AN EVALUATION OF THE PALAWIJA CROP RESEARCH PROGRAM OF AARD

Volume I - Main Report

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Agency for Agricultural Research and Development

Jalan Ragunan 29 Pasar Minggu
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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This report is the second from a series of reviews which will eventually embrace all the activities of AARD. The review was conducted jointly by a team of AARD staff and external consultants. Its principal objective was to carry out an analytical evaluation of the activities of AARD in palawija crop research.

By definition, palawija crops are those that are planted after rice, that is the "second" or third crop on a parcel of land. However, the term "palawija" is generally used for certain cereal, legume and root crops and is not usually applied to fruits, vegetables and other crops, such as tobacco, which may also be produced as second crops after rice.

To confuse the terminology still further, the palawija crops are often grown in cropping systems which do not include rice, but they are still called "palawija". The principal palawija crops are maize, sorghum, soybean, groundnut, mungbean, cassava and sweet potato. Wheat and certain minor grain legumes and root crops are also known as palawija crops but are of much less importance than the first seven commodities listed above.

Palawija crops are "secondary" in another sense in that they are less preferred by farmers compared with rice, which is the staple food of choice and is easier to market, store and use.

Historically, agricultural development efforts have devoted relatively limited attention to palawija crops compared with rice, although the NAR I and NAR II World Bank loans and the USAID SAR and AARP Projects have all laid stress on creating the human and physical infrastructure for palawija crop research, which is now gathering momentum. The current 5 year plan (Repelita IV) stresses the importance of palawija crops because of their significance where rice cannot be grown, and because the prospects for expanding rice production to meet future food demands are not unlimited.

This report examines the ongoing palawija research program, the way in which its priorities are set, the program is formulated and the research carried out. The linkages between research and extension and the impact of the research are discussed. The last chapter of the report offers suggestions relating to the future strategy for palawija crop research.

TERMS OF REFERENCE

The review team were given the following terms of reference:

(i) The team will review the program activities and management of the palawija program of AARD.

(ii) The primary purposes of the review are: (a) to provide the Government of Indonesia, AARD, and particularly its Research Institute Directors with an analysis of the past, ongoing and proposed activities of the palawija research program (b) to identify ways and means of strengthening the palawija research program; and (c) to increase the in-house evaluation capacity within AARD.

(iii) The review will form part of a series of about ten reviews which will eventually cover all of AARD's activities and which will examine both the achievements of the research programs to date and their objectives for the period until 1990.

(iv) The review is expected to report on the past, existing and proposed activities of the palawija research program and to make recommendations with respect to:

- (a) their management;
- (b) the quality and relevance of the current and proposed research;
- (c) the adequacy of the human, physical and financial resources;
- (d) the effectiveness of the linkages of the program with the scientific establishment both in Indonesia and overseas;
- (e) the nature and effectiveness of the linkages with the extension services and other agencies providing services to agriculture; and
- (f) possible new areas of national, regional and international support.

(v) Each review team will be expected, so far as is practical and relevant, to report within the framework of the given outline so that its report can be incorporated into a global overview at the end of the series of reviews.

1.3 MEMBERS OF THE REVIEW TEAM

The review took place in Indonesia between July 9 and July 30 1984 and was conducted by a team of AARD staff members and external consultants. The AARD research staff were:

Coordinators:

Dr. B.H. Siwi (Director CRIFC)
Dr. Soetaryo (Director MARIF)

CRIFC Staff :

Dr. Subandi [leader national corn and sorghum program]
Mr. Sadikin Somaatmadja [leader national grain legume program]
Dr. Sunaryo [leader national root crop program]

The external consultants on the team were:

Dr. F.W. Martin [USDA Puerto Rico - root crops]
Dr. E.B. Oyer [Cornell University - grain legumes]
Dr. B.L. Renfro [CIMMYT, Thailand - cereals]
Dr. R.S. Sinaga [IPB, Bogor - economist]

The Secretariat for the review was:

Dr. Joko Budianto (AARD Secretariate)
Dr. B. Nestel (ISNAR)
Dr. Sridodi (CRIFC - head of research programming)

ITINERARY

RI = Research Institute
RS = Research Station
EF = Experimental Farm

Sun. July 8	Assemble Jakarta
Mon. July 9) Tues. July 10)	Attend seminar at Bogor on AARD Programs and technical assistance links
Wed. July 11	Briefing at Bogor RI Visit Bogor Research Institute Cikeumeuh EF Muara EF
Thurs. July 12	Travel to Malang Visit Malang RI and EF
Fri. July 13	Visit with Kanwil and extension personnel Surabaya Visit Muneng RS/EF
Sat. July 14	Visit Pelem Pare Regional Extension Training Centre
Sun. July 15	Travel to Ujung Pandang Visit Bontobili EF
Mon. July 16	Visit Ballaci production area Visit Maros RI/EF
Tues. July 17	Visit Kanwil and extension personnel Maros Return to Jakarta
Wed. July 18	Travel to Padang Visit Sukarami RI
Thurs. July 19	Visit Kanwil and extension personnel Padang Return to Jakarta
Fri. July 20	Visit Sukamandi RI/EF
Sat. July 21	Travel to Lampung Visit Kanwil and extension personnel Visit Dinas Pertanian staff and seed and technology verification farm Visit Tamanbogo EF
Sun. July 22	Travel to Bogor Report drafting

Tues. July 24	Report drafting
Wed. July 25	Report drafting Meeting with Head of AARD
Thurs. July 26	Report drafting
Fri. July 27	Report drafting

CHAPTER 2

BACKGROUND

2.1 AGRICULTURE IN THE ECONOMY OF INDONESIA

The economy of Indonesia is based largely on agriculture, which provides about 60 percent of total employment, contributes about 25 percent to the GDP and provides one third of export earnings. Over 70 percent of the population live in rural areas and agriculture is the major source of income for about two thirds of rural households and one tenth of urban ones. There are over 17.5 million smallholder families providing subsistence and cash crops from holdings averaging under one hectare each.

Over the past decade the growth in agricultural production has exceeded 4 percent per annum. The driving force behind this growth has been the rice industry where yields, using new varieties, have increased spectacularly. Rather less progress has been made in other crops, a number of which offer good prospects for increasing rural incomes. This is very true for palawija crops where the rate of growth in production has barely kept pace with demand and yields are still low.

The disappointing performance of the non-rice sector has been recognised in recent years by both the Government and aid donors. Considerable effort is now being devoted to developing production from a wide range of agricultural commodities in order to raise farmer incomes, improve nutritional levels and increase export earnings. Indeed in order to meet the targets of the current (1984-89) Five Year Development Plan, agricultural production will have to continue its past growth trend of over 4% p.a., with the non-rice sector playing an increasingly important role.

2.2 AGRICULTURAL GOALS OF THE NATIONAL PLAN

The agricultural sector has made significant contributions to economic development during the first three Five Year Plans (Pelitas). Rice production increased by an average of 4.9 % each year, a rate which compares very favourably with other developing countries. In the fourth Five Year Plan (Repelita IV), which began in April 1984, more emphasis is being given to palawija crops which are staple foods for many Indonesians.

In the main the agricultural goals of the Plan are a continuation of those of the third Plan (1979-84) namely those of:

(a) Increasing incomes, export and food production, in order to achieve a prosperous agricultural society;

(b) Improving the level of farmers' incomes and broadening the work opportunities towards the achievement of a stable and dynamic agricultural structure; and
(c) Improving a continuous source of production, based on natural and manpower resources, towards the development of an efficient agricultural sector, commensurate with its potential.

In the fourth five-year plan (Repelita IV), these goals are continued with additional emphasis being given to:

(a) Improving nutrition;
(b) Generating gainful employment opportunities;
(c) Improving production to provide support for domestic industries through production of raw materials for domestic markets; and
(d) Maintaining an optimum ecological balance whilst improving the utilisation of natural resources and also conserving the environment.

2.3 THE IMPORTANCE OF PALAWIJA CROPS IN THE INDONESIAN ECONOMY

Food production policy in Indonesia has until recently centered on rice self sufficiency. Rice provides about half of the national calorie intake and the growth in its production, which has been supported by programs relating to research, procurement, price policy and investment has been impressive at more than 4% p.a. But there are physical contraints to the continuation of such growth indefinitely. In such circumstances government food production policy is now laying much greater stress on increasing the output of 'palawija crops'. These crops have, in the past received much less emphasis than rice and their yields and the returns per hectare from their production are often well below their potential.

The total area of utilised agricultural land in Indonesia, including 2.2 million hectares under estate crops, is about 18 million hectares. Of this total some 6 million or one third (including land planted after rice) is planted to palawija crops. The distribution of planting in relation to the human population is shown in Table 2.1. Broadly speaking palawija crops are relatively more important in Java and Sulawesi; and relatively less important in Sumatra and Kalimantan. Most palawija crops have a relatively similar importance in each region except for maize and groundnuts which are particularly important in Sulawesi and sweet potatoes which are a dietary staple in Nusa Tenggara and Irian Jaya.

TABLE 2.1

LOCATION OF PALAWIJA CROP PRODUCTION IN DIFFERENT REGIONS OF INDONESIA

Percentage

Location	Java	Sum	Bali	N. Ten.	Kali	Sul	Mol.	I. Java	Total
Human Population	61	19	2	4	4	7	1	1	100
Commodity									
Maize	73	4	2	6	-	15	-	-	100
Soybean	82	8	1	6	-	3	-	-	100
Groundnut	72	9	3	3	1	12	-	-	100
Cassava	73	11	2	6	2	5	1	-	100
Sweet Potato	43	14	6	12	2	9	3	11	100

Source : Statistical Handbook of Indonesia, 1982

Production levels vary from year to year but have generally stagnated during the period of Repelita III except for maize, whose production rose sharply in 1983. (Table 2.2)

TABLE 2.2

PRODUCTION OF PRINCIPAL PALAWIJA CROPS 1978-83

	'000 tonnes						% growth rate	
	1978	1979	1980	1981	1982	1983	1979-83 Actual	Repelita IV Target
Maize	4029	3606	3991	4509	3235	5095	8.5	5.1
Soybean	617	680	653	704	521	568	-0.6	18.8
Groundnut	446	424	470	475	437	469	1.3	8.7
Cassava	12902	13751	13726	13301	12988	11651	-1.8	6.1
Sweet Potato	2803	2194	2079	2094	1676	2044	0.6	2.8

Area, yield and production data for 1980, a fairly typical year, are shown in Table B1 (see Vol.2) which indicates a total production of 4 million tonnes of cereals, 1.3 million tonnes of grain legumes and 15.8 million tonnes of root crops. Collectively these provided 25% of the human calorie intake and 15% of the total protein supply. (Table B2)

Production of soybean and wheat (which is only produced on a very limited scale) falls far short of local demand and about 1.5 million tonnes of wheat, 400,000 tonnes of soybean and 200,000 tonnes of soybean meal (valued in total at over US $300m) are imported annually in addition to smaller quantities of groundnuts and mungbeans (Table B3). Exports of palawija crops are negligible except for dried cassava whose exports vary widely from year to year but, in general, have shown a downward tendency. (Table B4)

Collectively the contribution of palawija crops to the agricultural GDP was about 1600 billion Rupiahs (US $2.5 billion) in 1981. This represented about 12% of the agricultural GDP. Of the total sum 38% was made up by maize, 26% by cassava, 13% each by soybean and groundnut, 6% by sweet potato and 4% by mungbean. (Table B5). These percentages change very much from year to year and, for example, the importance of maize increased at the expense of cassava in 1983.

There is considerable scope for increasing the yields of palawija crops, maize and cassava yields, for example, are only 53% and 68% respectively those of Thailand; soybean and groundnut yields are half those of Malaysia.

Yields, however, are not the only problem. Domestic consumer demand for secondary crops remains highly inelastic, and rapid increases in supply could result in declining producer prices. Increasing the production of secondary crops must occur in conjunction with the development of new sources of demand for secondary crop products, and exports. Research will be needed to identify products and policy choices, including prices, for each crop. Some of the relevant issues are discussed below on a commodity basis.

MAIZE

In the period 1970-1980 the total area under maize in Indonesia fluctuated between 2.1 and 3.4 m ha. producing between 2.2 and 4.0m. tonnes with an average yield of about 1400 kg. Average annual consumption is 26 kg per capita but in South Sulawesi, East Nusa Tenggara and East Java it is 71,58 and 49 kg respectively. Nationally maize provides about 10% of the calorie intake, it is also used increasingly in the growing animal feed industry, whose demands have turned Indonesia from being a small exporter to becoming an importer of this commodity.

At present the main demand for maize in Indonesia is for human consumption. Unlike rice, however, maize is almost exclusively consumed in rural areas (with the exception of some consumption of fresh corn on the cob and young corn in urban areas) and, by and large, consumption decreases as incomes rise. This negative expenditure elasticity implies (at constant prices) a decreasing per capita demand for maize for direct human consumption as incomes increase and the population becomes more urbanized.

There is another major potential demand focus for maize, however, and that is the rapidly growing livestock sector. With egg, milk and meat production growing at 8 - 18% per year during Repelita III, the demand for commercial animal feed has and is expected to grow rapidly. The Directorate General of Food Crops estimates that about 12% of present maize production is used for animal feed (or over half a million tons per year), but the exact animal feed use is not known precisely. However, it seems likely that the expected increases in maize production due to the greater use of inputs and new seeds is likely to be absorbed principally in the animal feed industry.

CASSAVA

Cassava is grown on about 1.4 m ha. yielding an average of 9.7 t/ha. to give a total production of over 13m.tonnes or 10% of world production. Most of this production comes from Java with the Lampung area of Sumatra and East Nusa Tenggara also being important producing areas. Production fluctuates from year to year but, in general, has been fairly stagnant and has lagged far behind the Repelita III target. Most of it is used for consumption either fresh, after drying and storing, or after processing. Per capita consumption averages 72 kg/annum fresh cassava providing 8% of the national calorie intake, but in some parts of the country the intake may be several times this level.

10% of production is used industrially, either for manufacturing starch or for making chips, cubes or pellets which provide an energy component in animal feeds. The prime market for cassava feed is in Europe, exports fluctuate from year to year and in recent years have ranged from 400,000 to one million tonnes in terms of fresh cassava equivalent. The domestic animal feed industry also uses cassava, but at a level well below its potential.

Cassava is usually grown in free stand for industrial use and sometimes for home consumption. More often it is grown in combination with rice, other palawija crops and vegetables - capitalising on its drought tolerance and low labour inputs.

If the supply trends of cassava have not been encouraging, the demand picture is also mixed. Cassava is demanded by several major users: human consumers, the starch industry, and the export market. The domestic animal feed market is only a minor factor at present (estimated at 7.75% of total production by Dinas Peternakan, but mostly at the village level use and not through the commercial feed sector). Direct human consumption of fresh cassava and gaplek is widespread in Indonesia but varies by form. Urban consumption is virtually all for fresh roots which are consumed largely as a snack or side dish. Rural consumption is divided between fresh and dried forms with fresh roots having a positive, but modest, expenditure elasticity of demand and gaplek, the dried roots, having a large negative expenditure elasticity of demand. The net result is that direct human consumption demand for cassava is probably flat - increased fresh root demand is balanced by decreased gaplek demand.

