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Farming Systems Research
Upland Agriculture and Conservation Project

TREE CROPPING IN UPLAND FARMING SYSTEMS: AN AGROECOLOGICAL APPROACH

Exit Report

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and
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EXECUTIVE SUMMARY

This report describes my activities during 19 person-months as Tree Crop and Silvipasture Ecologist under a personal services contract with the United States Agency for International Development. I worked with the Farming Systems Research component of the Upland Agriculture and Conservation Project in Indonesia. A general goal of my consultancy was to forge a closer working relationship between researchers and extension agents, and between agriculture and forestry specialists, for a coordinated program of tree cropping, agroforestry and silvipasture.

My specific tasks involved helping project staff to plan and implement research on existing tree crop, silvipasture, and agroforestry systems in the uplands of Central and East Java. In the absence of a full-time consultant team for research, I also provided general guidance on research methodology and management. A major activity during my last three months was developing and implementing a training program for agroecosystems analysis through rapid rural appraisal technology. In addition, I advised USAID on forestry, agroforestry and biological diversity issues in Indonesia.

The second chapter of this report is a review of the technical issues associated with tree cropping and fodder production in upland farming systems. Agroforestry is defined as any sustainable land use system that maintains or increases total yields by combining annual crops with perennial crops and/or livestock on the same unit of land. It can be viewed as a strategy for promoting a transition from annual cropping to tree cropping by seeking combinations of perennial and annual crops which offer better economic returns and lower risks than current agricultural practices.

The role of applied research is analyzed in terms of the information needed by extension on potential agroforestry combinations. In addition, the following topics are identified as priorities for field research: 1) soil conservation benefits and economic returns of different tree cropping patterns now practiced by upland farmers, 2) socio-economic incentives and constraints to expanded tree cropping, 3) the suitability of hedgerow alley cropping of leguminous trees as an alternative to terrace construction on shallow, unstable soils, and 4) the degree of dependance of upland farmers in some project areas on forest products and the economic incentives to planting forestry species on private land.

In the third chapter, my activities and progress are described. One general accomplishment was more awareness by FSR staff of the need to integrate existing technical data. A detailed work plan was developed for agroecological zoning of project districts in East Java and for documenting existing tree cropping and agroforestry practices within each zone, although it was not implemented by FSR. I also helped train most of the FSR scientific staff in agroecosystems analysis and rapid rural appraisal methods. Case studies of two new research sites were conducted, representing the first diagnostic appraisals of farmer needs by FSR.

Subsequently, I developed and helped implement a large agroecosystems analysis training program for 52 project personnel. This training improved capabilities to recognize problems and opportunities in the field and to work more effectively in interdisciplinary teams. Case studies of four project villages were presented at a project-wide workshop to demonstrate the applications of agroecosystems analysis for the project. Several proposals by senior decision-makers are now under discussion to incorporate agroecosystems analysis into the routine planning and implementation process and to conduct training next year of technical staff at the rural extension centers.

Despite greater awareness of research needs, I was not able to develop an agroforestry research program within FSR. The fourth chapter discusses some of the institutional constraints to achieving more progress in interdisciplinary research and in promoting a close working relationship between extension and research. One constraint is the centralized structure of the Agency for Agriculture Research and Development which favors a commodity orientation and disciplinary biases. There is still a need for greater recognition of local features of farming systems. Another difficulty is the inconsistency of FSR leadership and technical assistance so that initiatives developed early in my consultancy were not implemented.

Three general recommendations are made. One is the formation of a committee to set priorities and coordinate all research in the project. This committee would have two levels, one level for the senior decision-makers from the upper echelons of the technical and coordinating ministries and the other at a more operational level within each province. The provincial committees would ensure the integration of existing technical information for planning and extension. This would be accomplished by supporting the standardization of land classification systems into agroecological zones and the production of extension manuals for each ecological zone.

Secondly, the groundwork is laid for incorporating agroecosystems analysis methods into the planning and extension process, but several important decisions will need to be made in the near future. The results of agroecosystems analysis training and workshop demonstrate this method can serve as a mechanism for the effective integration of disciplines in the field and for planning UACP activities using more "bottom up" information. The recommendations of the training team, as outlined in separate report to the Executive Secretariat and to USAID, will need careful consideration.

Thirdly, FSR faces a choice between devoting the majority of its staff time and resources to integrating existing technical information with a small field research program or to continuing the larger field program with limited involvement with planning and extension. There are good reasons for either choice, but from the perspective of UACP technical needs, I endorse the former.

Researchers could assist the agriculture information centers in both provinces to develop extension manuals organized by agroecological zone. The manuals would propose a range of

technical alternatives for food crops, tree crops, forestry species, terracing methods, and livestock management feasible for upland agriculture in that zone. Selected field studies would focus on existing land use practices to help indicate which technical options are compatible with local socio-economic conditions and farmers preferences.

ACKNOWLEDGEMENTS

I would like to extend my gratitude to the scientists of the Farming Systems Research offices in Salatiga, Klepu and Malang for the many hours they spent with me in the field and in the office while we discussed research issues. Their patience with my slow progress in the Indonesian language is particularly appreciated.

A special thanks goes to Dr. Achmad M. Fagi, who was the FSR Project Leader during most of my consultancy. My gratitude also goes to Ir. Engkah S. from the Directorate for Soil Conservation of the Ministry of Forestry. I would also like to acknowledge the kind reception I received from Dr. Soleh Sukmana, the current Project Leader, to my comments and requests. During the implementation of the agroecosystems analysis program, I enjoyed working with both two Provincial Coordination Offices, particularly with Ir. Danu Wijaya in East Java and Ir. Aris Budiono in Central Java. I am also grateful to the administrative staff of the Agency for Agriculture Research and Development for handling my frequent visa needs.

Most importantly, I want to thank Ron Greenberg, my project officer at USAID, who never failed to respond to all my queries and requests. His flexibility and encouragement made it possible for me to work productively throughout the nineteen months.

ABBREVIATIONS

AARD	Agency for Agricultural Research and Development (*Badan Litbang Pertanian*)
BANGDA	Directorate for Regional Development of the Ministry of Home Affairs (*Direktorat Jenderal Pembangunan Daerah*)
BAPPEDA	Regional Development Planning Board (I is at provincial level and II is at district level)
BIP	Agriculture Information Center (*Balai Informasi Pertanian*)
BLPP	Agriculture In-Service Training Centers (*Balai Latihan Pegawai Pertanian*)
BRLKT	Land Rehabilitation and Soil Conservation Center (*Balai Rehabilitasi Lahan dan Konservasi Tanah*)
BPP	Rural Extension Center (*Balai Penyuluhan Pertanian*)
BTPDAS	Watershed Management Technology Center in Solo (*Balai Teknologi Pengelolaan Daerah Aliran Sungai*)
F/FRED	Forestry/Fuelwood Research and Development, an Asian regional USAID project based in Bangkok
FSR	Farming Systems Research
GOI	Government of Indonesia
IIED	International Institute for Environment and Development
KEPAS	Research Group on Agroecosystems (*Kelompok Penelitian Agroekosistem*)
PCO	Project Coordination Office (provincial level)
PMU	Project Management Unit (district level)
PSC	Personal Services Contract
SUFS	Sustainable Upland Farming Systems (demonstration farms and expansion areas under UACP)
TAT	Technical Assistance Team (TAT/Winrock, TAT/DAI, and TAT/PASA serve the project in addition to myself and one other PSC, with all types of consultants referred to as the TAT/UACP)
UACP	Upland Agriculture and Conservation Project
UGM	Gadjah Mada University
USAID	United States Agency for International Development

PREFACE

The following report describes my activities as Tree Crop and Silvipasture Ecologist assigned to the Farming Systems Research (FSR) component of the Upland Agriculture and Conservation Project (UACP). The report describes 19 person-months of technical assistance under a personal services contract (PSC No. AID-497-0311-S-00-7008) with the United States Agency for International Development (USAID) in Indonesia. During the periods January 1987 - April 1988 and June - August 1988, I worked from a base in Salatiga, Central Java, where FSR staff from the Agency for Agriculture Research and Development (AARD) have their headquarters.

The purpose of this report is to review progress in accomplishing the tasks under my contract. Some of my comments are critical and I hope they are interpreted in the spirit they were meant, as a constructive analysis of problems and opportunities within the project.

The first chapter outlines the scope of my technical responsibilities and specific tasks. The subsequent chapter reviews the technical issues associated with tree cropping and fodder production in upland farming systems in Java. I also discuss more generally the role of interdisciplinary research for guiding extension in the project.

In the third chapter, I highlight my efforts to establish a long-term agroforestry component within FSR, initiate agroecosystems analysis training of UACP staff, and other activities associated with my contract. The fourth chapter discusses some of the underlying institutional constraints to interdisciplinary research which addresses rural resource management from a systems perspective and generates technical information which can be directly applied by extension personnel. Three recommendations are outlined in the last chapter for creating a more productive environment for interdisciplinary research and for better application of research results.

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I. SCOPE OF TECHNICAL ASSISTANCE

1.1 Background

In early 1986, I was invited by USAID/Jakarta to spend one month reviewing the agroforestry component of the FSR program in light of existing technical information and expertise available in Indonesia. I prepared a report highlighting research by Indonesian agencies and universities which had relevance to integrating tree crops into upland farming systems. My recommendations for improving the flow of technical information on agroforestry were presented to both USAID and to senior AARD scientists on the FSR steering committee. This preliminary effort served as the basis for USAID and the Government of Indonesia (GOI) to propose a long-term position for an advisor to work with FSR to strengthen the agroforestry and agroecology approaches of UACP.

1.2 Terms of reference

The technical scope of my responsibilities as Tree Crop and Silvipasture Ecologist are listed in Appendix I. On all matters related to my contract, I reported directly to the Agriculture and Rural Development division of USAID. An implicit goal of my consultancy was to forge a closer working relationship between agriculture and forestry scientists and to encourage a more coordinated approach to research on tree cropping, agroforestry and silvipasture technologies suitable for the uplands of Java. For this reason, USAID identified two liaison officials from the GOI as my counterparts, Dr. A. M. Fagi, FSR Project Leader from AARD of the Ministry of Agriculture and Ir. Engkah Soetadipradja, member of the UACP Executive-Secretariat representing the Directorate for Soil Conservation (RRL) of the Ministry of Forestry. Furthermore, my contract specified I was to assist the eight district governments, or Project Management Units (PMUs), participating in UACP in the identification of their information needs related to agroforestry and agroecology.

It is not surprising that each of these GOI offices had a different interpretation of the purpose of my technical assistance, which were not always compatible with USAID's interpretation. Because my primary counterpart was clearly the FSR Project Leader, I tried to conform most closely with AARD's expectations. However, during the final three months of my contract, I devoted most of my time to developing a training program on agroecosystems analysis which involved personnel from extension, research and planning. During this time, I worked mostly with the Project Coordination Offices (PCOs) of Central and East Java and with the UACP Executive Secretariat.

1.3 Chronology of activities

My activities during the 19-month period followed an evolutionary process as I became more familiar with the intricate workings of UACP and circumstances at FSR changed. A principle activity during my first six months was the identification of FSR's specific needs for improved research on tree crops, fodder and soil conservation and of appropriate mechanisms to meet those needs. During this period, I also provided general guidance to the FSR Project Leader on research management, communications and reporting. A further activity was guidance to USAID on agroforestry and natural resource issues in Indonesia.

By the end of this initial period it was clear that all the terms of reference for my position could not be fulfilled. This was because a significant portion of my time was diverted to providing general technical guidance to the FSR Project Leader in the absence of a long-term technical assistance team (TAT) for FSR. Delays in contracting the TAT meant that I was the sole advisor to FSR during the first 10 months of my contract. This delay also led to budgetary difficulties, with only one fourth of FSR's 1987-88 funds released by USAID early in the Indonesian fiscal year (April 1 through March 31). Under such conditions, it was impractical to promote interdisciplinary research on tree crops or a national session on agroforestry research and training.

After informing both USAID and GOI that some of my duties could not be met, a revised terms of reference was approved in January, 1988 which placed more emphasis on technical guidance on general research planning and management. My terms of reference were further revised when my contract was extended to assist UACP with agroecosystems analysis training.

II. OVERVIEW OF RESEARCH NEEDS

2.1 What is agroforestry?

In this report, there will be frequent mention of "agroforestry" and "silvipasture". Most international scientific bodies such as the International Council of Research on Agroforestry (ICRAF) use a very general definition:

> *Agroforestry is any sustainable land-use system that maintains or increases total yields by combining annual crops with perennial crops and/or livestock on the same unit of land, either alternately or at the same time, and is compatible with the local cultural practices and ecological conditions.*[1]

Silvipasture can be thought of as a type of agroforestry where foliage from tree crops is used as animal fodder.

