PN-ABF-762
67579

# Farming Systems Research & Extension Activities in Indonesia

## *A Results Inventory*

Office of Arid Lands Studies
University of Arizona
Tucson, Arizona

November 1988

Supported by:
USAID, Science and Technology Bureau, Office of Agriculture, USAID/Indonesia, and USDA, OICD

# FARMING SYSTEMS RESEARCH AND EXTENSION ACTIVITIES IN INDONESIA

## A Results Inventory

by

Harold J. McArthur
College of Tropical Agriculture and Human Resources
University of Hawaii at Manoa
U.S.A.

and

Kanok Rerkasem
Multiple Cropping Centre
Chiangmai University
Thailand

Supported by: USAID, Science and Technology Bureau
Office of Agriculture, USAID/Indonesia
and
USDA,OICD

November 1988

## TABLE OF CONTENTS


Acknowledgments . . . . . i

Executive Summary . . . . . ii

I. Introduction . . . . . 1

II. Background of FSR/E in Indonesia . . . . . 1

III. Organizational/Institutional Structure . . . . . 2

IV. Research Coordination . . . . . 7

V. Training . . . . . 8

VI. Networking . . . . . 9

VII. FSR/E Process and Content . . . . . 12

VIII. Impact of FSR/E . . . . . 20

IX. Factors Contributing to Institutionalization . . . . . 24

X. Constraints to Institutionalization. . . . . 26

XI. Recommendations . . . . . 29

XII. Conclusions . . . . . 31

Appendix I
Persons Contacted during the Study . . . . . 33

Appendix II
References . . . . . 35

ACKNOWLEDGMENTS

Without support from the U.S. AID Mission in Jakarta and the willingness of many Indonesian administrators and researchers to give freely of their valuable time it would not have been possible to complete this review.

We particularly wish to acknowledge assistance provided by the following individuals: Dr. Prabowo Tjitropranoto, Director, National Library of Agricultural Sciences; Dr. Soleh Sukmana, UACP/FSR Project Director; Dr. Achmad Syarifuddin Karama, Director, Bogor Research Institute for Food Crops; Dr. Dady Ganda Sukaryo, Director of Extension, Directorate General for Food Crops; Dr. Djoko Budijanto, Program Office, AARD; Dr. Mch. Iman, Project Leader SWAMP II; Dr. Achmad Fagi, Director, Sukamandi Research Institute for Food Crops; Dr. David McCaulley, Natural Resource Policy Advisor, USAID; Mr. Ronald Greenberg and Mr. George Like, Agricultural and Rural Development Office, USAID; and Dr. Cynthia Mackie, USAID Personal Services Constractor in Salatiga, Central Java.

## EXECUTIVE SUMMARY

The objective of this paper is to review, analyze, and document the results of Farming Systems Research and Extension (FSR/E) projects that have been implemented in Indonesia. The study, funded by the U.S. Agency for International Development, is part of a global assessment of the factors that affect sustainability of FSR/E within national agricultural research and extension systems.

Drawing on field observations, interviews with government administrators, agricultural scientists, technical assistance teams and consultants, and analysis of secondary data, the study attempts to identify:

(a) the degree to which externally funded projects have assisted in institutionalizing the FSR/E approach within the national agricultural research and extension system; and

(b) the extent to which national budgets are now supporting FSR/E activities.

Key topics addressed include organizational structures, training, networking, content of FSR/E programs, linkages with commodity research and extension programs, and the ability of Indonesia to meet recurrent costs.

The current status of farming systems research in Indonesia can only be understood and evaluated within the context of the historical and cultural perspective, and organizational structure, within which it has evolved. The FSR/E approach is seen as most relevant to the development of agricultural technology for transmigrant farmers who have been relocated to marginal tidal swamp and upland rainfed areas. Since these areas are not as suitable to intensive food crop production as the fertile irrigated lowlands, it has become necessary to look at more diversified systems for sustaining small-scale agriculture. The pressing need to improve the income of farmers in marginal areas has led researchers gradually to recognize the need to conduct interdisciplinary research focused on the needs of small farms with a range of interrelated farming operations.

Organizational Structure -- The establishment of the Agency for Agricultural Research and Development (AARD) in 1974 as the research arm of the Ministry of Agriculture has increased the potential for integrated farming systems research.

A small, but growing, cadre of senior scientists have made some progress toward an eventual integration of the FSR/E approach into the regular research programs of the various institutes and centers of the AARD. The process is slow and the proponents of FSR/E are faced with considerable institutional and personal conflict. Each of the institutes within AARD has a national mandate for research and development of a specific commodity or land type. These institutes have a history of working independently, rather than as collaborating units.

Institute-based scientists are assigned to foreign-funded FSR/E projects on an annual basis. Such assignments can generate a degree of conflict between loyalty to one's home institute and responsibility to the project. This situation is made even more difficult when the individual's project duties require relocation to a remote area. Salary and housing inducements provided by externally funded projects are often not seen as

sufficient compensation for being away from one's institutional home. Consequently, there is considerable movement of scientists in and out of project assignments, which makes long-term continuity difficult. The one advantage, however, is that increasing numbers of Indonesian scientists are being exposed, if even for a limited time, to the farming systems research process.

Training -- Major investments have been made in agricultural and farming systems related training for Indonesian researchers, agricultural educators, and extension personnel during the last ten years. This effort has been assisted by scholarships provided by foreign-funded projects and international development agencies. In addition, the Ministry of Agriculture and the AARD have emphasized short-term training to improve the capabilities of technical support personnel. Much of this training has been sponsored or influenced by the International Rice Research Institute's Asian Farming Systems Network.

Specialized training in farming systems research methods and agroecosystem analysis has been supported primarily by various externally funded projects. Recently, the Upland Agriculture and Conservation Project recruited six individuals to attend a four-month course at the University of Hawaii on the application of Farming Systems Methodologies to Upland Watershed Management and Conservation. Support for this training was provided from World Bank loan funds.

The Ford Foundation supported the establishment of the Research Groups on Agroecosystems (KEPAS) as a national network to develop and foster a social and ecological basis for agricultural development in Indonesia. This group has supported a number of training programs in the agroecosystems approach (AEA), which has been utilized to analyze different agricultural systems in Indonesia.

Networking -- Farming systems networking in Indonesia occurs in many forms. Some networking takes place on a relatively informal basis while other exchanges are rather formal in nature such as annual workshops and informational meetings. Indonesia has been involved formally in the Asian Cropping Systems Network since 1975. In addition to assisting IRRI to extend relevant technology and methodologies into national research programs, the network also helps to develop methodologies for farming systems programs. There are regular meetings of the network members as well as monitoring tours to specific sites once a year. Indonesia has served as a base for site visits on several occasions.

The KEPAS program provides a complementary network node through its various training programs and workshops on agroecosystem analysis. The major impact of KEPAS with respect to FSR/E appears to be (1) in providing broad guidelines for a shift in direction from commodity- based to resource-based farming systems in specific agroecosystems, and (2) in the establishment of inter- and intra-institutional linkages at the regional and provincial levels.

FSR researcher networks are also supported by various externally funded projects. Central to these activities is a farming systems component where researchers from various disciplines and research centers have been assigned to the projects. In this way, the project approach may be seen as fostering institutional networks. This type of networking tends to strengthen intra-institutional linkages (within AARD). However, at

the project site, inter–institutional networks are found, primarily the link between on–site research and local extension agents.

FSR Content -- Although precise definitions of farming systems research will differ from individual to individual, FSR is commonly used in Indonesia to refer to programs that involve the introduction of livestock and perennial crops into food–crop–based farming systems. Scientists are increasingly becoming aware that component research must be undertaken in a manner that recognizes the interaction among and competition between all farm enterprises for the farmer's limited labor and resources. Not only must attention be paid to the interaction between enterprises, but also to the impact these systems have on the natural environment.

Farming Systems Research has emerged in Indonesia as a logical outgrowth of more than ten years of experience in on–farm cropping systems research and as a response to the need to extend improved technologies to more marginal areas. Two distinct models have emerged for conducting farming systems research, each with a separate organizational base, target, and research focus. FSR supported by, and conducted within, the various institutes of AARD has been targeted primarily on rice–based and non–rice–based (palawija) food crop systems. The main research focus has been on improving yields under irrigated and rainfed conditions. Farming systems research supported by externally funded projects has been targeted on upland rainfed and marginal transmigration areas, rather than on specific commodities. The research has been focused on soil conservation and crop\livestock interactions.

Relatively large efforts by Indonesian researchers have contributed to on–farm research activity. The on–farm research carried out by the research institutes has been primarily commodity oriented and researcher managed. These efforts have been dominated by agronomists. In contrast, the externally funded projects have achieved greater flexibility and a higher degree of integration in their on–farm research activities. Project research tends to be more interdisciplinary in nature, often involving agronomists, economists, and in some cases, animal scientists. Social scientists have tended to be involved only on a short–term basis. Much of the on–farm work undertaken by projects consists of researcher–managed trials. However, there is a growing awareness of the importance of moving into the farmer–managed phase as a means of observing how the farmer will assess the proposed technology and how it will perform under his or her field conditions and management constraints.

Extension -- While agricultural research in Indonesia is centrally organized on the basis of commodities, extension has evolved a decentralized, area–based structure. The FSR linkage with extension is through the Agency for Agricultural Education, Training and Extension (AAETE), The World Bank--funded National Mass Guidance program (BIMAS), and the directorate generals of Food Crops, Animal Husbandry, and Fisheries. AAETE is charged at the national level with providing training for subject matter specialists and field extension workers employed by the three directorate generals and BIMAS.

Official lines of communication between research and extension require that information on a particular technology be channeled from the research institutes to the director general of AARD and then to the directorate generals of Food Crops, Animal

Husbandry, and Fisheries for dissemination. This process often results in a considerable lag between the development and multilocational testing of promising technologies. To speed up the transfer process, informal but effective linkages are often established between field-based farming systems researchers and local-level subject matter specialists and field extension workers.

Government Funding -- A critical constraint to the continued institutionalization of farming systems research and extension is the shortage of government funding. FSR research and training is being supported largely by externally funded projects. The Government of Indonesia provides counterpart budgets to cover Indonesian researcher salaries and recurrent operating expenses. With the drop in the world oil prices, the national budget has become tighter and tighter with the result that it is becoming increasingly difficult for institute directors and project managers to even meet their recurrent costs from government funding. Foreign projects usually cover the costs of expatriate advisors, consultants, training programs, inputs, major equipment, vehicles, and supplemental support for local researchers assigned to remote locations.

The problem of decreasing counterpart funding is compounded by a complex process of annual budget submissions within the Indonesian government. Although a project may be allocated a certain amount of support over the life of the program, annual budget requests must be submitted and acted upon each year. The process is extremely time consuming and usually results in a two- to three-month lapse in funding at the beginning of each fiscal year.

Conclusions -- Systems research has been well established in Indonesia as a result of the country's long participation in the Asian Farming Systems Network. Farming Systems Research and Extension, as a holistic and integrated process, focused on small farm families and the resources they control, is still an emerging concept within the national agricultural research and development organization. In the same manner that farmers select and tailor technologies to fit their particular farming system and resource base, Indonesian researchers are attempting to adjust and incorporate the FSR/E process within their national structure. The challenge they face is one of adapting a flexible and dynamic, bottom-up development process to a highly centralized and vertically structured research organization.

Foreign-funded, site-specific farming systems projects that cut across several institutes have provided an opportunity for scientists from different disciplines to experience the challenge of working together to achieve a set of interrelated conservation, production, and income-generation objectives. The key problem with the project system is one of continuity, both in terms of staffing and research thrust. However, as one senior consultant put it, "The project goes, but the flavor remains."

This "flavor" exists as an important ingredient for a viable national farming systems research and extension program in Indonesia. The challenge for government planners, researchers, and donor agencies is to find a way to link the diverse human and physical resources together in support of farmer-based, interdisciplinary research and extension. This will entail the design of a process that is culturally appropriate, politically acceptable, administratively manageable, and individually desirable.

## I. Introduction

The purpose of this study is to review, analyze, and document the results of Farming Systems Research and Extension (FSR/E) projects that have been implemented in Indonesia. The study will become part of a global synthesis report analyzing the factors that affect sustainability of FSR/E within national agricultural research and extension systems.

The main objective is to determine what factors have been most important in creating or preventing sustainability of the FSR/E process. Drawing on brief field studies, interviews, and analysis of secondary data, the study attempts to identify

(a) the degree to which externally funded projects have assisted in institutionalizing the FSR/E approach into the national agricultural research and extension system; and

(b) the extent to which national budgets are now supporting FSR/E activities.

