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AGRO-FORESTRY IN THE AFRICAN HUMID TROPICS

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FOREWORD

In the last five years there has been a virtual explosion of interest in agro-forestry. The concept has spread from a few anthropologists, foresters, and agricultural scientists to become a priority for a number of national and international agencies. As with any new and widespread term, there are any number of more or less congruent definitions. While we should not try to arbitrate this debate, the word "agro-forestry" is used here to encompass any agricultural system that combines trees with crops and/or animals, either spatially or sequentially. The concept has proved to be a very useful box in which to include examples as diverse as live fence posts, trees in pastures, *taungya* systems, and the high diversity farms and kitchen gardens found throughout the humid tropics.

Some people have tended to see agro-forestry systems as a panacea for all "marginal lands," and the agricultural ills of developing countries in particular. Certainly, there are a number of important ecological benefits that can result from including trees in a variety of cropping systems, but the net social, economic, and environmental benefits will not necessarily be higher simply because certain tree species are included in pastureland, cropland, or fallow. One must see agro-forestry systems as an alternative to the usual emphasis on monocultures and realize that they may be viable across the spectrum from low capital and low-input farming practices to high capital, high-input agricultural systems. In particular, there is an urgent need to devise and test agro-forestry systems that could be applied in areas already suffering from degradation.

Thus, those who use the term agro-forestry must find a balance between the promise of such integrated productive systems and the realistic assessment of costs and benefits from a humanistic, economic, and environmental point of view. However, the science of agro-forestry is at such an early stage and the diversity of agricultural systems so great that it may well be years before one can accurately assess what proportion of the land is actually better suited for agro-forestry practices than for monocultures. The possible combinations of trees and crops are virtually infinite, and, when one takes into account the variation with regard to spacing, fertilization, soil types, etc., one cannot help but feel daunted at the magnitude of unexplored space. At the very least there are the guideposts of traditional agricultural systems, and the information contained therein will provide valuable assistance in directing the first tentative steps.

It was against this background that the workshop on agro-forestry systems in the African humid tropics was convened. The initial stimulus came from both the United Nations University, which was planning a regional workshop in Africa as a follow-up to similar workshops in Latin America and South-East Asia, and the International Development Research Centre (IDRC), which was planning to bring together the scientists involved in its agro-forestry research projects in West Africa. These two organizations then contacted the International Council for Research in Agroforestry in Nairobi (ICRAF), which agreed to serve as a co-sponsor, supporting additional participants. Similarly, contact was established with the Economic Commission for Africa, UN Environmental Programme, FAO, Unesco, and the World Bank, and they each agreed to sponsor one or more participants. At the same time discussions were held with the University of Ibadan, the International Institute of Tropical Agriculture, and the Federal Department of Forestry, and these three institutions generously agreed to be the local co-sponsors for the workshop. While special thanks must be given to the International Institute of Tropical Agriculture for providing the conference centre and accommodations, all three local co-sponsors provided support critical to the success of the meeting.

Altogether there were more than 60 participants from 14 African countries and representatives from nine international organizations. The fact that so many scientists were able to come together and discuss agro-forestry is positive evidence of co-operation and interest in agro-forestry on both the national and international scale. Equally important was the exchange between English-speaking and French-speaking scientists, and the publication of these proceedings in both English and French should help to facilitate further contacts and exchanges.

The large number of participants meant that more than 30 papers were presented in three days, and this severely limited the time available for the three working groups as well as discussion within the plenary sessions. In this sense the proceedings are representative, as they include only a brief summary of the discussion after each group of papers. A separate account of the one-day field excursion was not

included, as most of the material can be found in the papers. The time available for the working groups was only one afternoon, and the respective reports were discussed in a plenary session just before closing. Thus, these reports represent a consensus on the three topics of research, education and extension, and management of agro-forestry systems, rather than a set of specific recommendations.

The large amount of material presented created its own problem: how to keep the proceedings to a manageable size. It was therefore decided that material being published elsewhere or not directly relevant to the theme of agro-forestry in the African humid tropics would not be included, and some papers are presented only as abstracts or extended summaries. The papers by Peter Poschen and Madické Niang in particular, which were concerned primarily with agro-forestry outside the African humid tropics, are presented in very abbreviated form.