A large amount of cassava is consumed in another form - cassava starch. Made from fresh roots, cassava starch is the leading commercial starch in Indonesia, it is used in snacks (krupuk) and baking, and may account for a quarter of total cassava production. There is a good demand for products that use cassava starch and, as such, this demand is expected to continue to grow.

Gaplek exports as pellets or cubes vary from year to year (Table B4). The European market is dominated by Thailand; Indonesia has a small part of the EEC quota which it has not been able to meet, because of price. Not enough gaplek was available at the FOB price that local processors could pay, given the European CIF prices.

There is no question but that cassava yields could be increased markedly through the use of inputs and new varieties but the rationale for this depends heavily on the demand and the price. These two factors are highly dependant and growth in demand for export pellets, domestic starch and animal feed are all price-linked with the domestic animal feed and starch sectors offering the best prospects, given the uncertainty of the future market in the EEC.

SOYBEAN

Soybean is a crop that has tremendous potential and yet, has had a poor recent performance record. Production has stagnated during Repelita III and hoped for sizeable increases have not been realized (see Table 2.2). In spite of relatively high internal prices, soybean yields are low, in part because of climatic and seed storage factors.

The area under soybean, principally in Java, has ranged between 650 and 800,000 ha in recent years. In 1981, 800,000 ha produced 690,000 tonnes, an average yield of 850 kg per hectare. A large part of the soybeans are produced in monoculture after rice with rather less coming from intercropping with maize, sorghum or cassava, often using very intensive systems, on upland soils.

At present soybean production is supplemented by large and growing imports. For example, in 1982 domestic production was about 521,000 tonnes and imports were 361,000 tonnes in 1983 domestic production increased to 568,000 tonnes and imports rose to 391,000 tonnes. Production in 1984 is estimated at 625,000 tonnes with imports of 400,000 tonnes. Soybean production plus imports are almost entirely consumed directly in the form of tahu (soybean cake) anu tempe (fermented soybeans). These soybean products are important protein sources in urban and rural areas, especially among lower income consumers. Demand for these products is strong and growing.

Another major user of soybean is the animal feed sector. This uses soybean meal as a protein (and energy) source for compound feeds. At present this demand is entirely met by imports; these have been increasing from 114,000 tonnes per year in 1982 to an estimated 200,000 tonnes in 1984. A soybean crushing facility is currently being constructed in Jakarta and will have a capacity of 300,000 tonnes of soybeans per year. These beans will probably have to be imported. Total present demand therefore, for human consumption and animal feed, is about 1.2 - 1.3 million tonnes per year, of which only half is met by domestic production. In this situation there is a large potential for rapid increases in domestic production as import substitutes. The only constraint is how fast production can be increased given the domestic soybean price (which is high), and agronomic developments.

Although a number of new varieties of soybean have been released, their uptake has been slow and 80% of the total area under the crop is still planted with traditional varieties. Many farmers have problems in obtaining good quality seed and germination is often reduced still further by planting after rice on soils that are still waterlogged.

GROUNDNUT

During the period 1970 - 1980 the harvested area under groundnuts increased from 375,000 to 500,000 hectares with an average annual production of about 450,000 tonnes representing a yield of 900 kg/ha. Most production is derived from Java whose groundnuts are grown on sawah, mixed with rice and soybean, or in free stand after rice, or more commonly, from upland areas where they are grown in combination with maize, cassava and grain legumes.

Most varieties used are short season, Spanish bunch types, highly susceptible to cercospora leaf-spot and were developed a number of years ago. Groundnuts are used mainly for human consumption. Production has been static over the last six years (Table 2.2) and a significant level of importation has developed (Table B3). Repelita IV has set a very high target for growth in production based on the domestic demand. There are however, both techncial and price constraints to be overcome before this target can be met.

MUNGBEAN

In 1981 150,000 tonnes of mungbeans were produced from 273,000 ha yielding an average of 550 kg/ha, a level only half of that returned at AVDRC. The area under the crop has tripled in the last ten years. It is mainly a cash crop, grown for producing transparent noodles and bean sprouts. Cultivation is either in free stand after rice or as an intercrop, usually with maize. The two systems require different plant types although most varieties grown are most suitable for mixed cropping.

The availability of high quality seed is limited, often because of primitive methods of seed separation leading to a high incidence of damaged seeds. It will be necessary to overcome this problem if the very ambitious target of self sufficiency by 1988, implying a 16.1% per annum growth rate in production, is to be met.

SWEET POTATO

Sweet potato production in Indonesia appears to have declined during the decade of the 1970's with the area under the crop falling from 378,000 to 265,000 hectares. However, yields increased from 6.1 to 7.6 tonnes/ha during this period and overall production in 1981 was about 2 million tonnes representing a per capita intake of 13 kg/annum. Intake levels were somewhat higher in the important production areas of East Nusa Tengarra and Irian Jaya, although overall about half of total production is grown in Java.

Repelita IV calls for a growth rate in production of 2.8% p.a., a modest target that would appear to be technically feasible.

SORGHUM

Sorghum is grown mainly in Central Java, East Java and East Nusa Tengarra. The area planted increased from 17,600 to 53,100 ha from 1973 to 1982; grain production increased from 10,500 to 42,200 tonnes and yields increased from 597 to 1,189 t/ha during this time. Sorghum is used mainly as a food during times of food shortage when it may be mixed with rice. It is sometimes fed to cattle and to poultry although its tannin content may limit its use for the other species.

Production is sometimes in monoculture but more usually in combination with other palawija crops. The crop has many similarities to maize but has a greater drought tolerance and, therefore, has a potential role to play in the development of the eastern parts of Indonesia, provided that a mechanism can be established for marketing it at a satisfactory price either in the domestic food market or by exporting it, probably to Hong-Kong or Singapore, which already purchase part of Indonesia's production.

CROPPING SYSTEMS

Although palawija crops are grown in systems of monoculture they are more frequently found in mutiple cropping systems, either after rice or on non-rice lands. Multiple cropping is often preferred to monoculture by farmers on grounds of yield, of risk aversion, of protection from pests, etc. Nevertheless, multiple cropping systems are more difficult to improve than systems of monoculture. The interactions of two or more crops together in the field at one time are more difficult to predict. While improvement of variety, culture, and pest control offer relatively immediate gains in yield, multiple cropping systems can raise the level of productivity even further. Nevertheless, multiple cropping systems can be more site-specific and thus need careful research and verification.

In Indonesia, cropping systems have evolved that, like old clothes, are comfortable for the farmer, even though they might not make maximum use of the land. Because the welfare of the farmer is at stake, cropping systems are not easily changed. The cropping system is not entirely inflexible, however, and thus farmers vary the system, chiefly according to weather, but also in response to prices and marketing possibilities.

Thus, the palawija crop grown in the cropping system is selected on the basis of available water, and the time available before replanting rice. Maize is easily managed but returns per unit of land have been low. Cassava yields more, economically, but requires a system of maintenance of planting material throughout the year, and must be used or processed rapidly after harvest. Therefore, marketing is often a problem. Legumes are of high value but low yields, and are often exposed to pest attack. Furthermore, obtaining high quality seed is often a problem. Sweet potatoes also require a system of planting material, and after harvest they are not readily processed into high quality long-lasting forms.

However, in recent years a great deal of cropping systems research has been carried out in Indonesia and some of this has indicated that in particular circumstances multiple cropping involving palawija crops can be as profitable, or even more so, than rice monoculture. This is, however, not the normal situation and palawija crop production is constrained by the availibility of suitable seed supplies; the inappropriate use of imports; the inadequacy of water control; the incidence of pests and diseases; high post-harvest losses; and insecure marketing outlets. Overcoming those contraints is the task that faces the CRIFC if palawija crop production is to meet the ambitious goals set for it in Repelita IV.

2.4 AGRICULTURAL RESEARCH IN INDONESIA

The prospects for raising the productivity, not only of palawija crops, but of a large number of agricultural commodities in Indonesia are considerable. In order to realise this potential it is necessary to have available a continuous flow of pertinent and factual information and ensure that there is a mechanism for transmitting this to the farmer.

To help make this possible and to respond to the 1973 State Guidelines for National Development, decreed with the People's Consultative Assembly, which called for the "The strengthening of national capabilities in science and technology and to support and provide orientation for national development", the Agency for Agricultural Research and Development (AARD) was established in 1974. Since its inception AARD has attempted to consolidate all agricultural research and both internal and external support for it into an integrated national program, which both meets the goal of the national five-year plan and serves to strengthen AARD itself. The Agency has received substantial external support, particularly from the World Bank and USAID, to help it realise its objectives.

Since its origins in 1974, AARD has grown from a very small staff to an Agency with over 1,600 scientists, of which more than 300 are trained to M.Sc. level and 100 have Ph.D's. The Agency has twenty eight major Research Centres/Institutes (Fig. A1) and a total of over 200 experimental stations and farms, which are distributed throughout the length and breadth of the Indonesian Archipelago. Some of these facilities are directed to palawija crop research. Research on these commodities other than that carried out by AARD is very limited, as few University or private sector funds are devoted to agricultural research (with the exception of some activities on maize breeding), so that AARD carries the prime national responsibility for this task.

2.5 PALAWIJA CROP RESEARCH IN INDONESIA

Indonesia's palawija production has tended to stagnate over the last ten years; production of some commodities has actually fallen. In a seminar on palawija crops held in Yogyakarta in 1983, it was concluded that the failure to achieve palawija production goals was due to shortcomings in production development programs. There was competition from rice and sugarcane on wet lands, and from horticultural crops on dry lands. This has resulted in changes in the major producing areas of palawija crops and year to year fluctuations in the areas planted to them.

In contrast, the consumption of palawija crops has risen steadily. This has resulted from Indonesia's increasing population and the improvement of the national diet. The shortfall between supply and demand has been made up by imports, particularly soybean.

Recent advances in palawija research have offered prospects for increasing farmers' outputs of these crops. Various products of research have been successfully applied at the farm level: high-yielding varieties resistant to pests and diseases, appropriate cropping systems for high productivity, and suitable pest and disease control methods. Despite these advances, the national palawija output has not yet been significantly increased.

The development of new palawija technology is expected to take place alongside that of rice, because of the interdependence of the two groups of crops in traditional cropping systems. It is anticipated that this interdependence will continue, since it :

1. increases the efficiency of use of facilities, resources and labour;

2. increase farmers' incomes;

3. reduces risks of harvest failure; and

4. conserves soil fertility.

Because the development of palawija crops is inseparable from the development of cropping systems (or farming systems), research on palawija cannot be divorced from research on farming systems and this activity forms an important part of AARD's program.

CRIFC staff expect the following developments to take place in palawija production systems :

1. The role of palawija crops as an industrial raw material will increase. This means that their role as food will decline in relative terms (though not necessarily absolutely).

2. There will be a shift towards new food products made from processed palawija commodities.

3. Palawija crops will be increasingly involved in the commercial economy. This cannot take place without improvements throughout the agribusiness system, involving post-harvest technology and the processing industries.

4. Production practices will be intensified through :

   (a) the localization of specific commodities in certain areas, dependent on their suitability to the

   environmental and socio-economic conditions of that area; and

(b) the application of new cropping systems which are likely to be linked to the area/commodity focus.

Palawija processing industries are already emerging; they include the production of animal feed, maize oil, glucose and (most recently) gasohol. The first three of these face problems of the continuity of supply of raw materials at suitable prices and of appropriate quality. Maize oil factories are already dependent on imported maize. The animal feed industry also has problems with its raw material supplies (maize and soybean), which have to be imported. The sugar (glucose) factory in Malang, which processes cassava, has had to start importing tapioca, even though local cassava production could be raised relatively easily.

The core of the research program is, therefore, geared to bringing about production increases at price levels which are attractive to the farmer. AARD has a massive research program directed towards this goal.

During 1984/85 the CRIFC plans to conduct 671 research units (experiments) on palawija crops and a further 179 on farming systems, many of which have a palawija component (Table M1). This research program can be sub-divided into 39% cereal, 46% grain legume and 15% root crop components. The program has built up rapidly from a small program only a decade ago and has involved many of CRIFC's 45 experimental farms. It now has a graduate manpower of 186 plus several hundred support staff and an annual budget of 2400m Rp. (US $2.4m).

GRAIN LEGUMES

The largest component of the research program deals with grain legumes where demand is increasing rapidly for both human food and animal feed. Current production levels are low, and have not risen markedly over the last ten years. Although researchers can readily obtain 1.6 t/ha of soybean, 1.4 t/ha of groundnut, and 1.5 t/ha of mungbean on experimental farms, in general farmers obtain only 50% of these yields. Such low yields are caused mainly by the application of inappropriate technology, ineffective management and poor use of natural resources.

AARD's general strategy for research on legumes is to concentrate on raising production and yield stability, and improving seed quality. It is directed towards achieving high yields per unit area using inputs at costs within farmers' reach. An integrated approach is used to create technologies suited to different agroclimatic zones.

Key problems which the research program seeks to overcome are :

1. Legumes planted after wet land rice are often flooded during their early growth, but suffer from drought in the generative stage. The time available for a palawija crop may be short (less than 3 months), but local varieties are generally late-maturing.

2. The change from wet land previously planted to rice to dry land cropping of legumes in the following season leads to problems of land preparation, water control and weed control.

3. The expansion of legume cropping outside Java (on ultisols and oxisols) is often impeded by problems of low pH, Al toxicity, and deficiencies of phosphate and other nutrients. Research on liming, fertilization and the use of organic fertilizers is urgently required. Legumes, especially soybean, are extremely susceptible to Al toxicity and low pH. Breeding to obtain varieties tolerant to these conditions is necessary.

4. *Rhizobium* bacteria are not present in newly opened land. Research is needed on suitable *rhizobium* strains and inoculation methods so as to obtain optimal biological N fixation.

5. Correct plant populations are necessary to attain maximum yields. The soil fertility, season and plant type greatly affect the optimum plant population. Broadcast planting, as frequently practiced by farmers after rice cropping, often leads to uneven crop stands and makes crop care difficult. Further research is necessary on the ideal plant densities of new varieties/lines.

6. The cropping of legumes on dry land involves problems of low soil fertility, weed competition, shading, and competition with other plants. Legumes are cropped on dry land during the wet season. Research is required on suitable technologies for cropping legumes in such areas and also for seed production.

7. Pests are the major cause of unstable legume yields. The most important pests are: (soybean) *Agromyza* sp.; *Spodoptera litura*, *Nezara viridula*, *Riptortus Linearis*, and *Etiella zinckenella*; (mungbean) *Agromyza* sp. *Riptortus linearis*, *Nezara viridula*;1 (groundnut) *Spodoptera litura*, *Plusia chalcites*, *Stomopteryx subsecivella*, and *Lamprosema indicata*. The methods of biological (resistant varieties, crop rotation) and chemical control of these insects must be studied. Their biology must also be investigated to provide a basis for developing control measures.