Key topics addressed within the context of institutional sustainability include organizational structures, training, networking, content of FSR/E programs, linkages with commodity research programs and extension programs, and the ability of Indonesia to meet recurrent costs.

The data and findings presented in this study were developed from interviews with government administrators and agricultural scientists, technical assistance teams and consultants, field observations and a review of secondary data. Over twenty-five Indonesian researchers and administrators in the Ministry of Agriculture and the Agency for Agricultural Research and Development (AARD) were interviewed. Field visits were made to project sites and research institutes in West, Central, and East Java between July 15 and August 9, 1988. Secondary data were also collected on farming systems projects operating in transmigration areas in South Sumatra and South Sulawesi. The study presents an assessment of the results of more than ten years of cropping systems/farming systems research activities in Indonesia. As such, it does not attempt to review any single past or present project in depth but rather to ascertain the degree to which these activities have contributed to the institutionalization of the farming systems research approach to development in Indonesia.

## II. Background of FSR/E in Indonesia

Two forces have had a major influence on the manner in which farming systems research has evolved in Indonesia. First, the long history of cropping systems research under the direction of the International Rice Research Institute (IRRI), and second, the need to develop integrated systems for the management of marginal lands and newly opened transmigration areas.

In response to the need to develop crop technologies to meet the needs of Indonesia's small farmers, cropping systems research was initiated in 1972 by the Central Research Institute for Agriculture (CRIA), subsequently renamed the Central Research Institute for Food Crops (CRIFC). Research was initially focused on two lowland and upland transmigration sites on the island of Sumatra. Through work at these sites, CRIA scientists gained valuable experience in conducting systems-oriented research on food

crops (AARD/CRIFC, 1986). Building upon this experience, cropping systems research was ultimately extended by CRIFC researchers to all the major ecological zones of Indonesia, with the major emphasis on developing food self-sufficiency. During this period methodologies were refined and over 100 research and extension workers were sent to IRRI and other places for training programs, workshops, and monitoring tours in cropping systems (McIntosh, 1986).

The demand for applied on-farm research and technology transfer increased as the government's transmigration program was expanded into more marginal areas, particularly tidal swamps and fragile rainfed uplands. Since these areas are not nearly as suitable to intensive food crop production as the fertile irrigated lowlands, it has become necessary to look at more diversified systems for sustainable small-scale agriculture. The pressing need to improve the income of farmers in marginal areas has gradually led researchers to recognize the need to conduct interdisciplinary research focused on the needs of small farms with a wide number of interrelated farming operations. While commodity-focused component research had long been carried out by the various research institutes, the establishment of AARD in 1974 greatly increased the potential for integrated farming systems research.

Although precise definitions of farming systems research will differ from individual to individual depending on experience, training, and personal interests, FSR is commonly used in Indonesia to refer to programs that involve the introduction of livestock (cattle, poultry, ducks, and fish) and perennial crops into food-crop-based farming systems. Scientists are becoming increasingly aware that component research must be undertaken in a manner that recognizes the interaction and competition among all farm enterprises for the farmer's limited labor and resources. Not only must attention be paid to the interaction between enterprises but also to the impact these systems have on the natural environment.

The urgent need to address issues of soil and water conservation in the upper watersheds of Java has led some researchers to question whether such areas are suitable for intensive food crop cultivation. Recent research experience in these areas has prompted some scientists to suggest that the future generation of farming systems work in Indonesia must involve integrated on- farm, resource-based research.

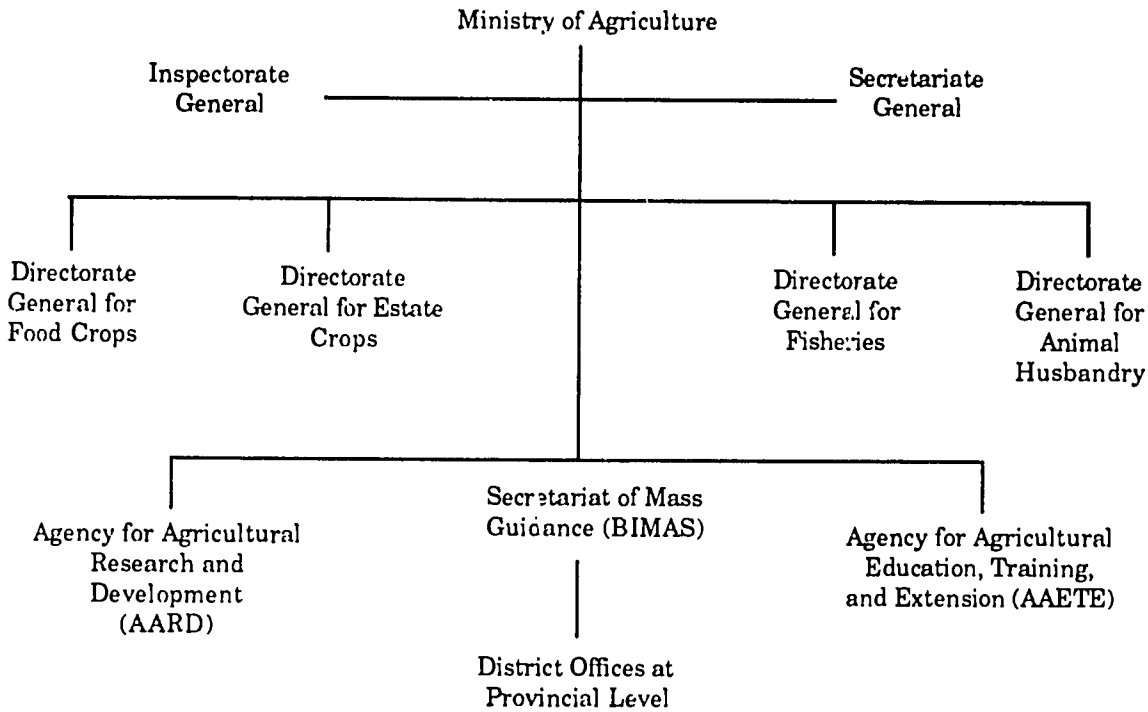
## III. Organizational/Institutional Structure

Farming Systems Research and Extension is housed within the Ministry (or Department) of Agriculture, which is divided into seven key units (see figure 1). The Agency for Agricultural Research and Development (AARD) is the research arm of the Ministry of Agriculture. Research on food crops is conducted by six research institutes coordinated by the Central Research Institute for Food Crops (CRIFC). Each of these institutes has a national mandate for the research and development of a specific commodity or land type.

The research component of FSR/E is housed within the Agency for Agricultural Research and Development. AARD itself is divided into separate research coordinating centers (RCC) responsible for food crops, horticultural crops, industrial and estate crops, animal sciences, and fisheries. The efforts of these research units are supported by a Secretariate, a Center for Agricultural Statistics and Data Processing, the Center for Soil Research, and the National Library for Agricultural Sciences (see figure 2). The Central

Figure 1

ORGANIZATIONAL CHART OF THE
INDONESIAN MINISTRY OF AGRICULTURE



Research Institute for Food Crops (CRIFC), which coordinates the majority of the country's FSR programs, is divided into six commodity institutes, thirteen research stations, and thirty-nine experimental farms, located throughout Indonesia.

A Farming Systems Advisory Team has been created within AARD. It is composed of the director general of AARD, who serves as chairman; the directors of each of the research coordinating centers and the Center for Soil Research; and the AARD secretary. The group is designed to provide interdisciplinary planning and guidance to each of the externally funded FSR projects. At the present time there are five externally funded farming systems projects being implemented through AARD:

Upland Agriculture and Conservation Project (UACP/FSR)
USAID funded

Agricultural Research and Development in Tidal Swamps Project (SWAMPS II)
World Bank funded

Transmigration Development Project (TRANS II)
World Bank funded
Nusa Tengara Agricultural Support Project (NATASP)
World Bank funded

Crop-Livestock Systems Research Project (CLSRP)
IDRC funded

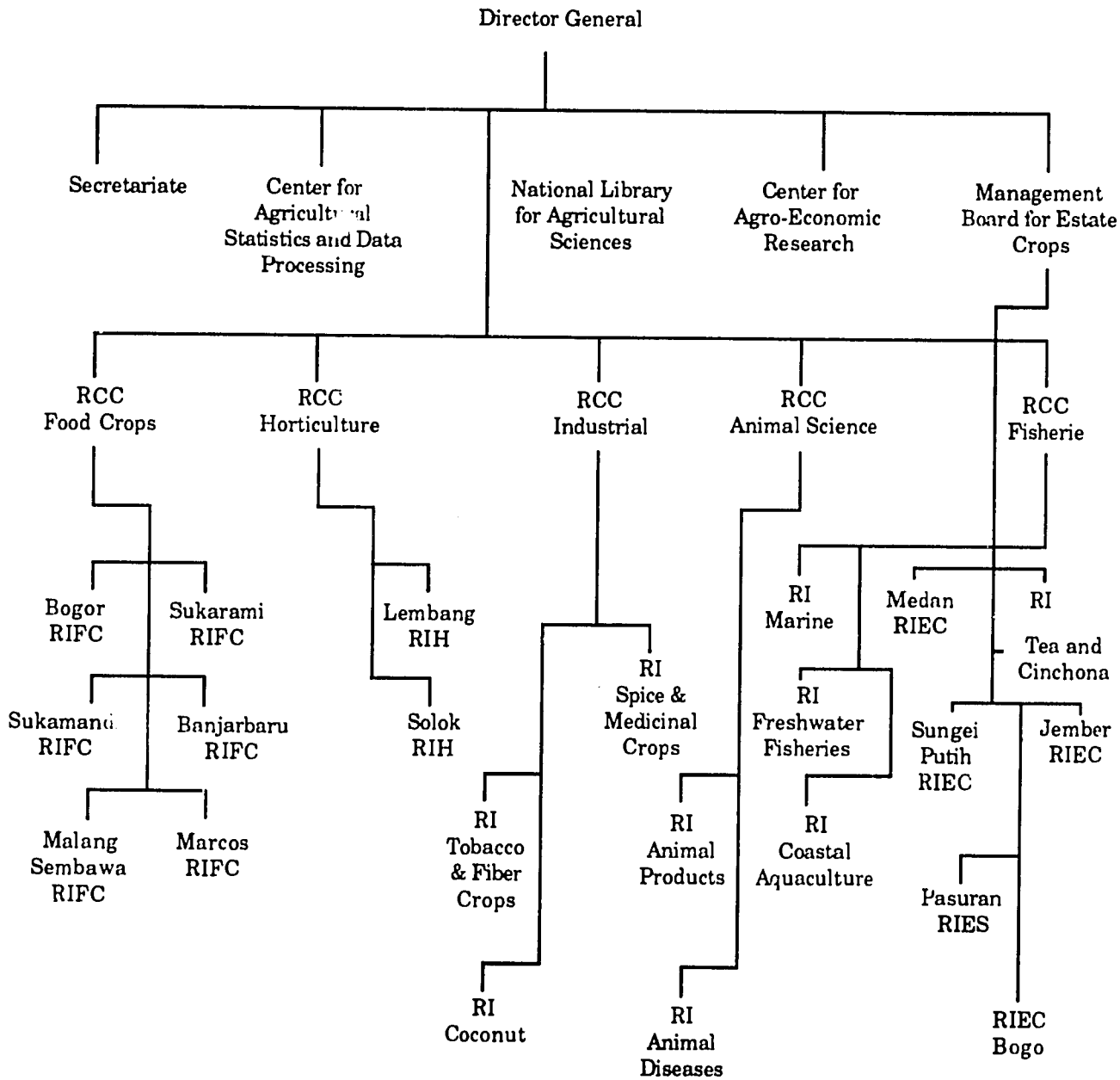
The day-to-day overview responsibility for projects is assigned to different members of the Advisory Team, depending upon the primary problem focus of the project. The FSR component of the Upland Agriculture and Conservation Project (UACP) is coordinated by the director of the Center for Soil Research, since its primary focus is on the conservation of soil and water resources in upper watershed areas. The Agricultural Research and Development in Tidal Swamps Project (SWAMPS II) and the Crop- Livestock Systems Research Project (CLSRP) are coordinated by the Director for the Central Research Institute for Food Crops.

Each project is supported by a technical team composed of six to ten senior researchers from the lead and supporting centers and institutes within AARD. The technical teams have played a key role in the initial design phases of the projects and provide regular support and guidance to the project manager and field staff.