In preparing the material for publication it was also necessary to rearrange the papers from the order in which they were presented at the meeting. Since clear-cut classifications are usually a figment of the imagination, a liberal licence was taken to establish five main headings. The first section, "Principles of Agro-forestry," includes five thought-provoking papers that are relevant to all discussions on agro-forestry. These are followed by seven papers that use various traditional agro-forestry systems in the African humid tropics as their starting point and then discuss the prospects for further development. The third group, of six papers, is devoted to *taungya* systems in Nigeria and three other West African countries. The ten papers that follow are grouped under the heading of "Current Agro-forestry Activities," and these present most of the research that has been carried out on a variety of tree, crop, and animal combinations in seven countries, ranging from Rwanda to Cameroon. The final set of papers includes four case studies from different countries, some of which are only presented as extended summaries, and two papers detailing the concern of FAO and UNEP with agro-forestry.

We are grateful also for the presence at the conference of Amy Chouinard of the IDRC Communications Division. Her editorial advice and assistance were essential to the publication of this manuscript.

While these proceedings are concerned primarily with agro-forestry in the African humid tropics, the conceptual points are relevant to other agro-forestry systems as well; even many of the specific papers will be of value to those working in the Neotropics or Asia. Of course, the tree, pasture, or crop species may not be relevant to sites in other areas, but the experimental design or concern with developing traditional systems may apply.

It is our sincere hope that the audience for these proceedings will be as broad as possible, for the great need is to inform scientists, planners, and government officials of the possibilities for agro-forestry, and these proceedings provide the essential conceptual and technical base for all those working in the field of land-use management.

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PRINCIPLES OF AGRO-FORESTRY

AN IDENTITY AND STRATEGY FOR AGRO-FORESTRY

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Abstract

The fact that agro-forestry land-use systems are location-specific makes it difficult to design models adapted to all circumstances. It is therefore proposed to pursue the development of new methods applicable to the description of both existing and conceptual land-use systems. The aim is to identify constraints that can potentially be overcome by the application of an agro-forestry approach.

It is also argued that the development and implementation of agro-forestry systems may benefit from the institutionalization of such an approach to land use.

Introduction

Agro-forestry is the new word for an age-old practice—that of having trees in the agricultural landscape. It has become more refined in meaning and now connotes trees with a purpose such that the land-use system yields both a food product and a tree product, each meeting the needs of the user of the system. At the same time, the agro-forestry system should be stabilizing in its impact on the environment and stable in its output of products.

The modern concern for agro-forestry arose among the foresters. They saw the forested lands being threatened by a growing population demanding more food and hence by farmers seeking more land upon which to grow that food. Their reaction was rational — find a way to accommodate some aspects of agriculture within forestry. In contrast, conventional agriculture, and here I include both crop and animal agriculture, has made virtually no contribution to alleviating the concern for the pressure that its activities are placing on the non-agricultural tree-covered areas.

To leave the concern and the development of agro-forestry with the foresters would deny to it the body of knowledge that exists outside forestry, while to delegate to agriculture the responsibility for agro-forestry would not correct the situation but merely reverse the wrongs and accomplish nothing. The need is to *institutionalize* agro-forestry; to establish it independently of both agriculture and forestry so that it can develop its own concepts, body of knowledge, and principles, not engulfed by either of its antecedents but able to draw upon their resources as is deemed necessary. The International Council for Research in Agroforestry (ICRAF) is such an institution.

There is ample precedence for the efficacy of institutionalization. Statistics, for instance, with its approach to design and analysis of experiments, began to emerge from mathematics when R.A. Fisher started his classic work at Rothamsted: he was, literally, the institution. Genetics, likewise, did not establish a clear identity until it separated from biology, be it botany or zoology. In many universities today that separation has not been effectively concluded. Agro-forestry is much less clearly defined than either statistics or genetics and is thus even more in need of its own institution. I hasten to add, however, that if in establishing the institution — whether agro-forestry or genetics — one divorced it from all those areas that have relevance to it, then that would be a retrograde step.

The Systems Approach

The establishment of the institution is merely the first step in establishing an identity; the next critical move is to develop the focus, the raison d'être, the strategy. With this, one would then develop the approach to the problems and the activities deemed most appropriate to provide answers. Further, the kind of staff would be identified and the targets for the activity would become clearer.

The key word is systems. Agro-forestry is a system of land use. It is, at the same time, a food and tree-product production system. It is not a single commodity nor a single management practice but rather a complex interacting set of subsystems, components, and practices suited to a particular environment and needs.