In Indonesia, confusion arises because agroforestry is used to describe a variety of government programs from the Ministry of Forestry, including the Regreening Program (Penghijauan) for privately owned land and the *tumpangsari* system of the State Forestry Service (Perum Perhutani) where local people cultivate government land for two or three years in return for planting plantation trees such as teak and mahogany. However, many Indonesian scientists also consider agroforestry descriptive of all combinations of woody plant and annual cropping, such as mixed homegardens (*pekarangan*), village forests (*hutan rakyat*) that have annual crops cultivated in them, secondary forest gardens (*talun*) and long fallow shifting cultivation.[2]

From the very first I would like to reemphasize that I am using agroforestry in the broad sense of its meaning. Some of my Indonesian colleagues from the agricultural sciences have resisted using the word agroforestry because it is often associated with urging farmers to plant "forestry" species (such as teak or pine). Furthermore, agroforestry often connotes a general model or technological "package" such as that promoted by the Ministry of Forestry's Regreening program. For example, the Soil Conservation and Land Rehabilitation Stations (BRLKT) use demonstration farms to promote an agroforestry system for uplands sloping more than 50%. UACP is explicitly designed to develop innovative alternatives to these general approaches to upland farming. Perhaps for this reason my agriculture colleagues preferred my technical title to be "tree crop ecologist" rather

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[1] Vergara, Napolean T. (Ed.), 1982. *New Directions in Agroforestry: The Potential of Tropical Legume Trees.* Prepared by the Working Group on Agroforestry. Environment and Policy Institute, East-West Center, Honolulu, Hawaii.

[2] Sanusi Wiradinata, 1986. Present Condition and Problems of Agroforestry in Indonesia: In Particular Outside Forest Areas. *In: Comparative Studies on the utilization and Conservation of Natural Environment by Agroforestry Systems.* Monsoon Asia Agroforestry Joint Research Team, Faculty of Agriculture, Kyoto University, Japan. pp. 52-65.

than "agroforestry advisor". Although I am sensitive to the possible misinterpretations of the word agroforestry, the term has a very practical value by emphasizing the sustainability of natural resource use for agriculture. This is what distinguishes agroforestry approaches from the narrower commodity perspective of tree cropping.

A final note on terminology is important: the use of the word agroforestry does not mean one particular agroforestry model is advocated. Throughout this report I will be emphasizing that it is extraordinarily risky for researchers to test pre-conceived solutions to the problems of sustainable upland farming, including agroforestry models. One of the most difficult challenges for farming systems research is correctly identifying local constraints to tree cropping and testing low-risk ways to overcome them. When researchers assume they already know what farmers need and all that is left is to apply a theory or introduce a technological model, the model itself becomes a barrier between the research and the farmer. On the other hand, there are general approaches, such as agroecosystems analysis, which help to identify local constraints quickly so that appropriate tree cropping technologies and agroforestry practices can be promoted. In essence, agroforestry is a strategy for improving the sustainability of land use practices by taking advantage of the multiple functions that tree crops can serve.

2.2 Why is agroforestry important to UACP?

This section reviews the expectations for perennial crops within the project to underline the complex, multiple functions required of the perennial crop component. Tree crops and fodder species are crucial elements of UACP's strategy to promote sustainable farming practices in upland Java. The project seeks to increase farmers' incomes at the same time as improving soil conservation. Perennial crops in general provide a better opportunity to accomplish these goals than annual cropping. This is because many of the project areas have unstable soils and/or are already marginal in the sense of thin top soil and low fertility. These areas cannot support an intensification of annual cropping and can only remain productive in the long run if planted in perennial crops, multipurpose leguminous trees and fodder grasses. Because tree crops are supposed to serve both economic and conservation functions within a sustainable land use system, UACP is based on agroforestry principles.

The UACP technical staff are well aware of the advantages of tree cropping, but is worth summarizing them here. The perennial species in the project fall into two general categories. The first includes all the leguminous trees which are planted primarily for better soil management and secondarily for their production of wood, edible fruits and fodder. The second category encompasses perennial crops which are planted primarily because of the commercial value of the commodities they produce and secondarily to improve soil conservation.

Among the advantages of the leguminous trees, such as Leuceana leucocephala (*lamtoro*), Gliricidia spp. (*gamal*), Sesbania spp. (*turi*) and others, are:

- o quickly anchoring soils
- o increasing nitrogen availability in the soil
- o green manure
- o fodder
- o fuelwood and timber
- o edible leaves and fruit

In addition, these trees tend to be familiar to farmers, grow quickly, are relatively easy to propagate and tolerate repeated cutting by resprouting (coppicing). Further, the costs of introducing leguminous trees for improving soil conservation is relatively low compared to the construction of terraces. In fact, these trees can be planted in dense rows to help form terraces, a method commonly called hedgerow alley cropping.

The second class of perennial crops include fruit trees (e.g., citrus, papaya, mango), industrial (plantation) and fiber crops (e.g., coffee, kapok), spices (e.g., clove), forestry species (e.g. teak, albizia, bamboo) and some medicinal plants (e.g., cardamom). Some species are difficult to categorize, for example coconut trees, which are used for sugar production, nuts, copra, thatch and wood. The most important function of these crops is their contribution to rural household needs and for cash income. Some of these perennials also help stabilize soils by having deeper tap roots than annual crops and by having relatively permanent foliage which modifies the impact of intense rainfall.

There seems to be a strong link between the economic value of tree crops in upland fields and incentives for intensive soil management. The cultivation of medium and high-value tree crops leads to better terrace construction and maintenance because soil erosion directly affects crop production by exposing tree roots and reducing yields. One example of this relationship was documented in East Java by the Research Group on Agroecosystems (KEPAS) for farmers growing apples. Therefore, tree crops with medium to high commercial value may be one of the keys to the long-term success of the sustainable upland farming systems (SUFS) introduced by UACP using demonstration farms and expansion areas. Also advantageous are perennial crops that can be processed locally, because they offer more the economic benefits to upland communities by stimulating rural industries. However, these commercial perennial crops often represent high risks to upland farmers of economic losses.

The process of species selection requires consideration of the multiple functions expected of each tree crop within an upland farming system and the socio-economic acceptability of the species, as well as its environmental suitability. It is not sufficient merely to disseminate trees based on commodity priorities, because only certain combinations of leguminous trees, low-value perennials that grow quickly and higher value tree crops will prove effective for soil management at the same time as generating reliable economic benefits to upland households. This implies that an interdisciplinary perspective is required to pinpoint the best cropping combination for particular upland sites, which is the essential meaning of an agroforestry strategy.

Another implication is that there are no simple agroforestry "packages" which can be broadly disseminated to farmers. The desire to find such general solutions has led to the promotion of single tree species with the concomitant risks of monocultures. A notable example is the widespread planting of the Leucaena leucocephala in Java and eastern Indonesia. Subsequent Leucaena defoliations by a plant pest, or psyllid (Heterophylla cubana), have caused considerable economic, environmental and agricultural setbacks. The introduction of new perennial crops as commodities is especially risky when local marketing networks are not yet established.

2.3 Information needs for agroforestry planning and extension

Although the selection of appropriate agroforestry combinations is a critical aspect of SUFS planning, the technical information available to the PMUs is not provided in a form that is easy to use. The environmental conditions in UACP districts are extraordinarily variable, in terms of soils, climate and topography. The technical information disseminated by research centers is organized by commodity and does not recommend a set of suitable crops for the specific ecological conditions an upland planner is likely to encounter. In fact, most agricultural information available to the rural extension centers (BPPs) relates to intensifying wet rice production on irrigated land rather than to cultivating perennials in the uplands. Much of the technical data on perennial crops is not yet available in sufficient detail for extension personnel to help upland farmers cope with the specific problems of different upland environments. Furthermore, extension agents with horticultural and industrial crop expertise are very thinly spread and tend to promote only a few commodities. In many project areas, farmers have never received advice on the improved cultivation of perennial crops in their nonirrigated fields.

In the absence of available information, the district technical services often rely on farmers' requests for particular crops and on forestry species which are familiar from the Regreening Program. However, farmers themselves are not always certain which species will thrive or their alternatives in terms of varieties and cultivation practices. The Regreening Program itself has had uneven success because many of the forestry species are not matched to local socio-economic conditions.

The problem facing SUFS planners is even more complicated than just determining which perennial crops will grow on a particular site. Theoretically, the demonstration farms should offer a mixture of annual and perennial crops which will meet farmers' immediate needs at the same time as assisting the eventual transition to commercial tree cropping. The probability of introducing the right mixture is extremely low unless quite detailed socio-economic information is available.

In the uplands, the market value of products from tree crops varies considerably and is somewhat linked to the ease of propagation (including seedling availability), number of years before the first harvest, reliability of production, and their degree of tolerance to environmental extremes. Thus the tree crops which have a narrow environmental range and slow growth

rate, such as durian, tend to command higher market prices than versatile, fast-growing crops like banana.

Although this economic relationship may seem obvious, it is worth emphasizing because of two implications for the project. First, UACP subsidies to farmers for two years will not cover the lag time between planting and the first harvest for most medium and high-value perennials. If perennials of lower value are provided instead, which yield more quickly, upland farmers may not gain sufficient benefits to justify the investment of their labor and capital in maintaining soil conservation technologies once the subsidies are dropped. In some communities it is more profitable and less risky to seek seasonal off-farm employment or to invest in livestock than to cultivate low-value perennials in the upland fields.

Secondly, the risk of losses in terms of invested time and funds are potentially high if inappropriate tree crops are selected. A mismatch between growth requirements and site conditions, for example, can result in an entire batch of high quality tree seedlings dying. Replanting may not be possible of trees die after the two year subsidy. The extended dry season during 1987 demonstrates how vulnerable SUFS sites are to climatic fluctuations, with subsequent crop failures. Even when the tree crops introduced are appropriate technically, they may not be acceptable economically or incompatible with local household resources. This can occur, for example, when the local marketing systems for a tree crop do not yet exist, or cultivation requires too much labor during the dry season when members of the household are working off-farm.

2.4 Agroforestry research priorities

A primary role of agroforestry research in UACP should be the synthesis of existing technical information into a form that can be directly used by extension. In particular, appropriate combinations of annual and perennial crops for different upland environments need to be identified that offer low risk ways for farmers to rely increasingly on tree crops in their upland farming systems. The information should offer options for each upland environment for intercropping annual species already cultivated by farmers with fast-growing leguminous trees, fast-to-moderate growing perennial fruit and industrial species, and several high-value slower growing tree crops.

These combinations should be suitable in terms of: 1) the tolerances of crop species and varieties to a specific ecological zone without large investments of fertilizers or pesticides; 2) products from some of the perennial crops and leguminous trees harvestable within two years of cultivation, for example fodder or bananas; 3) some of the perennial crops yielding products within five to seven years which have relatively high economic value; 4) the spacing and density of perennial crops allow some annual cropping to continue during the first two years; and 5) the perennial crops have root and crown features which improve soil conservation in terms of anchoring soils, stabilizing terraces and/or providing green manure. Extension agents would select among the options according to local socio-economic conditions, farmer preferences and existing marketing networks to reduce the risk of large economic losses.

In addition to improving the application of existing information, there are several topics which require further field research in upland areas. Extensive agroforestry and silvipasture research has been conducted in Indonesia by the Ministry of Forestry (MOF), the Ministry of Agriculture (MOA), universities and the National Biology Institute (LBN).[3] Nevertheless, there is an inadequate assessment of the success of different approaches for both increasing farmer income and for improving soil conservation.

Some studies are too descriptive to allow any scientific generalizations. Others reflect the biases of researchers without adequate integration between the disciplines of agronomy, economics, soil science, forestry and horticulture. An example is the testing of agroforestry systems by forestry scientists to serve one major function, such as fuelwood production. The specific needs of farmers in different upland areas are not always obvious and require careful documentation before designing a field study. For example, the assumption that fuelwood is in short supply for upland farmers is not valid for some communities in West Java.[4]

Field studies of agroforestry should be limited to locations where improving the tree component of the local farming system will have major environmental and economic benefits. In areas where other components of the farming system are more critical for increasing farmer income and for reducing soil erosion, it is not efficient to pursue substantial research on tree crops. To select appropriate sites for agroforestry research therefore requires an understanding of the overall agriculture and resource management system. This systems perspective is often missing from agroforestry research.

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[3] Directorate for Reforestation and Land Rehabilitation (Directorate General for Forestry) and the Center for Forestry Research (Agency for Agricultural Research and Development), Proceedings Seminar Agroforestry dan Pengendalian Perladangan. Jakarta: 19-21 November, 1981.