In addition to the Advisory Team, which meets approximately once a year, and the project technical teams, which ideally meet on a monthly basis, there are a series of FSR coordinators and subcoordinators within each of the CRIFC research centers and institutes (see figure 2). These individuals are responsible for coordinating and monitoring the systems-based, on-station and on-farm research that is undertaken by the respective units, separate from support they may provide to externally funded FSR/E projects. In this manner, efforts are being made to realize both a vertical and horizontal integration of the farming system approach to research within the Central Research Institute for Food Crops. Given the extreme difficulty in creating new governmental units and the potential for competition and duplication of effort, the senior administrators within the Ministry of Agriculture have chosen a strategy of integration rather than attempting to establish a new institute or center for farming systems research.

Figure 2

ORGANIZATIONAL STRUCTURE OF THE AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT (AARD)

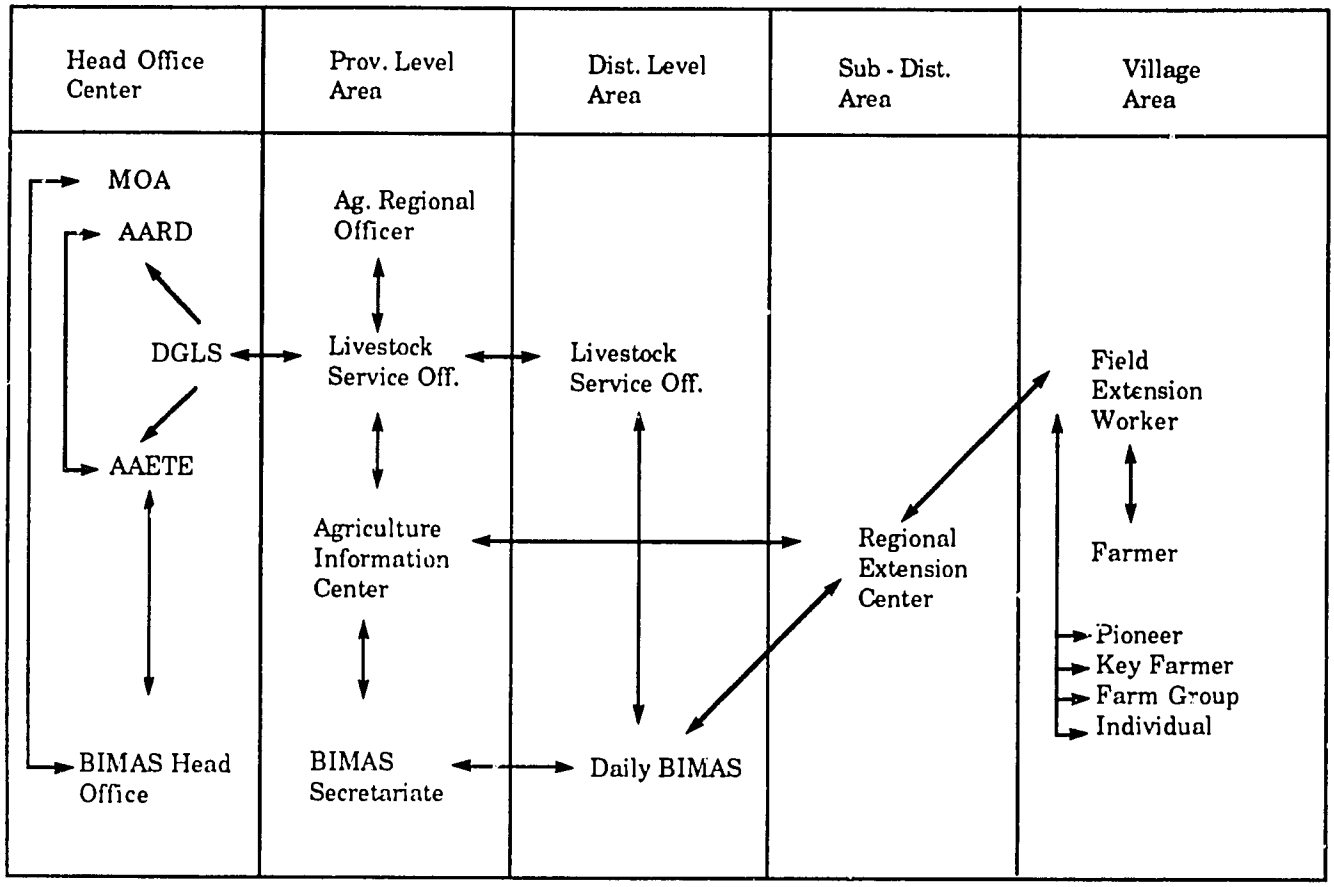



Note: RCC : Research Coordinating Center
RIFC : Research Institute for Food Crops
RIH : Research Institute for Horticulture
RIEC : Research Institute for Estate Crops
RI : Research Institute

Source: AARD, 1985.

Figure 3

LINKAGE OF AARD AND EXTENSION




Note : MOA : Ministry of Agriculture
AARD : Agency for Agricultural Research and Development
BIMAS : National Mass Guidance (Extension) Program
DGLS : Directorate General for Livestock

Source: Office of Directorate General for Livestock Extensionn.

The linkage with extension is through the Agency for Agricultural Education, Training, and Extension (AAETE), the World Bank-funded National Mass Guidance Proje (BIMAS), and the directorate generals of Food Crops, Animal Husbandry, and Fisheries (see figure 3). AAETE is charged at the national level with providing training for subject matter specialists and field extension workers employed by the three directorate generals and the BIMAS project. BIMAS is charged with implementing the Training and Visit (T&V) approach to agricultural extension. The three directorate generals are responsible for subject matter extension in their respective areas. Technology developed by AARD is communicated to these institutions through publications, regular meetings, seminars, symposia, field days, exhibitions, and through cooperative research in farmers' fields (Ministry of Agriculture, 1988).

While agricultural research in Indonesia is centrally organized on the basis of commodities, extension has evolved a decentralized, area-based structure, with personnel from BIMAS and the directorate generals operating at the province, district, sub-district, and village levels. The director generals test the applicability of new technologies under varying conditions at multiple locations throughout the country. Ideally, the results of these tests contribute to the development of "packages" of improved technology suited to each of the environmental zones in Indonesia. The local extension services in each district inform groups of "key farmers" of the technology and provide support to farmers in the form of credit, seed, and fertilizer to encourage them to adopt the recommended technologies, (Ministry of Agriculture, 1988).

The official lines of communication between research and extension require that information on a particular technology be channeled from the research institutes to the director general of AARD and then to the directorate generals for Food Crops, Animal Husbandry, and Fisheries for dissemination downward to the province and district-level extension workers. This process often results in considerable lag between the development and multilocational testing of promising technologies. To speed up the transfer process, informal but effective linkages are often established between field-based researchers and project staff and local-level subject matter specialists and field extension workers.

## IV. Research Coordination

Coordination of interdisciplinary farming systems projects presents a challenge within the Indonesian research organization. Ideally, such activities are administered by AARD, which has the power to call upon staff and resources from each of its commodity- and discipline-focused centers and institutes. In reality, one institute, such as CRIFC or the Center for Soil Research, is assigned lead responsibility for a project, which can make difficult the full integration and use of staff from other centers. Problems occur when the lines of authority and areas of responsibility are not clearly identified. This situation is further complicated if the project funds are channeled through the lead center rather than being allocated directly by AARD to each of the participating units.

At the individual level, being assigned to a farming systems project can generate a degree of conflict between loyalty to one's home institute and responsibility to the project. The situation is made even more difficult if the assignment requires relocation to a remote project site. Career patterns within AARD are largely within a single

institute. Assignment to an interdisciplinary project raises the possibility of being put in the uncomfortable position of having to answer to two bosses: the project leader and one's institute supervisor. Salary and housing inducements provided by externally funded projects are often not seen as sufficient compensation for being away from one's institutional home.

Creation of the Farming Systems Advisory Team indicates a level of concern among senior AARD administrators and is an important step toward finding ways to facilitate interaction between research institutes in the support and implementation of FSR activities. The ultimate success of this effort will depend to a great extent on the level of individual commitment to and support of interdisciplinary collaboration. There is a small but highly motivated group of scientists within CRIFC who are committed to the farming systems approach. Through direct experience in cropping systems programs they have seen the benefits of adaptive on-farm research and are now calling for collaborative research focused on the potential integration of livestock, fish, and perennial crops into farming systems for marginal areas. It is hoped that a similar level of interest can be instilled in key researchers from the other AARD centers and institutes.

## V. Training

Major investments have been made in agricultural- and farming-systems- related training for Indonesian researchers, agricultural educators, and extension personnel during the last ten years. A human resources development program was launched in close collaboration with the creation of AARD to provide a trained staff to meet the growing need for agricultural research. This effort has been assisted by scholarships from international and foreign funding agencies. Table 1 indicates the significant increase that has been achieved in the level of training of AARD researchers during the last ten years.

In addition, the Ministry of Agriculture and AARD have emphasized short-term training to improve the capabilities of technical support personnel. Much of this training has been sponsored or influenced by the International Rice Research Institute (IRRI) and the Asian Farming Systems Network. An average of thirty individuals per year have been sent to IRRI for various training courses and numerous senior staff have been supported to attend international conferences. IRRI regularly supports the participation of one or two Indonesian researchers in the annual Farming Systems Workshop and the Farming Systems Network Monitoring Tour. Additional individuals are often supported by special project funds to participate in these activities. Building upon this experience, Indonesia now offers a regional rice production technology course that draws participants from Malaysia and Brunei.

Specialized training in farming systems research methods has been supported primarily by various externally funded projects. Recently, the Upland Agriculture and Conservation Project recruited six individuals (three junior researchers and three regional planners from Central and Eastern Java) to attend a four- month course at the University of Hawaii on the application of farming systems methodologies to upland watershed management and conservation. Support for this program was provided from World Bank loan funds.

Although there has been some interest in farming systems shown by a few faculty, none of the agricultural colleges and universities in Indonesia as yet offer any regular

courses in farming systems concepts or methods. On occasion, research scientists from AARD have given special seminars and lectures on FSR/E. One effort to address this need was a special course organized by the USAID-funded Western Universities Training Project to provide training in FSR/E to Indonesian agricultural faculty. The content of the course was developed and presented by senior AARD researchers with considerable experience with the farming systems approach to research.

While a critical mass of staff trained in cropping systems exists within CRIFC, there is a need to provide basic farming systems training to the junior and senior staff of CRIFC and the other units within AARD, particularly the centers for livestock and fisheries research, which are being increasingly called on to participate in farming systems projects. Few Indonesians have received formal training and or experience in the diagnostic, design, on-farm testing, and evaluation phases of the farming systems research and extension process.

Table 1

MANPOWER DEVELOPMENT IN AARD
1975 TO 1986

| Level of Education | Numbers | | | |
|---|---|---|---|---|
| | 1975 | (%) | 1986 | (%) |
| Ph.D. | 16 | (0.47) | 150 | (1.30) |
| M.Sc. | 26 | (0.76) | 350 | (3.10) |
| Local university graduate | 243 | (7.07) | 1,409 | (12.20) |
| B.Sc. or lower | 3,153 | (91.70) | 9,603 | (83.40) |
| Total | 3,438 | (100) | 11,512 | (100) |

Source: AARD, 1988

## VI. Networking

Farming systems networking in Indonesia occurs in many forms. Some networking takes place on a relatively informal basis while other exchanges are rather formal in nature, such as annual workshops and informational meetings.

### Asian Rice Farming Systems Network

This is an international network that was initiated by the IRRI in 1975. Formally, it was known as the Asian Cropping Systems Network. Researchers from Indonesia have been involved since the beginning in the network that now comprises seventeen countries

in South and Southeast Asia. In addition to assisting IRRI to extend relevant technology and methodologies into national research programs, the network also helps to develop and establish methods for farming systems programs through various activities such as collaborative research on major problems in crop intensification and crop–livestock integration, and through the sharing of experimental results on a wide range of environmental complexes (Carangal, 1986). There are regular meetings between network members as well as monitoring tours to specific sites once a year. Indonesia has served as a base for potential site visits several times.

