

Opening channels of communication with the off-campus community is a high priority for the Agroecology Program, for the program can truly improve agriculture only through sharing research findings and learning from the agricultural community. In order to achieve these goals, the Agroecology Program is creating a communications

network of publications, lectures, and seminars connecting students, researchers, UC Agricultural Extension agents, and growers throughout California and the rest of the world.

Many long-time residents of the Santa Cruz area have valuable knowledge to share about the conditions and requirements of the local environment. The Agroecology Program hopes to work closely with local farmers and gardeners to apply research in field trials and to share information about specific agricultural problems.

Program Director

Stephen R. Gliessman, the founder and director of UCSC's Agroecology Program, has a wealth of both practical field experience and professional academic training. After receiving his B.A. in botany, M.A. in biology, and Ph.D. in plant ecology from UC Santa Barbara, Gliessman worked for several years as farmer and ecologist on an experimental vegetable farm in Costa Rica, and then managed a large-scale commercial nursery in Guadalajara, Mexico. Before coming to UC Santa Cruz in 1981, Gliessman chaired the Ecology Department at the Colegio Superior de Agricultura Tropical in Tabasco, Mexico, for five years, and also directed the college's Agroecosystems Research Program. In his research, Gliessman integrates ecological theory into the design and testing of alternative agricultural systems, and focuses on nutrient cycling, biological control of weeds and pests, allelopathy, and multiple cropping.

Program Support

The Agroecology Program is jointly supported by private and public funds. Major support has been made possible through gifts from the San Francisco Foundation, Alfred E. Heller, the Columbia Foundation, the Richard and Rhoda Goldman Fund, Alan Gussow, and Bernard Petri. For many years the Friends of the UCSC Farm and Garden have provided steady support. Substantial funding has been received from the California State Environmental Protection Program, the University of California Appropriate Technology Program, and the University of California, Santa Cruz.

For further information

If you would like to participate in the program or contribute to its support, please write or call the Agroecology Program, Environmental Studies, College Eight, University of California, Santa Cruz, California 95064, 408/429-4140.

Written by Jan Ambrosini Design by Hulda Nelson
Produced by UCSC Publications for the Agroecology Program
1-88(8283-22 3000)T

Working Towards Sustainable Agriculture

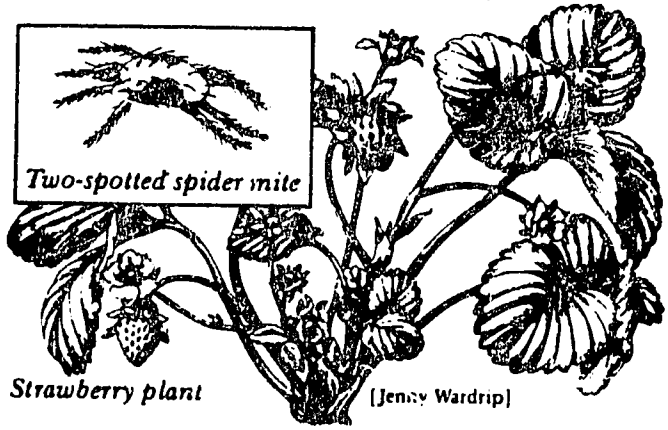
MODERN AGRICULTURE has given us dramatic increases in food production in the last thirty years, mostly due to the development of chemical pesticides and fertilizers, sophisticated machinery, irrigation systems, and new crop varieties. But now we are beginning to suffer the economic and ecological costs of this abundance.

Farmers know the economic costs of agriculture only too well. The already exorbitant price of energy continues to soar as nonrenewable fossil fuels are depleted. Energy is the farmer's principal financial problem today, with the high cost of fertilizers, pesticides, and irrigation water adding a heavier financial burden every day.

But in the long run, the ecological costs may be just as threatening to our agricultural abundance as these economic costs. In the United States, soil productivity has declined steadily from excessive soil erosion and loss of organic matter. In fact, Soil Conservation Service statistics show that in many areas of the U.S. soil erosion is worse today than during the Dust Bowl of the 1930s. Organic matter and vital nutrients are continually removed from the system—rather than recycled—weakening the ability of the agroecosystem to rejuvenate itself naturally. Farmers apply increasing amounts of chemical additives to compensate for this loss of soil and nutrients.

Chemical additions of pesticides, fertilizers, and minerals pose many dangers for the future productivity of agriculture. Our heavy reliance on chemical pesticides, for example, now appears to have disadvantages as well as benefits. Many insect pests quickly build up resistance to chemical pesticides, so that ever greater amounts of the chemicals must be added to maintain the same level of pest control. Pesticides harm many organisms besides the pest, including people, wildlife, beneficial insects, and the soil microorganisms that play a vital role in plant nutrition.