Wiersum, K.F., "Observations on Agroforestry on Java, Indonesia." Report on an agroforestry course organized at Forestry Faculty, Gadjah Mada University, Yogyakarta: Gadjah Mada University and Wageningen: Department of Forest Management, Agricultural University, 1981.

Mackie, C., "Report on Agroforestry and Silvipasture Research in Java." Jakarta: U.S. Agency for International Development, June, 1986.

[4] Indonesian Rural Women's Work and Energy Project Team (from the Bandung Institute of Technology and the Bogor Agricultural Institute), 1986. *Rural Women and Social Structures in Change: A Case Study of Women's Work and Energy in West Java, Indonesia.* International Labour Organization, Geneva.

The following topics would help identify appropriate agroforestry technologies for different upland areas:

1) soil conservation benefits and economic returns of different tree cropping patterns now practiced by upland farmers,

2) socio-economic factors which explain spontaneous tree crop planting by some upland farmers;

3) the suitability of hedgerow alley cropping of leguminous trees as an alternative to terrace construction on shallow soils, and

4) the economics of forest product use in UACP communities.

Existing tree cropping practices in the uplands are often not recognized as a valuable source of information which can save years of experimental trials. In many of the project districts, some farmers are already cultivating perennial crops and leguminous trees on nonirrigated land. Basic information regarding soil erosion and runoff from these fields can be compared to more destructive land use practices and used as a crude measure of the soil conservation benefits that can be anticipated if UACP successfully promotes the spread of tree cropping. Some practices may serve as useful examples of intercropping for SUFS demonstration farms. An analysis of the economic returns from these practices will clarify what effects on household income different intercropping combinations might have.

Another important research topic focuses on understanding why are most farmers are not planting more trees in their upland fields whereas others are. There is a tendency for visitors to project sites to give pat or superficial reasons for farmer's behavior which reflect their own technical and cultural biases. Java has some of the most varied and dynamic upland agricultural systems in the world, with farmers responding to different conditions and opportunities each year. The history of small-holder cultivation in the uplands is recent and many project areas were still under forest at the start of World War II. Some communities have gone through "boom and bust" cycles of tree crop cultivation. An example is Kates in Tulung Agung, where durian was intensively cultivated in orchards and then cut, cloves were planted years later only to have them all die, and now citrus cultivation is rapidly expanding without any initial assistance from the government.

Research on this dynamic history would help pinpoint what socio-economic conditions are necessary for tree cropping to be viewed as a favorable economic strategy by upland farmers or, conversely, existing constraints to tree cropping. This information particularly important for understanding where subsidies will be needed for periods longer than two years or the technologies introduced by the SUFS demonstration farms and expansion areas will not be sustainable.

A common theme of UACP consultant reports has been the need to discover alternatives to bench terracing for shallow and unstable soils such as limestone areas in Blitar and Boyolali.

The experience of hedgerow alley cropping with leguminous trees is encouraging from eastern Indonesian islands, however the soil conditions are different in upland Java and this technology needs to be carefully tested on these soils.

The present technical package used in the SUFS always includes forestry species (e.g., Gliricidia, Calliandra, Sesbania and other legumes, as well as teak and mahogany) with no socio-economic data supporting the assumption that farmers want these trees. My own intuition is that the economics of forestry trees in upland fields may only be favorable in the poorest limestone areas where horticultural species are a high risk investment for farmers.

What is needed is a focused economic survey and field study of forest product collection and marketing by farmers in project communities. This would include an analysis of: a) total household requirements for forestry resources, including for economic enterprises such as ceramic making; b) the socio-economic characteristics of households most dependant on forest products; c) a list of forestry species already planted by farmers on their private land; d) degree of community dependance on forest products collected from government lands, e) commercial prospects for forest products in each project district, including rural industries and local factories, and f) subsequent recommendations for tree planting in SUFS for each district, including which species are the most acceptable to farmers and what steps are needed to stimulate cooperative marketing enterprises by farmers.

2.5 Agroecosystems analysis as a tool for coordinating research and extension

The previous discussion has outlined why an agroforestry strategy is important for UACP and the information needed to pursue this strategy. The difficulties of recognizing what combination of annual and perennial crops is appropriate for a particular site require a closer working relationship between farmers, extension agents, researchers and planners. Another words, no simple answer exists and tree crops need to be viewed as part of the entire farming system.

The challenge for UACP staff is to find better ways of collecting and analyzing field information in a short period of time, to assess which initiatives have the greatest likelihood of success in each particular site, and to identify the concomitant priorities for extension and applied research to help ensure that success. Presently, field technical staff from different disciplines (agronomy, horticulture, soil science, forestry, etc.) do not have a reliable mechanism to conduct information gathering together. Each maintains a separate vision of what the major technical problems are in a site without understanding the linkages to other disciplines or to other elements of local resource use systems. Furthermore, research planning and SUFS planning are conducted independently from one another, leading to different perceptions of technical priorities.

One possible solution is a diagnostic approach called agroecosystems analysis. The concept of agroecosystem embraces both the physical characteristics of agricultural systems, as

well as the socio-economic factors which influence farmer decision-making. Researchers, planners and extension personnel can use this approach as a way of working together to agree on priorities for research and development.

The features of agroecosystems analysis are:

- a focus on the diversity of land uses and factors that explain this diversity (both biophysical and socio-economic)
- the complexity of each site is reduced to a few key problems and opportunities which help planners, field technicians and researchers agree on priorities for action
- small interdisciplinary teams collect field data together using rapid rural appraisal methods
- field information is analyzed from a systems perspective, avoiding commodity biases and emphasizing the relative impact of each recommendation on overall productivity, stability, sustainability and equitability of the farming system
- local conditions and the farmer's perspective are considered at the start of the planning process, so that it is a "bottom-up" approach which reduces the risk of project failure
- staff time and resources are saved by avoiding detailed, quantitative data collection until after the most important and relevant questions about a site are identified and agreed to.

These features could be especially useful for establishing coordinated agroforestry research and development. Specifically, agroecosystems analysis would encourage greater harmony through the integration of existing technical information on perennial crops and leguminous trees by forestry and agriculture experts. It also provides a routine mechanism to understand problems from the farmer's perspective, which is important for guiding extension efforts and for ensuring that agroforestry research is relevant to the socio-economic conditions found in project sites.

III. SPECIFIC ACTIVITIES

Before describing my activities in detail, this chapter summarizes major accomplishments during my consultancy in terms of significant impact on FSR, UACP, and USAID programs. The subsequent sections review specific efforts to address the issues outlined in the previous chapter.

3.1 Highlights

A general accomplishment was more awareness by FSR staff of the value of a research design based on the analysis of existing farming practices and on an interdisciplinary perspective. This has helped FSR staff begin the transition from testing preconceived models to addressing the specific technical needs of different project sites. The FSR field sites selected in 1987 reflected this progress in the sense that they were located adjacent to SUFS demonstration farms and represented ecological conditions commonly found in UACP districts. Two case studies of new sites were conducted as part of an agroecosystems analysis training program. This represented the first efforts by FSR to undertake diagnostic appraisals of farmer needs and to analyze data from an systems perspective. I contributed substantial portions of the final report on this training activity together with other members of the training team.

Secondly, I developed a detailed work plan with the FSR Project Leader for agroecological zoning of project districts in East Java and for documenting existing tree cropping and agroforestry practices within each zone. Although the work plan was ultimately not implemented by FSR, the process of developing it involved detailed discussions with FSR staff, UACP consultants, local scientists, and presentations to the PMUs, PCO and some members of the Executive Secretariat. This dialogue inspired one component of the work plan to be incorporated into the horticultural study supported by the East Java PCO using the same local scientists. In addition, many of the FSR staff are now familiar with the technical and institutional issues associated with developing an agroforestry research program.

Thirdly, I developed and helped implement an agroecosystems analysis training program for 52 UACP staff to improve their capabilities to recognize problems and opportunities in project communities and to work more effectively in interdisciplinary teams. This training produced case studies of four SUFS sites which were presented at a project-wide workshop. The usefulness of applying this method has led several specific proposals by senior UACP decision-makers to incorporate agroecosystems analysis into the SUFS planning and implementation process and to conduct more training next year.

Finally, I provided technical guidance during USAID's formulation of a strategy for supporting natural resource management in Indonesia. This included conducting an analysis of forestry and agroforestry policy in Indonesia as part of a major team report to USAID reviewing natural resource and environmental issues and priorities. In addition, I reviewed early versions of a concept paper for a new natural resources management project in Kalimantan and provided guidance on biological diversity aspects.

3.2 Strengthening research methodology and reporting

Field study design

After arriving to Salatiga, I reviewed with the Project Leader the overall design of field research. The initial design of FSR involved a comparison between a sample of farmer's "traditional" practices to the technologies tested by FSR staff on a variety of soil and slope conditions. The terminology used was "Pola A" farmers versus the introduced technologies of "Pola B, C and D". As the outgoing FSR consultant, James Clarkson, had already noted in his final report, there were serious flaws in this type of design. My initial strategy was to present to the FSR staff reasons why this design would not yield important research results for the project. Because FSR was not yet prepared to abandon this approach, I tried to improve the quality of the data that were produced.

It may seem repetitious to review the weaknesses of the initial FSR design here in light of the recent comprehensive evaluation of FSR's program by the Winrock TAT. Certainly all the UACP technical consultants seem unanimous in their basic questioning of the Pola A, B, C and D approach. Despite of all of these efforts, however, I have noticed that some of the FSR staff still describe the Pola A, B, C and D design to visitors as if this approach remains the main thrust of the FSR program. For this reason, I will reiterate here a few of my comments to FSR last year.

The first FSR field sites were selected to be minicatchment areas to test three different soil conservation technologies: bench terracing (Pola B), ridge terracing (Pola C) and hedgerow alley cropping (Pola D). In Figure 1, the three physical variables used to determine which terracing system should be used are presented.

Figure 1. The FSR design for on-farm research and terracing recommendations.

	SOIL DEPTH					
	90 cm		90 - 40 cm		40 cm	
EROSION RISK	Low	High	Low	High	Low	High
SLOPE (%)						
<15	B1	B2	B3	B4	C1	C2
15-30	B5	B6	B7	C3	C4	C5
30-45	B8	C6	C7	C8	C9	D1
>45	D2	D3	D4	D5	D6	D7

The classification system involved three variables so that each land category (B, C and D) represented a wide range of conditions. By numbering the land categories as indicated in the figure above, I argued that this variability seriously restricts the conclusions one can make about the suitability of soil conservation technologies under different conditions. Thus, B1 B8 have very different physical characteristics and it remains an untested hypothesis that bench terracing is necessarily appropriate on all soil types.

First and foremost, the technologies tested in Pola B, C and D are not based on local farming practices and needs, but on preconceived notions of improved upland farming systems. In fact, this design is primarily aimed at providing an alternative classification system for land use recommendations to the BRLKT system, which divides uplands into below 50% slope and above 50% slope. Although it may be necessary to find alternatives to the BRLKT system, the FSR breakdown of land types was just as theoretical without sufficient empirical evidence that the different soil conservation recommendations were indeed appropriate for particular soil conditions.

Secondly, the basic design is unscientific because three physical factors were simultaneously varied: erodibility, slope and soil depth at the same time as the tested technologies and cropping systems. All comparisons of productivity, erosion, costs, and labor are unjustified because each "Pola" represents a completely different set of physical and agricultural conditions.

With junior FSR researchers in Malang and Salatiga I examined this design in greater detail by remeasuring all the research plots according to the numbering system in the table above. We discovered that the FSR recommendations are not always strictly followed, although this is not mentioned in the research reports. The value of all data from these sites is therefore extremely dubious. For example, more than one field in Dampit, Malang falls into the "C" or "D" land category but bench terraces were constructed. This is due to resistance by cooperating farmers to alternative technologies and subsequently lower subsidies. Farmers' resistance should have signalled FSR staff that these technologies were not acceptable.

One of my recommendations was more direct testing of the FSR hypothesis that ridge terracing is the most appropriate soil conservation technology for intermediate categories of critical land ("Pola C") and alley cropping for the most critical categories ("Pola D"). I suggested that both terracing technologies need to be tested under a range of slope, soil depth and erodibility conditions to test this assumption. The Project Leader agreed and planned to try this approach in 1987/88. This plan was not followed once FSR encountered financial delays, staffing shortages and the general confusion of a change in FSR leadership.

Revising "Pola A"

FSR staff identified two reasons for having a sample of non-participating farmers, or Pola A. The first was using a sample of upland fields as "controls" for comparisons to research plots,

such as relative soil erosion, crop productivity and benefit/cost ratios for each of the tested technologies (Pola B, C and D). The second purpose was to have a wide sample of households for monitoring the socio-economic conditions and agricultural practices of upland farmers in the vicinity of the research sites.