The first four years of collaborative research supported by the network concentrated on rice–based cropping pattern testing under various water conditions in paddy land. Central to this work was the intensive cultivation of high–yielding rice varieties. As a partial result of these efforts, Indonesia was able to reach self–sufficiency levels in rice production in 1984. Through collaborative research on varietal testing of dry–land crops, large amounts of genetic material were exchanged between the network members. Many improved cropping systems have utilized these materials to increase productivity of traditional cropping systems in the various agroecological zones of Indonesia, for example, rice/maize/cassava/peanuts or soybean, which has been adopted in many rainfed and tidal swamp areas of Indonesia (Syariffudin et al., 1985; AARD/CLSR, 1986). The intercropping of maize/cassava/peanuts is also found extensively in upland rainfed areas of Central Java (UACP/FSR, 1987).

The building up of personnel and strengthening of the research capability of national programs is another concern of the network. A three–month FSR course on socioeconomic training has been carried out at IRRI to strengthen the socioeconomic component of research in the national FSR programs.

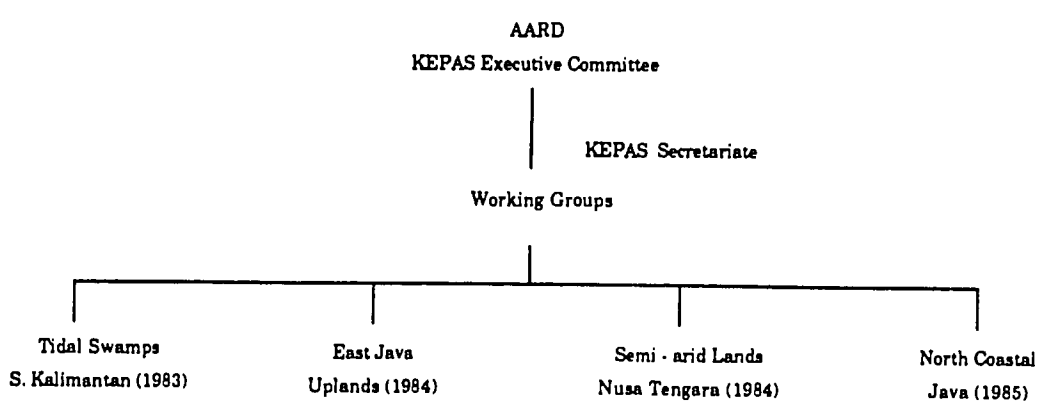
Linkage with the Research Groups on Agroecosystems (KEPAS)

The Research Groups on Agroecosystems (KEPAS) were established in 1982 as a national network to draw on the expertise of individuals from government agencies and local universities in planning, coordinating, and exchanging research results by focusing agricultural development of Indonesia on a social and ecological basis (KEPAS, 1984, 1985a, 1985b, 1986).

An agroecosystems approach (AEA) was adopted to analyze different agricultural systems of Indonesia. The approach was originally developed and applied extensively in the Southeast Asian Universities Agroecosystems Network (SUAN), hence a regional linkage between KEPAS and SUAN was simultaneously established (Krisnawati et al., 1988).

In 1985 the KEPAS secretariate was established with the aim of providing guidance, training, research support, and monitoring and coordination of program funding. The major role has been to stimulate the development of new working groups as well as organizing regional planning meetings and workshops (see figure 4).

Figure 4



At present, the secretariate serves an important liaison function within the AARD and the Ministry of Agriculture. It also supervises the publication of research findings, workshop reports, and training manuals (Pretty et al., 1988). Because the secretariate is presently based in CRIFC, where the current chairman of the executive committee is located, it has had less influence on the other research units within AARD.

The major impact of KEPAS in relation to FSR/E appears to be (1) in providing a broad guideline for a shift in direction from commodity-based to resource-based farming systems in specific agroecosystems, e.g., uplands, tidal swamps, or semi-arid lands; and (2) in the establishment of inter- and intra-institutional linkages at regional and provincial levels. Intensive training programs on Agroecosystem Analysis and Rapid Rural Appraisal (RRA) have involved not only staff from AARD but also from other government agencies and nongovernmental organizations at the district and provincial levels (Fisher, McCauley, and Hussein, 1988).

Research guidelines developed by the KEPAS working groups have been utilized by the FSR technical teams in initial design of AARD's FSR projects, e.g., Swamp II, UACP/FSR, and Trans II. However, many FSR researchers feel that agroecosystem analysis has still to be focused to the micro level and indeed to the field level, where cropping systems are being tested. The interactions between KEPAS and FSR have yet to reach some common areas of concern. Perhaps some specific topics may be introduced to stimulate the interactions. Recently an RRA training workshop was conducted but the results have yet to be evaluated.

Externally Supported Projects

FSR researcher networks have not only been established with the line agencies, as shown in the case of the IRRI Asian Farming Systems Network. They are also found in various externally funded projects such as the Upland Agriculture and Conservation Project (UACP), SWAMP II, the Crop-Livestock Systems Research Project and others. Central to these projects is a farming systems component where researchers from various disciplines and research centers have been assigned to the projects. In this way the project approach may be seen as fostering institutional networks. This kind of networking tends to strengthen intra- institutional linkages (within AARD), rather than the inter- institution communication. However, at the project site inter-institutional networks are found to predominate, in particular the link between on-site researchers and local extension workers. In many cases these links are informal; however, in the case of the UACP project the link has now become institutionalized. To overcome the problems of transferability of soil conservation technologies, the project's on-farm research sites have been recently located in the impact areas of extension. In this case a "handshake" agreement (from the USAID logo) was reached between UACP and the Sustainable Upland Farming Systems (SUSFS) project at the the Congdenglagi site. This collaborative approach will be extended to a new project site at Gunungsari in late 1988.

Agricultural Information Network

The National Library for Agricultural Sciences (NLAS) has been assigned to develop and coordinate communication and dissemination of agricultural information through all appropriate channels (AARD, 1988). A number of research reports and journals have been published. Lists of bibliographies have been prepared for specific clients, e.g., policy makers, research scientists, and general audiences, including farmers. Requests can be mailed directly to the library and NLAS staff will provide follow-up on each

inquiry. Due to the increasing work load of the information support service, NLAS has now been able to recruit subject matter specialists to carry out this task. The flow of information may be summarized as a diagram shown in figure 5.

## VII. The FSR/E Process/Content

Following the cropping systems research, which began in 1970 within the corn and sorghum agronomy section of the Central Research Institute for Agriculture (CRIA), joint collaborative research was undertaken with IRRI. From this work the concept of farming systems research began to emerge in the early 1980s. The emergence of FSR was primarily due to the experience of on-farm cropping systems research and the need to extend the improved technologies to more marginal areas and to diversified agricultural systems in the transmigration areas in Sumatra and Kalimantan (Syarifudin et al., 1985; AARD/CRIFC, 1986; Sjarifudin et al. 1988). In connection with this process, five key areas were identified on the basis of ecological variability: (1) lowland rice areas, (2) upland rainfed humid areas, (3) upland rainfed drought-prone areas, (4) tidal swamp areas, and (5) palawija crop areas.

To deliver improved technologies across the diversified agricultural systems of Indonesia, both in terms of commodity as well as target areas of development concern, two distinct models of research organization were developed to carry out farming systems research for different target areas or commodities with special emphasis on different issues of research (see figure 6).

Our observations indicate that a major concern of government institutions is to develop and then test potential cropping patterns in different areas and against various physical constraints, according to their respective mandates (see tables 2 and 3). However, the carrying out of farming systems component research within the research institutes often requires inputs from other centers outside CRIFC. The Sukamandi Research Institute for Food Crops (SURIF), which has a mandate to work on intensive wet rice production, is incorporating fish and animal components (i.e., ducks) in their rice-based cropping systems. Current field experiments at the station include a comparison of different rice-fish systems, effects of fish population and initial size on fish production in minipadi (rice/fish-rice/fish- fallow) systems, and trench design. It should be noted that out of eighty-five researchers at the station, none has any training in fishery. In addition, there is also a one-hectare demonstration plot for rice/fish/ducks.

McIntosh (1986) has suggested a possible administrative structure to facilitate technical coordination between the various AARD institutes. We did not observe such coordinative efforts during our study, except for the coordination that exists at the higher levels as a result of the Advisory Team (see Section II). In general, cropping patterns to be tested by on-site researchers will be decided based on available component technologies, e.g., variety and agronomic management, including pest and disease control measures. The improved cropping patterns are tested against a conventional farmer's system. In the case of the upland rainfed area of MARIF, for example, four cropping patterns are being compared under field conditions. These include the following:

Model A: Farmer practice; cassava/maize intercropping

Model B: Farmer practice with researcher supervision;

Figure 5

AGRICULTURAL INFORMATION NETWORK

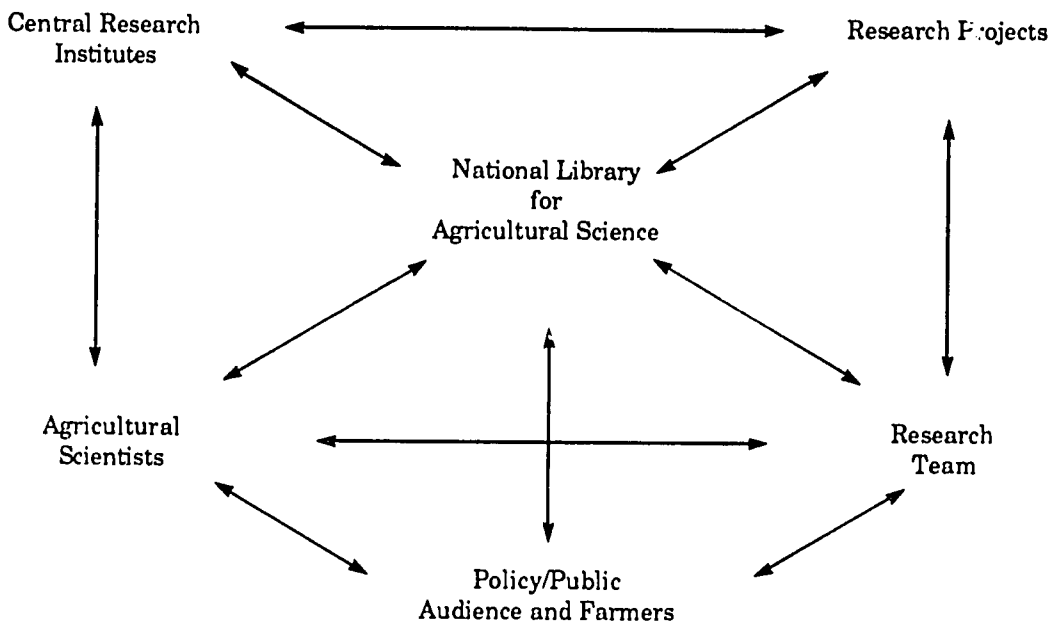
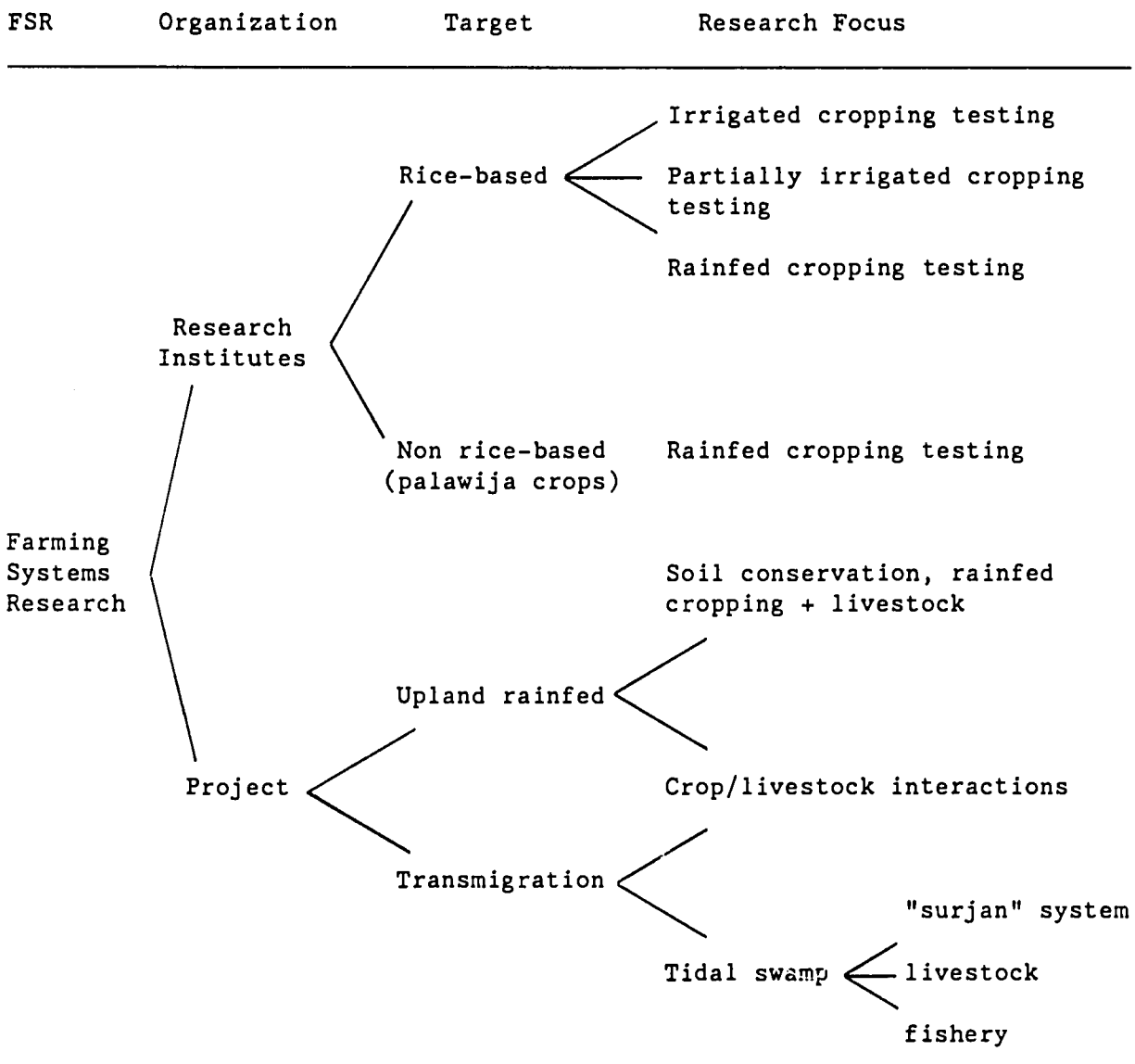