One reason these problems have developed is that our current practices focus on short-term economic gains and virtually ignore ecological interactions between crops, weeds, animals, soil, nutrients, and energy. But now farmers and scientists are beginning to question whether our agricultural systems are sustainable over time, and to search for methods that allow high yields, yet are also affordable, energy-conserving, and environmentally sensible. This is the goal of *agroecology*.



Strawberry plant [Jenny Wardrip]

What is agroecology?

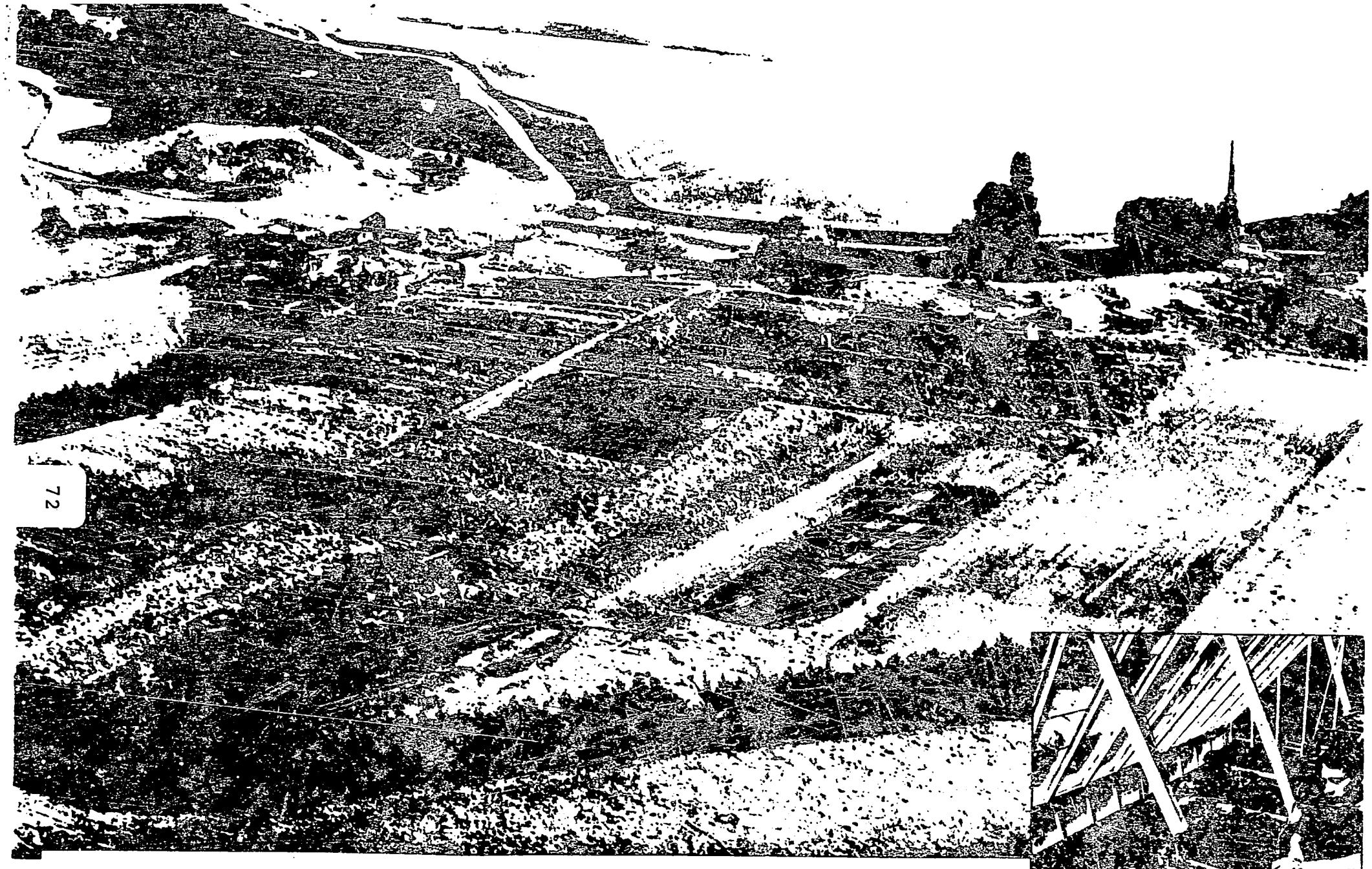
For centuries people have cultivated the land, learning through experience and hard work how to cull sustenance from the earth without depleting its resources of water, nutrients, soil, and organic matter. In some parts of the world this knowledge has been passed down for generations, creating a rich history of agricultural wisdom. Many of these traditional farming systems bear a striking resemblance to natural ecosystems.