The systems approach implies, first, that one does not engage in piecemeal consideration of problems, and, second, that there is an analytic rather than merely intuitive approach to land use systems. The analytic approach is the diagnostic method that enables one to analyse the state of the system, to identify the critical subsystems, and to determine the problems or operative constraints as well as the potentials for improvements of system performance. From the diagnosis will then flow the capability to identify

existing agro-forestry technologies that are appropriate to system needs. From it will flow the definition of the research and development problems that must be solved if one is to generate new agro-forestry technologies that possess the specific capacities needed to improve system performance. The International Council for Research in Agroforestry (ICRAF) has adopted this approach and aims to focus agro-forestry research and development on real world problems and conditions.

The Cycle of Development

The basic logic of ICRAF's research programme is dictated by the cycle of development (fig. 1). Each phase in the cycle embraces a series of research activities. Each situation to which the cycle is applied will require a different mix of the particular activities in order to complete the cycle. The cycle takes its starting point from the inescapable conclusion that the process of developing a solution to a problem begins with the capacity to analyse the problem, in this case the land-use system in which agro-forestry technology is deemed to have a role. The diagnosis of existing land-use systems is aimed at discovering the agro-forestry-related constraints and potentials. This is the deductive, analytic, or diagnostic part of the technology development cycle.

One of the main conclusions to come from the agricultural development research of the past decade is that the conditions under which the majority of farmers operate often bear little resemblance to those on agricultural research stations, with the consequence that, unless a special effort is made to take account of these conditions, the resulting technology is often inappropriate for the majority of farmers. To identify the full set of operant constraints and potentials that govern decision-making with regard to land-use practices in a given area, it is essential that the multidisciplinary expertise of a team of biological and social scientists be assembled to diagnose factors ranging from climatic constraints to cultural values.

One important outcome of the first phase of the land-use system diagnosis will be the identification of land-use subsystems. In this effort, ICRAF is developing a "basic needs" approach to the identification of production subsystems in terms of output categories that answer the universal human need for food, energy, shelter, cash, and community integration. In this way it is ensured that what is analysed is highly relevant to people's needs.

How it is analysed, in the second phase of the diagnostic research, is also a subject of intense methodological interest. Agro-forestry, by definition, is equally concerned with production and conservation. In this respect it differs from most other branches of plant science, in which conservation aspects of production systems are frequently of secondary,