Figure 6

TARGET AREA AND RESEARCH FOCUS
OF FARMING SYSTEMS RESEARCH IN AARD



cassava/maize with recommended agronomic variety, adding fertilizer and optimum plant spacing

Model C: New cropping system; cassava/maize/gain legumes–maize with 300 kg of urea, 200 kg triple super phosphate and 100 kg of potassium chloride per hectare

Model D: Intensive system; cassava/maize/peanut–maize/grain legumes (soybean or mungbean) with the same rate of fertilizers as in Model C

Intensification through cropping systems with different levels of inputs are apparent in this case. It was also evident that the improved technologies, which are superior to the traditional systems in overall productivity, are unlikely to be adopted due to higher demand for labor at critical periods and the scarce availability of inputs. Modification of these systems is not practical at the field level as the planning has been based on recommendations of the technical team, which is physically stationed in Bogor.

In contrast to the research institutes, the externally funded projects are attempting to conduct FSR research at a specific site in an integrated manner. Field laboratories have been established where coordination between the research center and the project site team is encouraged (McIntosh, 1986). The real impact of the field laboratory, however, has yet to be seen since most of the projects have just started to test this methodology. The field laboratory is currently being used for component research, seed multiplication for on–farm testing, evaluation, and some field demonstrations. In the past, the on–farm activity and planning was similar to that of the research institutes. The Bogor–based technical team is responsible for planning and packaging technologies to be tested in the farmer's field. In the case of the UACP project, staffing increased with the addition of junior researchers on leave from different research institutes and with the arrival of the consultant team, the FSR planning appears to be focused more at the site. The UACP project has recently carried out a physical description and socioeconomic survey of their new site (Colfer et al., 1988). Also, the project aims to strengthen the livestock component to improve farmers' income (Getz, 1988).

During the period of the study, it was obvious that FSR has been applied extensively in various government agencies and agricultural development projects. However, the implementation of FSR concepts and methodologies are quite variable and no attempts have been made to arrive at any common consensus in terms of methods or objectives.

To obtain an idea of the range and type of research activities incorporated under the umbrella of FSR, Indonesian farming activities may be divided into different components.

The Descriptive and Diagnostic Component.

Descriptive surveys and on–site problem identification has apparently not been a key component of most farming systems research in Indonesia. The AARD technical teams may have carried out such analyses on an ad–hoc basis prior to determining the location of research sites and developing designs for on–farm trials; however, evidence of such

Table 2

MANDATES OF RESEARCH INSTITUTES UNDER CRIFC

| Mandate | Research Institute | Location |
|---|---|---|
| Wetland rice areas | Sukamandi (SURIF) | West Java |
| Non-rice (palawija crops) | Malang (MARIF) | East Java |
| Upland rainfed in drought-prone areas | Maros (MORIF) | South Sulawesi |
| Upland rainfed in humid areas | Sukarami (SARIF) | West Sumatra |
| Tidal swamp areas | Banjarbaru (BARIF) | South Kalimantan |
| Pioneering research | Bogor (BORIF) | West Java |

Source: AARD, 1988

Table 3

SUMMARY OF MAIN RESEARCH TOPICS
OF RESEARCH INSTITUTES UNDER CRIFC

| Research Institute | Research Topics |
|---|---|
| SURIF | Intensification and diversification of irrigated paddy lands |
| MARIF | Secondary food crops; maize, sorghum, soybeans, peanuts, mungbean, cassava, wheat, and sweet potatoes |
| | Varietal development and intercropping |
| MORIF | Intensification of upland rainfed areas under drought conditions |
| SARIF | Food crop development for red-yellow podsolic soils, in upland rainfed areas |
| | Upland rice and palawija crops |
| BARIF | HYV rice for swampy land; deep water rice |
| BORIF | Basic research for rice and palawija crops to support other institute, e.g., collection and evaluation of genetic resources, pest or disease management, biotechnology, BNF and agronomic commodity analysis |

Source: AARD, 1988, and interviews.

activity is rare. One of the few examples of FSR baseline survey work that focused on identifying farmer perceptions of soil conservation and farming systems was recently carried out by a foreign consultant in support of the Upland Agriculture and Conservation Project (Colfer et al., 1988).

There needs to be more emphasis in Indonesia on the various approaches for initial data collection and analysis. The well-known "sondeo" approach was developed in the late 1970s (Hildebrand, 1979a, 1979b, and 1981). Since then, a number of other methods, generally labeled as "rapid rural appraisal," have been developed and used successfully in other parts of Southeast Asia and the world Khon Kaen University, 1987).

The analysis of existing farming systems and farmers' practices needs to be encouraged. Some FSR projects in Indonesia have demonstrated the benefits of understanding and building upon traditional knowledge and farm management practices. For example, the UACP project is involved in packaging and modifying existing technologies to fit the land use patterns in the Jratunseluna and Brantas watershed of Central and East Java (UACP, 1987). In a similar manner, the "surjan" -- sunken and raised bed systems originally developed by farmers in Yogyakarta some decades ago -- are being transferred to newly opened lands in transmigration areas such as Karant Agung and Delta Upang of South Sumatra or Alabio and Unit Tatas of South Kalimantan (AARD, 1987).

The Analytical Component of the FSR Process

This involves in-depth analysis of the existing farming systems in the target or impact area with the aim of understanding the structure and interactions within the system and between the system and the larger environment in which it exists. It usually involves follow-up surveys, systems modeling, and the collection and analysis of secondary climatic and biophysical data. The best example of this kind of work in Indonesia is the agroecology analysis system developed by the KEPAS group. KEPAS, which began work in 1982 under AARD, has attempted to analyze a range of agricultural development programs in Indonesia in terms of intensification (KEPAS, 1984). Opportunities for intensifying agricultural production were identified in terms of interrelationships between agricultural, ecological, and socioeconomic parameters. These include wet- rice "sawah" ecosystems and the development of marginal or under-utilized lands (Conway and McCauley, 1983; Conway, Manwan, and McCauley, 1983). Three major categories of marginal lands were identified for potential development: (1) the critical uplands, which are loosely defined as lands suffering severe degradation due to soil erosion (estimated at ten to forty million hectares); (2) grasslands covered by "alang-alang" (Imperata cylindrica) (approximately fifteen million hectares); (3) the costal swamp lands (comprising about 35 million hectares). These marginal lands make up a third of Indonesia's land surface.

Many members from the AARD farming systems project technical teams have participated in the KEPAS activities and have utilized some of the findings in the planning and implementation of their projects. However, many have also felt that the KEPAS approach tends to be too broad in its focus and hence is of limited utility in FSR research. Its main focus is on a regional or watershed level. Hence, the agriculturalists claim it does not really help in setting field-level research priorities. Many argue that the approach relies heavily on secondary data and the so-called "rapid rural appraisal"

type of primary data collection.

During the last five years the KEPAS group has been able to carry out baseline survey research and conduct agroecological analyses of a range of environmental zones throughout Indonesia. These include cast studies of the critical uplands in Eastern Java (KEPAS, 1985a, 1988), tidal swamp agroecosystems of South Kalimantan (KEPAS, 1985b) and in the semi-arid areas of Nusa Tengara (KEPAS, 1986), and village studies in Timor (Krisnawati et al., 1988).

The Experimental Component.

This important aspect of FSR invovles both on-station and on-farm research, including both researcher- and farmer-managed trials. The purpose is to develop, test, and adapt problem- solving technologies to farmer conditions. All of the principal food crops research institutes within AARD are said to be actively involved in supporting FSR. As shown in table 3, almost all the institutes engage in station-based technology generation in accordance with their mandates for specific crops. An obvious exception is the Bogor Research Institute for Food Crops (BORIF), which is concerned with more basic "pioneering" research that cuts across commodity- or location-specific issues. In general, it may be said that the AARD research institutes are contributing to the farming systems process in terms of packaging technology to be tested under real farm conditions.

Relatively large efforts by Indonesian researchers have contributed to on-farm research activity. The on-farm research carried out by the research institutes has been primarily commodity oriented and researcher managed. These efforts, which were a logical extension of the earlier cropping systems research program, have been dominated by agronomists.

In contrast, the externally funded projects have achieved greater flexibility and a higher degree of integration in their on-farm research activities. Project research tends to be more interdisciplinary in nature, often involving agronomists, economists, and in some cases, animal scientists, where a livestock component has been incorporated into the research design. Social scientists, however, have tended to be involved only on a short-term basis. Although much of the on-farm work undertaken by the projects consists of researcher-managed trials, there is a growing awareness of the importance of moving into the farmer-managed phase as a means of seeing how the farmer will assess the proposed technology and how it will perform under his field conditions and management constraints.

The Extension Component.

As was noted earlier, extension has not been a formally supported component of the FSR/E process in Indonesia. The historical precedent set by the cropping systems program and the centralized structure of AARD undoubtedly contributed to the present-day emphasis on research to the exclusion of extension. This separation has even carried over to the foreign donors who tend to fund either farming systems or extension projects. The main link with extension exists between project staff and extension agents at the various field sites. On an informal basis the local extension agents are encouraged to use the project as a source of ideas and technology for local distribution

and assessment.

The Research Focus.

In assessing the diagnostic, analytical, and experimental components it is important to look at the general focus of the research program. Although the total farming system is becoming more and more the unit of analysis, many on-farm research activities in Indonesia still neglect to take into account the total complex set of enterprises managed by the farm household. Commonly, only the food crop production of the farm household is considered as the focus of research and analysis. Major efforts have been spent on on-farm testing with little effort on diagnostic survey and extension. On-farm monitoring is also weak, largely because of the limited capabilities of the junior staff at the sites and the decreasing frequency of visits by the technical teams. Data obtained from on-farm research does not appear to find ways back to the institutes to serve as a basis for further research at the station.

Farmer Participation.

Another key factor in farming systems research is farmer participation. Almost all of the externally funded projects involve local farmers as cooperators in the on-farm testing phase, but only a few have integrated them into the total range of the FSR process, including problem identification, research design, and evaluation. Yet the significance of farmer-managed research is quite evident and has been recently documented in a transmigration area of West Sumatra (Wade, et al., 1986). Ideally, farmers are given opportunities to compare results from researchers' recommendations and technology packages with their own practices. On the other hand, researchers gain access to the knowledge and experience of the farmers in a practical, hands- on fashion. Often it is through on-farm testing that the most important limiting factors affecting a farmer's production can be recognized.

An attempt has been made to compare the different FSR research strategies currently being followed in Indonesia and the results of this exercise are summarized in table 4. The externally funded projects have more flexibility in carrying out their research agendas than the institute-based programs. However, they require a higher level of external support and backstopping, often in the form of expatriate technical assistance teams. Although the projects command a disproportionate level of resources, there is some spin-off benefit to the institutes in terms of staff training, travel, and budgetary support of relevant on-station research.