8. Legume diseases often cause harvest failure. The most important diseases are : (soybean) virus, rust, bacterial leaf rot, and nematodes; (groundnut) bacterial wilt, rust, *Cercospora*, mottle virus, mosaic virus, and mycoplasma; (mungbean) rust, scab, powdery mildew, and mosaic virus. The control of these diseases requires research on the following : developing resistant varieties, host plants, insect vectors, and control methods.

A summary and more details of on-going activities in legume research and the location of the research institutes where they are being carried out is presented in Tables J5 and J6.

CEREALS

The second major component of palawija research is that covering cereals, principally maize and, to a much lesser extent, sorghum and wheat. Maize and sorghum are increasingly being used as animal feeds, although maize is an important staple in areas where rice cannot be grown. Little wheat is grown but wheat is a major import (Table L1) even though per capita consumption is low (Table L2) and there is a major interest in trying to grow wheat to reduce the outflow of foreign exchange used for its purchase.

Research in maize and sorghum has led to the development of high yielding varieties, improved cultivation methods and integrated pest and disease control methods that have enabled yield increases to be obtained. Indonesia's national maize production rose considerably in 1983 but further increases can be attained. The country's sorghum production, on the other hand, is still low and wheat production has hardly begun. The research strategy being adopted is that of providing component technologies in the form of improved varieties (open-pollinated and hybrid) suited to various cropping systems; high quality seed; suitable cultivation methods; and effective pest and disease control methods. In order to be able to assemble these components into profitable technology packages, AARD has an integrated program of cereal research.

The major problems which this research endeavours to overcome are that:

1. Maize and sorghum deteriorate easily and are subject to pest and disease attacks while in storage. They are also attacked in the field by pests (stemborers. seedling fly, beetle larva, *Prodenia*, etc.) and diseases (downy mildew, rust, leaf blight and ear rot) which threaten their yield stability.

2. Attempts to increase the area harvested to these crops are frequently impeded by soil problems, such as high acidity, AL toxicity, phosphate deficiency, etc. Research is necessary in order to improve the quality of these problem soils. Plants which show tolerance to acidity (usually

related to AL toxicity and low phosphate in the soil) must be sought, to enable high yielding varieties to be developed. There is a need for research on soil nutrients in marginal areas.

3. The provision of a sufficient quantity of high quality seed of improved varieties is a key to increased production. Seed supply remains the major constraint to increased output. The hot, wet, tropical climate causes seeds to deteriorate rapidly in storage. Increasing the supply of breeder seed is a high priority, and research on seed technology and physiology needs to be expanded.

4. The adoption of a new technology may affect the balance of the ecosystem. High fertilizer application rates, for instance, may result in nutrient imbalances in the soil and this requires study.

5. In order to attain the equity goals of the national plan it will be necessary for appropriate technological innovations to be adopted in a wide range of different ecosystems. This will entail conducting more maize and sorghum research in dry land and swamp areas. Research on these crops in irrigated areas must concentrate on the efficient use of water, particularly in the dry season.

6. Most of the country's maize output is harvested during the wet season. It is estimated that over 20% of the output is lost during harvesting, drying, shelling, storage and transport. Both maize and its by-products are not used efficiently. Additional post harvest research is needed to reduce losses and increase the efficiency of the crop and its by-products.

7. Maize generally yields lower profits than other food crops. This does not encourage farmers to increase their maize production. Socio-economic research is needed to study ways in which the institutional, marketing, and other non-technical constraints to production can be overcome.

A summary and more detail of on-going activities in maize research and the location of the research institute where they are being carried out is shown in Tables J1 and J2 and the same information is presented for sorghum in Tables J3 and J4.

The problems and needs of wheat are somewhat different to maize and sorghum. The crop is grown on a limited scale in the highlands where the prospects for a major expansion in production to substitute for part of Indonesia's growing wheat imports seem limited. The goal of the research in this case is to develop production packages that will yield at least 1.5 tonnes/hectare at altitudes of 600m or less.

This will entail:

1. Identification and development of high-yielding wheat genotypes.

2. Determination of suitable soil cultivation methods.

3. Evaluation of agronomic traits and responses to environment.

4. Determination of ideal planting times in integrated cropping systems.

5. Evaluation of planting methods.

6. Determination of quality and nutritive value.

7. Determination of consumer acceptability.

ROOT CROPS

The third major palawija program activity is in the field of root crops where national yields are very low and could be doubled or even tripled. Currently the major part of root crop production is used for human food but the prospects for using these crops for a variety of agro-industrial purposes is considerable, providing that appropriate markets and price policies can be established. Thus the research strategy for root crops aims to develop technology packages and technical information that will bring about the increased production and utilisation of root crops. Research activities are directed at both pre- and post-harvest problems.

The major problems in pre-harvest production of these crops are the use of inadequate propagating materials, poor planting methods, the use of marginal land, and yield reductions caused by pests, diseases and physiological stress.

1. Reductions in the productivity of root and tuber crops caused by alterations within the plant itself and in its environment make it necessary to continuaously improve the varieties/clones planted. This is also closely related to the increased pest and disease attacks suffered. The major cassava pest is the red spider mite (*Tetranychus* sp.), while the most important sweet potato pest is the weevil (*Cylas formicarius*). The most important cassava diseases are bacterial leaf blight (*Xanthomonas campestris* cv *manihotis*), wilt (*Pseudomonas solanacearum*) and leaf spot (*Cercospora* sp.). The first two diseases may cause an 80% reduction in yield, while the last may cause a loss of 20%.

2. Although cassava is usually regarded as a crop able to grow in problem soils, it possesses limits related to the variety (clone) and the land type on which it is planted. It is necessary to seek varieties suited to such conditions.

3. The supply of sufficient quantities of high quality planting material requires attention, since the multiplication and supply of planting material of these crops requires a long time, and their multiplication rate is slower than other food crops. The propagating material is bulky and perishable, and must be growing vigorously when cut for planting.

4. The planting methods used by farmers are generally still poor. The selection of planting material, crop care and fertilization are below recommended levels.

Post-harvest problems are also very important in the development of root and tuber crops, since these commodities deteriorate rapidly after harvest. Such deterioration greatly influences their market prices. The major post-harvest problems are the timing of harvest, marketing, processing, storage, quality control, and market prices. All these problems are interrelated.

1. The correct timing of harvest is a condition for good quality yields. The ideal timing of harvest is influenced by variety, season, and environment.

2. The marketing of these crops has long been a major problem. Price fluctuations mean that farmers cannot predict the profitablility of planting roots and tubers. This situation is complicated by the poor quality and low availability of the storage and processing facilities available to farmers.

3. Root crops are often planted in areas remote from consumers or processing industries. Adequate transport facilities and infrastructure are very important to ensure that the commodity reaches the consumer in good condition.

4. Because of the perishability of the product the farmer is very much at the mercy of the market which can be very sensitive to supply. Where farmers produce cassava on a seasonal basis and the roots are destined for processing this can result in very low prices being paid to the farmer.

Post-harvest technology research is aimed at developing methods of securing and raising the yield quality for consumption and industrial use. Research activities include harvesting methods, optimum harvesting times and processing into a semi-finished product with a longer storage life in order to try to dampen price fluctuations.

A summary of proposed activities in root and tuber crop research and the location of the research institute where the work will be done is shown in Table J7.

2.6 AARD's MANDATE FOR PALAWIJA CROP RESEARCH

The palawija crop research program of AARD has as its goal the task of carrying out palawija crop research which will assist in enhancing national productivity of palawija crops. The institutional structure of this program is made up of a Coordinating Centre at Bogor plus six Research Institutes located at Bogor, Banjarmasin, Maros, Malang, Sukamandi and Sukarami. These 6 Institutes have 15 Research Stations and a total of 45 Experimental Farms. Their organisational structure is shown in Figure A2 and the location of the Research Institutes, Stations and Farms in Figures A3 and A4 and Table A5.

Collectively these facilities and their supporting personnel make up the Central Research Institute for Food Crops (CRIFC). The Institute works on both palawija crops and rice. Each of its six component institutes has a specific lead mandate (e.g. tidal rice, irrigated rice, swamp rice, palawija crops and genetic/disease research) although all six institutes work on both rice and palawija crops in the specific region in which they are located. Thus the Malang Research Institute now has the lead mandate for palawija crops but supports its other 5 sister institutes in carrying out research on their specific mandates, likewise all 5 of them have a palawija crop program for which a national coordination system exists and for which Malang will (when its manpower has grown sufficiently to fulfil this role) take the national leadership. This is expected to take a few years to develop as the manpower strength currently lies at Bogor, but the mandate assigned to the Malang Research Institute calls upon it to:

a. Be recognised as a national point of reference on matters concerning the culture of palawija crops, through having a clearly formulated and well directed programme of research and coordinating all AARD activities in this field;

b. Develop adequate research facilities in the form of buildings, laboratories, libraries and experimental fields;

c. Develop adequate staff, consisting of qualified researchers and supportive personnel; and

d. Be capable of providing effective support to regional and national palawija crop development.

It is expected that a strong research programme on palawija crops will lead to increases in production, which will:

a. Raise the income of many small farmers, who would benefit from the growing demand for these commodities.

b. Increase employment, not only at the farm level, but also in the transport, marketing and processing industries;

c. Lead to a reduction in imports and thereby bring about savings in foreign exchange;

d. Bring about the development of agro-industry; and

e. Assist transmigration programs in which palawija crops often play a key role, especially in their early stages.

In order to fulfil this mandate the Malang Research Institute has the long term goal of :

- Identifying opportunities for advance in agricultural productivity and profitability and estimating their potential impact.
- Helping establish goals against which progress can be measured, and elaborating strategies and tactics for reaching those goals at reasonable cost.
- Developing and testing components for improved production practices, better systems of harvesting, storage, transport, and marketing of produce, and more effective conservation of resources.
- Combining component technology into profitable high-yielding farming systems in each major agro-ecological area.
- Identifying and making known improvements in the supply of services such as extension, cropping systems, fertilizer application, pest control, post harvest technology, and others.
- Training staff for research, extension, educational institutions, government and private industry.

2.7 PHYSICAL RESOURCES CURRENTLY AVAILABLE FOR PALAWIJA CROPS RESEARCH

The physical resources currently available for palawija crop research are detailed in Table A5 and in Tables C1/C2, D1/D2, E1/E2, F1/F2, G1/G2 and H1/H2 of Volume 2 of this report. At the present time the Coordinating Centre and the Research Institutes at Bogor, Sukarami, Sukamandi are either well developed and equipped or in the process of acheiving this goal. The Institutes at Maros, Bajarmasin and Malang are undergoing development but still have major construction programs to be completed. About half of the research stations and a smaller fraction of the experimental farms can be said to have adequate facilities.

Collectively the institutes, stations and farms cover over 2000 ha, although it must be recognised that this land is used for research on rice as well as palawija crops. The two activities are also related through an important farming (or rather cropping) systems research program. Overall the review team estimated that about 40% of the activities of CRIFC related to palawija crops (Table M1).

The facilities completed at the two major CRIFC programs total over 20,000 m^2 of offices, 9,500 m^2 of laboratories, 3,300 m^2 of library and auditorium space, 10,000 m^2 plus of green/screen houses, 17,000 m^2 plus of stores, workshops and garages, 10,000 m^2 plus of drying floors and 50,000 m^2 of staff and guest houses. (Table 2.3).

Much of this physical plant has been developed in the last few years, especially at Sukamandi and Sukarami where major development programs have been carried out with support from the World Bank and USAID respectively. Bogor, Maros, Banjarmasin and Malang have also received support from these two sources and some Dutch bilateral aid has gone towards equipping Malang.

The identifiable external inputs from the IBRD and USAID programs are shown in Table 2.4. The figures shown indicate that considerable additional construction is still under way and the data shown in the volume 2 tables and summarised in Table 2.3 are clearly incomplete and indicate the on-going status of much of the construction.

TABLE 2.3

CURRENT PHYSICAL RESOURCES OF THE CENTRAL RESEARCH INSTITUTE FOR FOOD CROPS

	BORIF	MARIF	SURIF	SARIF	MORIF	BARIF	TOTA
Institute	1	1	1	1	1	1	6
Stations	0	2	0	4	5	4	15
Farms	5	6	7	9	8	10	45
Total Area (ha)	10	206	558	443	430	230	1975
1 Offices m^2	9269	2307	4320	2022+	2060	1282	21260
2 Laboratories m^2	4331	185	3390	1075	452	56	9489
3 Library m^2	274	100	260	440	96	164	1334
4 Auditorium m^2	700	100	588	276	92	265	2021
5 Green/Greenhouses m^2	3341	N/A	2170	1580	2380	472	10,000
6 Stores m^2	9750	4176	1267	N/A	1790	N/A	17,000
7 Drying Floors m^2	N/A	7252	N/A	N/A	2570	N/A	10,000
8 Guest Houses m^2	3527	909	4441	1180	240	318	10,615
9 Staff Houses m^2	9145	3078	7728	13708	4711	951	39,321

Note: N/A = not available to review team.

TABLE 2.4

SOME RECENT EXTERNAL SUPPORT FOR THE CENTRAL RESEARCH INSTITUTE FOR FOOD CROPS

Source of Funds	Research Institute	Offices	Laboratories	Housing	Green/Screen Houses
		square metres constructed			
IBRD - NAR 1	Sukamandi	3533 [1]	3290	15356	1717
IBRD - NAR 2	Sukamandi	812	--	--	--
IBRD - NAR 2	Maros	400	1620	1890	--
IBRD - NAR 2	Malang	500	5530	1520	600
SAR 2 USAID	Sukarami [2]	14272	1355	19786	2200
AARP USAID	Bogor	9500	2000	--	3000
AARP USAID	Maros [3]	3590	--	1080	800
AARP USAID	Banjarmasin [4]	2060	400	1310	150
	TOTAL [5]	34667	14195	40942	8467

Notes : 1) Includes 2917 renovated

2) Includes 9 locations

3) Includes 4 locations

4) Includes 3 locations

5) Totals are not consistent with Table 2.3 because much of above construction has not yet been incorporated in Table 2.3

2.8 HUMAN RESOURCES FOR PALAWIJA CROP RESEARCH

The manpower resources of the CRIFC are shown in detail in Tables C3-4-5, D3-4-5 through to H3-4-5 and are summarised in Tables M2, M3 and M4. These show a total current staffing of 186 graduates with 14 Ph.D.'s and 29 M.Sc.'s.* These totals include some scientists involved in socio-economic, cropping systems and post harvest research who work on both rice and palawija crops. These scientists have been included in Table 2.5 which summarises the current situation, including staff undergoing training.