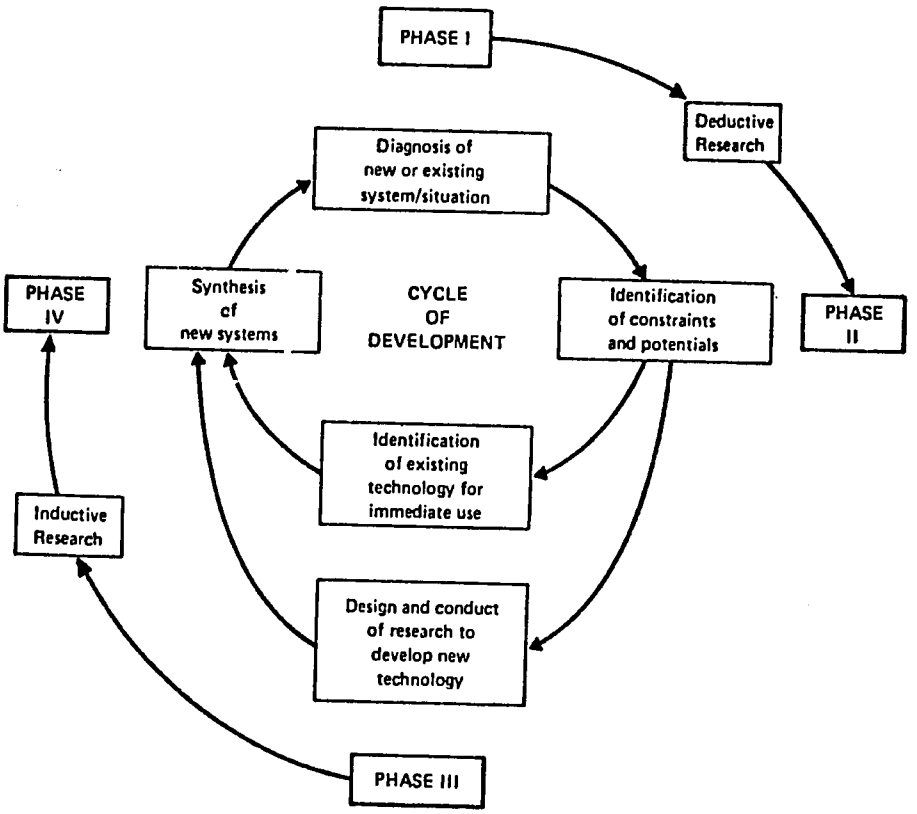

FIG. 1. . The Cycle of Technology Development

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if any, concern. This difference in purpose requires a difference in methods. ICRAF is now exploring analytic techniques to diagnose the performance of basic output subsystems in terms of both their productivity and their sustainability, thus encompassing both aspects of its diagnostic objective.

The final output of the diagnostic part of the cycle will be a set of general design specifications for agro-forestry technologies in terms of functional or end-use requirements. These then become the primary input for the inductive, synthetic, or R&D part of the cycle of agro-forestry development.

Two courses of action are possible in the first part of phase three. One is to identify existing agro-forestry technologies that are generally appropriate to local needs and that can be used directly to bring about an improvement in the immediate situation. The other is to generate, through research, new technology that is specially designed to meet the diagnostic specifications. These two courses of action are not mutually exclusive; in fact, the most likely situation will be that in which a temporary improvement is gained by the use of existing technology while new technology is being developed. The cycle of development is a continuous iterative process. One seeks the best technology but settles for one that is merely better, hoping to continuously improve it.

Phase four in the cycle of development encompasses the research necessary to synthesize a new land-use system that incorporates the new agro-forestry technology into the existing pattern of land use in a manner consistent with local and regional production purposes and constraints. Finally, the cycle is completed by a new round of diagnostic research to identify the set of constraints and potentials now operating. These must be addressed by a new round of technology generation if the system is to be further optimized. The four phases of the cycle of technology development define the scope of ICRAF's research activities. Each situation in which the cycle is applied will require a different mix of the particular activities to complete the cycle. An interdisciplinary approach will be pursued throughout (fig. 2).

Research Activities

The implication of the adoption of the strategy is that there will be two distinct but complementary research activities. These are:

- The development of the diagnostic capability for the identification of agro-forestry needs and potentials. This will be done through on-farm studies of the system used by the smallholder. This will also treat "communities," particularly when land use and environmental impact is of major concern. This research will initially be carried out in Kenya but later extended to other countries.
- The identification of methods to develop new agro-forestry technology. These may range from methods of evaluating multi-purpose trees to design of experiments to test new systems. This research will be carried out at the Machakos field station in Kenya.

The appropriate relationship between these two activities is for the diagnostic research to identify the problems of highest priority for the development of the methodology. There will undoubtedly be some technology generated as a consequence of this research activity but that is not the objective per se; rather it is a spin-off from the development of the methodology.

Agro-forestry, as implied, is both a system of land-use-cum-resource-management and a production system with multiple outputs of food products—plant and animal—and tree products that may range from food to fuel. When fuel is the aim, the target will almost invariably be the farmer: generally, the small farmer.

The technology will most likely be relatively labour-intensive. The objective, however, is not to develop a low-input system but rather one that uses inputs efficiently and achieves a stable and sustainable output.

Where one is dealing with an agro-forestry solution as a resource management/land-use system, the target goes beyond the individual user. Thus, where an agro-forestry system is deemed to be the solution for water/erosion control on sloping land, then the catchment area becomes the target. The individual farmers will use the technology, but the complete area must adopt it if they are to benefit. Inherent in such a situation will be the individual farmer's food/tree-product production but all predicated on the primary objective of resource management.

Mention has been made of trees in the landscape. This is probably a more rational approach than to consider "trees in crops." The latter will tend to force one to think in terms of tree-crop mixtures that, in the majority of cases, will result in lowered productivity of the crops. In contrast, to consider trees in the landscape will tend to accord to trees the dominant role where that is necessary and to crops the dominant role where that is appropriate. One would then seek to find the relationship that defines the role for each, yet achieves the stability that is sought and the productivity that is needed.

Institutionalization

Finally, I return to the question of institutionalizing agro-forestry. I believe it is important to seek institutionalization