By studying the farming techniques of many cultures—both ancient and modern—and trying to understand how natural ecosystems work, researchers are weaving together old and new ideas to create agricultural ecology, or agroecology.

In a natural ecosystem, a diverse mixture of plants and animals allows the system to survive and adapt to environmental changes. Each organism fills a special niche—its "profession"—and plays an important role in health and flexibility of the whole system. In terms of nutrients and energy, a natural ecosystem works like a closed loop. Plants, animals, and soil provide all the vital nutrients, and energy from the sun fuels the recycling of these resources through the ecosystem.

The goal of agroecology is to understand these features of natural ecosystems and their application in agricultural systems. Hence, an agroecologist strives to create a farm in which energy is conserved and nutrients are recycled through out the agroecosystem. Planting certain combinations of crops (such as corn, beans and squash), or intercropping with beneficial weeds creates natural pest and weed control by suppressing harmful species and attracting helpful ones. Plants such as legumes that can fix atmospheric nitrogen in the soil reduce the need for chemical additions of such nutrients. Biomass can be incorporated back into the soil throughout the yearly cycle, reducing soil erosion and replenishing vital nutrients. And finally, farmers and agroecologists are finding ways to use solar energy more efficiently and to power greenhouses and crop driers less expensively than with nonrenewable energy sources.

By applying these ideas in the field, farmers in many parts of the world have developed agroecosystems that are both productive and sustainable for many generations. ■



At far left: *The number-one strawberry pest, the two-spotted spider mite, quickly becomes resistant to pesticides when farmers spray to combat another harmful pest, the lygus bug. Insects that naturally prey on the mites are eliminated by the pesticides. By using "trap plants" to lure lygus bugs away from the strawberries and by introducing lygus predators into the field, farmers may be able to control lygus bugs without pesticides, allowing natural predators of the [illegible]ted spider mite to control the mites biologically.*

Above: *At UC Santa Cruz, agroecology is studied both in classrooms and at the UCSC Farm and Garden. The aerial photograph above shows the seventeen-acre Farm, with the solar greenhouse and new Agroecology laboratory building in the upper right, the Farm Center used for meetings and lectures in the top center, and storage barns and animal compounds in the upper left. The Farm's cultivated fields, experimental plots, and intensive raised beds are sheltered by the windbreak shown along the lower*

edge of the photograph. Above, Garden Ma[illegible] Martin tends lettuce and passion flower seed[illegible] Garden's solar greenhouse, where plants are [illegible] and prepared for transplanting to outdoor [illegible]

APPENDIX I.

Agroecosystem analysis workshops

AGROECOSYSTEM ANALYSIS WORKSHOPS

A multidisciplinary workshop procedure for use in the training and development of university and research institute staff.

G R CONWAY

Centre for Environmental Technology, Imperial College of Science and Technology, London, SW7 1LU, UK

ABSTRACT

The formulation of agricultural research and development programmes for university and government teams can be assisted by workshops in which a wide range of disciplines participate. A suitable workshop procedure has been devised and six successful workshops have been held in Thailand and Indonesia.

INTRODUCTION

The last decade has been characterised by the return of large numbers of LDC agricultural scientists from postgradute studies in the industrialised countries with, far too often, a training which reflects the increasing degree of specialisation that characterises much of modern agrciultural education. On their return they are often overwhelmed by the complexity of agricultural development issues and find it difficult to determine appropriate research priorities.

At the same time there has been a growing demand for a more multidisciplinary and holistic content to agricultural research and development. Farming systems research and integrated rural development are two responses to this demand but, in common with other multidisciplinary approaches, they face the problem of trying to encompass a breadth of expertise while at the same time generating a common agreement on worthwhile practical action. Resort to bureaucratic methods or to formal systems analysis is often unsatisfactory because it tends to impose a straitjacket on the participants which inhibits creative thinking and analysis.

An alternative response is to hold workshops which bring together a wide range of disciplines spanning the natural and social sciences and use these to analyse local, representative, agricultural systems with the aim of determining research priorities. A procedure has been devised for these workshops which combines a rigorous framework with sufficient flexibility to encourage genuine interdisciplinary interaction.