At the time of my arrival, about 14 upland fields were labeled "Pola A" at each of the four research sites. With junior research staff, I visited all the Pola A upland fields in Central and East Java. It is clear that the Pola A the sample was not selected with sufficient care. Many are not on the same soils as the research plots or are actually irrigated rice fields. A reselection of Pola A fields was initiated by FSR based on these discoveries. I recommended focusing on land use extremes, representing the best and worst land management to see what circumstances in household helped explain this variability and to document differences in soil fertility and erosion rates.

During 1987, FSR initiated an elaborate farm record keeping effort in Central Java of all Pola A farmers, with only sporadic data collected in East Java. The information on the forms, if collected diligently, would have provided a detailed portrait of some of the farming households through time in the project areas. However, the quality of the data collected was difficult to determine because the most junior field assistants were assigned to collect it and the reselection of Pola A fields was never completed to my knowledge. This was partly due to a lack of consensus between FSR senior and junior scientists regarding the function of the Pola A upland fields and farm record keeping.

One Pola A field in each of the FSR sites is used to monitor soil erosion and runoff from "traditional" farming practices for comparisons to the introduced terracing technologies. I advised the FSR staff that the physical conditions of the Pola A fields should be as close as possible to the research plots. Therefore, the physical conditions in both the Pola A and the research plots need to be documented carefully to ensure accurate data analysis. All four Pola A fields were remeasured and compared to the research plots to determine how similar they were. The erosion data for the 1986 rainy season was reanalyzed and presented in a paper by Dr. Fagi at a seminar in Puerto Rico, based materials we prepared together.[5]

Another suggestion was additional soil collectors for Pola A "control" fields to match each of the basic research plot slope conditions. For example, if there are research plots with B4, C1, and D2 physical characteristics, then there should also be soil collectors monitoring a Pola A field matching each of these three categories. This recommendation was discussed in detail with the FSR junior soil scientists and the Project Leader. Although they agreed in principle, the recommendation was not included in the 1987/88 budget.

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[5] Achmad M. Fagi and Cynthia Mackie, In Press. Watershed Management in Java's Uplands: Past Experience and Future Directions. Chapter 28 In: *M. Schnepf (Ed.), Steep Land Agriculture and Watershed Management(?)*, Soil and Water Conservation Society, Ankeny, Iowa.

I also recommended that additional information be routinely collected for all fields with soil collectors. For example, simple maps would show field boundaries, slope characteristics and crop spacing. These maps would allow more exact calculations of field area, crop density, and crop cover. The first two factors need to be measured in order to make better use of the crop production data. Crop density in farmers' fields, particularly in mixed cropping fields, seems to vary and should not be assumed to be constant. Data on crop density and productivity would allow a more precise estimate of crop productivity per individual plant for comparisons to productivity in research plots.

Maps of crop spacing would also facilitate the measurement of crop cover, an important variable for the analysis of soil erosion data. These data are especially needed because many of the research plots and Pola A fields already had tree crops on them of varying density. Particularly important is the accurate measurement of area under cultivation. A basic map for each research and control plot could be photocopied and sketched on by field assistants each month to note down changes in crop cover. Average cover per crop species (including perennial crops and fodder grasses) could be estimated and then extrapolated for the entire field. This would give a rough index of annual and perennial crop cover, a key variable for interpreting soil erosion data. While this recommendation seemed well received it also was never implemented.

Ungaran Field Laboratory

Some of my time was devoted to reviewing with FSR staff the objectives of the new Ungaran field lab composed of almost 10 hectares of hilly land. The initial 2 ha of land in Ungaran were available in 1987 for controlled experiments. I was concerned that FSR planned to repeat the general Pola A, B, C, D model there. I accompanied a series of visitors to the field lab to encourage suggestions from the other technical consultants, the Ungaran PMU office and from senior Litbang Pertanian scientists associated with FSR. My major emphasis was that research at the field lab should focus on rigorous experimental testing of a selected few technologies which cannot be conducted directly on farmers' fields. Since the lab was being set up to try a variety of terracing systems, I also urged that hedgerow alley cropping be included in the design.

There is some risk that too much FSR staff time and resources would be invested in field lab research to the detriment of on-farm research. A constraint to generating valuable information from the field lab is the relatively good quality of the soil there compared to most of the SUFS locations. A general agreement was reached that the field lab should focus on tree crops, which is still reflected in FSR's 1988/89 research plan. I have recommended that simple experiments be conducted to document the effectiveness of different commercial tree crops for soil conservation. Another useful activity would be testing innovative ways to reduce the competition between tree crops and annuals by trying different pruning regimes. Finally, new varieties of *Leuceana leucocephala*, which may be resistant to the

psyllid pest, can be tested at the lab before trying them on farmer's fields.

Research planning for 1987/88

During 1987, FSR planned an expansion into two new districts in Central Java and two in East Java, matching the general expansion of SUFS activities. This seemed the appropriate point to move away from FSR's original design and try simpler, more focused on-farm research. To this end, I visited all the prospective SUFS sites in the new districts with FSR staff. We reported to the Project Leader our recommendations for the FSR field activities, emphasizing smaller on-farm sites adjacent to the SUFS demonstration farms. Some simple diagnostic methods were used to pinpoint important technical needs in these locations. In recognition of previous criticisms of FSR's approach, greater emphasis was to be given to soil conservation technologies, agroforestry and fodder production.

The original plans for research developed by junior FSR staff and the Project Leader included: 1) a silvipasture study on steep slopes in Ngengklir, Blora, 2) assisting farmers in Kates, Tulung Agung to improve the production of existing fruit trees on the upland fields, and 3) testing a variety of fodder grasses and cover crops in Boto Putih, Trenggalek as terrace stabilizers. Many of these ideas were later abandoned after a visit by the senior AARD scientists on FSR's steering committee. A detailed research plan was the formal responsibility of this senior team, but it was not provided in time to implement before the onset of the rainy season. The direction given to the FSR watershed coordinators by the senior committee conflicted with the ideas developed by the full-time field staff.

Further confusion resulted from trying to plan research for too many sites. FSR wanted to expand its field studies to four new sites in the Semarang and Boyolali districts in response to requests by the PMUs. The shortage of qualified field staff made this an overambitious plan. During discussions in November, 1987, I convinced the Project Leader to reduce the new field sites in half. Even with this reduction, the new sites proved to create too many demands on the FSR staff. The end result was that only agronomic field trials were established because they are the simplest to implement in a short period of time. The arrival of the Winrock TAT and an slight increase in FSR staff, together with a more focused research agenda should prevent such serious problems from reoccurring during the establishment of 1988/89 research.

Data analysis

During my first year with FSR, I became concerned with the overall process of data collection, analysis and reporting. Originally, I had expected to work with junior staff on the analysis on their 1986 data on tree crops. This was not possible because raw data were compiled by junior staff and then sent to Salatiga for analysis by only a few staff members. I discovered a general hesitancy among the staff to show me the raw data or to participate in its analysis. The final analysis and reporting were undertaken by senior AARD scientists in Bogor, so that important observations about the characteristics of the field

sites and the participating households were often missing from the tabulations sent from the field. In addition, negative field results tended to be omitted, perhaps out of the mistaken feeling that poor crop performance would be interpreted as poor researcher performance.

This "top-down" system of data analysis constrained my ability to advise on revisions of tree crop research and priorities. These concerns were shared with the Project Leader and with senior scientists from AARD during staff meetings, presentations and in my monthly reports. Although important progress has been made recently with the restructuring of FSR activities, I believe further decentralization of responsibilities for analysis will be needed.

Communications

It was clear from the onset that FSR did not exchange much technical information with the PMUs or PCOs, other than low-level interactions in the field through the efforts of a few industrious individuals. The regular technical meetings at the district and provincial levels provided an opportunity to improve this situation. The FSR Project Leader and I decided it was critical for FSR staff to start attending these meetings and to share with the PMUs new research results, technical concerns and future plans. For these reasons, we attended many of the early meetings in all eight districts together with key FSR staff. This was the first time the Project Leader came into contact with the East Java PCO.

I also encouraged other UACP technical consultants to become familiar with FSR's program and staff in both provinces. In East Java, the PASA soil scientist has become particularly helpful to FSR on the design of soil erosion research. Regular contact with both of the TAT/DAI extension agronomists contributed many ideas, information and general advice regarding SUFS activities and important research priorities. These informal discussions have proved an important mechanism for coordination between FSR and PMU's.

In some instances, I provided advice to the Project Leader regarding USAID procedures. As discussions unfolded during the 1987/88 fiscal year regarding FSR's work plan and funding, I tried to improve the understanding of concerns and constraints between FSR and USAID. Other assistance involved helping coordinate visits by guests associated with USAID, developing schedules for planning FSR activities and meetings, advising on how to address FSR's immediate training needs and generally facilitating communications with USAID and other UACP offices.

3.3 Improving agroforestry research

This section outlines my efforts to promote a coordinated research program in agroforestry. It will be clear from the discussion below that I was not able to accomplish this goal. The institutional constraints I encountered are described in more detail in the following chapter.

Tree crop selection

Some of the perennial crops introduced by FSR to upland farmers require large inputs of fertilizers and pesticides, such as perennial cotton. In addition, field researchers often resort to intensive management techniques when trees were not performing well to ensure high productivity. This approach seems more appropriate for research stations than for on-farm studies in cooperation with farmers. It certainly exceeds the investment possible by the PMUs for the SUFS demonstration farms. Insecticide spraying of *lamtoro* trees afflicted with the psyllid pest is an example. The experience to date with tree crops in the FSR sites suggests that some of them are not suitable for UACP despite their biological potential and high national priority as commodities for export. This is because many of the UACP sites are on critical lands where farmers are not yet in a position to risk new crops requiring intensive cultivation techniques and high capital investments.

I urged more attention to existing tree cropping patterns as the crops favored by local farmers are frequently not included in the FSR field studies. The most obvious example is the omission of coffee from the Dampit site in Malang, even though coffee is the most prevalent tree crop grown there. During the formulation of research at Ungaran field laboratory, I accompanied FSR's tree crop scientist to interview local farmers about perennial crops they had experimented with or wanted to try. Although these interviews suggested which crops were appropriate for the lab, many of the trees ultimately planted were unfamiliar commodities with no local markets.

Testing Hedgerow alley cropping

On-farm research by FSR on the steepest slopes (Pola D) is referred to as hedgerow alley cropping with leguminous trees. However, none of the FSR sites have successfully established this technology. A major reason for farmer resistance to adopting this technology was the higher subsidies received by their neighbors from FSR to build ridge terraces or bench terraces. Further, the psyllid pest on Leucaena leucocephala seriously stunted the trees so that they never formed an effective barrier to soil movement. The crops planted on the Pola D fields were mostly horticultural and industrial perennials without sufficient thought to the long lag time before their first harvest. An additional problem was that this technology was promoted on sites selected entirely on slope and soil criteria with no consideration of socio-economic factors which affect how individual households might weigh the relative advantages and disadvantages of different introduced technologies.

My advice for existing FSR sites was to replant the hedgerows with other leguminous trees such as Gliricidia and to plant fast growing perennials in combination with the slower yielding ones. I encountered a general unfamiliarity with the successful hedgerow alley cropping technologies used in eastern Indonesia and shared literature to encourage researchers to improve their field design. One continuing constraint is that FSR staff feel more comfortable with field research on annual crops on the bench terraces and therefore are not yet prepared to devote much attention to testing hedgerow alley cropping.

Farmers' reluctance in the face of lower subsidies could be overcome if FSR is more creative with the subsidy system.

There remains no true example in any of the FSR sites of a viable form of hedgerow alley cropping, which I believe is a major weakness in meeting UACP technical needs. In the FSR research plan for 1988/89, hedgerow alley cropping is specifically mentioned. Hopefully the field testing of this soil conservation technology will be carefully designed to yield immediate, as well as long-term, benefits to farmers based on local needs and preferences. However, the leguminous tree species should not be preselected but rather determined based on local needs for fodder, fuelwood, and other products and on the physical characteristics of the site. The potential households for participation in this study should be evaluated carefully to ensure that the key advantages of hedgerow alley cropping match their particular socio-economic needs. For example, families managing large livestock herds might be less interested in leguminous trees stabilizing steep slopes of their fields or providing green manure, when animal manure is already available and the livestock can be used to work the soil intensively.

Inventory of existing tree cropping practices

A significant activity was assisting FSR to develop a detailed work plan for activities during 1987/88 East Java entitled, "Inventory of Agroecosystems and Existing Tree Cropping and Fodder Production Practices". The inventory was based on a phased approach in order to generate information in the immediate future for SUFS planners, while also building a comprehensive data base for long-term planning. A similar process was planned for Central Java in 1988. The concept and details of this work plan were developed in close cooperation with the Project Leader, FSR East Java staff, KEPAS and other UACP consultants. I presented the outlines of the plan in Bogor at a meeting on the applications of the UACP soil survey.