## VIII. Impact of FSR/E

As indicated previously, a sustained commitment to cropping systems research was one of the major factors that contributed to the achievement of rice self-sufficiency. The primary goal now is to use the broader-based concept of farming systems research to sustain present levels of rice production and increase small farmer income, particularly in marginal upland and tidal swamp areas.

FSR/E in Indonesia has had varying degrees of impact at different levels of the agricultural research and delivery system, from the farmer in the field to the most senior

Table 4

COMPARISONS BETWEEN FSR PROJECTS CONDUCTED BY RESEARCH INSTITUTES AND EXTERNALLY FUNDED PROJECTS

| Variable | Project Characteristics | |
|---|---|---|
| | Conducted by Research Institutes | Conducted by Projects |
| Research | | |
| -Planning | Centralized | Moving toward decentralized decisions |
| -Orientation | Commodity based | Moving toward resource base |
| -Framework | Narrowly focused | Attemping a holistic systems perspective |
| -Research group | Single discipline | Developing an inter-disciplinary team |
| -Technical support | Direct | Indirect |
| -Dependency on external support | Low | High |
| Extension | | |
| -Linkage to research | No direct link | Informal links |
| -Farmer involvement | Minimal | Variable |
| -Field day excursions for extension agents | Official/once a year | Unoffically organized |
| -Field demonstrations | Irregular basis | Plan basis |
| -Extension materials | Few | Some* |
| Training requirements** | | |
| -Survey and data collection | High | Moderate |
| -Methodology | High | Moderate |
| -Field experimentation | High | High |

* = Includes project brochures, booklets, pamphlets, demonstrations at field laboratories, and equipment.

** = Applicable for field staff and junior researchers.

administrators and government planners in Jakarta.

### Farmer Level

The study schedule permitted only a limited amount of field research time so it was difficult to gain a clear feeling of the full range of impact that FSR/E has had on Indonesian farmers. It is clear that the conditions of farmers in various transmigration areas have improved as a result of government development efforts. How much of the improvement can be attributed to farming systems research is difficult to determine. A certain amount of development is bound to occur as the result of new roads and better communication.

In the area of agricultural production, transmigrant farmers are often a client group in search of new ideas and solutions. Generally, they find themselves in areas where their traditional farming skills and knowledge are of minimal value. Lowland, wet-rice farmers from Central Java, for example, are in need of a totally different knowledge base when they are moved to upland rainfed and tidal swamp areas. Farmers who previously were accustomed to intensive cultivation of an extremely small plot of land now find themselves in the situation of having to manage several hectares with the same, or decreasing, levels of labor. Technologies developed elsewhere have not always worked under such marginal conditions and hence there is an opportunity for FSR to fill the gap.

In some cases , however, project staff report that farmers have not been willing to follow management systems that require additional labor, even when all the inputs were provided free. Researchers complain about the difficulty of obtaining accurate data from on-farm trials when this happens, but they often fail to recognize that the same farmers may be conducting useful experiments of their own that could provide useful input to project planning and research design activities. At one project site, it was noted that local farmers had stolen certain grasses from researcher-managed trial plots while ignoring other varieties. Although frustrating to the research, such acts are an indication that farmers are observing and benefitting from FSR research in ways that are often not recognized. The act of stealing the grass is an example of farmer selection that should be closely monitored. Were the grasses transplanted or fed to cattle? If fed to cattle, why did farmers choose a certain variety over others? If planted, where are the grasses being grown and how are they managed?

With respect to assessing farmer-level impact, there is a need for researchers to pay more attention to farmer initiatives and indigenous experimentation. Constraints to this may be the tendency of researchers to see farmers as ignorant and the problem that farmers' activities and trials do not always fit with nationally approved programs and development models.

### Researcher Level

The concept of farming systems is recognized by a wide range of administrators and agricultural scientists in Indonesia. Few individuals, however, have had an opportunity to participate in a truly integrated and inter-disciplinary field-level farming systems research effort. Junior researchers who have received FSR training may have difficulties in transferring their knowledge into actions if their supervisors do not actively create opportunities for them to share their knowledge and skills with others. The senior scientists with the greatest understanding of the concepts of FSR are frequently assigned

to adminstrative duties.

There is a small but highly motivated group of senior scientists who are striving to find ways to integrate the FSR approach into the regular research programs of the various food crop research institutes of AARD. Since these individuals are frequently assigned to locations some distance from the actual field sites, their ultimate impact will probably be felt through their role on project technical committees and through their management of research institute programs. In a few cases the senior farming systems scientists have been called upon to give lectures on the FSR process to students at agricultural universities.

## Local/Provincial Level

Perhaps the most visible impact has been at the local level where project staff have had direct contact with farmers, extension staff, and district and province officials. The informal "handshake" linkages between FSR projects and other agencies are found at this level. Extension agents, local government officers, and representatives from other development projects often participate in FSR project field days and various activities involving direct interaction with farmers. It is at this level that FSR has its greatest influence on the extension system through project-supported field laboratory work, on farm trials, and needs assessment surveys.

It is also at this level that the provincial planning agencies (BAPPEDA) have begun to see the potential role that FSR can play in the planning and implementation of provincial development programs, particularly in the marginal upland and tidal swamp areas. In Central and East Java two members of the respective province planning agencies recently completed a special short course on the application of farming systems research to upland conservation and watershed management.

## Regional Level

At the regional level the locus of FSR impact is at the various research institutes, which carry out the basic component research to develop the technology recommendations that are adapted to site-specific conditions by externally funded farming systems projects. Although most of the institutes under the Central Research Center for Food Crops have designated farming systems coordinators, the greatest impact has been at those centers located near specific FSR project sites. In 1985, the Sukamandi Research Institute for Food Crops in West Java hosted a national workshop on farming systems research in Indonesia in cooperation with the Center for Agro-Economic Research. In 1986 an international farming systems workshop was hosted by the Sukarami Research Institute for Food Crops in West Sumatra. The interest of these two institutes in FSR is directly related to their respective mandates for research on wet and dryland rice, which was also the focus of the early cropping systems research.

The Research Institute at Malang, East Java, which specializes in "palawija" or secondary food crops, has begun to focus part of its efforts on farming systems that incoporate such crops as corn, soybeans, peanuts, mungbeans, cassava, and sweet potatoe. Other regional research institutes such as those at Maros, South Sulawesi, and

Banjarbaru, in South Kalimantan, have mandates to develop farming systems appropriate to dryland areas and tidal swamps.

National/Policy Level

At the national level the influence of FSR is seen most directly in the establishment of the Farming Systems Advisory Team within the Agency for Agricultural Research and Development. This team oversees the implementation of externally funded FSR projects within AARD. Another indicator of the impact of FSR is the recognition among senior government officials and planners that a key factor in the success of future transmigration programs will be the development of sustainable farming systems for the marginal upland, dryland, and tidal swamp areas. At this level, FSR/E has begun to have an influence not only on the policies and research priorities of AARD but also on those of other government agencies, such as the ministries of Public Works and Transmigration.

The need to provide appropriate information to transmigrant farmers on how to manage and sustain production on rainfed uplands and reclaimed swamp land has prompted the ministries of Agriculture and Public Works to coordinate their roles and respective inputs. Preparation of newly opened transmigrant areas, including the clearing of forested areas and the drainage of tidal swamps, is the responsibility of the Ministry of Public Works. The Ministry of Agriculture is expected to develop appropriate recommendations for farm production in these areas. Problems have resulted when the work of the two ministries was well coordinated.

Application of an FSR approach has demonstrated the need for the involvement of soil scientists as well as engineers in the design of land clearing programs. Likewise, the hydrologists, who design tidal swamp drainage, need to understand the kind of agricultural systems being planned for the area and their irrigation and management requirements. A growing recognition of the need to develop transmigration schemes that are environmentally sound as well as economically feasible has led planners and agriculturalists to support farming systems research and the kind of agroecological assessment work being conducted by the KEPAS program.

With respect to formal institutionalization there is an explicit policy that favors the incorporation of FSR concepts and methods into the programs of exisiting research centers, as opposed to the creation of a separate institute or center for farming systems research. Although FSR centers have been established in Thailand and the Philippines, Indonesian agricultural scientists and administrators feel that such an approach would not be effective in Indonesia. They fear that a separate institute would lead to further competition for staff and funds within a government system that already has serious staff and budget problems. The Indonesian policy is one of vertical and horizontal integration of FSR concepts and methods throughout the Agency for Agricultural Research and Development.

## IX. Factors Contributing to Institutionalization

### Experience with Systems Research

A systems approach to research is not new to Indonesia. AARD scientists have

more than ten years experience working on cropping systems research, which has provided a foundation in applied, problem-focused research upon which the more recent farming systems methodology has been built.

Presence of Trained Personnel and Disciplinary Research Capability

With the creation of AARD, Indonesia launched a major effort to upgrade its research capability. Existing research facilities were improved and new facilities built to house the various commodity- and mandate-focused research institutes and centers of AARD. During the same period large numbers of Indonesian researchers were sent abroad for specialized short courses and degree training at the Ph.D. and M.Sc. level. More than sixty million dollars was contributed by foreign donors toward this personnel and physical research capability development effort, with the result that Indonesia now has the basic disciplinary research capability to support a farming systems research program.

Government Priority on Development of Systems for Small-Scale, Sustainable Agriculture in Marginal Upland and Tidal Swamp Areas

The Government of Indonesia's expanded transmigration program to relocate large numbers of people from Java and Bali to less-populated areas of Sumatra, Sulawesi, and South Kalimantan has generated an urgent need for agricultural technologies suited to the newly-opened marginal upland and tidal swamp transmigration sites. Since many of these areas are not well suited to intensive cultivation of food crops, a farming systems approach is being utilized to identify and adapt a range of integrated farming technologies. This effort has provided the impetus for the use of a resource-based farming systems approach to technology development.

Development of Inter- and Intra-Institutional Linkages

Involvement in externally funded farming systems projects and participation in the Asian Farming Systems Network have fostered a series of formal and informal linkages between individual scientists and institutions involved in farming systems research, and between researchers and extension personnel.

Emergence of a Critical Mass of Senior Scientists with an Understanding and Commitment to the Farming Systems Approach to Research

The history of cropping systems research, coupled with specialized training and field experience in the transmigration areas has, led to the emergence of a small but dedicated group of senior scientists in AARD who are committed to fostering greater use of the farming systems approach.

Growing Support for an Agroecosystems and Natural Resource Approach to National Development

A Ford Foundation-supported program to develop agroecosystem working groups (KEPAS) has generated increasing concern for sustainable and environmentally sound development strategies. The KEPAS project has provided training in rapid rural appraisal

and conducted agroecosystem analyses of key environmental zones in Indonesia. While not directly linked with FSR, these studies have provided a sound base upon which more in- depth diagnostic surveys have been developed for existing farming systems projects.

### Recognition of Interdisciplinary Research Activity

With the growing concern for natural resource development issues and the long experience of the systems approach, the FSR researchers have readily recognized the significant role of interdisciplinary work in farming systems research. Although there are constraints to implementing an interdisciplinary approach throughout the AARD, the current on-farm research activities being conducted by the externally funded FSR projects provide a support base for interdisciplinary research at the site level.

## X. Constraints to Institutionalization

### Internal Constraints

#### Lack of indigenous knowledge

Because of a tendency of government planners and researchers to think in terms of developing broad-based technology packages and farming systems "models" for different agroecological zones, many FSR/E projects suffer from insufficient knowledge and understanding of the local-level indigenous farming systems. In theory, new technologies are evaluated against farmer practices; it is often difficult for researchers to describe in detail the farmer practice or traditional system. However, many of the "improved" technologies, such as back slanted terraces and the "surjan" (raised/sunken bed system), represent improvements to existing farming systems found in other parts of the country.

#### Farmer participation

The most common form of farmer participation in Indonesian farming systems projects appears to be that of the "Farmer Cooperator." These individuals are commonly identified by the village head and agree to test a certain cultivar or cropping pattern on one of their fields in return for a free supply of inputs. There does not appear to be much systematic involvement of farmers in the design and/or formal evaluation of the on-farm trials. This situation is most probably the result of a combination of factors -- centralized research designs coming from the technical team in Bogor, lack of training in the concepts and techniques of participatory development, and shortage of personnel for effective on-farm monitoring.