OUTLINE OF THE PROCEDURE

At the heart of the procedure are the concepts of the system, system hierarchies, system properties and the agroecosystem. The participants begin by defining the objectives of the analysis and the

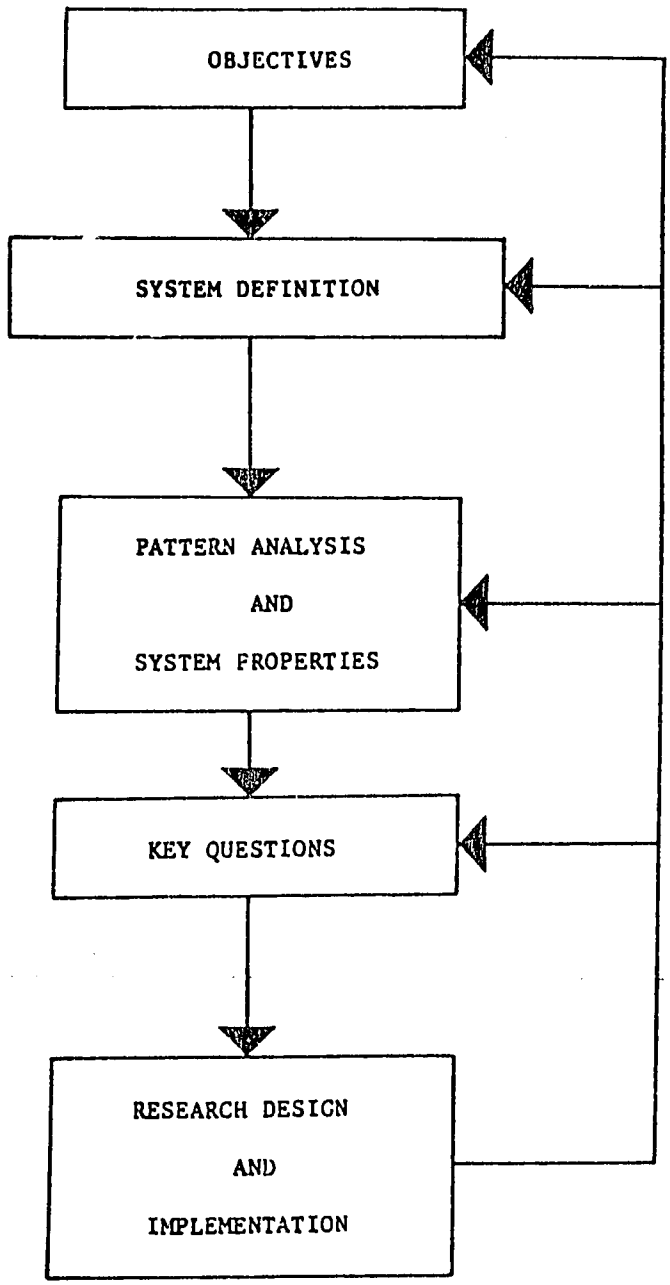


Figure 1 Outline of the procedure of agroecosystem analysis

relevant systems, their boundaries and hierarchic arrangement. This is followed by pattern analysis, the systems being analysed by all the participating disciplines in terms of space, time, flows and decisions. These patterns are important in determining four system properties of agroecosystems:

1. Productivity which is defined as the yield or net income of the agroecosystem;

2. Stability which is the degree of constancy in the yield or net income in the face of normal fluctuations of climate or other environmental variables;

3. Sustainability which mneasures the ability of the system to maintain productivity in spite of a major disturbance; and

4. Equitability which expresses how evenly the products of the system are shared among the human beneficiaries.

The outcome of these analyses are a set of agreed key questions for future research or a set of tentative guidelines for development.

THE WORKSHOPS

Before the workshop, teams from the host institution spend two to three months in gathering basic data on the case study agroecosystems. The workshop itself extends over a week (Table 1).

Table 1 Timetable for a week long workshop of agroecosystem analysis

Typically there are 30-40 participants drawn from the host institution and outside, with a mixture of university and government staff. They ideally span a wide range of disciplines including agronomy, soil science, livestock husbandry, plant protection, plant breeding, ecology, agricultural economics, rural sociology, anthropology, geography, remote sensing, etc.

Six workshops have been held so far. The first was at the University of Chiang Mai in Northern Thailand. It focussed on the agroecosystems of the Chiang Mai Valley and aimed to provide a research programme for the Multiple Cropping Project (Gypmantasiri et al, 1980). Two further workshops, with similar objectives, were then conducted for the Cropping Systems Project of the University of Khon Kaen in Northeast Thailand (KKU-Ford Cropping Systems Project, 1982 a,

b). A subsequent workshop was held jointly between the University of Khon Kaen and the USAID - North Eastern Regional Agricultural Development Project with the aim of producing tentative guidelines for the development of eight village clusters. (Limpinuntana and Patanothai, 1983).