The first phase of the inventory focused on generating immediate recommendations regarding appropriate perennial crops and fodder species for 1988/89 SUFS. The second phase entailed a more comprehensive synthesis of existing data into a computerized data base for distribution to each PMU, in addition to the publication of maps and technical pamphlets describing propagation and cultural techniques for each recommended species. Further, a field research program in SUFS locations was proposed to address important information gaps. These field studies are expected to range from on-farm trials of selected perennial crops, trees and fodder species to case studies of upland household decision-making.

The intended outputs of the inventory were:

- agroecological zoning of all project areas in East Java
- a computer data base of the biophysical characteristics of each zone
- a list of suitable perennial crops, forestry and fodder species which could grow in each zone

- identification of existing agroforestry and silvipasture practices within each zone with good prospects for meeting project objectives
- an analysis socio-economic conditions which act as disincentives to the wider adoption of these pre-existing practices
- a long-term plan to refine the zoning system and incorporate soil survey results, and
- a research plan for in-depth field studies to address the major technical issues raised by the inventory, including appropriate institutions to conduct the studies.

This inventory was developed in recognition of the substantial amount of information that is already available for both watersheds, but has not been compiled and synthesized in such a way that SUFS planners may easily use it. Funds totalling 25-30 million rupiah were intended in FSR's 1987/88 budget for the East Java inventory, but were later used for other purposes. FSR staff availability and experience were major constraints to implementing the inventory. Several ways were explored to overcome the staffing shortage. The Balai Penelitian Tanaman Pagan in Malang (MARIF), which chairs the East Java KEPAS group, was asked to help manage the inventory by providing office space and administrative services. Several Indonesian scientists were approached to participate in the inventory on a short-term, contractual basis to cover horticulture, biology and socio-economic disciplines. Despite these efforts, the change in FSR leadership, arrival of the Winrock consultant team, and the ambitious nature of the inventory prevented it from being feasible during 1988. The East Java PCO subsequently allocated funds for 1988/89 to conduct many elements of the inventory with a sharper focus on horticultural trees.

Collaboration with outside experts

Throughout my consultancy, I recommended various experts from Indonesia and elsewhere who could help FSR establish an agroforestry program. This included working closely with the Agroecosystem Research Group (KEPAS) in East Java during their study of four upland communities, which represented different agroecological zones. As a member of the resource committee, I highlighted the agroforestry research issues for UACP and encouraged FSR to become involved in KEPAS initiatives in East Java. One outcome was KEPAS participation in 1988 agroecosystems analysis training of UACP staff, which had a topical focus of understanding tree cropping constraints and opportunities in project sites. (This training is described in more detail in Section 3.4.)

One of the specific objectives of my consultancy was to facilitate a working relationship between BTPDAS and FSR. BTPDAS is a permanent part of the Ministry of Forestry, responsible for conducting applied research on watershed management technologies and for subsequent dissemination in the form of manuals and technical materials to land rehabilitation and soil conservation stations (BRLKT). Ongoing research relevant to UACP includes

field studies of sedimentation resulting from different land uses in the Solo watershed, socio-economic incentives and constraints to the adoption of soil conservation technologies in six model farms in DAS Citanduy, and agroforestry field trials with local farmers in 13 locations in upland Java.

I helped arrange a formal meeting in Solo to learn about the BTPDAS research program and to receive formal endorsement from senior forestry and agriculture officials to exchange information freely between the two field offices. While this meeting was well represented by forestry personnel, UACP consultants and USAID staff, the FSR Project Leader was not able attend. The lack of a strong FSR presence prevented any significant follow-up. I had limited means for facilitating a reciprocal meeting hosted by FSR other than proposing possible dates to the Project Leader.

Specific collaboration was also proposed between FSR and BTPDAS to test agroforestry and silvipasture technologies in Nglengkir, Blora and at the Ungaran field lab. Because the sharing of FSR funds with BTPDAS seemed increasingly unlikely, I tried to include BTPDAS in discussions with U.S. forestry scientists visiting Indonesia as part of the AID regional Forestry/Fuelwood Research and Development (F/FRED) project. This resulted in field trips to the Ungaran field lab and Nglengkir, with several research ideas for BTPDAS - FSR collaboration, but no detailed plan emerged. Subsequently, USAID made the commitment of FSR 1988/89 funds contingent on collaborative research with BTPDAS in Boyolali. A proposal was recently submitted by BTPDAS to FSR.

In April 1987, I represented USAID at a meeting in Bangkok on mechanisms for country participation in the F/FRED project. During my trip to Bangkok, I also visited scientists at Khon Kaen University associated with an USAID/Bangkok farming systems research program. This visit strengthened my interest in training FSR staff in rapid rural appraisal methods. My recommendations were presented to AARD senior scientists in Bogor associated with FSR.

The F/FRED technical team visited Indonesia as a result of the Bangkok meeting. I facilitated the team's introduction with senior forestry researchers and with a visit to FSR in Salatiga. Subsequently, F/FRED sent two forestry experts from U.S. universities to visit Indonesia in early 1988. Both times I assisted the Project Leader with preparations for briefings and field trips because of evident FSR interest in the F/FRED international research network on agroforestry and multipurpose tree species. One of the TAT/Winrock consultants and the Project Leader were later invited by F/FRED to attend a meeting in Nepal on economic methods for multipurpose tree research.

Evidence of AARD's lack of commitment to agroforestry research subsequently led me to recommend that FSR not receive further technical assistance or support from F/FRED. Instead, I suggested that future F/FRED visits should concentrate on assisting BTPDAS and Gadjah Mada University (UGM) scientists to develop a research proposal for an economic survey of forest product use by upland farmers in UACP participating districts.

Dr. Sumitro and other forestry economists at UGM have developed a rapid survey technique for studying forest product use by rural communities based on their participation in the social forestry program of the State Forestry Corporation (Perum Perhutani). I recommended a social forestry study in Grobogan by UGM to document local uses and demand for forestry products, identify which tree species bring the greatest income to farmers and the significance of Perum Perhutani programs for farmer participation in UACP activities. The incentives for adopting and maintaining soil conservation technologies, such as tree planting on private land are not clear because some UACP communities are almost surrounded by Perum Perhutani forest plantations.

The FSR Project Leader agreed to this idea for using unspent funds set aside for Grobogan. I visited UGM and reached a preliminary understanding with Dr. Sumitro about the study and the research proposal that would need to be submitted. However, I was unable to obtain approval when the FSR leadership changed to continue to develop this study with UGM.

Agroforestry research priorities for 1988/89

All proposals for 1988/89 UACP research were evaluated during a meeting in February in Semarang between branches of the project, consultants and USAID. These were later consolidated into a few discrete topics based on group consensus regarding both the urgency for the research and a concomitant willingness by one of the UACP offices to include it in their budget and to arrange for administration and implementation. My recommendations focused on the agroforestry and agroecology topics already described in this report, such as agroecological zoning of project areas, field studies of existing agroforestry practices, and an economic survey of forest product use by upland farmers in UACP districts.

The majority of these recommendations did not survive the screening process, and an agreement was reached on the technical boundaries of FSR's 1988/89 program, with agroecology and agroforestry research restricted to:

(1) Inclusion of leguminous trees in the livestock forage conservation species trials proposed for Blora, this component to be implemented by BTPDAS-Solo using funds from FSR;

(2) Consideration of existing agroforestry practices in upland Java when selecting alternative soil conservation technologies to test in the field;

(3) Inclusion in the socio-economic studies an analysis of the opportunities and constraints to expanded tree planting in upland fields, based on the previous diagnostic agroecosystem analyses by FSR in Blora and Tulung Agung; and

(4) Inclusion of agroforestry technologies such as hedgerow alley cropping in the field research on the management of shallow limestone soils in Boyolali, this element to be done in collaboration with BTPDAS.

Progress in these four areas has not been encouraging and my technical assistance has not been drawn on by FSR to develop these topics further.

3.4 Training in agroecosystems analysis

East Java KEPAS research, which included two FSR staff, demonstrated the value of applying agroecosystems analysis techniques to understanding upland resource use. This prompted me to devote more attention to training. In this section I describe the two major training efforts I helped to develop and implement.

Training of FSR staff in 1987

The idea of a short course on rapid rural appraisal techniques and the analysis of information from an agroecosystems perspective was proposed by the Project Leader to assist with the planning of FSR activities on new sites. Technical assistance for the training was supported by USAID/Jakarta, AID/Washington, the International Institute for Environment and Development in London (IIED) and Winrock. The training team was composed of myself, two consultants from IIED and one from the East-West Center.

Participants in Central Java were composed of 8 staff from FSR, 3 from PMUs and one from the PCO whereas in East Java there were 7 staff from FSR, 1 from a PMU, 1 from the PCO staff and a researcher from the Center for Industrial Crops (Balittas). In each province the training was run as an intensive ten-day program of lectures, group discussions, field visits and data analysis. Case studies of villages with 1987/88 SUFS demplots, where FSR planned to initiate field research, were undertaken in Nglengkir, Blora and in Kates, Tulung Agung.

The goals of the training were:

- to improve staff capabilities in problem-oriented, quick information-gathering techniques to identify priorities during the diagnostic stage of research planning,
- to increase FSR staff skills for implementing their plan for research on agroecosystems and existing tree cropping practices in East Java, and
- to test the value and acceptability of AA as a standard method for UACP staff to collect field data and to identify priorities for extension, training and applied research.

When asked to evaluate the usefulness of the methods and concepts introduced to them, the participants strongly recommended an expanded program of training in 1988. In particular, they urged more joint training between FSR staff, SUFS planners and extension specialists to improve their ability to collect information swiftly during the preliminary surveys of 1989/90 SUFS. It was also recommended that senior UACP staff become familiar with agroecosystem analysis as a technique to rank priorities for research and development and to improve the

flow of technical information between farmers, extension, research and planners.

Recommendations from the 1987 training were presented to the UACP Executive Secretariat and appeared in a report written by the team.[1] An analysis of research priorities in the form of key questions were generated by the case studies and resulted in several discoveries about these communities which were not immediate obvious. A publication of the findings in the Indonesian language was planned, but required another meeting of the participants to complete their background descriptions of the figures and diagrams. The meeting never received authorization by the incoming FSR Project Leader, so that the dissemination of results did not occur and the case study recommendations for research were not followed.

Agroecosystems Analysis Training and Workshop in 1988

Based on the experience and recommendations arising from the first training effort, I developed a draft proposal for an expanded training program. This proposal was circulated widely and was funded through the provincial budgets for 1988 training. The program focused on improving UACP skills for the survey and planning of 1989/90 SUFS expansion areas and the implementation of the second year of 1988/89 demonstration plots. A project-wide workshop was funded through the Executive Secretariat and administered by the Directorate for Regional Development (BANGDA). The purpose of the workshop was to give an opportunity to UACP personnel to review the practicality of incorporating agroecosystems analysis into the planning and implementation process and to agree upon follow-up activities.

The specific objectives of the agroecosystems analysis program were:

(1) To improve the capability of UACP technical and planning staff to conduct rapid rural appraisals in project communities, such as gathering field information quickly, identifying the particular needs and constraints, and assessing subsequent priorities for research and extension activities;

(2) To develop better skills in the interpretation of secondary data, interviewing farmers, documenting local land use practices and analyzing data from a systems perspective;

(3) To establish a closer working relationship between SUFS planners and technical experts from Indonesian agencies and institutions (both within and outside the project) by conducting case studies of project sites in joint, interdisciplinary teams;

(4) To familiarize senior and middle-level UACP staff during the final workshop with the methods of agroecosystems analysis, particularly the technique called "innovation assessment," which

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[1] J.N. Pretty, J.A. McCracken, D.S. McCauley and C. Mackie, 1988. *Agroecosystem Analysis Training in Central and East Java, Indonesia.* Report submitted to USAID/Jakarta and the Government of Indonesia by the International Institute for Environment and Development, London.

helps planners to weigh the trade-offs involved with each recommended project activity;

(5) To address during the workshop how the flow of technical information in the project can be improved, particularly between farmers, extension agents and researchers, and between junior and middle-level UACP staff and senior decision-makers. This included identifying specific actions to improve the incorporation of "bottom-up" methods into the planning process and an agreement on follow-up activities based on trainee recommendations.