The initial designs for the current farming systems projects being implemented through AARD were developed by the senior-level technical teams following a brief site survey. Some of the projects are now beginning to recognize the need for more in-depth surveys of farmers' perceptions of problems and their needs and aspirations. As the site teams take on greater responsibility for generating this kind of information, a base may be established at the project level for greater involvement of farmers in trial design and evaluation.

### The systems approach

Although there is a recognition that farming systems research requires one to look at the interaction of a broad range of farm systems and enterprises, most FSR research in Indonesia is still focused primarily on the food crop subsystem with a growing secondary interest in the incorporation of poultry and livestock enterprises. Little attention has been paid to marketing strategies and options, the role of women, and the relative importance of off-farm income. These issues have been looked at on a limited basis by expatriate consultants who have produced a set of background papers (Colfer et al., 1988; Getz, 1988; Young, and Amir, 1988).

Most farming systems researchers are basically cropping systems scientists with little, if any, training in how to collect and interpret socioeconomic data. Because there are no formal linkages between AARD and the university community, it is difficult to recruit qualified Indonesian rural sociologists and cultural anthropologists for sustained work on farming systems projects.

## External Constraints

### Organizational structure

Organizational structure and the Indonesian bureaucratic tradition make real coordination between different government units and agencies difficult at the national level. AARD is organized along commodity lines with an emphasis on achieving national yield/production targets. Research, agricultural education, and extension are the responsibilities of separate units within the Ministry of Agriculture. Farming systems projects are attempting to link units and integrate disciplines at the local level within a research and delivery system that is highly centralized. Farmer participation in bottom-up planning and research is difficult to achieve within a system that requires lines of authority and responsibility to be clearly defined by the central offices.

### The cropping systems legacy

The cropping systems experience played a major role in the institution-building phase of agricultural research, and ultimately led to the achievement of self-sufficiency in rice production. It has, however, left a legacy of component research and cropping models that tends to counter efforts toward a more balanced assessment of the total farm system. This has led to the concept of farming systems research as a process of introducing additional components, such as livestock and perennials, to a food crop system.

### An administrative emphasis on "coordination" rather than "integration"

The need in the Indonesian system to clarify lines of authority and responsibility has led to the practice within AARD of assigning oversight responsibility for each externally funded farming systems project to one of the Central Research Center directors. While this process does create clear lines of information flow between the Advisory Team and the project staff, it does not always foster the desired level of cooperation between institutes within AARD. If project staff are recruited from the Advisory Team member's own institute, there is a tendency for them to function under

the coordinator as institute staff, rather than as individual researchers assigned to an AARD project. Likewise, researchers from other institutes are often hesitant to leave their own institute for a project assignment that requires them to work under the direction of another institute director.

Data analysis and interpretation

Most farming systems projects suffer from a weakness in data management, analysis, and interpretation. There is a problem both in determining what kinds of data are important, and it setting up systems to insure that key data is collected in a reliable and uniform manner. This problem appears to be the combined result of centralized planning of research and insufficient training and supervision of site researchers and village-level field staff. Often quantitative data, which may have little or no meaning because of lack of control in its collection and management, is considered more important than observable evidence of farmer adoption or rejection.

Researchers from several sites reported a problem with farmers stealing planting materials from demonstration plots and research sites. Although such acts may make it difficult to obtain desired performance data, they should also be seen as important indicators of farmer selection and preference.

Minimal linkage with extension

This report has used the term FSR rather than FSR/E since there is no formal involvement of extension in farming systems research in Indonesia. With the responsibility for extension assigned to three different agencies outside of AARD, linkages between research and extension exist only on a informal basis at the province and field level. Senior scientists and project managers point to good working relations at the field level. Extension, however, often feels that it is not officially involved or supported by farming systems research projects and only gets called upon when the researchers need something done. Subject matter specialists within the directorate generals of Livestock, Animal Husbandry, and Fisheries have rarely been involved in any formal farming systems training programs.

Generic Constraints

Shortage of FSR skill and experience

The term "farming systems research" is known and recognized by most Indonesian agricultural scientists. Indeed, most researchers can articulate the steps of the FSR process in one form or another, but few have actual field-level experience. Those Indonesians who know the most about FSR seem, by force of their administrative duties, to be the farthest from the field. Both the science of field research and the art of integrating the results into an appropriate range of recommendations for further testing and transfer is left largely to expatriates and junior scientists stationed at the project site.

There is a critical need for more hands-on training of field staff in conducting rapid rural assessments, identifying research areas and recommendation domains, conducting diagnostic and problem-focused surveys, and designing, implementing, and

evaluating on–farm research. Few researchers come to a project with these skills. The training they receive depends to a great extent on the presence of expatriate advisors, the nature of the project's plan of work, and the size of the budget.

Lack of funding

A critical constraint to the continued institutionalization of farming systems research and extension is the shortage of government funding. FSR research and training is being supported largely by externally funded projects. The Government of Indonesia does provide counterpart budgets to cover Indonesian researcher salaries and recurrent operating expenses. With the drop in world oil prices the national budget has become tighter and tighter, with the result that it is becoming increasingly difficult for institute directors and project managers even to meet their recurrent costs from government funding. Foreign projects usually cover the costs of expatriate advisors, consultants, training programs, inputs, major equipment, vehicles, and supplemental support for local researchers assigned from Bogor to project sites.

Government funding is required to meet researcher salaries and recurrent station and field operation expenses. The problem of decreasing counterpart funding is compounded by the complex process of annual budget submissions within the Indonesian government. Although a project may be allocated a certain amount of support over the life of the program, annual budget requests must be submitted and acted upon each year. The process is extremely time consuming and usually results in a two– to three–month lapse in funding at the beginning of each fiscal year.

## XI. Recommendations

Building upon the preceeding discussion of opportunities and constraints, this section offers a set of recommended actions that might be taken to reinforce the process of institutionalizing FSR/E in Indonesia. The purpose of this study was not to evaluate the quality of farming systems research being conducted by individual projects. This has been done elsewhere. The emphasis here is on ways of expanding the support base and reinforcing the integration of farming systems concepts and methods throughout the national agricultural research and delivery system. Specific recommendations are divided into actions that might be taken by Indonesian researchers and agricultural administrators, expatriate technical assistance advisors, and the various international and bilateral donor agencies.

### The Agency for Agricultural Research and Development

1. Steps should be taken within AARD to find ways of developing and supporting a closer interaction between the KEPAS agroecosystem analysis research and training programs and the initial survey and diagnostic assessment stages of the FSR process. It is hoped that through staff collaboration ways could be found to make future agroecosystem studies more useful to those who design, monitor, and implement farming systems projects.

2. AARD needs to define interdisciplinary farming systems as one of its agency–wide mandates and to establish mechanisms that facilitate interinstitute funding and staff assignments. An important first step in this direction would be the

designation of all FSR projects as AARD activities, possibly underthe supervision of an agency farming systems coordinator. While this appears to be the intent, the current practice of assigning day–to–day over– sight responsibility to individual institute directors tends to reinforce, rather than eliminate, barriers to effective interdisciplinary and inter–unit cooperation.

3. Another action that would help to support interinstitute cooperation would be developing a mechanism for administering FSR funds in a way that does not require the total project or activity budget to be channeled through a specific institute or research center. At the present time there are many factors that make it difficult for a project supervisor to allocate funds and staff to projects or units outside of his own institute. Initially, this approach could be applied to externally–funded projects that require personnel and technical support from several of the AARD centers. A mutually supportive scope of work would be defined for each center, which would then receive appropriate funding to cover its responsibilities. This approach could be applied to the administration of externally funded FSR projects and eventually extended to GOI–funded interdisciplinary programs within AARD and between AARD and other government agencies.

Technical Assistance Advisors

1. Technical assistance advisors should take their direction as much from the host country as from the donor agency. This is particularly true in the design of training programs. The development of training programs and the identification of participants needs to be well coordinated with institute directors, supervisors, and project directors, who are in a position to create or deny participants an opportunity to utilize and share their newly gained knowledge and skills. For maximum benefit from training it is important that the trainees and their immediate supervisors both have a vested interest in the program.

2. As much as possible foreign advisors should be required to work within the existing research and extension systems rather than through richly endowed projects that have little resemblance to the working realities of national scientists and extension workers. While the upgrading of research facilities and support services is important, equal attention needs to be focused on helping national scientists to work more effectively within the exisiting resource base.

3. Expatriate advisors and donor agencies should resistthe temptation to hire short–term consultants to conduct special project related assessments and technical studies. While the use of consultants may be a cost effective way of generating important baseline data and research plans, this practiceoften make little, if any, contribution to the overall capabilities of the national staff.

4. External advisors need to do more to reinforce upon the AARD staff the importance of farmer involvement in the design, implementation, and evaluation of on–farm trials. Examples exist in Indonesia of situations where research designs were modified as a result of input from farmers when the researchers

shared with the community the objectives and procedures of the research before the trials were layed out. Rejection of a particular practice should also be treated as farmer input since it represents an indigenous assessment of the technology. Researchers should be encouraged to investigate and report the specific reasons for farmer rejections so that this information can be taken into consideration in the design of future research.

Donor Agencies

1. Donor agencies should identify one or more project objectives specifically related to the institutionalization of the FSR/E process and fund activities that contribute directly to the institutionalization goal. Projects that focus primarily on short- term technology generation and/or production objectives may ultimately impede, rather than reinforce, the long-term goal of integrating the concepts and methods of the FSR process into the national research and delivery system.

2. With respect to the support of long-term process goals, donors might give thought to allocating a portion of their development budget to the creation of special funds for the sponsorship of FSR initiatives. Government agencies or individual scientists could apply these funds for sponsorship of national FSR symposiums or training programs. Deserving scientists could apply for travel funds to enable them to attend international meetings and maintain valuable contacts with key FSR practitioners throughout the world. Another use of such a fund could be to support institutional and possibly individual subscriptions to key international journals and farming systems newsletters.

3. In designing future projects, donors should consider how realistic is the possibility that most host country agencies will be able to sustain the level of funding and staff support commonly associated with externally sponsored projects. The scale of projects may be the biggest barrier to national sustainability of externally funded development initiatives.

## XII. Conclusions

The current status of farming systems research in Indonesia can only be understood and evaluated within the context of the historical perspective within which it has evolved and the national research structure in which it exists. Indonesian agricultural planners and researchers recognize the role the FSR/E approach can play in addressing the many environmental and production problems faced by small farmers in marginal areas. The approach is seen as particularly relevant to the development of technology appropriate for transmigrants who have been recently relocated to newly opened tidal swamps and upland rainfed areas.

Systems research has been well established in Indonesia as a result of the country's long participation in the Asian Farming Systems Network. Farming Systems Research and Extension, as a holistic and integrated process foucused on small farm families and the resources they control, is still an emerging concept within the national agricultural research and development organization. In the same manner that farmers select and

tailor technologies to fit their particular farming system and resource base, Indonesian researchers are attempting to adjust and incorproate the FSR/E process within their national structure. The challenge they face is one of adapting a flexible and dynamic bottom– up development process to a highly centralized and vertically structured research organization.

Progress has been made under the guidance of a small but growing cadre of senior scientists who are committed to fostering an eventual integration of the FSR/E approach into the regular research programs of the various institutes and centers of the Agency for Agricultural Research and Development (AARD). The process is slow and faced with considerable institutional conflict. The research institutes are organized around commodity targets and have a history of working independently, rather than as a collective unit. Likewise, individual career advancement is largely achieved within a single institute or center. Consequently, there is little professional reward for interdisciplinary and interinstitutional collaboration.

With respect to research, FSR in Indonesia has covered two of the major activities proposed in the farming systems research classification proposed by Deborah Sands (1986): adaptive research and component research. Although extensive activities are now devoted to applied research, most effort has been paid to on–farm testing with little diagnostic survey and on–farm monitoring. Many of the special projects are making efforts to develop the capacity for interdisciplinary research at the site level. This will certainly help to expand the scope of on–farm research to cover a broader range of FSR/E activites.

There is an urgent need to carry out farming systems analysis intensively so that the in–depth understanding of existing farming conditions will be well understood. A closer linkage between FSR and KEPAS activities may help to overcome this problem on a short–term basis. The establishment of an interdisciplinary research mandate within AARD would be a major step toward a long–range solution.

Foreign–funded, site–specific farming systems projects that cut across several institutes have provided an opportunity for junior and senior scientists from different disciplines to experience the challenge of working together to achieve a set of interrelated conservation, production and income objectives. There is a problem of continuity in that neither projects nor their staff are permanent. Projects usually have a specified life of three to five years. Institute researchers are generally assigned to these activities on an annual basis. While the movement of Indonesian researchers in and out of project assignments makes short–range continuity within a project difficult, there may be a long–range benefit of exposing larger numbers of scientists to an FSR experience, which hopefully they can take back to their institutes. As one senior consultant put it, "The project goes, but the flavor remains."