TABLE 2.5

CURRENT MANPOWER IN PALAWIJA RESEARCH

	Ph.D.	M.Sc.	Sarjana/B.Sc.	Total
CEREALS				
On hand	5	6	37	48
Away training	3	18(-3)	(-18)	-
SUB TOTAL	8	21	19	48
GRAIN LEGUMES				
On hand	4	16	47	67
Away training	5	13(-5)	(-13)	-
SUB TOTAL	9	24	34	67
ROOT CROPS				
On hand	1	2	16	19
Away training	0	3	(-3)	-
SUB TOTAL	1	5	13	19
FARMING SYSTEMS ETC				
On hand	4	5	3	52
Away training	1	4(-1)	(-4)	-
SUB TOTAL	5	8	39	52
GRAND TOTAL	23	58	105	186
CURRENT TOTAL	14	29	143	186

Note : 1) Figures in brackets represent staff being upgraded from sarjana to M.Sc. or M.Sc. to Ph.D.

2) Grand Total represents situation when present trainees complete

3) Table ignores new sarjana recruitment.

The growth in trained manpower, especially over the next 3 years, as current trainees complete, is likely to be impressive. The review team has tried to examine this potential growth in terms of location, commodity and discipline. Table 2.6 shows that the growth is heavily weighted in the direction of the Bogor Institute (BORIF) and there is a need to try to bias future training in favour of the other institutes, especially MARIF if that Institute is to lead the palawija research.

TABLE 2.6

AVAILABLE MANPOWER BY INSTITUTE

	Current		Now In Training		Available 1987/88	
	Ph.D.	M.Sc.	Ph.D.	M.Sc.	Ph.D.	M.Sc.*
BORIF	7	15	7	11	14	19
MARIF	2	2	1	6	3	7
SURIF	3	6	0	6	3	12
SARIF	1	2	0	9	1	11
MORIF	0	4	1	4	1	7
BARIF	1	0	0	2	1	2
TOTAL	14	29	9	38	23	58

By 1988 there will be 81 scientists with post graduate degrees working on palawija crops but about half of them will be at BORIF. BARIF and, perhaps, MORIF and SARIF, would appear to be likely to lack the critical mass of skilled manpower required for the size of their palawija research activities.

It is difficult to be precise on this because the CRIFC has, as yet, no specific targets for palawija crop manpower. A CRIFC paper in early 1984 proposed a total target of 158 staff for the 3 commodity groups. Currently 134 of these are on hand (or 186 if farming systems, agro-economics and post-harvest personnel are included). A manpower plan was also made for Sukarami in 1980, this postulated 9 Ph.D.'s and over 100 M.Sc.'s in the SARIF complex by 1990 but as the mandate has changed since that time it is difficult to compare this plan with the current situation. The root crop program has proposed a 1990 manpower target of 8 Ph.D.'s, 16 M.Sc.'s and 32 Sarjanas. When staff currently undergoing training complete their degrees - say by 1988 - the root crop program will still be short of this target but the grain legume and cereal programs will meet it (except for sarjanas in cereals). (Table 2.7).

* M.Sc. totals adjusted for fall in numbers due to 9 M.Sc.'s being upgraded to Ph.D.

TABLE 2.7

LIKELY MANPOWER LEVELS FOR COMMODITY PROGRAMS
WHEN CURRENT TRAINEES COMPLETE

	Ph.D.	M.Sc.	Sarjana	Total
Cereals	8	21	19	48
Grain Legumes	9	24	34	67
Root Crops	1	5	13	19
Support Activities	5	8	39	52
Total	23	58	105	186

Overall it would appear that a critical mass of scientists is being developed but there would appear to be a shortfall developing in terms of root crops and support activities. The latter point shows up more clearly when we look at the current staff composition by discipline and also examine tho current training program. In Table 2.8 the likely staffing around 1988 is compared with "possible targets" based on each of the three major programs being staffed along the lines of the root crop plan. There would appear to be an ample build up of plant breeders and agronomists, especially for grain legumes and cereals, a need for a limited number of additional Ph.D.'s in physiology, entomology and pathology and for a significant strengthening of staff in post-harvest work and particularly in socio-economics.

TABLE 2.8
CURRENT TRAINING PROGRAM IN RELATION TO MANPOWER GOALS

	A			B		C			D		
	Current Staff On Hand			Current Staff in training		Total Columns* (A+B)			Possible Target for 1990		
	Ph.D.	M.Sc.	Sar.	Ph.D.	M.Sc.	Ph.D.	M.Sc.	Sar	Ph.D.	M.Sc.	Sar.
Plant breeding	7	5	24	4	6	11	7	18	6	12	24
Agronomy	1	7	33	3	15	4	19	18	3	6	12
Physiology	0	5	15	1	4	1	8	11	3	6	12
Entomology	1	6	9	1	3	2	8	6	3	6	12
Pathology	1	1	11	0	5	1	6	6	3	6	12
Socio-Economics	0	2	13	0	0	0	2	13	3	6	12
Post-Harvest	1	2	16	0	1	1	3	15	3	6	12
Farming Systems	3	1	22	0	4	3	5	18	see Agronomy		
TOTAL	14	29	143	9	38	23	58	105	24	48	96

* Adjusted for movement from M.Sc. to Ph.D. category

Thus overall the review team has the impression that the manpower situation is developing well but in an unbalanced fashion. Priorities for the future are to train more staff at the advanced level at Institutes other than BORIF, with various disciplines being needed in root crops, and economists and post-harvest specialists being needed to serve all commodities.

These priorities need to be set against the background of a need to develop an overall manpower plan for palawija research which sets targets by commodity by discipline and by research institute. In the context of this goal the figures in the final columns of Table 2.6, in Table 2.7 and in Column C of Table 2.8 need close examination.

2.9 FINANCIAL RESOURCES FOR PALAWIJA CROP RESEARCH

AARD derives its budget from both domestic and external sources. In the last two years the downturn in the oil economy and the build up in the World Bank NAR II program have caused an increasing share of AARD's total budget to be derived from external sources. It is difficult to disaggregate all of this external support into commodity components but this can be done for the Government of Indonesia support to AARD through both its Routine and Development Budgets. In order to do this the budgets for each of the six CRIFC Institutes have been isolated in Tables C6/7, D6/7 through to H6/7. Using the percentage of experiments under palawija crops as the criteria for pro-rating each institute's budget to palawija crops, an approximate palawija budget for each institute was derived (Tables C8, D8 through H8). These figures are brought together in Table M7 which shows the total palawija budget for 1984/85 at 2,393m Rp. This table also indicates that 39% of the palawija research (Table M1) was for corn/sorghum, 46% for grain legumes and 15% for root crops.

These figures were then built into AARD's total budget to show that 11% of the total budget, exclusive of the estate crop and sugar cess, or 7.4% of the budget including these cesses is devoted to palawija research. (Table 2.9).

TABLE 2.9

PALAWIJA CROP SHARE IN AARD'S 1984/85 BUDGET

	M.Rp	%
ROUTINE BUDGET		
Maize/Sorghum	347	4.5
Grain Legumes	410	5.4
Root Crops	134	1.8
sub total palawija	891	11.7
TOTAL BUDGET	7598	100.0
DEVELOPMENT BUDGET		
Maize/Sorghum	586	4.2
Grain Legumes	691	4.9
Root Crops	225	1.6
Sub total palawija	1502	10.7
TOTAL BUDGET	14058	100.0
TOTAL AARD BUDGET		
Maize/sorghum	993	2.9
Grain Legumes	1101	3.4
Root Crops	359	1.1
sub total palawija	2393	7.4
TOTAL BUDGET	32130	100.0

Notes : 1] Total AARD Budget includes estates crops and sugar cess but not donor aid

2] This table is based on the methodology footnoted in Table M7

It is difficult to look at budgets on a historic basis due to the creation of the Central Coordinating Unit in 1983 and the separation off of horticultural research into a new Central Research Institute for Horticulture in 1984. However, the best available evidence suggests that the budget for palawija research has grown in recent years.

The overall share of palawija crops in the total AARD budget (excluding the estate crop cess) is similar to the contribution of palawija crops to the agricultural GDP (Table 2.10). Given the limited flexibility in the Routine Budget and the fact that the Development Budget has to cover the counterpart costs of external aid as well as the support services that benefit all commodity programs, it is clear that AARD is making a massive effort in the field of palawija crop research.

TABLE 2.10

AARD DEVELOPMENT BUDGET 1984/85

Commodity	M.Rp	% Total Commodity Budget	% Which Commodity Contributes to Agricultural GDP
Rice	2075	21	34
Other Cereals	586	6)	5)
Grain legumes	691	7) 15	4)
Root Crops	225	2)	4)
Horticulture	749	8	11
Fisheries	1431	15	8
Livestock	1911	19	9
Non-food crops	2293	23 *	24
Sub-total	9961	100	100
Development Projects	2747		
Support Services	1350		
TOTAL	14058		

The CRIFC budget can be broken down into five main activities in order to derive the amount of funding available for actual research. Whilst the five budget heads are not sharply defined the data in Table 2.11 indicate the limited funding available for both "research operations" and "maintenance of facilities".

In addition to these figures the estate crop cess (including sugar) totalled Rp. 10,427m.

Table 2.11

FUNCTIONAL COMPONENTS OF CRIFC BUDGET 1984/85
(from Table M6)

	%
Salaries	54
Capital	19
Research Operations	12
Maintenance of Facilities	3
Other	12
TOTAL	100%

These data do not separate rice from palawija crops. An attempt has been made to do this in Table 2.12 which shows the distribution of palawija expenditure by Institute.

TABLE 2.12

DISTRIBUTION OF PALAWIJA CROP RESEARCH EXPENDITURE
(from Table M7)

Institute	% Total Palawija Expenditure
BORIF	23
MARIF	21
SURIF	11
SARIF	16
MORIF	14
BARIF	6
Res. Coord. Centre	9
TOTAL	100

These figures, which largely represent the historic situation, suggest that some redistribution of funding may be necessary in the future if MARIF is to fulfil its palawija mandate. However, with 54% of costs being used for salaries and with so many senior staff at BORIF, such a shift will be difficult. Unless staff are prepared to transfer, BORIF will therefore need to play an important role in the palawija research activities over the forthcoming years irrespective of its lead mandate.

CHAPTER 3

PLANNING AND PROGRAM FORMULATION

3.1 INTRODUCTION

An examination of the planning and program formulation activities of the CRIFC with respect to palawija crops formed an important part of the review. This permitted the team to make judgements as to the relevance of the program to the national goals for palawija crop production. These goals have been given increased importance in Repelita IV which highlights the need for food self-sufficiency rather than, as in the past, rice self-sufficiency, and also emphasises the tasks of developing the use of palawija crops for animal feed, agro-industry and for transmigration programs. The goals of the national plan are, therfore quite general and the task of translating these goals into operational priorities lies in the hands of AARD.

3.2 SETTING PRIORITIES

Within the Agency the choice of research problems to be worked on in palawija crops is made largely within CRIFC. In the main the activities carried out seek to overcome production contraints. The most rapid progress in low technology farming systems is expected to come through: improved varieties, the use of fertilizer, the reduction of pest and disease losses, and structural changes. These types of innovation are covered by present research plans. Other goals, such as increasing the nutritional quality of seed have already influenced plant breeding decisions.

The research carried out must be in agreement with national objectives, yet the details of how this is to be done vary and research decisions are made on other bases as well. Research also aims to solve problems experienced by farmers and at the research station level there may often be a lot of pressure in this direction from local groups.

However, not all problems can be tackled at once. Different crops and research disciplines are given priorities depending on the following:

- Importance of the crop for food, feed and industrial use;
- Status of the crop in national food policy;
- Demand for the crop and its products;
- Prospects for export;
- Seriousness of problems faced by farmers; and
- Availability of resources (manpower, facilities, budget).

Research priorities are set after discussions with the extension personnel of the Directorate General for Food Crops, local government staff, university scientists, and farmers. The process is one of seeking concensus and is very informal.

This informality entails some risks. The key decisions are taken by a small group of people who at this stage in AARD's development tend to be strongly oriented towards plant breeding and agronomy. The priority setting process thus tends to have social goals from the national plan and technical objectives from the AARD scientists. The area that is, however, weakly covered is that of economic analysis. This is of particular concern for commodities such as cassava and maize where demand features so prominently in determining future production prospects (see Chapter 2). For such crops an inadequate projection of future demand could lead to priorities being set which would be of limited value, or even detrimental, to the farmer.

To a certain extent this situation arises from the shortage of staff trained in economics within CRIFC and to the limited input that the Centre for Agro-Economic Research makes to the CRIFC planning process. In the long term the strengthening of CRIFC's economic resources is probably the best solution, but until this can be brought about a closer working relationship with the CAER would be desirable. In this context the recent proposal from the CAER for assistance from USAID and ADB in conducting demand and supply studies on certain major agricultural commodities would seem to be a very positive move in the right direction.

The availability of manpower influences not only the economics program but other disciplines as well. Currently the palawija program tends to stress breeding and agronomy because these are the areas of greatest strength, but as staff numbers build up more of a balance in disciplines is expected although, as we have noted elsewhere, the shortage of personnel skilled in post-harvest and farming systems research could lead to these areas remaining relatively neglected in the priority setting process.

The review team were particularly concerned about cropping systems in relation to the generation of research priorities. As a general rule, cropping systems are highly varied. Nevertheless, in any region there may be uniformity of the cropping system or there may be only a few cropping systems. A group of farmers that practice similar cropping systems in a given agroecological zone and facing similar socio-economic contraints may be defined as a "recommendation domaine". The "recommendation domaine" is the target for research recommendations and, therefore, should be recognized and utilized when developing research priorities. While considerable work has already been done in Indonesia in defining agroecological zones, cropping systems, and recommendation domaines, it appeared to the review team that this type of thinking does not dominate the process of setting research priorities.

The identification of constraints depends, in theory, on the percolation of identified problems from the farmers to the extension worker to the research service. In the case of some constraints, such as disease or insect problems, this process often works very well, and thus there is a common recognition of a problem. However, the possibility of increased production through creative innovation (changes in time and spacial arrangements, increased fertilizer use, substitution of variety, or even of crop, in the farming system) may not be perceived, except by a very competent observer.

It is the impression of the evaluation team that the first type of constraint, the "visible", is well recognized at all levels. Because of a shortage of personnel, and the vast areas of production, the presence of the second class of constraint (lack of creative innovation) is often not recognized. While documentation and evaluation revealed a logical identification of highly visible constraints, there appeared to be less imagination for less obvious but, possibly, equally valuable innovations.

There is no available estimate of the number of recommendation domaines, but with respect to palawija crops alone there are probably hundreds. This implies a tremendous task of diagnosis, even before adequate research is attempted. It is highly probable that the research system will not be able to cope with the problem of fine tuning of many cropping systems in a large number of recommendation domaines. In place of such fine tuning it is probably necessary to address research to problems common to many systems, including the need for fertilizer, pesticides, and better varieties. It appeared to the evaluation team that research personnel were well aware of general biological constraints but often less aware of socioeconomic contraints, and certainly far from making a diagnosis of fine points or of making recommendations for specific recommendation domaines. At this relatively early stage in the transformation of traditional Indonesian agriculture, it would be difficult to improve the diagnosis and decision making processes without more personnel, and without a consensus on the priority setting process. However, this process needs to be kept under continuous review as AARD's manpower resources develop. Particular attention needs to be devoted, at an early date, to evolving a mechanism to ensure that those areas, such as cropping systems and post-harvest technology, which transcend disciplines, have a full voice in the priority setting process.