The original mechanism for providing technical assistance was to be a contract between IIED and the International Institute of Education (IIE) using Executive Secretariat funds. The changing nature of GOI regulations on contracting later closed this option and a five-person team was eventually recruited through the existing sub-contracts of DAI. I helped identify the best candidates for the training team who could also help develop a set of materials in the Indonesian language. The methods and training materials available through IIED and KEPAS proved the most suitable. An additional goal of this training program was to stimulate an exchange of training materials and ideas between these two institutions.

The enthusiasm for trying this innovative technique became evident when both Provincial Coordinating Offices (PCOs) decided to implement the three-week course as their first training initiative implemented with 1988 funds. In each province, training involved 26 UACP staff from a mixture of disciplines and positions. The participants were from local branches of SBRLKT, agricultural technical services, district planning boards (BAPPEDA TKII), FSR and from provincial offices. A total of four case studies were completed in villages in Semarang, Grobogan, Blitar and Trenggalek districts.

The final workshop was held in Solo on August 12-13 and my formal presentation of the expectations from the workshop is provided in Appendix II. The trainees described their evaluation of the usefulness of the training and exhibited considerable enthusiasm. Their presentations of the case studies demonstrated how agroecosystems analysis helped technical staff summarize and communicate to their superiors relevant information about project sites.

An interesting outcome was the marked difference in the key issues resulting from each case study. For example, livestock fodder was identified as a problem in one site whereas in another, improving tree cropping was considered the key to increasing income and reducing soil erosion. In the working group sessions, this helped planners to recognize that different interventions were appropriate in different sites, and that SUFS resources should be allocated accordingly. One problem found in all four sites was weak local institutions, such as farmer groups, which limited the transfer of technology and community participation. In addition, several important development opportunities were identified that were outside the formal boundaries of UACP. For example, suggestions emerged for improving sawah irrigation and for Perum Perhutani's agroforestry

program, highlighting areas in need of coordination between UACP and other projects.

The working groups were able to agree on a specific set of recommendations for next year's project activities in the four sites. The extent to which these recommendations are actually followed will reveal whether important institutional constraints remain to applying agroecosystems analysis as a planning tool. Implicit in the adoption of this approach is a more active voice by junior technical personnel in the selection of SUFS priorities. Furthermore, research recommendations generated in this manner may not reach the ear of FSR decision-makers.

A final panel discussion addressed some of the policy constraints to using technical information derived from "bottom-up" methods such as agroecosystems analysis for sustainable development planning. A conclusion was that agroecosystems analysis fitted into UACP's long-term strategy and would help bridge the gap between the technical approaches of BRLKT and the agricultural services. The East Java PCO proposed that the BPPs use agroecosystems analysis to conduct case studies of all UACP communities and present results to each PMU prasurvei team. Recommendations from the case studies would guide the design of detailed SUFS plans. Additional training in 1989 would prepare the BPP staff to conduct these case studies.

The results of the training and workshop were presented to USAID earlier this month. A final report by the training team is in the process of being submitted to the Executive Secretariat. This report includes a detailed description in the Indonesian language of each case study, with all pertinent diagrams and maps, which will be forwarded to the PMUs and to all training participants. The team report focuses on the specific steps which will be necessary in order for agroecosystems analysis to be adopted as a routine planning tool and for training to be implemented with more efficiency in 1989.

3.5 Advising USAID on resource management issues

On a few occasions USAID has asked for my contribution to the analysis of general policy issues related to natural resource management, forest conservation and agroforestry in Indonesia. This included representing USAID/Jakarta during the country monitors meeting of the AID regional Forestry/Fuelwood Research and Development (F/FRED) project in Bangkok.

When various visitors have come from Washington and elsewhere under USAID and World Bank auspices, I have participated in field visits and helped coordinate FSR's involvement. During the nineteen months in Salatiga, this involved briefing over twenty-five teams or individuals interested in FSR's program and the technical issues associated with tree cropping and agroforestry. For example, I assisted with the visit by Dr. Siew Tuan Chew during her collection of information on agroforestry programs in Indonesia for AID/Washington and accompanied her to Lombok to see the CARE Dryland Agriculture project. I also briefed six different World Bank teams. When the TAT/Winrock arrived in late 1987, I devoted considerable time to outlining my views of research priorities

and major needs for improved management. In addition, I have briefed five different short-term Winrock consultants.

Another contribution was writing significant portions of forestry and agroforestry sections of a major report to USAID regarding environment and natural resource management issues in Indonesia.[2] Occasionally I was also called on to assist USAID with technical aspects of developing a new natural resource management project in Kalimantan, particular biological diversity aspects. This included assisting discussions of technical assistance needs for project design and with reviewing the credentials of candidates for various natural resource management positions.

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[2] Tarrant, J.J. et al., 1987. *Natural Resources and Environmental Management In Indonesia.* A two-volume report submitted to USAID/Indonesia.

IV. UNDERLYING INSTITUTIONAL CONSTRAINTS

This chapter addresses some of the difficulties of establishing an applied research program which serves the information needs of UACP. Indirectly it helps explain why there is still no agroforestry research program at FSR. As the project reaches its midway point, I believe it is time to recognize these constraints and to discuss to what extent the GOI and the donors are committed to overcoming them. In particular, further investment in applied research should be based on a frank assessment of the prospects for significant benefits to UACP in the absence of major institutional restructuring and strengthening.

4.1 Role of FSR in the project

According to the UACP Project Paper, FSR was conceived, "to develop technologies to increase agricultural production and promote soil and water conservation in upland rainfed areas of Java in ways that are socially and economically acceptable". I would like to suggest that new technologies, while needed, are not as important for planning and implementing SUFS as developing better mechanisms for applying existing technical information. In the second chapter of this report, I have already described how environmental features of the project areas are not yet combined with growth requirement data to guide the basic selection of tree crops for SUFS. The poor integration of technical data from agriculture and forestry is a general problem not limited just to tree crops.

The fundamental difference between immediate information needs and long-term needs for field studies has led to conflicting perceptions of priorities for research by the PMUs and AARD. For example, it was informally proposed in 1987 that FSR staff take part in the preliminary survey (*prasurvei*) of 1988/89 SUFS sites in East Java to provide direct technical input to the planning of these sites. This proposal was not considered feasible by the FSR Project Leader in light of staff commitments to the ongoing field research program, as well as the lack of specific budget allocations for participating in the *prasurvei*.

Underlying this conflict is the fact that basic technical information generated from the different AARD research stations is not combined by the regional Agriculture Information Centers (BIPs) for dissemination to extension in a form which addresses sustainable land use for different environmental conditions such as, for example, the shallow limestone soils of upland Java. The commodity orientation of AARD results in extension materials organized according to crop species rather than to agricultural technologies for different ecological conditions. It is perhaps a flaw in the design of UACP that technical assistance and donor support for AARD has emphasized additional field research rather than a reanalysis of existing technical data from the research centers to improve extension applications.

One solution would be reorienting FSR to act as an "information broker" for the research centers in close coordination with the provincial BIPs. However, evidence of FSR's commitment to serving this function has not been encouraging. For example even when the FSR Project Leader

personally endorsed a strategy of integrating existing data, in the form of an inventory of agroecosystems and tree cropping practices in East Java, unsurmountable constraints and resistance within AARD itself were encountered. The major difficulties with the inventory were the amount of FSR staff time that would have to be withdrawn from the ongoing field research program, inexperience with problem-oriented data analysis and hesitancy to collaborate with scientists outside of immediate FSR staff.

The decision on FSR's role within the project was already made to some extent during the February 1988 meeting in Semarang on research priorities for 1988/89. FSR and other branches of UACP agreed at that time that FSR would concentrate on a focused program of field research and the PCO's would finance independently studies and surveys that meet their particular planning and extension needs.

An outcome of the PCOs becoming more involved in addressing information needs is a process of increasing isolation of FSR from mainstream project activities. For example, several technical agencies and development projects in East Java, with representation from TAT/DAI are discussing ways to improve the information provided to extension within the Brantas watershed by using a unified system of agroecological zoning and village diagnostic surveys. The commitment of East Java BAPPEDA TKI to this strategy is reflected in the PCO support of a horticultural survey using agroecological zoning and agroecosystems analysis methods. FSR is only involved in these efforts in a peripheral way, again because its own independent field studies are given higher priority.

This isolation was further underlined at the recent workshop on agroecosystems analysis, when East Java consultants and the PCO publicly endorsed using agroecosystems analysis as a diagnostic method by the BPPs to guide the preliminary survey of new SUFS. FSR will be effectively closed out of the process of planning and extension SUFS unless FSR staff actively participate in the diagnostic case studies conducted by the BPPs. The weak attendance of FSR staff and consultants during the workshop prevented serious consideration this option.

Presently FSR is still seeking a mechanism for satisfying PMU needs while also conducting a large research program. It is my opinion that FSR is too weak an institution to fulfill both roles and that an attempt to do so will only result in continued confusion and friction between FSR and the PMUs. A formal choice should be made between improving the application of existing technologies and an independent research program.

The first option is not feasible without a bold reordering of FSR priorities and a commitment to working closely with the BPPs and BIPs, as well as with local research institutions and scientists in the two provinces. This is especially true as SUFS planners are being encouraged to identify research priorities during the *prasurvei*, when FSR is absent. Section 4.2 describes some of the institutional difficulties of improving the working relationship between FSR and extension.

FSR and the TAT/Winrock would certainly be justified in opting to focus on field studies given the customary role of AARD

staff as researchers, not as technical advisors to district and provincial governments. However, this option requires lowering the expectations for FSR's contribution to the SUFS component of the project and an agreement by the two regional governments that upland farming systems research is sufficiently important in the long-run for their watershed management efforts to justify FSR remaining a formal part of UACP. Furthermore, FSR's existing field research program will still require considerable revision before it will address long-term technical needs. Section 4.3 describes my views of the particular constraints to achieving such fundamental change.

4.2 Barriers to coordination between extension and research

The institutional configuration of UACP makes it difficult for FSR to work in close harmony with local government. The project emphasizes strengthening capabilities at district and provincial levels to try more innovative approaches to upland development. The information needed for developing detailed plans for the SUFS demonstration farms and expansion areas are therefore coordinated through local technical services affiliated with PMUs and PCOs. This has meant reliance on existing expertise in the district branches of BRLKT and of the agricultural services and, in fact, strengthening their ability to plan and implement development programs.

In this context of a decentralized approach, FSR is expected to establish field studies which test technologies for different upland conditions for application by SUFS planners. As part of a line agency, FSR has no direct responsibility to the provincial or district governments in which it works, and even has a separate technical assistance team. Interactions with the PMUs is limited to field encounters, joint training and FSR attendance at PMU technical meetings. While these are all useful mechanisms for communication, there is no incentive for FSR staff to reorient their research priorities to address PMU needs. Funds for FSR come from a separate Project Implementation Letter (PIL) from USAID, without any requirement that the PCOs approve the FSR research agenda.

An inherent tension will persist as long as FSR does not fall under provincial authority. For example, FSR frequently disregards basic security procedures required by BAPPEDA, perhaps in the philosophy that central government agencies need not adhere to these requirements. This was a major problem during the implementation of agroecosystems analysis training of FSR staff in East and Central Java in 1987, when letters were not provided to the district and sub-district heads informing them of plans for four foreigners and ten trainees to spend several nights in project villages. East Java security clearances for foreign consultants to visit field locations and interview farmers are considered essential by the PCO and PMUs, to the extent that FSR's Winrock consultants were not permitted to develop a socio-economic survey in Blitar.

4.3 Constraints to research with a natural resource perspective

The following discussion is directed at FSR programs in general in Indonesia, with examples drawn from FSR/UACP. Farming systems research has reached a stage where efforts in different

provinces need more freedom to develop according to local conditions and needs. The earliest phase of establishing an FSR program in Indonesia probably required strong direction from the senior AARD scientists in Bogor and Jakarta. For individual projects such as UACP, this is no longer the case and the individual FSR efforts need to be allowed to mature and become less dependant these senior scientists. In particular, new institutional arrangements and methodological approaches should be considered in order to improve the technical quality of FSR programs and their appropriateness for addressing project specific research needs.

For example, until the search for a technical package is abandoned, FSR will never really conduct on-farm research with active involvement of farmers. The Pola A, B, C and D approach diverts attention from existing farming practices and from clues to identifying which interventions will have the greatest economic and conservation benefits. Even though the original research design is recognized by the Project Leader to be seriously flawed, FSR staff still describe this design to visitors as if it is generating information of relevance to UACP.

Interdisciplinary studies which help apply existing technologies to achieve more sustainable land use practices require a decentralized system of decision-making. This is a fundamental fact which cannot be avoided. Unless AARD recognizes the need to decentralize its authority and to restructure the management of FSR programs, little progress will be made in projects such as UACP. Field studies must be designed and implemented from the local FSR offices and not from the AARD research centers in Bogor, or commodity and disciplinary biases will dominate. There is little purpose in assigning technical assistance teams to the FSR field offices if all substantial decisions are made in Bogor. If AARD is concerned about the ability of junior scientists to design and implement appropriate field studies, then more senior scientists can be assigned to the field.