Two workshops have also been held in Indonesia. The first focussed on tidal swampland agroecosystems in Southern Borneo and was hosted by the Agricultural Research Institute at Banjarmasin; the second looked at upland agroecosystems and was jointly hosted by Brawijaya University and the Agricultural Research Institute at Malang in East Java (KEPAS, 1984a, b). A third workshop on the dryland agroecosystems of Timor is planned for later in 1984.

The concepts and approaches used in the workshop procedure are also forming a core component in the new MSc in Agricultural Systems which is being offered by the University of Chiang Mai in Northern Thailand.

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APPENDIX J.

Descriptive brochure for
Ecological Agriculture Projects

- At present, EAP relies on private foundations, individual donations, and contract research for funding. Sponsored research from government and private organizations is solicited.

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Macdonald College, Quebec
Monday - Friday, 8 a.m. - 5 p.m.

(Enter through Barton Building or Macdonald Stewart Building)

Ecological Agriculture Projects (EAP)

MACDONALD CAMPUS OF McGILL UNIVERSITY

*(copying 10¢/page, subject to change)

WHY EAP?

- Further developments within the food system are urgently required if we are to meet growing world food needs and avoid pollution and resource depletion.

- It is becoming increasingly apparent that the physical sciences, on which most past developments have been based, are limited in their potential to meet these demands.

- Many eminent scientists are convinced that the biological sciences, particularly ecology, hold the key to further developments.

- Advantages of ecological approaches include savings in energy, reduced environmental impact, greater emphasis on food quality and a recognition of the subtle interrelations between soil, food and health.

- These approaches hold particular hope for developing countries, as access to complex technology is not a prerequisite for success.

- EAP is committed to the development of food systems based on ecological principles.

- EAP is in a unique position to make major contributions as it has the most comprehensive resource library on ecological agriculture in the world and is the only project of its kind associated with a University Faculty of Agriculture.

OBJECTIVES

EAP works to:

- promote, at local, national, and international levels, the development of sustainable food production systems based on ecological principles;

- advise individuals and groups engaged in developing such systems;

- assemble and make available the required resource materials for the development of teaching, research and extension programs in ecological agriculture;

- maintain contact, and cooperate with other groups interested in similar approaches.

ACTIVITIES

Information

- Our library comprises over 25,000 articles, 2,000 books, 60 journals, and audio-visual materials relating not only to ecological agriculture, but also to solar and renewable energy, conservation, rural development, waste management, nutrition, and health.

- This unique collection of resource materials is in continuous use, not only by students, local practitioners and members of the general public, but also by research-workers in government, industry and other universities in Canada and around the world.

Research

- EAP staff has been instrumental in generating new food and energy policy directives both in Canada and elsewhere.

- Some of our staff have conducted a major study for the Science Council of Canada on Sustainable Food Systems.

- We have also been called upon to advise or prepare reports for the following organizations and projects:

  — Agricultural Resources Study Group, Government of New Brunswick;

  — Environment Canada, Ottawa;

  — Farm Energy Conservation Project, Energy, Mines and Resources, Ottawa;

  — International Federation of Organic Agriculture Movements (IFOAM), Switzerland;

  — New Alchemy Institute, Massachusetts;

  — Man and Resources Institute, Prince Edward Island;

  — Quebec Environmental Coalition;

and many others.

Liaison

- EAP maintains active contact with other individuals and groups around the world interested in sustainable food systems.

- Our file of more than 2,000 names from at least 30 countries around the world, expands daily.

- EAP's staff is constantly called upon to speak on ecological agriculture at local, national and international gatherings such as the First Global Conference on the Future, Toronto 1980.

- In addition we have assisted in organizing several conferences, including the 1978 IFOAM Conference, held in Montreal.

- On the Macdonald Campus we help coordinate the very successful Ecolifestyles Seminar Series.

- Members of our staff have been interviewed many times on radio and television, and numerous newspaper articles have reported our work.

ESTABLISHMENT AND SUPPORT

- The establishment of EAP in 1974 on the Macdonald Campus of McGill University showed significant foresight on the part of Dr. & Mrs. David Stewart of the Macdonald Stewart Foundation.

- The immensity of the task ahead makes it imperative for projects such as ours to be supported and expanded.

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