3.3 PROGRAM FORMULATION

Planning activities can be divided into long term and short term. Long term planning, up to 10 years, is somewhat informal and considered to be "soft" planning. It offers the best current projection of what needs to be done, especially in terms of the development and allocation of resources.

Long term planning is initiated by the AARD administration where long term decisions are made with respect to the mandates of the research institutes. (In a number of instances these mandates have been changed recently). Long term planning also involves training which is an essential step in developing research capabilities. CRIFC has been particularly active in this field as can be seen from the build up in numbers of trained staff (Table 2.8). Long term planning takes into account the most recent 5 year plan, the terms of agreement of development projects, such as NAR II, and the budgetary and manpower limitations, to the extent that they can be perceived.

Short term planning or program formulation is an annual process that includes plans for experiments and the budget necessary to execute them. In practice it starts by researchers making proposals which are submitted at their respective research institutes to disciplinary based coordinators. These coordinators revise the proposals on technical grounds and then submit them to the research institute director, who evaluates them, assigns priorities and submits an institute plan to the director of CRIFC who, in turn, passes it on to the head of AARD and through him to the Secretary General of the Ministry of Agriculture and ultimately to the Ministry of Planning. Most component institutes (balai) of CRIFC have retained the discipline department as the "home" for individual scientists with commodity responsibility spreading across the disciplines. The administrative instrument designed to direct this commodity focus across disciplines is the commodity coordinator within the balai. However, BORIF, with its rather specific mandate is an exception to this and is organised purely on a disciplinary basis.

While in theory this system should function well, the balai director and department chairman who control the budget appear to have more influence over the coordination process than does the coordinator himself. This fact does not mean that multidisciplinary work is not done, but it does mean that the commodity coordinator must be very much a leader and a "persuader" in influencing both balai directors and department chairmen in the need for and value of multidisciplinary research.

The review team was informed that the role of commodity coordinators at the balai level has not been effective in the past. That judgement is easy to understand during a time when AARD has been developing its manpower capacity. It is obvious that a number of multidisciplinary and even multi-commodity projects are under way, but it is perceived that these projects are functioning because of the leadership and direction provided by the balai directors rather than the commodity coordinators.

This situation should change as increasing numbers of trained persons return to the balais and exert leadership at the commodity level. But even then, a significant and enduring change is unlikely unless the coordinators' are given some measure of budgetary responsibility. This comment applies also at the CRIFC level where there are coordinators assigned to maize/sorghum, grain legumes, root crops, wheat and agro-economics. These scientists are assigned to work with the director of the Malang institute in developing research programs for all 6 CRIFC institutes. In practice it is difficult for them to fulfil this function properly as they have no authority over the programs at institutes other than BORIF (where they are based), they do not see all research protocols and results and they have no travel funds for coordination. Nor are they necessarily consulted by institute directors when budgets are cut and programs have to be revised. Indeed the final authority at the program level lies more with research institute directors than with national commodity program coordinators even though both respond to the director of CRIFC.

The review team found that in spite of assigned mandates representing a national program, directors of research institutes are often under pressure from the local Kanwil as well as from farmers to dedicate research time to immediate local needs. Furthermore, progressive farmers often bring their problems to and seek advice from the research institutes. The former pressures as well as the latter requests can divide the research effort and divert it from urgent national objectives.

One of the major recommendations of the review team relates to coordination and calls for a strengthening of the role of both the national and the balai coordinators in order to develop truly national programs for palawija crops. The team felt that the national coordinators, currently based at Bogor, would ultimately need to locate at Malang if the institute there were to be the one mandated to lead palawija research. Whilst there is no immediate haste for this change, and the national coordinators can function effectively from their current location at Bogor, before they can do this they need to be given more authority for their respective programs. To do this they need to see and to be the final arbiters of all program proposals in their commodity; to receive programs and final reports on the work and to have sufficient funds to visit each of the balais from time to time. They should also meet together each year with their commodity coordinators from all 6 balais in order to review past progress and coordinate future plans. At the balai level the coordinators will need strong backing from the balai directors and heads of disciplinary units if they are to be effective.

This recommendation implies a shift in authority at the program level. It does not seek to undermine the authority of institute directors or heads of disciplinary units in their main spheres of influence but it does take away from these groups certain decisions about program priorities. It also gives the national coordinators an opportunity to develop programs built up on a national strategy rather than by combining six separate sub-programs. However, the success of this approach will call for close team-work between the national coordinators and the institute directors and strong leadership from the head of CRIFC because, whilst the programs may become the responsibility of the coordinators, the final accountability for balai budgets must lie with the balai directors.

Having made this point it is only fair to point out that, notwithstanding these difficulties, the maize program, which has now had a national coordinator since 1982 and has had good support from CIMMYT, clearly shows as a national activity. Grain legumes and root crops, which have had national coordinators for rather less time, are not so advanced in their national integration, but for all three commodities the current status of the program speaks well for the persuasive powers of the national coordinators working under very difficult circumstances.

Hand in hand with strengthening the role of the national coordinators is the need for them to play an active leadership role in their respective commodities. This is particularly important on their visits to the balais where there is a need for them to lend the benefit of their experience to the younger scientists and to assist the balai directors in shifting the emphasis of research meetings and seminars from "issues" to "science".

There is also a need for the coordinators to bring past results from all balai to bear in planning the actual research programs of each individual balai. To do this they must have access to all of the data from research in their commodity. They also need to build a stronger feedback system so that results from component technology (e.g. a new variety) being used by the cropping systems program and the extension services are brought back quickly and directly to the research workers. At present there does not seem to be a very explicit mechanism for informing AARD scientists of the feed back from technology verification trials conducted by the extension services.

One area of program formulation that was of concern to the team was cropping systems. Work in this area has made considerable strides in Indonesia and some elegant research has been conducted, but the activity hangs rather uneasily within CRIFC and, historically, has been largely dependent on external assistance for its operational budget. Even today only a small part of the CRIFC budget is specifically designated for cropping systems research. Fortunately the importance of farming systems is recognised by the CRIFC and much of the component research in the palawija program is geared to incorporation into traditional systems. The emphasis on short season varieties is a good example of this. However, overall there appears to be a need to provide cropping systems research with a more formal status within AARD, possibly putting it on the same basis as a commodity research activity. It does appear as a line item in some budgets but it is possibly there more as an "add-on" rather than as a directed research thrust. But on small farms, particularly non-irrigated units of under 2 ha, it may be vital to develop an intensive "system" if the farmer is to rise above the poverty level, and for this purpose a major research input would appear to be essential.

The review team did not examine the large palawija research program in great detail. Indeed with over 750 trials of various sorts scheduled in the current fiscal year this would not have been possible. We did look at a number of experiments in the field, examined some research protocols and had described to us the RRTP (program area) system and how it linked into the program goals (which are shown in the tables in Section J of volume 2 of this report).

The review team believes that all of the research underway is related to the objectives of the program, and thus justifiable. Nevertheless, the research task is enormous and therefore only a small amount of the desirable research has been tackled so far. Because manpower available is still far from sufficient, the task of selecting priorities is much more critical, so that the research goals selected can be those with more potential impact. However, the analysis of recommendation domaines as a basis for setting priorities from it has not been given sufficient attention.

The team has noted that in some cases research activities are closely related to short term local problems, and feels that this may result in neglect of wider constraints. The research on crop fertilization levels is likely to be extremely location specific, and thus not likely to result in significant impacts. Furthermore, the team feels that the breeding efforts with palawija crops may not represent continuous long-term efforts with expected short and long term results. Later in this report we have offered detailed suggestions on individual commodity programs. We would, however, like to suggest that the following general areas of research warrant more attention as soon as manpower is available to devote to them:

1. Identification of major and minor cropping systems as an aid in setting priorities.

2. Post harvest research to improve the storage, transportation, and eventual use of the palawija crops for both food and feed.

3. Long term breeding, including:

    a. Pest resistance and drought tolerance in corn
    b. Pest and virus resistance in legumes
    c. Earlyness in cassava
    d. Palatability in sweet potato

(This list does not exhaust the desirable attributes in the breeding objectives but emphasizes some neglected aspects).

4. Soil management for problem soils

5. Water management on partially irrigated lands

6. Seed production and technology

The final comment that we would like to address ourselves to with respect to program formulation relates to the link between the program of work and the budget. It is difficult to identify this link because of the budgetary system used by AARD, the many budget codes, the split of personnel emoluments amongst many heads, the overlap between routine and development budgets and the pooling of CRIFC rice and palawija costs. We could really get no further than to attempt to get global orders of magnitude of the budget for each of the three major groups of palawija crops (Table M7). This did indicate that a major national effort was being devoted to these commodities. It would be useful to be able to disaggregate the budget still further but this would require major changes in AARD's system of budgeting. This would present a much tighter link to be drawn between the budget and the work program and would permit budgets to be built up from programs and targets rather than vice versa. Currently the budget system is that the director of the CRIFC is given part or all of his budget request which he then allocates to balai's who then allocate it to commodities after the 85%+ of fixed costs for salaries, maintenance, capital etc. have been put aside. Currently no attempt is made to pro-rata these costs between commodities and it was not possible to do this effectively from the information presented to us. There would be a lot of merit in re-organising the budget layout in order to do this, but we recognise that such an act may require support and approval from government departments other than AARD. Nevertheless, in the interests of management efficiency we would recommend cautious moves being made in this direction.

CHAPTER 4

RESOURCES AND ACTIVITIES

4.1 INTRODUCTION

This chapter discusses the ongoing research program, the adequac of the methology being used and the extent to which the requirec resources are both available and utilised. Further information on the resources is summarised in the tables in Chapter 2 of thi volume and in the tables in Volume 2 which not only show details of manpower and physical resources but also provide information on the type of research under-way and its physical location.

4.2 PROGRAM ACTIVITIES

The Indonesian national non-rice food crops (palawija) research program consists of four sub-programs:

1. Maize, sorghum and wheat (sometimes treated as a separate sub-program in its own right).

2. Roots and tubers, i.e. cassava, sweet potato, and othe root crops.

3. Grain legumes, including soybean, groundnut, mungbean and, to a lesser degree, pigeonpea.

4. Agro-economics.

The first three of these have components dealing with :

1. Varietal improvement.

2. Cultural methods.

3. Plant protection.

4. Post harvest technology, including seed technology.

The agro-economic program covers :

1. Production systems.

2. Consumption systems.

3. Institutional and marketing systems.

The background, problems, strategies and aims of research in ea of these areas are given later in this chapter. The research i aimed at solving problems so as to raise productivity and devel farming systems. The research effort is integrated across disciplines and the various research institutes so as to develo packets of appropriate technology.

In attempting to raise the productivity of each commodity, attention is focussed on :

1. Yield potential.

2. Varietal adaptability.

3. Yield stability.

4. Yield quality in relation to the end-use.

Malang Research Institute for Food Crops (MARIF) has the national mandate for research on palawija crops. The other Research Institutes conduct palawija research in their mandate agro-ecosystems, under the coordination of MARIF.

The research program has, in the past, given prime emphasis to maize and soybean although it is now also stressing groundnut, mungbean, cassava, sweet potato and, to a lesser extent sorghum, wheat and some less important grain legumes and root crops. Work is under way in the disciplines of plant breeding, agronomy, physiology, entomology, pathology, post harvest technology and agro-economics. Varietal improvement and agronomy are emphasised and are intended as the core of current research, with other disciplines in support, so that technology packages can be developed.

More recently research activities have been broadened to include the development of technologies adapted to a range of agro-ecological conditions; for instance irrigated lands, alkaline soils (such as in Madura), non-irrigated lands with a dry climate which are drought prone, tidal swamp areas where acidity and drainage are problems, and non-irrigated lands with a humid climate where a low pH and aluminium toxicity exist. All of these activities are relevant to the national goals of both increasing productivity levels and opening up new and more difficult lands, outside of Java, through transmigration programs. In most instances AARD is the only Agency with adequate resources to research these types of problems, although several universities also have agricultural research programs often with competent manpower but, invariably, with very limited operational funds. Within AARD there is little scope for overlap as most Central Research Institutes have very specific mandates, only in the case of soils and agricultural economics is there a potential for duplication, but because so much research is needed and resources are relatively limited, the areas where duplication occurs (such as the example in Lampung quoted in Chapter 4) appear to be very few.

Maize is the most active area of palawija research. The program currently emphasises breeding and production agronomy, other disciplinary units to support these efforts are not yet fully developed. The breeding effort has developed back-up pools, advanced populations and open pollinated varieties and is now attempting to develop hybrids. It is backed by agronomy research both on-station and on-farm. In the past, the research has emphasised high input technology for monocrop purposes. More recently the maize program has been working on some of the more problematical soil and climate areas referred to earlier in this chapter and has been developing component technology for maize grown in polyculture.

To this end the maize program works with both open-pollinated and hybrid varieties. This is a good strategy, because open pollinated varieties (heterogenous populations) can :

1) serve as base populations for developing hybrids, 2) be expected to be more stable and to have a wider adaption, and 3) be more suitable in remote areas, on marginal lands, for low input technology and for poorer farmers.

In the varietal development program, emphasis for the specific traits required in each research institute has been set up, e.g., for MORIF emphasis is given to developing early varieties (less than 90 days); both yellow and white grain; resistance to downy mildew; drought tolerance; and high yields. Different breeding activities are well defined and are executed cooperatively by the various research institutes. The germ plasm collection is being gradually shifted from Bogor to Malang. This appears to be a logical step given the importance of the Malang area in maize production and MARIF's new mandate.

Until recently gene pool development was coordinated by BORIF with other research institutes participating, based on their needs. More advanced population improvement is now coordinated by MARIF with other research institutes collaborating. Specific selection is conducted by individual research institutes in line with their mandates. Hybrid development is concentrated in Sukamandi. Regional yield trials including materials from various research institutes are coordinated by BORIF. Production of breeder seeds will be gradually shifted to MARIF. Research that is more fundamental in nature will remain at BORIF.

While coordination in varietal improvement is steadily improving, coordination across research institutes for the disciplines other than breeding needs to be strengthened, particularly with respect to work on :

1) disease and insect resistance;

2) tolerance to physical stresses (drought, low pH and Al toxicity, water logging);

3) seed production and technology;

4) post harvest, processing, and marketing; and

5) socio-economy and crop utilization.

The sorghum program is a small one based at MARIF and BORIF which appear to be sound geographical choices, the Muneng station of MARIF is particularly suitable because of its lengthy dry season.