For example, the FSR/UACP watershed coordinators have no authority to respond directly to local government requests. The centralized system of fund allocations and the assignment of most of the FSR vehicles to the Salatiga administrative office prevents these coordinators from an active voice in the selection of an appropriate research agenda. Furthermore, the integration of technical information into a form usable by extension requires FSR collaboration with the Ministry of Forestry (MOF), specifically with BTPDAS and the SBRLKT offices for Jratunseluna and Brantas watersheds. By decentralizing FSR authority, local Project Leaders and watershed coordinators can approach their forestry colleagues without seeking formal permission from their superiors.

A further difficulty is maintaining a long-term research program with a natural resource perspective is the inconsistency in direction and objectives caused by frequent changes in FSR leadership and technical advisors. In UACP, the FSR Project Leader has changed twice, with different AARD senior scientists supervising FSR operations at different times. I am the second PSC advisor and Winrock has already changed its chief of party once. This has caused many initiatives to be lost, with an

overall lack of continuity in long-term goals. The confusion of junior staff operating in this context is extraordinary and has resulted in field research of little value during 1988. This does not reflect well on AARD and hurts the agency's reputation for supporting interdisciplinary approaches to rural development. Therefore, the designation of an FSR Project Leader should be for a minimum of two years, particularly in light of the highly personal style favored by most Indonesian managers.

The fact that different technical assistance teams serve FSR and the PMUs widens the gap between these components of the project. There are four different types of advisors in UACP (TAT/DAI, TAT/Winrock, TAT/PASA and PSCs), each with different reporting responsibilities and technical agendas. This results in different consultants giving the same counterparts contradictory guidance. Even within FSR this has proved to be a problem. For example, the TAT/Winrock chose not to build on my previous training efforts or on the introduction of agroecosystems analysis by KEPAS, myself and the previous Project Leader. When the project-wide training in agroecosystems analysis in 1988 was planned, the TAT/Winrock scheduled an independent training program in diagnostic survey methodology during that period. Ironically, this diagnostic training was almost identical to the agroecosystems analysis training conducted last year, causing considerable confusion among FSR staff about different rapid rural appraisal techniques.

This inconsistency in direct has made it difficult for FSR staff to overcome their disciplinary biases and work effectively with other branches of the project. The commodity orientation of FSR staff remains very strong, as revealed in the disproportionate investment of staff time and resources in testing annual crops using high-input technologies. Despite various training programs in diagnostic methods and rapid rural appraisal, research priorities are still selected separately by discipline. There is no sense that the most significant technical needs will vary from site to site and that it is not efficient to implement annual cropping, tree cropping, livestock and soil conservation research in every field location. Another words, a systems perspective is still missing which would help FSR recognize the key intervention in any particular farming system which offers the best chance for increasing farmer income and reducing soil erosion.

Furthermore, the staff evaluation of success is still dominated by production criteria, which do not address the long-term sustainability of project initiatives or the prospects of spontaneous adoption by farmers living in expansion areas. Production increases, particularly of annual crops, are the most visible and short-term indicators of success and therefore are relied upon. Resource management goals are considered secondarily rather than a part of long-term success and an evolutionary perspective on changing farming systems from annual crops to perennial crops becomes lost.

V. RECOMMENDATIONS

5.1 Research committee for upland farming systems

A formal research committee is needed to coordinate the integration of technical information into a form which is practical for extension programs and to identify priorities for field research in each province. This committee would be composed of two levels, one level for the senior decision-makers from the upper echelons of the technical and coordinating ministries and the second at the provincial level.

The provincial level research committees could be chaired by BAPPEDA TKI and be composed of local technical agencies and institutions active in research and extension, including FSR, local AARD research centers, BTPDAS, BIP, BLPP, BRLKT (or the Watershed sub-stations SBRLKT), and local universities. Some of the technical consultants from TAT/Winrock, TAT/DAI and TAT/PASA could serve as committee advisors and provide guidance regarding research and extension needs. The provincial committees would serve two primary functions. First would be set priorities for research within the project, including the identification of appropriate institutions to undertake particular topics, funding mechanisms and technical assistance requirements. This would include reviewing FSR's annual research plan. USAID funding of FSR would be contingent on formal endorsement by each provincial research committee of its annual research plan.

Secondly, the provincial committees would promote the integration of technical information for planning and extension, with a strong emphasis on standardizing the classification of lands for the uplands and on the production of extension manuals which address the particular technical problems of different upland ecological conditions. This would include promoting the integration of soil survey results, existing climatological data aerial photos and other biophysical data into a simple system of agroecological zones. Extension manuals would be produced for each zone, outlining specific options for soil conservation, agricultural production and livestock management feasible for upland farmers within that zone. The selection of appropriate options would be based on diagnostic surveys of village needs conducted by the BPP in cooperation with local SBRLT offices.

The provincial research committees could modeled after the ongoing efforts in East Java to integrate technical information and to standardize the use of agroecological zones and village diagnostic surveys in the Brantas watershed. These informal efforts by East Java, originally inspired by KEPAS, should become more formally acknowledged to allow for budgeting of committee meetings and the production of manuals. Ideally, FSR would be the appropriate institution to actually produce the manuals, but it would first have to demonstrate a stronger commitment to working as an "information broker" for local technical institutions, including forestry experts. If the senior AARD scientists on FSR's steering committee do not relinquish decision-making power for setting priorities for FSR's activities, then FSR should be given only an advisory role in the development of the manuals and another technical institution should be selected, such as BRLKT or BIP.

The UACP Executive Secretariat could function as the senior level research committee by holding meetings once or twice a year with a specific agenda for reviewing progress reports from the provincial committees. The Executive Secretariat would: 1) promote a common research strategy in the two provinces, 2) facilitate dialogue among technical and planning ministries regarding necessary policy reforms for accomplishing an integrated approach to upland research and extension, and 3) review the provincial committees' responses to FSR's annual research plan and formally transmit approval or disapproval to USAID and AARD.

5.2 Institutionalizing agroecosystem analysis

The results of the 1988 training and workshop establish a mechanism for more effective integration of disciplines in the field and for planning UACP activities using more "bottom up" information. This is an important step for strengthening local government's ability to develop innovative approaches to sustainable upland agriculture. The groundwork is laid for incorporating agroecosystems analysis methods into the planning process, but several important decisions will need to be made in the near future. The recommendations of the training team, as outlined in the report they are submitting to the Executive Secretariat and to USAID will need careful consideration.

The specific recommendations generated during the working group sessions of the Solo workshop may not be followed up spontaneously. Meetings held by the PMUs with the relevant BPPs will probably be necessary to incorporate case study recommendations into the 1988/89 plans for those communities. This will be a test of the degree of institutional resistance to giving field technicians a more active voice during the planning of SUFS. This resistance is natural given the hierarchical structure of Indonesian government decision-making and the justifiable concern of whether junior technical personnel are always capable of identifying development priorities. By following up the recommendations from the four case studies, it will be clearer what institutional difficulties can be expected to incorporating agroecosystems analysis into the planning process in such a way that recommendations by junior staff are reviewed and refined before serving the basis of SUFS development plans.

The difficulties of implementing the training program and workshop were many, requiring an extraordinary investment in USAID and consultant time. The training team report highlights many of these difficulties and their recommendations might serve as preconditions for reimbursement for future training efforts. For example: 1) participants should be completely released from their day-to-day responsibilities during the training activity and required to spend all the scheduled nights in the field, 2) no one who arrives more than a day late should be given a training certificate, 3) the initial letters announcing the training should include a detailed description of the training program goals, as provided by the training team, 4) the letters should be sent two weeks before training starts, and 5) participants should receive sufficient financial compensation

during training so that they are motivated to devote all their attention to the program.

In my view, the contracting of technical assistance and the planning of the final workshop were the most difficult aspects c the 1988 agroecosystems analysis program. Considerable management time and technical assistance was wasted trying to contract the training team through the Executive Secretariat budget as administered by BANGDA. I recommend that this mechanism not even be considered next year, even if progress is made with establishing a contracting mechanism through the International Institute for Education. This is critical if KEPAS or IIED staff are wanted as trainers, because an additiona sour experience with BANGDA may prevent these institutions from developing long-term working relationships with the regional governments. A direct link with ongoing programs in the provinces and efficient supervision of team activities are also more certain using one of the existing TAT contracts.

If another workshop is proposed next year, I recommend that AARD, specifically KEPAS, be invited to manage it. The funds could be processed through FSR's budget without having to go through the Executive Secretariat. AARD has more flexibility in holding workshops which mix technical disciplines together and involve decision-makers from different echelons without the rigi adherence to protocol. Furthermore, the technical quality of a workshop will not be compromised by bureaucratic and budgetary inefficiencies. KEPAS has already demonstrated its ability to plan and implement large workshops on agroecosystems analysis. FSR's involvement would strengthen its links with both KEPAS and the provincial governments.

There is some danger of relying on UACP staff who participate only once in agroecosystems analysis training. The method requires continuous practice or the natural biases of a team members will dominate. Some of the training participants may be overconfident in their capabilities to identify development problems and opportunities in a community and will need close supervision to avoid spurious conclusions. A recommendation from the training team which I strongly endorse i the building of a cadre of UACP staff capable of leading agroecosystems analysis teams. The best of the participants during 1988 training, in terms of their intuitive ability to apply agroecosystems analysis methods, should be provided with special intensive training with KEPAS so that they may serve as assistant trainers during future agroecosystems analysis efforts

The incorporation of agroecosystems analysis into the planning and extension process will isolate FSR from the rest of the project unless FSR becomes more committed to the future training. Although four FSR staff participated in the 1988 training, none of the team's requests for FSR staff with substantial previous agroecosystems analysis training were provided. The initial concept of the training program was that the FSR staff recently returned from the University of Hawaii would assist the training team and become part of the core of UACP personnel capable of leading future teams in agroecosystems analysis.

This isolation will be reinforced if FSR does not assist the BPPs with the case studies of project sites in East Java. Although FSR cannot address all the research topics which are generated by case studies of SUFS communities, it can help identify sources of technical information. Furthermore, recurrent research issues that come out of the case studies will be obvious priorities for FSR field studies. For example, all four case studies presented in Solo involved recommendations for strengthening local village institutions. However the recommendations were quite general and reflected a weak understanding of social institutions. Certainly more research is needed on this topic to clarify how to stimulate farmer participation in project activities.

It is my belief that if research priorities are not determined together with extension, then FSR's contribution to upland development will remain minimal. In addition, FSR research results would be more applicable and understandable to the PMUs if the same analytical tools are used and reports are organized according to agroecological zones, not according to commodities or disciplines. For example, all FSR field results for limestone soils should be reported together, integrating the food crop, tree crop, terracing and livestock elements. The weighing of technical recommendations could be presented in table form showing the impacts on agroecosystem productivity, stability, sustainability and equability, similar to the innovation assessment tables introduced at the Solo workshop. The meshing of FSR research methods, data analysis and reporting with the agroecosystems analysis techniques now being developed with extension will require closer coordination between TAT/Winrock and the rest of the TAT/UACP.

Finally, it is clear that East Java is in a better position to institutionalize agroecosystems analysis methods than Central Java. This is because local research centers abound in East Java and because KEPAS has devoted several years to establishing a working relationship between the different technical institutions. Decision-makers at BAPPEDA TKI have familiarity with agroecosystems analysis through frequent KEPAS seminars and workshops. A preliminary agroecological zoning system for DAS Brantas is already available. Central Java does not have these advantages. One solution would be to invite KEPAS to Central Java to start forming the linkages between existing technical institutions and to start the integration of biophysical data necessary for agroecological zoning. This would depend on FSR's willingness to assist KEPAS, given the lack of other local AARD institutions in Central Java. At this point, I recommend only that the advantages and disadvantages of KEPAS in Central Java be given a thorough review by FSR and the Central Java PCO, together with KEPAS staff.

5.3 Reordering of priorities for field research

As described in the previous chapter, FSR faces a choice between devoting the majority of its staff time and resources to integrating existing technical information with a small field research program or to continuing the larger field program with limited involvement with the rest of the project. There are good reasons for either choice, but from the perspective of UACP technical needs, I must endorse the former.

The main objective of FSR activities would be to work with the provincial BIPs to develop extension manuals organized by agroecological zone which would offer a range of technical alternatives for food crops, tree crops, forestry species, terracing methods, and livestock management feasible for upland agriculture in that zone. Field research would be primarily based on the study of existing land use practices within each zone, in the form of case studies conducted with the BPPs. The case studies would help indicate which technical options are compatible with local socio-economic conditions and farmers preferences. A few simple field experiments with farmers at representative sites in each zone would be identified during these case studies, with the selection of priority topics decided for each district based on meetings between FSR, the BPPs and the PMUs.