The ingredients for a viable national farming systems research and extension are present in Indonesia. The challenge for government planners and the donor agencies is to find a way to link the diverse human and physical resources together in support of farmer–based inter– disciplinary research. To insure sustainability of the FSR process, whatever coordinating mechanism is developed must be uniquely Indonesian. It must involve a process that is culturally appropriate, politically acceptable, administratively manageable, and individually desirable.

## Appendix I

## PERSONS CONTACTED DURING THE STUDY

The following persons contributed to this study by graciously sharing with the authors their insights, opinions, and background knowledge related to the development of farming systems research and extension activities in Indonesia.

1. Dr. Prabowo Tjitropranoto, Director, National Library for Agricultural Sciences.
2. Dr. Cynthia Mackie, USAID Personal Services Contractor based in Salatiga, Central Java.
3. Dr. Pervaiz Amir, Agricultural Economist, Winrock International, Salatiga, Central Java.
4. Dr. Djojo Martono Muljadi, Consultant to the UACP/FSR Project, Salatiga, Central Java.
5. Dr. Soleh Sukmana, UACP/FSR Project Director, Salatiga, Central Java.
6. Dr. Joel Levine, DAI representative assigned to the Sustainable Upland Farming Systems Project, Salatiga, Central Java.
7. Dr. Ibrahim Manwan, Director, Central Research Institute for Food Crops, Bogor, West Java.
8. Dr. Suljadi, Director, Center for Soil Research, Bogor, West Java.
9. Dr. Achmad Syarifuddin Karama, Director, Bogor Research Institute for Food Crops, Bogor, West Java.
10. Mr. Inu G. Ismail, Farming Systems Agronomist, UACP/FSR Project, Bogor, West Java.
11. Director of Training, Agency for Agricultural Education, Training, and Extension, Pasar Minggu, West Java.
12. Ir. Asep Saefuddin, KEPAS Project, CRIFC, Bogor, West Java.
13. Ir. Dady Ganda Sukaryo, Director of Extension, Directorate General for Food Crops, Pasar Minggu, West Java.
14. Dr. Almiro Blumenschein, Winrock International, Chief of Party, AARP II Project, Bogor, West Java.

15. Dr. Achmad Suryana, Agricultural Economist, Center for Agro–Economic Research, Bogor, West Java.

16. Dr. Bonifacio Felizardo, Winrock International, Chief of Party, UACP/FSR Project, Salatiga, Central Java.

17. Dr. Djoko Budijanto, Program Office, Agency for Agricultural Research and Development, Pasar Minggu, West Java.

18. Dr. Martias Midin, Director of Extension, Directorate General for Animal Husbandry, Pasar Minggu, West Java.

19. Mr. M. Nainy A. Kirom, UACP Project (Research Component), Salatiga, Central Java.

20. Ms. Dewi Juniar Putriatni, Planner in BAPPEDA, Surabaya, East Java.

21. Mr. Robert Watung, Junior Researcher, UACP/FSR Project, Salatiga, Central Java.

22. Mr. Walter Tappan, IRRI Representative, CRIFC, Bogor, West Java.

23. Mr. Marwoto, Entomologist and FSR Coordinator, MARIF, Malang, East Java.

24. Mr. Joko Puknomo, Agronomist, MARIF, Malang,East Java.

25. Dr. Mch. Iman, Project Leader SWAMP II Project, Palembang, South Sumatra.

26. Dr. I. Harahap, Rice Breeder, CRIFC, Bogor, West Java.

27. Dr. Sutjiptoph, FSR Agronomist, CRIFC, Bogor, West Java.

28. Mr. S. Adivibowo, Center for Natural Resource Management and Environmental Studies, Bogor Agricultural University, Bogor, West Java.

29. Mr. Abunawan, Center for Agro–Economic Research, Bogor, West Java.

30. Mr. Ronald Greenberg, USAID/ARD, Jakarta.

31. Mr. Frank Gillespi, USAID/ARD, Jakarta.

32. Mr. George Like, USAID/ARD, Jakarta.

33. Dr. Achmad M. Fagi, Director, Sukamandi Research Institute For Food Crops, Sukamandi, West Java.

34. Dr. David McCauley, Natural Resource Policy Advisor, USAID/Jakarta.

Appendix II

## REFERENCES


AARD

1985 This is the Agency for Agricultural Research and Development (AARD). Department of Agriculture, Bogor, Republic of Indonesia.

1987 Agricultural Research and Development in Tidal Swamps. SWAMP II Research Highlights 1986/87. Ministry of Agriculture, Agency for Agricultural Research and Development, Bogor, Indonesia.

1988 5-years of Agricultural Research (1981-1986): Its Contribution to Agricultural Development in Indonesia. Agency for Agricultural Research and Development. Ministry of Agriculture, Bogor, Indonesia.

AARD/CAER

1985 Proceedings of Workshop on Farming Systems Research in Indonesia. Sukamandi, 13-16 August 1984. Center for Agro-economic Research, Agency for Agricultural Research and Development. Ministry of Agriculture, Bogor, Indonesia.

AARD/CLSR

1986 Crop-Livestock Systems Research. Annual Report for 1985/86. Agency for Agricultural Research and Development, Batumarta, Indonesia.

1987 Crop-Livestock Systems Research. Annual Report for 1986/87. Agency for Agricultural Research and Development, Batumarta, Indonesia.

AARD/CRIFC

1986 Indonesian Farming Systems Research and Development: The Food Crop Sub-system. Central Research Institute for Food Crops, Agency for Agricultural Research and Development, Bogor, Indonesia.

AARD/CRIFC/IDRC

1986 The Impact of Cropping Systems Research in Indonesia: A Case Study. Central Research Institute for Food Crops, Bogor, Indonesia.

AARD/SURIF

1986 Proceedings of the International Farming Systems Workshop. Sukarami (West Sumatra), 10-13 December 1985. Agency for Agricultural Research and Development, Sukarami Research Institute for Food Crops, Sukarami, Indonesia.

Carangal, V. R.

1986 Collaborative Research on Rice-Based Farming/Cropping Systems in Asia. Pp. 305-331 in Proceedings of International Farming Systems Workshop. Agency for Agricultural Research and Development, Sukarami Research Institute for Food Crops, Sukarami, Indonesia.

Colfer, Carol J. P., L. Suharti, B. Prasetyo, and J. Ihalauw
1988 Farmer Perceptions of Soil Conservation and Farming Systems in East and Central Java: Some Anthropological and Sociological Observations. Upland Agriculture Conservation Project, Farming Systems Component, Salatiga, Central Java, Indonesia.

Conway, G. R. and D. S. McCauley
1983 Intensifying Tropical Agriculture: The Indonesian Experience. Nature 302:288–289.

Conway , G. R., I. Manwan, and D. S. McCauley
1983 The Development of Marginal Lands in the Tropics. Nature 304:392.

Department of Agriculture/CRIFC
1988 Women's Role in Integrated Farming Systems Research in Indonesia. CRIFC, Bogor, Indonesia.

Fagi, A.M., and C. Mackie
1987 Watershed Management in Upland Java: Past Experience and Future Directions. Paper presented at a Conference of the Soil Conservation Society of America on Soil and Water Conservation on Steep Lands, 22–27 March 1987. San Juan, Puerto Rico.

Fisher, L., McCauley, D., and Hussein Sawit
1988 Program Assessment: The Research Group on Agro–Ecosystems (KEPAS), April, 1988. Paper prepared for the Indonesian Agency for Agricultural Research and Development and the Ford Foundation, Jakarta, Indonesia.

Getz, William R., in collaboration with Uka Kusnadi, Teguh Prasetyo, and Darwinsyah Lubis
1988 An Assessment of the UACP/FSR Livestock Component in Two Watersheds of East and Central Java, Indonesia: Opportunities for Enhancement.

Hildebrand, P. E.

1979a Comments about Multidisciplinary Team Efforts. Paper for the Rapid Rural Appraisal Conference, 4–7 December, Institute of Development Studies, University of Sussex, Brighton, England.

1979b Summary of the Sondeo Methodology used by ICTA. Paper for the Rapid Rural Appraisal Conference, 4–7 December, Institute of Development Studies, University of Sussex, Brighton, England.

1981 Combining Disciplines in Rapid Appraisal: The Sondeo Approach. Agricultural Administration 8:423–32.

Ismail, Inu, Aman Diauhari, P. Bembang, Wayam Sabe, and J. L. McIntoch
1986 Methodology, Plans and Progress of the Crop/Livestock Systems Research in Batumarta, South Sumatra. Pp. 97–114 in Proceedings of the International Farming Systems Workshop. Sukarami, Indonesia.

KEPAS
1984 The Sustainability of Agricultural Intensification in Indonesia. Kelompok Penelitian Agro–ekosistem, Badan Litbang Pertanian.

1985a The Critical Uplands of Eastern Java. Kelompok Penelitian Agro–ekosistem, Badan Litbang Pertanian.

1985b Tidal Swamp Agroecosystem of Southern Kalimantan. Kelompok Penelitian Agro–Ecosystem, Badan Litban, Pertanian.

1986 Agro–Ecosystem Daeraj Kering di Nusa Tengara Timur: studi kasus enam desa pengambangan pertanian. Kelompok Penelitian Agro–ekosistem, Badan Litbang Pertanian.

1988 Pendekatan Agroekosistem Pada Pola Pertanian Lahan Kering: Hasil Penelitian di Empat Zone Agroekosistem Jawa Timuor. (Agroecosystem Approach to Dealing with Diversity in the Upland of Java: Results of an Agroecosystem Analysis in the Upland of East Java.)

Khon Kaen University
1987 Proceedings of the 1985 International Conference on Rapid Rural Appraisal. Rural Systems Research and Farming Systems Research Projects, Khon Kaen University, Khon Kaen, Thailand.

Krisnawati, Suryanta, W. I. I. Mella, A. P. Y. Diogo, and Andi Renggana
1988 An Analysis of a Village Agroecosystem in Timur. In K. Rerkasem and A. T. Rambo, eds. Agroecosystem Research for Rural Development. MCC/SUAN/EAPI.

McIntosh, J. L.
1986 Directions and Strategy for Future Farming Systems Research in Indonesia. Pp. 265–291 in Proceedings of the International Farming Systems Workshop. AARD/SURIF, Sukarami, Indonesia.

Ministry of Agriculture
1988 Indonesia and Its Food Crops Agriculture. Agency for Agricultural Research and Development, Bogor, Indonesia.

Pretty, J. N., J. A. McCracken, D. S. McCauley, and C. Mackie
1988 Agroecosystem Analysis Training in Central and East Java, Indonesia. International Institute for Environment and Development (IIED), Sustainable Agricultural Programme, London.

Sands, Deborah Merrill
1986 Farming Systems Research: Classification of Terms and Concepts. Experimental Agriculture 22:87–104.

Sjarifudin, Baharsiah, Sostatwo Hadiwigeno, and D. Hadley
1988 Agricultural Policy and Food Sufficiency in a Developing Country. Paper presented at the 1988 World Food Conference.

Sultoni, Arifin, Inu Ismail, and Mahyuddin Syam
1986 Farming Systems in Upper River Watersheds. Pp. 115–138 in Proceedings of the International Farming Systems Workshop. AARD/SURIF, Sukarami, Indonesia.

Syarifuddin, A. K., Inu Ismail, and J. L. McIntosh
1985 Review of Cropping/Farming Systems Research and Development in Indonesia. Pp. 32–67 in Proceedings of a Workshop on Farming Systems Research in Indonesia, Sukamandi, 13–16 August 1984. AARD/CAER, Bogor, Indonesia.

UACP/FSR
1987 Farming Systems Research: Upland Agriculture and Conservation Research Highlights 1985–86. Upland Agriculture and Conservation Project, Agency for Agricultural Research and Development, Indonesia.

Wade, Michale K., Faghmuddin Agus, and Carol P. Colfer
1986 The Contribution of Farmer–Managed Research in Technology Development. Pp. 201–213 in Proceedings of the International Farming Systems Workshop. AARD/SURIF, Sukarami, Indonesia.

Young, K., P. Amir, with M. Syam and B. Rahmanto
1988 Village Marketing Systems in Selected FSR Sites in Central and East Java: A Case Study. Submitted to AARD–USAID, Jakarta.