As with maize the current work focusses on varietal improvement and agronomy. The breeding objectives are to develop varieties organoleptically acceptable to man; easily processed; with a high grain protein; high yield; good ratooning ability; low to medium stature; with semi-open heads; and of both early (for cropping systems) and medium maturity (for monoculture). On the agronomic side effort is being devoted to investigating soil fertility, plant density, planting date and other similar information with respect to different varieties and relative to their use in different cropping systems regimes. The entire program is likely to receive greater emphasis shortly when the program leader returns from completing his Ph.D. in plant breeding.

WHEAT

There is currently a small wheat program based at SURIF and primarily consisting of screening and evaluating materials received from CIMMYT and some Asian countries (especially India and Pakistan). These materials are further distributed to BORIF, MORIF, SARIF and MARIF for planting and evaluation at regional experimental sites. The disciplines involved in this work are breeding, agronomy and pathology. At SURIF some post-harvest studies are also under way. The screening is carried out mainly for yield and grain quality, this is supported by agronomic and pathological studies to assess the techniques and costs of introducing wheat into upland cropping systems since, at present, only a very limited area is under this crop in Indonesia.

At the level of the individual cereal programs the current resources of CRIFC are, as already noted, permitting a sizeable and effective program to be carried out. But in order to accomodate all the staff currently undergoing training and to meet the targets of the forseeable future, significant additional resources will be needed. The review team have tried to identify these in rather general terms and have prepared the following matrix diagram comparing the most critical program needs of the cereal program with the additional resources likely to be required in the foreseeable future (Table 4.1).

TABLE 4.1

ADDITIONAL RESOURCE NEEDS FOR THE CEREAL PROGRAM

Research Activities	Resource Needs		
	Physical	Financial	Manpower
1. Seed Production and technology	++	+	+
2. Breeding for resistance and management of pests and disease	+	++	++
3. Breeding for physical stress (drought, low pH, water logging)	+	+	+
4. Post harvest/marketing	++	++	+++
5. Agroeconomics	+	++	++
6. Production Agronomy	-	+++	++
7. Main breeding program	++	+	+

+ slight increase

++ modest increase

+++ significant increase

GRAIN LEGUMES

The grain legume research program is heavily biased towards germplasm collection, evaluation, maintenance and utilization in a varietal improvement program. The program is commodity centered on the three most important grain legumes-soybean, groundnut and mungbean. In addition to breeding, there is emphasis on agronomy, pest and disease control and cropping systems. The program adequately addresses the current need for new varieties and practices for grain legume production in both monoculture and as a component of cropping systems. While the current research program activities are well related to the goals of agricultural development, additional resources are needed to address some additional crop and problem areas. For example both cowpeas and pigeonpeas are crops of potential benefit to Indonesia but receive very little attention in the current research program. As in the case of cereals, there is a significant training program under way and there will be a need for providing additional resources to fully utilise the manpower likely to be on site shortly. The following table indicates the likely areas of resource shortage in the foreseeable future (Table 4.2)

TABLE 4.2

ADDITIONAL RESOURCE NEEDS FOR THE GRAIN LEGUME PROGRAM

Research Activities	Resource Needs		
	Physical	Financial	Manpower
1) Seed production and technology	++	+	+
2) Breeding for pest and disease resistance	+	+	++
3) Acid soils adaptation	-	+	+
4) Postharvest/marketing	++	++	+++
5) Agro-economics	+	++	+++
6) Rhizobium/N fixation	+	+	+
7) In-service training	-	+	+

+ - slight increase
++ - modest increase
+++ - significant increase

In addition the program would benefit from integrated inputs in certain specialised fields such as *Rhizobium* and nitrogen fixation, seed production technology and post harvest technology. Currently this expertise is very limited and widely dispersed amongst the balais and there is a need to capitalise on it more effectively.

ROOTS AND TUBERS

Root and tuber research is concentrated on two root crops, cassava, of major importance, and sweet potato, of minor importance. Both crops are propagated vegetatively and therefore pose special problems in the production and maintenance of quality planting materials. Both crops produce a tuberous root of high water content (70-75%), and the roots have poor storage characteristics. Therefore, these roots have to be sold rapidly after harvesting and used fresh, or they must be processed before shipment to distant points or storage. The special requirements of these crops limit their use in Indonesian cropping systems. Furthermore, the production season for cassava is long, but the requirements of the cropping systems are such that a shorter than normal growing period is common. Both have their specific disease and insect problems. The breeding projects, while good, are still not extensive enough for the need.

Research with root crops concentrates on the development of better varieties through plant breeding at Bogor. The breeding programs for cassava and for sweet potato are old but continuing projects that have been successful in developing new varieties. These projects take into account the pioneering efforts of the major international centres, which have been used as a source of some plant materials. Research objectives include tolerance or resistance to disease as well as yield, and there is some interest in stress tolerance, especially of drought and marginal soil. The development of better varieties of these crops is a sound basis for palawija development.

The plant breeding research is complemented by agronomic research to improve production technology, which includes management of propagating materials, planting techniques, fertilization, and pest control. Such research is located at all but one of the research institutes and is severely limited by lack of sufficient personnel (Table 4.3).

TABLE 4.3

A SUMMARY OF CURRENT RESEARCH PERSONNEL IN ROOT AND TUBER CROPS AS RELATED TO RESEARCH INSTITUTE AND DISCIPLINE*L[1]

Research Institute	Total BS or higher personnel assigned	Breed-ing	Agro-nomy	Physio-logy	Entomo-logy	Patho-logy	Post harves
Bogor (BORIF)	13	3	3	2	1	1	3
Malang (MARIF)	2	0	2	0	0	0	0
Maros (MORIF)	1	0	1	0	0	0	0
Banjarmasin (BARIF)	5	1	3	1	0		0
Sukarami (SARIF)	1	1	0	0	0	0	0
Sukamandi (SURIF)	2	0	1	0	0	1	0

*L[1] Not necessarily full time (for this reason the table differs slightly from Table

Research underway has both general components likely to be of value anywhere, such as management of propagating materials, and location specific components, such as fertilizer use. The need for this type of research is great and there is much more still to be done. While some of the work may appear duplicative, all was judged essential.

A major limitation in the production of root crops is the subsequent problem of marketing. In the use of cassava the useful life of harvested tubers may be only one week. Most sweet potatoes in the tropics also lose quality rapidly after harvest and are not easily marketable after one month. In other parts of the tropics cassava is processed into durable forms. There already exist several technologies for cassava processing ranging in scope from the farm to small factories to large industrial plants. In the case of the sweet potato no such range of technologies exists, but the extraction of starch is simply managed. The research in processing of roots is carried out at BORIF where 3 persons are assigned, at least part time. Post harvest research with root crops includes analysis of their nutritive value, this is already done for current varieties.

Studies have shown that cassava roots can be stored satisfactorily for up to 2 weeks in moistened sawdust. One percent KOH solution can be used in the treatment of cassava chips before sun drying with reduction in enzymatic blackening and, thus, an increase in quality. The storage life of freshly harvested sweet potatoes can be increased by treatment with wood ashes from the kitchen stove, this reduces fungal growth.

Other roots and tubers play, or could play, an important role in the cropping systems of Indonesia. These include the yams (Dioscorea), the taros (Colocasia) and the giant swamp taro (Cyrtosperma). These crops could help in the expansion of food production but it must be recognised that little research has been done on them in the country so far.

As with the case of cereals and grain legumes the review team has tried to anticipate the areas where consideration should now be given to strengthening the resources in order to have a balanced program in the future (Table 4.4).

TABLE 4.4

ADDITIONAL RESOURCE NEEDS FOR THE ROOT AND TUBER PROGRAM

Research Activities	Resource Needs		
	Physical	Financial	Manpower
1. Breeding and plant Introduction	-	++	++
2. Post havest/processing	+++	+++	+++
3. Insect and disease Research and control	++	++	++
4. Site specific technology	-	+	+
5. Cropping system and on farm testing	-	++	++
6. Agroeconomics	-	+++	++

+ slight increase

++ modest increase

+++ significant increase

It is interesting and, perhaps, noteworthy that in tables 4.1, 4.2 and 4.4 all three major commodity groups lay particular stress on the need to strengthen post-harvest and agro-economic activities. A nominal program in agro-economics actually exists and is referred to in the next section of this chapter, although in practice its coordinator post was vacated just before the review team arrived in Indonesia and the program has very few staff. However it does exist on paper and has a set of objects that the review team fully endorses.

The same cannot be said for post-harvest research which appears to be a "Cinderella" activity that is poorly staffed, widely dispersed and without a strong national coordinating focus. The team has elsewhere in this report emphasised the need for more work to be done on both seed processing and storage and on the post harvest utilisation of palawija crops for industrial use. In order to do this either new facilities have to be created or, more probably, existing laboratories need to be modified, equipped and staffed to carry out this work. This cannot be done overnight and the first priority would seem to be for AARD to establish its post harvest strategy in terms of manpower and location (will one balai lead this work for all food crops or will expertise be dispersed amongst the balai's and if so what manpower is needed). In view of the time element involved in training, the next stage would appear to be to give priority to identifying trainees and to have them accepted. Until they return consideration might also be given to sub-contracting som post-harvest work to institutions such as IPB where there is an existing capacity in this field. But the important thing is to start planning and acting now, as all commodity groups in CRIFC identified this as a priority problem.

AGRO-ECONOMICS

Increased palawija production is dependent not only on technical knowledge, but also on socio-economic factors. These socio-economic factors can be summarized into a palawija commodity system that covers production, consumption and commercial aspects of each commodity. Once these aspects are known, policy decisions can be made to increase national palawija production.

When adequate staff are available the program will need to :

1. Investigate various socio-economic constraints to production, marketing, consumption and utilisation efficiency, and proprose alternative approaches.

2. Investigate the socio-economic suitability of technology developed by research institutes, and evaluate the impact of such technology at the farm level.

3. Investigate various socio-economic aspects of land use, so as to discover suitable cropping system for development.

4. Investigate institutional dynamics aimed at developing farmer groups and appropriate cooperatives.

Although Malang Institute has the mandate for palawija research, it at present has few staff working on socio-economic aspects of these crops. Bogor Institute, on the other hand, has the mandate for pioneering research and commodity analysis, and so it is likely to have to coordinate socio-economic research on palawija crops until Malang Institute is able to take over this role. The prime need of the agro-economics program is, as pointed out repeatedly in this report, for increased manpower to fulfil the tasks specified above. Such manpower needs not only to be at BORIF, where it can work with the CAER on matters relating to all food crops but also to be created in the other CRIFC institutes where it can participate in experimental design and analysis and conduct work on regional problems in the socio-economic field.

4.3 RESEARCH METHODOLOGY

The current research program concentrates on practical and immediate needs, as it should. It uses methodologies that are for the greater part relatively simple, developed abroad, almost standardised and well documented in some of the publications on palawija research. The breeding strategy of distributing segregating populations to the several Balais is commended and will require active follow up by the national coordinators to assure that general resources are adequately evaluated and utilised.

More complex methodologies, especially for studies that are not site specific, are usually developed at Bogor where facilities for this type of work are good. With the build up in skilled staff offering opportunities for widening the research horizons there is now scope for developing specific methodologies for activities such as screening for pests (corn borer, shoot fly etc.), diseases (leaf blight, rust), and physical stress (drought, low pH, Al toxicity, waterlogging), for growing grain legumes on rich soils, for utilising Rhizobia and for post-harvest research. All of these activities need to be developed as time and resources permit.

At the field level the review team looked at a number of experimental plots. Most of them gave the appearance of being well-managed in terms of pest, disease, weed and water control, choice of homogenous experimental plots, use of genetically true-to-type varieties and choice of appropriate time, locale and genetic material. All in all the field visits indicated an impressive research lay out that the review team wishes to commend.

The detailed research program was too large for us to attempt to review every trial. We discussed experiments at random and gained the view that the system of planning and reporting on individual experiments conformed with standard protocol. We believe that the system could be tightened, as already mentioned, by having all experiments approved by national coordinators although we recognise that some, if not all, balai directors do monitor all research proposals at their institute very carefully. We did not gain a clear impression of how well the literature is reviewed before experiments are written up. We noticed a paucity of library materials in some balai's and were advised that measures were in progress to strengthen their libraries and to operate a title page "current contents" service from the Central Library. But these activities do not yet seem to be functioning effectively.

The review team was pleased to hear of the programs for dissemination of new information from the Central Library and urges that these should be implemented as quickly as possible because it regards a ready source of up-to-date research information and reference material as vital tools in any research program.

4.4 RESOURCE AVAILABILTY

The review team considered that the total physical, financial and human resources available for palawija research, if optimised in their use, were of an adequate level to carry out a modes but realistic national palawija research program.

In order to do this the research needs to be sharply focussed on goals:

a) for which resources (especially manpower) exist;
b) which relate to farmers needs; and
c) which offer reasonable chances of success (which often implies that a minimal critical mass of manpower and money are available).

This calls for a very careful process of program formulation to ensure that:

a) there are sufficient resources to adequately tackle priority objectives;
b) only limited funding is allocated to low priority goals;
c) complementary use is made of domestic and external funding in order to maximize the total available;
d) the program is balanced geographically.

The goals are, to a large extent being met in the case of cereals and grain legumes at the present time, or are on the way to being met once the on-going construction and training programs are complete. However, the root crops program is still a long way from having a critical mass of manpower and is under funded in terms of the value of the crop at the present time.

The adequacy of the existing physical resources varies from location to location but given the on-going support from Dutch, USAID and World Bank projects the six research institutes of the CRIFC are well on the way to becoming adequately developed physical plants. There is, however, still a need to improve facilities on a number of the experimental farms. The geographical coverage of these appears reasonable, except perhaps in the east of the country, given the existing patterns of population and production, and there appears to be sufficient land available on the research stations and farms of CRIFC to conduct a research program compatible with the staff training goals.

The review team did not have the opportunity to conduct a detailed review of the scientific equipment available at all the CRIFC institutes but formed the overall impression that Bogor, Sukamandi and Sukarami (when its equipment is installed) will be adequately equipped in most respects. Malang less so and Maros, Banjarmasin and many of the research stations should benefit from additional equipment, particularly as their staff levels build up. However, overall there is sufficient scientific equipment and facilities for a significant volume of work to be undertaken.

Mention has already been made about the adequacy of literature and the steps being taken to improve this situation. It is essential that all research institutes and stations should have subscriptions to a limited number of essential journals which are essential for day to day work, although we recognise that the Central Library must retain the function of being the key information source for researchers.

In the past manpower has been a major limiting resource but as the data in Tables 2.5 and 2.6 show, this is now not necessarily the case although temporary problems do exist due to the absence of so many staff away on advanced training. The manpower training program is large and appears to be successful. The main concern that the review team holds regarding this program is that it is likely to produce an unbalanced mix of staff at the end of the decade. The policy to date has been to give freedom of training in their own choice of commodity and discipline to all who met the rather high entrance criteria for advanced training. This appears to be leading to a situation in which AARD could have a relative surplus of plant breeders and agronomists specialised in a few crops and a total absence of important but, perhaps, less fashionable skills such as root crop pathology or grain legume physiology. The team recommends that those responsible for manpower training in AARD should examine this issue to see whether some form of quota, or alternatively an incentive system, could be used to shift the emphasis in manpower training towards the attainment of defined targets for disciplines, commodities and institutes.