This process leaves behind at the end of the project better information in the hands of the BPPs and PMUs for extension and planning in the uplands. An independent field research program even if it addresses long-term technical issues of relevance to UACP, does not affect the operation of the most critical institution for upland development: extension.

In order for FSR to effectively act as an "information broker", all the institutional constraints discussed in the previous chapter would have to be overcome. Many of the long-term research topics would not be conducted by FSR, but instead by local institutions and scientists supervised by FSR. This strategy also forges closer linkages between local government and scientists and ensures more continuity in long-term field research.

Agroforestry research, in this scenario, would be conducted primarily by institutions other than FSR, such as BTPDAS in Central Java and Balithort in East Java. However, the study of existing land use practices during the agroecosystems analysis case studies should lead to a few on-farm experiments focused on overcoming local constraints to expanded tree cropping in upland fields. For example, FSR has proposed a study during 1988/89 of the optimal spatial arrangement of perennial crops in homegardens. This has little relationship to extension needs or priorities. A more relevant topic would be improving propagation technologies for tree crops in village nurseries located in homegardens.

If FSR decides instead to continue its efforts on a few long-term field studies, then the institutional constraints addressed in Section 4.3 will need to be overcome. In terms of agroforestry research, I still maintain that the priorities are:

1) soil conservation benefits and economic returns of different tree cropping patterns now practiced by upland farmers,

2) socio-economic incentives and constraints to spontaneous tree crop cultivation,

3) the suitability of hedgerow alley cropping of leguminous trees as an alternative to terrace construction on highly unstable soils, and

4) the economics of forest product use in UACP communities.

I believe that UACP agroforestry technical needs would be best met by AARD because the farmer's needs are more likely to be considered by agricultural scientists than forestry experts. In addition, AARD has progressed further than any other government institution in trying to apply interdisciplinary, problem-oriented methods of research design and implementation through the efforts for KEPAS. I also believe that the quality of FSR studies on soil conservation aspects of agroforestry would significantly benefit by collaboration with forestry experts. If this does not start soon, the MOF will take the lead in agroforestry research in UACP and it will remain a technical specialty, not an interdisciplinary, problem-oriented strategy.

APPENDIX I. SCOPE OF WORK

General Responsibilities

The contractor will work as a Tree Crop/Silvipasture Ecologist (TSE) to the UACP. She will provide technical advice to establish a long-term agroforestry component of the farming systems research program. The Contractor will coordinate day-to-day tasks with the FSR Project Leader. She will also advise USAID on agroforestry and ecological issues.

She will assist the FSR Project Leader and the PMU officers in each UACP kabupaten to: 1) refine current annual agroforestry research plans; 2) assist the FSR Project Leader to identify and set priorities for medium and long term farming systems research related to soil conservation; 3) prepare technical recommendations on agroforestry for UACP staff; and 4) organize a training and information exchange session on agroforestry.

Specific Responsibilities

*Task 1. Assist the UACP project staff in planning and implementing research on existing tree crop/silvipasture/agroforestry systems.

*Task 2. Assist the UACP staff in developing, coordinating and implementing a training program in agroecosystems analysis through rapid rural appraisal technology.

Task 3. Help analyze the information flow regarding agroforestry between:

-AARD basic research sites and FSR sites (i.e., findings from AARD to FSR and needs from FSR to AARD),

-other past or on-going development efforts in upland areas,

-FSR research sites and SUFS demplots and expansion areas.

Task 4. Complete a survey, review evaluate and prepare an annotated bibliography on agroforestry research in Indonesia.

Task 5. Assist the FSR team to prepare annual and specific reports on agroforestry research.

*Task 6. In the absence of a full-time FSR consultant team, assist the FSR Project Leader with general guidance on research methodology and report preparation.

*Task 7. Provide advice and assistance on agroforestry and agroecology applications in FSR and SUFS activities to the PMU staff, the commercial contractors, and PASA advisors supplied TA to the GOI.

* These tasks were revised during the January 2, 1987 amendment of my contract. Prior to this amendment, the tasks were listed as:

Task 1. Assist the FSR staff in planning and implementing research on existing tree crop/silvipasture/ agroforestry systems with particular reference to:

-location-specific constraints (seed availability, labor costs, etc.),

-documenting and monitoring best and worst examples of such systems,

-time allocated for fodder production and fuelwood gathering and use, and

-further refining the incorporation of trees and other perennial crops into farming systems.

Task 2. Assist the appropriate AARD and FSR staff in developing research on:

-different ranges of canopy cover, and
-the incorporation of new species in research design.

Task 6. Organize a training and information exchange session on agroforestry research and application.

Task 7. Provide advice and assistance on agroforestry applications in SUFS to the PMU staff, the commercial contractors and PASA advisors supplying TA to the GOI.

APPENDIX II. PRESENTATION AT THE WORKSHOP ON AGROECOSYSTEM ANALYSIS IN SOLO

Introduction

An Agroecosystems Analysis training program was recently completed for Upland Agriculture and Conservation Project (UACP) staff in East and Central Java. In each province, training was conducted over a three-week period and involved 26 UACP staff from a mixture of disciplines and positions. The implementation of this training program will be described in more detail by the team of technical advisors who organized the training. In this presentation, I will try to explain why this workshop was viewed as an important final step in the training program and why a mixture of UACP senior personnel and technical staff, as well as distinguished outside scientists, have been invited to participate.

Agroecosystems Analysis as a Planning Tool

Agroecosystems Analysis is a practical method for collecting field information on land use practices in order to identify priorities for research and development. The concept of agroecosystem embraces both the physical characteristics of agricultural systems, as well as the socio-economic factors which influence farmer decision-making. We will be hearing later today more specifically about what these techniques are.

This approach is particularly useful in watershed management efforts such as UACP where the goal is to reduce natural resource degradation at the same time as increasing rural incomes. Although we assume it is possible to accomplish both these goals, how to do so remains difficult. The challenge for UACP is to find better ways of collecting and analyzing field information in a short period of time, to assess which initiatives have the greatest likelihood of success in each particular site, and to determine what extension, training and research activities are necessary to support these initiatives. Agroecosystems analysis may assist UACP to meet this challenge, and that is what we will be assessing during this workshop.

Agroecosystems analysis provides a simple technique not only for collecting field information, but also for evaluating it. Land uses are analyzed as agroecosystems with characteristic properties of productivity, stability, sustainability and equitability. By considering these properties in a project site, the trade-offs are clarified between increasing productivity (for example, of food crops) and other system properties (for example, sustainability of natural resources, such as soil erosion trends). These trade-offs lead to a process called innovation assessment, where priorities for research and extension activities are agreed upon after consideration of costs, long-term benefits, government policy and acceptability by farmers. During the workshop, we will work together to do innovation assessments in working groups based on the results of the four case studies presented by the training participants.

Background

The Agroecosystems Analysis training conducted recently was originally proposed as the result of an earlier, more modest training effort. I would like briefly to review the history of the proposal for this training and workshop, because it shows how this has been an evolutionary process with considerable contributions by various UACP staff to the refinement of the idea. We will be encouraging frank discussions of any weaknesses in the training approach or in the design of this workshop, because this evolutionary process needs continue if we are to make use of the agroecosystems analysis in UACP.

In late 1987, a modest agroecosystems analysis training effort was proposed by the Farming Systems Research (FSR) component of UACP with participants from FSR, PMU and PCO offices in Central and East Java. Case studies of two 1987/88 SUFS demplots, where FSR planned to initiate field research, were undertaken in Blora and Tulung Agung. When asked to evaluate the usefulness of the methods and concepts introduced to them, the participants strongly recommended an expanded program of training in 1988. In particular, they urged more joint training between FSR staff, SUFS planners and extension specialists to improve their ability to collect information swiftly during the preliminary surveys of 1989/90 SUFS. It was also recommended that senior UACP staff become familiar with agroecosystem analysis as a technique to rank priorities for research and development and to improve the flow of technical information between farmers, extension, research and planners.

The following is a list of the specific advantages of Agroecosystems Analysis reported by the participants during the 1987 training:

--it is a quick method for obtaining field information, and interpreting results to guide planning,

--it encourages different branches of project to work together as a team and to share their expertise and opinions, so that greater harmony is achieved between planners, extension agents and researchers, with more open sharing of technical information and concerns,

--it provides a routine mechanism to understand problems from the farmer's perspective, which is important for guiding extension efforts and for ensuring that project activities are compatible with local socio-economic conditions,

--it encourages more careful weighing of recommendations and gives a clear framework for assessing priorities,

--it helps identify underlying institutional or policy constraints to achieving project goals in an objective way that can be presented to senior decision-makers,

Recommendations from the 1987 training were presented to the UACP Executive Secretariat and later were written up as a proposal for training with a final workshop. This proposal was circulated widely, revised and then incorporated into the UACP

1988/89 training and workshop budgets. The enthusiasm for trying this training program became evident when both Provincial Coordinating Offices (PCOs) decided to implement the three-week courses as their first training initiative implemented with 1988 funds.

Workshop Rationale

Recently, senior Indonesian policy-makers have emphasized the need to adopt a more integrated approach to agricultural development planning in the upper watersheds of Java. In August of last year, the State Minister for Population and the Environment organized a meeting of a variety of government agencies and technical institutions to discuss the problems of sustainable watershed management. One conclusion was that district governments need to become more actively involved in designing development programs to ensure an integrated approach which reflects local conditions and needs. Agroecosystems analysis was mentioned as one possible approach to stimulate more "bottom-up", environmentally oriented planning.

UACP is the first rural development project in Indonesia to try to incorporate agroecosystems analysis methods into the planning and implementation system of the district and provincial government. This reflects UACP's specific mandate to try innovative approaches to upland development, with an emphasis on strengthening the capabilities of district-level and provincial-level staff. Because of the experimental nature of the training effort, senior UACP decision-makers and outside scientists were invited to this workshop to help evaluate the usefulness of applying an agroecosystems analysis as a routine method for planning and project implementation.

Expected Outputs from the Workshop

This workshop is a necessary final step to ensure that the results of the training are evaluated and that a follow-up plan is formulated. It is an opportunity for UACP personnel to learn of the applications of agroecosystems analysis by directly participating in an innovation assessment of recommendations generated by the four case studies. The results of four case studies will highlight how agroecosystems analysis can help with the collection of relevant information about local resource management and the conditions and motivations of upland farmers. It is hoped that the constraints and opportunities for integrating an agroecosystems analysis approach into the project system for planning, extension and research will become evident during these working group sessions. A final panel discussion, drawing on the expertise of scientists outside of the project, will address some of the key policy constraints to using technical information derived from "bottom-up" methods such as agroecosystems analysis for sustainable development planning. Specific recommendations are expected to result both from the working groups and the panel discussion.

More specifically, the following outputs are anticipated.

1. Presentations during the first day:

   - Discussion of the shortcomings of current procedures for collecting technical information and using it for planning project activities, and an understanding of how agroecosystems analysis might provide a viable alternative,

   - Familiarity with the concepts and application of agroecosystems analysis in Indonesia and other countries,

   - Awareness of the experience to date with agroecosystems analysis training of UACP staff and of the training team's evaluation of the 1988 training implementation.

2. Case study presentations in four working groups:

   - Improved skills by technical staff in the presentation of field information in a brief, clear style that highlights the issues requiring attention by project decision-makers.

   - Interdisciplinary case studies of four SUFS sites with specific recommendations for research and extension, reflecting cooperative teamwork among UACP project staff from the PMUs, SBRLKTs, FSR, PCOs and BPPs.

   - Greater familiarity by district, provincial and central government decision-makers of the variety of biophysical conditions and farmer motivations in the uplands, and the consequences of this variety for setting development priorities.

3. Innovation assessment of case study recommendations:

   - Familiarity with a formal technique of innovation assessment which helps to clarify the trade-offs implied by each development recommendation.

   - A series of specific steps agreed upon by each working group for following up the results of the case studies, including the assignment of responsibilities to appropriate institutions and individuals.

   - An evaluation by each working group of the value of the case studies and innovation assessment for project planning, and subsequent recommendations for incorporating any of these techniques into this year's preliminary survey and planning system.

4. Final panel discussion:

   - Specific recommendations on how to improve the flow of technical information within the project, forming better linkages between research and extension, access to technical information from line agencies, and the integration of agriculture and forestry natural resource data,

   - Specific recommendations on how to overcome policy and institutional constraints to applying interdisciplinary, "bottom-up" techniques such as agroecosystems analysis, with particular attention to additional training needs.