One particular reason for doing this is that although Malang has the mandate to lead palawija research the biggest manpower resource for this (and the largest number in training) are BORIF staff. Unless priority can be given to training MARIF staff or BORIF staff can be induced to transfer to MARIF, a situation will arise where the human resources for palawija research will be located in Bogor where the mandate is for more fundamental research (genetic evaluation, pest and disease management, agricultural economics, communications, physiology, biotechnolc and post harvest) and the mandate for applied field research on palawija crops will be located at an institute which lacks the personnel to do the job.

It will take some time to adjust this situation and during this period BORIF, through its palawija crop national coordinators (who are BORIF staff) will have an important role to play in guiding the palawija program and in working closely with MARIF this. The Dutch bilateral program at MARIF is playing an important role in developing that institute.

It appeared to the review team that the Dutch scientists were well incorporated in project planning and implementation activities and the document they assisted in preparing for the team's briefing was very well done.

However, in the long run while external financing can assist in the development of any or all of the balai's of CRIFC it is the core support from the Government of Indonesia which will ultimately determine whether or not these institutes function properly. In this respect the team has three concerns. The first relates to the share of CRIFC's budget that is devoted to maintenance (Table M6). This is only 3% of the total palawija budget and whilst this may have been adequate for the resources at the CRIFC institutes in the past, it must be recognised that some 15 - 20 million US dollars has recently gone or is going into developing the physical plant and equipment for these institutes, their research stations and experimental farms. About 40% of their facilities are devoted to palawija research (Table M1) but if the component of the palawija budget that is used for maintaining facilities remains at only 3% or approximately US $72,000, it is unlikely that the vastly expande facilities will be adequately maintained in the future.

The second matter of concern regarding CRIFC's financial resources relates to the limited portion of the budget that relates to "operational costs" for research. Whilst the term "operational costs" is difficult to define precisely and does not include the salaries of permanent staff, it is the part of the budget that is likely to come under the most pressure as post-graduate trainees return and begin to conduct research in the specialised fields in which they have studied. A number of trainees have already returned but the number will snowball over the next few years.

Given the many forces competing for government funds and the tightness of the overall national economy following the decline in oil prices, the government's ability to increase AARD's budget to meet the demands of maintaining and utilising its vast new resources, be they physical or human, must be a cause for some concern. Currently AARD's development program as a whole is highly dependent on external assistance which in 1984/85 will provide US $3.0m of the US $8.5m total budget of CRIFC

(Table M5). But on-going activities have to be financed nationally and the size of these facilities has increased and is increasing at a faster rate than AARD's total budget.

On top of this there is a third problem, namely that of local professional salary levels. This has been commented upon at some length in the 1981 ISNAR review of AARD. It is a problem that affects AARD as a whole and not just the CRIFC or its palawija program. It is, however, a problem of increasing importance as more highly trained personnel return to AARD, since the pool of fringe benefit honoraria which have helped the better trained AARD staff members to supplement their very low salaries is not large enough to include all of the new personnel with higher degrees, and frustration and staff wastage would appear to be a major risk.

The review team recognises that the solution to this problem lies outside of the hands of AARD but it feels that it has a duty to place on record its concern that many of the expensive training and development activities of AARD could be counter productive investments unless the right environment is provided for scientific personnel to work in. Indonesia needs a strong agricultural research service, past results from such research in Indonesia and elsewhere suggest that the benefit-cost ratio for such research can be very high. But at salaries that are linked to a rigid civil service scale and compare unfavourably with the private sector (even when benefits such as free housing are taken into account), AARD may have difficulties in retaining bright and creative research workers, especially those trained in highly entrepreneurial external cultures.

4.5 RESOURCE UTILISATION

In the last section of this chapter we have expressed the opinion that the steps taken to develop the physical and manpower resources of AARD, including CRIFC, will go a long way towards meeting the goals of having a strong national research organisation by the end of the decade. Better facilities are needed at some locations and a shift in emphasis on manpower training is necessary. But these are both issues that are well within AARD's powers to implement.

In general, the program has utilized the manpower, funds and land available well and efficiently. The laboratory facilities and equipment appear to be fairly well maintained, although the review team did not investigate either this or the maintainence of field equipment and buildings very thoroughly. Equipment is not used exclusively for the palawija program, but for all crops on the institute or station where it is located. We were informed that a lack of funds and skills led to field equipment and other facilities being poorly maintained but we did not see any evidence that research work was constrained by current maintainence policies.

The review team attempted to relate the level of manpower to the use of facilities in 1984/85 by measuring the experimental load on each scientist. It is difficult to quantify this precisely because of the very dynamic nature of the changes in facilities and manpower at the present time. The Table below (4.5) needs to be interpreted rather carefully and to recognise that some of the manpower arrived on site after the program for the year had been finalised. The table shows the strength of all 3 programs at BORIF and of grain legumes at MARIF. The overall pattern of 20 experiments per Ph.D. or M.Sc. and of 7 per Sarjana looks reasonable but at a number of locations there are no Ph.D./M.Sc.'s leading RPTP's, or the ones that do carry a very heavy load. It may also be worth following up why Bogor with just over 50% of the Ph.D. and M.Sc. staff accounts for only 27% of the experimental units. Does this mean that the staff there are more heavily engaged in other tasks such as coordination, does their "fundamental" program mean that each scientist can do less experiments, do the sarjanas there do less than elsewhere because they are less experienced, or is there another explanation. The question may be worth asking since so much of the palawija manpower is at BORIF.

TABLE 4.5

NUMBER OF PALAWIJA EXPERIMENTS [1)]

PER SCIENTIST 1984/85

	No of Experments	No of Scientists			Experiments per Scientist		
		Ph.D/M.Sc	Sar	Total	Ph.D/M.Sc	Sar	Total
CORN/SORGHUM							
BORIF	62	4	8	12	5	8	5
MARIF	60	1	8	9	60	8	7
SURIF	44	3	5	8	15	9	6
SARIF	18	1	9	10	18	9	6
MORIF	(50) [2)]	2	3	5	25	17	10
BARIF	11	0	4	4		3	3
subtotal corn	(245)	11	37	48	22	7	5
GRAIN LEGUMES							
BORIF	75	13	7	20	6	10	4
MARIF	78	3	18	21	26	4	4
SURIF	41	3	5	8	14	8	5
SARIF	30	1	6	7	30	5	4
MORIF	(88)	0	10	10		9	9
BARIF	16	0	1	1		16	16
Subtotal legumes	(328)	20	47	67	16	7	5
ROOT CROPS							
BORIF	42	3	10	13	14	4	3
MARIF	12	0	1	1		12	12
SURIF	0	0	1	1	-	-	-
SARIF	11	0	0	0		-	-
MORIF	(25)	0	1	1		25	25
BARIF	6	0	2	2		3	3
Subtotal legumes	(96)	3	16	19	24	6	5
GRAND TOTAL	669	34	100	134	20	7	5

1) The figurs exclude cropping systems experiments
2) MORIF figures are estimates as only a mixed total was available

There are two other aspects of manpower resources that we have examined. The first of these relate to collaborative research outside of AARD. Facilities for doing this exist but it is rarely done. This seems to be a pity in circumstances where another institution, such as a university, possesses skills that AARD lacks. The team felt that this type of consultancy link should be encouraged as it could be mutually beneficial and they have recommended that it be the subject of study by the top management of AARD to see whether ways and means of utilising non-AARD personnel more widely could be devised.

The second external source of manpower is the pool of technical existance experts working in bilateral or multilateral programs assisting AARD. Historically such personnel have been used mainly on line tasks to fill gaps in the research complement or to work on specific problems where local expertise was lacking. As a result of the training program the needs in these two fields are diminishing but there is, perhaps, a new need in providing an intermittent but long term consulting service to newly returned trainees. This appears to be carried out very effectively in selected fields by locally and regionally based staff of some IARC's and would seem to be a strategy which might be built upon by some of the other donors assisting the CRIFC, until such time as these services are no longer necessary.

The most disturbing feature relating to resource utilisation is again that of finance. An issue here that it should be possible to overcome is that although funds can be carried over from year to year there is often a delay in disbursement of the initial tranche of the annual budget so that there can be a shortage of funds in the early months of a financial year (April to June) which can seriously affect the research program. The simple solution will be to build up a reserve of funds to carry over to cover this period. Not all directors are aware of this and others fear to use it because budgets are not infrequently cut during the year and they fear that such reserve funds would be the first to be lost. Even as it is key on-going experiments are sometimes lost due to financial cuts. Notwithstanding this a major part of the annual program is completed each year.

It would be useful to see each years results quantified and published so that a comparison could be made between the research plans for each year and the work actually acheived. This would also help bring about a better accountability of individual performances and tie in closely with the comments made below on evaluation.

4.6 MONITORING AND EVALUATION

No formal monitoring or evaluation mechanism now exists in the palawija crops program of AARD with respect to the assessment of progress made on the performance of staff-members. Conversely, the expenditure is monitored internally and evaluated in terms of the budget allocation. In addition, an annual audit of the expenditures is made by financial staff of the Government of Indonesia.

At present, an informal assessment of the quality of research, development and staff performance is made internally during annual meetings, seminars, farmers' field days, expositions and visits to research plots and laboratories, and through a study of annual progress reports and publications. The Review Team is of the opinion that monitoring should be a continuous process and become the responsibility of disciplinary leaders, coordinators and institute directors. We urge that the same individuals conduct an evaluation of progress and staff performance annually with the report submitted to the Head of AARD by The Director of CRIFC. We are of the opinion that CRIFC now has the in-house capability to carry out these tasks. It is our further opinion that a formal evaluation of progress made and of staff performance should be conducted every 3-4 years by a 3-4 person team composed of non-members of AARD with a majority of the team being Indonesians from agencies such as AAETE. the Directorate General of Food Crops, the office of the Secretary General of Agriculture, BAPENAS and the Universities.

CHAPTER 5

LINKAGES

5.1 INTRODUCTION

For an agricultural research service to serve the agricultural community effectively it is essential that the service should have an appropriate system of communication channels. Communication needs to flow in both directions between policy makers, researchers, extension staff and farmers so that policies adopted and actions taken relate to farmers capabilities and needs. We can, thus, distinguish three levels of communication in an agricultural research system:

1. Communication between researchers and policy makers;
2. Communication within the research community itself, and
3. Communication between researchers, extension workers and farmers

5.2 LINKAGES WITH POLICY MAKERS

The CRIFC, which is responsible for palawija crop research appears to have well formed and effective linkages with the Director General and Secretariate of AARD who, in turn, communicate directly with the senior staff of the Ministry of Agriculture. The Central Coordinating Unit of CRIFC works with both the direction of AARD and with its own six Research Institutes and appears to link both closely and effectively. The excellent budgetary support afforded to palawija research and the major donor inputs to this field indicate that the direction of the CRIFC has an effective dialogue with government policy makers and donor agencies. This is borne out by the fact that the palawija research program relates closely to the policies spelled out in Repelita IV and to the fact that Government Ministers have frequently referred, in official statements, to the importance of increasing palawija crop production. Recently the Asian Development Bank agreed to fund a technical assistance grant for a project to develop palawija crop production through the Directorate General of Food Crops. Clearly there is an awareness at the policy making level regarding the importance and potential of palawija crops.

5.3 LINKAGES WITH OTHER AARD RESEARCH WORKERS

The second linkage referred to above is the one at the working level, at the scientific interface. AARD has gone to some lengths to develop this internally through an elaborate organizational structure of research coordinators, disciplinary coordinators, commodity coordinators and program (RPTP) leaders. In addition the directors of AARD's several centers and research institutes meet frequently for program and budget planning and coordination sessions and many research scientists attend the annual AARD meeting. The review team formed the impression that much of the time and effort at these formal meetings was devoted to administration rather than technical issues and whilst it would not suggest reducing the number of contact meetings amongst senior staff it believes that a shift in emphasis away from so much administration is probably now appropriate.

Within AARD the informal channels of communication appear to be very effective. As in most other research organisations individual scientists in different institutes meet on a personal basis when common interests, opportunities and concerns bring them together. This informal linkage is strongest where the manpower pool is strong and undoubtedly is highly productive in relation to generating and evaluating new ideas.

The best communication network appears to be among the maize and grain legume breeders, as nurseries and progeny and uniform station yield trials are conducted at multi-locations, being sent-out particularly from BORIF and MARIF, with staff travelling to monitor and tend to these plantings. As a result the breeders form quite a close, integrated unit and one of seemingly mutual respect and trust.

This type of informal linkage is expected to develop as more highly trained people return to work in the palawija program. It would undoubtedly benefit from receiving some degree of formalisation through the activities of the commodity coordinators. Indeed the review team felt that an annual working (technical) meeting of the research workers in all palawija crops with both plenary and crop specific sessions would be desirable. This would not only improve communications within the program but would also provide both the coordinator and research workers with recognition as leaders and participants in a team research effort. Such a meeting will, however, require some shift in the current approach and calls for more of a commodity, rather than the institute, focus that exists in the present system of meetings. The review team has mentioned elsewhere the important role that it forsees for the commodity coordinators in this respect.

It also felt that the system of regular research seminars, which some institute directors were establishing, could be seen as a very effective and efficient way to inform colleagues both of specific ideas and plans and also to expose research procedures and results for peer evaluation and discussion. The review team believes that institute directors and program leaders should make every attempt to attend these seminars regularly to both set a good example for the younger staff and to provide further information and guidance to them. They should also endeavour to make younger scientists participate in such seminars and not just serve as uncritical listeners. Clearly this will be easier to do as trainees return and a "critical mass" of higher level personnel return to each institute.

Agency-wide technical meetings would not only afford AARD scientists the opportunities to review annually the outstanding research results of the year from the individual institutes, but would also permit presentation of results from multidisciplinary programs which cut across the research institute and commodity boundaries. Farming systems, post harvest and agro-economics activities are particular areas where this needs to be done.

Interdisciplinary research projects require a great deal of interaction and communication with colleagues. Because the palawija crops are usually grown in rotation with rice, it is logical that linkages with scientists who work in cropping or farming systems should be particularly strong. Involving the socio-economist in the planning of research with palawija crops grown as part of the farming system will be particularly beneficial in providing an analytical base for evaluating the results and interpreting the importance of the research in the entire system being influenced. The AARD organizational structure is ideally suited to this type of activity and its usefulness could be positively demonstrated in this way. Furthermore such an approach could serve as a valuable in-house training exercise, an activity that is likely to assume increasing importance with the growth in numbers of staff working on palawija crops.

The linkage between the six CRIFC Institutes, each of which conducts some work on palawija crops, is important. Because of the recent changes in mandates this linkage is at a formative stage. It is important that it be developed if a truly integrated national palawija program is to be established. The way in which this development takes place is also important. The review team felt that scientific leadership was vital in this respect and that, given the current manpower resources of AARD, this leadership should come from the commodity coordinators rather than from the mandated institute at MARIF. Ultimately it is envisaged that the commodity coordinators will be located at MARIF, but for the present AARD is correct in building coordinatiion around scientists located at Bogor and, as mentioned earlier, these coordinators should have a key role to play in the integration of palawija commodity programs between institutes. That is to say they should have some responsibility for program formulation as well as for its implementation.

The review team has also looked at communications between CRIFC scientists and those working elsewhere in AARD. This is important because so much agricultural research in Indonesia lies within AARD that there is some risk of professional isolation. In the case of palawija crops this is reduced by the fact that the scientists working on these crops share facilities with scientists working on rice. There are also growing links with Asian regional programs. Exchanges of breeding materials with national maize programs in Thailand and the Philippines have led, for example, to the release of the varieties Arjuna, Bromo, Sadewa, Nakula and Abimanyu.

Communication between palawija research workers and staff from the AARD centres dealing with statistics, economics, soils and communications (library) appears to offer scope for strengthening. The review team recognises that each of these four centres has an important role to play in developing its own program but believes that they could also play important complementary activities in supporting CRIFC palawija researchers working in fields in which these four centres are the national centres of excellence. Reference has already been made to this in the discussion on socio-economics. A similar observation applies to statistics where an opportunity exists for the Centre for Statistics and Data Processing to provide direction, if not leadership, in the selection of micro-computers for use at the various CRIFC institutes so that they will be compatible with the mainframe computers at Bogor/Jakarta. It is recognized that the fields of both computer hardware and software are changing rapidly and that the Statistics Centre also has responsibilities to other sections in the Ministry of Agriculture, but concern was expressed about the diversity of equipment and the risk of incompatibility between programs at the various CRIFC institutes and the coordinating centre.

To some degree the insularity that has led to the above comment also exists within CRIFC. For example, the team was concerned to see research being conducted on the very important fish/rice system which did not in any way involve staff of the Research Institute for Inland Fisheries. Where palawija systems' research involves fish or livestock, advantage should be taken of the expertise available in sister AARD institutes and joint programs be developed or appropriate expertise consulted.

5.4 LINKAGES WITH RESEARCH WORKERS OUTSIDE OF AARD

During the course of its visits the review team also discussed channels of communication between the palawija program and research workers outside of AARD. These channels are usually informal and based on personal contacts. Such contacts exist with some of the research centres of the Ministry of Science and Technology, with the Atomic Energy Agency and with Lembaga Biologie Nasional. There appears to be no structural deterrent to individual scientists working together and neither was a need for more formal linkages expressed.

Linkages with universities are quite extensive and appear to come in three forms: through the training of AARD scientists as students at the university; through AARD staff giving lectures in their specific subject matter areas at the university; and through AARD requesting the services of the university faculty as consulants.

While these three channels provide effective communication, the team feels that it would be advantageous were university linkages strengthened and, perhaps, further institutionalized. The opportunity to accomplish this will vary with location and the personal relationships between the individuals involved. One opportunity for strengthening these linkages is through bringing about a closer integration of training and research.

While AARD's recent record of manpower development is highly impressive, the need for more trained manpower will continue and even grow as AARD continues to develop its national programs and mandates. The evidence to date gives the impression that both qualification and seniority have played a greater role in the selection of trainees than has the need for people in specialized disciplines. For example, marketing was frequently mentioned as a real constraint to the production of palawija crops, and post harvest and food processing were often alluded to as needed disciplines. It is perhaps time for AARD's Manpower Commission to address these needs and recruit applicants accordingly.

The strengthening of the linkage with the university could come by expanding the contact between AARD and the professor who advises the AARD student on his graduate courses. AARD pays for not only the designated tuition and stipend, but also funds the student's thesis research and one visit of his professor to the student's research station. Occasionally the AARD scientist concerned with the student is invited to his thesis defence. This contact needs to be used more frequently as it can lead to collaboration and communication between AARD scientists and the universities.

An additional strategy for integrating research and training, which has been used occasionally, but needs to be more commonly practiced, is that in which the student is assigned a thesis problem which relates directly to AARD's program. This provides a direct link between the university professor, the AARD supervisor and the graduate student and gives all three of them a common interest which may lead to a mutual interest in continuing collaboration after the student completes his degree requirements.

There are several other areas of possible common interest with the universities, particularly local ones. For example postharvest and food processing studies are not well advanced in Indonesia. Both relate to marketing - a constraint to increasing the production of palawija crops that was frequently mentioned to the review team. Marketing is usually a sub-discipline of agricultural economics which itself is a relatively new field in AARD. Marketing is also a field in which the available expertise is limited within Indonesian Universities. Joint programs to develop this expertise would, therefore, strengthen both partners and serve both agricultural and national development efforts. Alternatively, where AARD does not possess a specific expertise and a local university does, there would appear to be scope for collaborative research, although we recognise that to do this effectively may call for some changes in AARD's administrative procedures.

One of the mandates of the Ministry of Agriculture is to utilize the country's natural resources for production whilst at the same time exercising conservation measures. Several of Indonesia's universities have a special curriculum for environmental assessment and there would appear to be mutual benefit to be derived from AARD collaborating with these programs since some of its intensification programs could have an environmental effect.

Communication and library science are another area where mutual interests could be served by stronger linkages between AARD and the agricultural universities of Indonesia.

The palawija programs have established some effective and worthwhile linkages with the private sector, including pesticide, fertiliser and seed companies. Limited contracts with food handling and processing companies also exist and these contacts need to be enlarged as AARD develops its post-harvest and food processing activities.

The review team was particularly impressed by two private sector linkages. The first was the role that the maize program had played in the testing and evaluation of a new hybrid variety which appears to out-perform existing maize germ plasm. The second was a collaborative effort between the root crop program and a large cassava plantation in Sumatra which was providing the AARD root crop breeder with facilities for on-farm agronomic trials and germ plasm evaluation. The review team felt that both of these private sector links could have a national value and could help accelerate the uptake of new technology. If such a policy does not currently exist it would seem to be important that AARD should develop one regarding cooperation with and services to private companies so that both adequate balance and appropriate reimbursement is retained.

AARD has had a long experience in relating to international centres and current cooperation with ISNAR on research reviews demonstrates the potential for further interaction with international centres if needed and desired. Currently there is an excellent linkages with IRRI through its cropping systems network, with CIMMYT on maize and with AVRDC on sweet potatoes. Other linkages exist with CIAT and IITA (root crops) ICRISAT and INTSORMIL (a USAID funded US University Cooperative Program) on sorghum. Prospects exist for further linkages with CIMMYT on wheat and CIAT and IITA on lowland maize.

However, in general, AARD has been at the forefront of international activities in cooperation with regional and international programs. This is well illustrated by the maize program whose collaboration with CIMMYT has entailed the exchange of germplasm, participation in international testing programs, staff receiving training of various types (production, improvement, laboratory and station management), participation in meetings and workshops and sponsored trips to other Asian maize programs.

The linkages to CIMMYT and to South-East Asian national programs have been very effective in both directions. High quality data is obtained and submitted to CIMMYT in their international testing and population and variety development programs, and other Asian countries use materials emanating from the Indonesian national maize program.

A similar strategy although, except in the case of cropping systems, not yet so advanced in development, is being pursued by the other palawija programs. If any criticism at all can be offered of the international centre linkages it is that they are as yet primarily linked to CRIFC staff and there could be some merit in having other AARD centres, such as those for soil and agro-economic research, and even Universities which do some maize research, such as IPB and Gadja Mada, and possibly even the private sector, more closely linked to the regional and international activities.

5.5 LINKAGES WITH THE EXTENSION SERVICES

The linkage between research and extension in Indonesia is, perhaps, rather more complex and somewhat different from that encountered in most countries. In general, research results are not channeled directly to farmers, although occasional meetings, in the form of field days, are held with them. Some on-farm research is carried out, particularly in East Java and in cropping systems research. This is based on the rationale that experimental farms do not necessarily represent real life situations for some types of research, particularly agronomic, soil and physiology research. However, in the main, on farm work is regarded as technology verification and is carried out by the extension services. The role of the research workers is to provide these services with appropriate technology packages. These are promoted and disseminated through training programs, breeder seed production and distribution, demonstration and field days, preparation of research reports and other written materials and the use of the various public media (newspapers, radio, TV). As the chapter on Impact will discuss, this has been done very actively during the last three years.

AARD has two prime extension clients, the Agency for Agricultural Education, Training and Extension (AAETE) and the Directorate General of Food Crops (DGFC). The former agency is primarily responsible for training extension personnel and farmers. Its role and link to AARD were described to the review team in its briefing meetings but we had very little opportunity to follow up on this on our field visits.

It is worthy of note that the AAETE was seldom mentioned as a supporting organization in any of our meetings with extension workers, unless the subject was brought up by a team member. This indicates that either the role of AAETE is not sufficiently recognized and appreciated or that AAETE is doing such an adequate job that it is taken for granted. We find ourselves, therefore, not really able to comment on the AAETE-AARD linkage other, perhaps, than to suggest that future missions in this series of reviews might need to structure their program to particularly address this point since it appears to be one of some importance.

The review team were able to look more closely at the linkages with the DGFC, although here again a word of caution is necessary in that it was possible for us to meet only a handful of extension personnel in the time at our disposal and our opinions are obviously biased by the views expressed to us.

The joint AARD/Dutch team at MARIF gave us a useful schematic presentation of technology transfer in Indonesia (Fig 5.1)

TRANSFERENCE OF TECHNOLOGY AT THE NATIONAL LEVEL

AARD

DGFC AAETE

DIPERTA

TRANSFERENCE OF TECHNOLOGY AT THE FARM LEVEL

Coordinated by Kanwil <----(Provincial Agricultural Services)

Provincial Research Stations
(Test and adapt in various climatic zones)

District Agricultural Extension Office

Staffed by PPS <--------------(KABUPATEN)
(subject matter specialists)

Sub-district Agricultural Extension Centre
Staffed by PPM <-------------(KECAMATAN)
has <---- (Sub-district Ag. E Officers)
observation
plots
serving
2000-4000
farmers

Staffed by PPL <--------- Village Level
(village level extension workers)

Responsible for 600-1000 farmers

Contact Farmers

Farmer Group

Other Farmers

FIGURE 5.1

TECHNOLOGY TRANSFER IN INDONESIA

We were able to meet jointly with the directors of SARIF, MARIF and MORIF and the Kanwils of the provinces in which they are located and also with the Kanwil and his staff in Lampung. In all instances we were impressed by the cordial relationships between the Kanwils and the research personnel. However, we also gained the impression that the linkages between the research and extension personnel at the provincial level was more tenuous and less direct and in some instances we felt that there was a sensitivity about researchers being involved in extension. However, care must be taken in generalising as much depends on personnel relationships. At Malang the team met an extension information officer posted at MARIF, this seemed to be a very effective way of developing a research - extension linkage and a step that would be desirable at all 6 research institutes.

We were advised that research - extension links were excellent at the higher levels and that all research results were reported to the Coordinating Centre in Bogor from whence they were transmitted to AAETE and DGFC, who then channelled them along the pathways shown in Figure 5.1, thus it was suggested that the need for direct communications between research and extension workers could be limited. Nevertheless we felt that it would have been beneficial to provincial extension workers for them to have had direct inputs from research staff in their technology verification trials.

The team did not have the opportunity to meet any extension subject matter specialists (PPS's) but was given to understand that whereas there was a strong cadre of these officers for rice, this was not the case for palawija crops. There would appear to be a need for such persons and for more interaction between this level of extension worker and research staff in order to facilitate the dissemination and interpretation of research results to farmers through the field extension agents (PPL's).

There are also important lessons for the research staff to learn from the extension personnel and we felt that in order to do this there was a need for improving lateral linkages at both the national and the provincial level. In order not to generalise we offer a detailed example on this topic.

In the Sitiung area of West Sumatra, fertiliser and liming experiments have been conducted since, at least 1978. At least four institutions have been involved namely:

a) IPB
b) Andallas University
c) AARD's Centre for Soil Research
d) SARIF

In our conversation with the Kanwil it was suggested that the Dinas Pertanian in West Sumatra had taken the initiative in planning seminars to collect the research information available and apply it to local extension programs and regional development efforts under their responsibility. However, the Kanwil illustrated the need for additional research information. Stated another way, he asked a lot of researchable questions such as the following:

1) What is the response of soybean to lime passed through screens of varying sizes?

2) Should lime prices be related to mesh screening?

3) The local cement plant could produce 500 mesh limestone at the level of 2,000 tons/day. What is the effectiveness and residual effect of such finely screened lime?

4) What should be the source of the limestone to be used? Should it be;
   a. Local, of 60 mesh fineness costing Rp 60/kg
   b. Imported from Java, which would be finer material, Rp 90/kg.
   c. 500 mesh limestone from the local cement plant. (It was known that processed cement sells for Rp 90/kg in W. Sumatra and yet the price of limestone at the local cement plant was not known).

The review team felt that the logical way to address these enquiries in a holistic manner was for AARD to take the lead role since it could bring its soils and agro-economic centres as well as CRIFC and SARIF to work on them and also link with the University programs.

AARD's leadership would demonstrate the value of lateral communication both within AARD and between AARD units and the universities working in related fields. A planned and unified approach to this problem of liming soybeans in West Sumatra would provide the provincial extension services with the type of information needed to answer the problems posed by the Kanwil and, at the same time, would optimise the use of the funds and personnel available for research.

It was suggested to us that the example quoted was not unique, more than one Kanwil spoke of the desirability for closer links between the various AARD institutes and stations working in their province.

The ultimate client for AARD's research is, of course, the farmer. We gained the impression that there was some sensitivity about researchers making direct contact with farmers or doing on-farm research without adequate contact with or through extension workers. On the other hand there was no indication of inadequate contact between researchers and farmers. At each research station and experimental farm visited, visits by farmers were encouraged and special field days were held to provide farmers with the opportunity to see research results and discuss problems with research workers.

Again, the personality of the researcher, the type of research program conducted and the amount of direct involvement with farmers required for any particular research activity are strong determinants of the amount of contact between researchers and farmers. Whilst better communication at every level, both within and between organizations is always possible we did not observe any direct evidence of a threatening lack of contact and information flow in both directions between palawija researchers and farmers.

CHAPTER 6

IMPACT

6.1 INTRODUCTION

Much agricultural research, even when very well endowed, as in the CGIAR centers, takes 7 - 10 years from the planning stage until tangible results are available on farmers fields. When the research is based upon the sort of manpower, physical and financial facilities that AARD had when it started to function about 1976, then a different sort of time horizon has to be considered. In effect the present palawija research program has had some skilled personnel in its maize, grain legume and cropping systems activities since the early days of AARD, but only in the last 2 or 3 years have numbers built up as NAR I trainees started to return. So, much of the program that was reviewed is relatively new although it is built up on a solid foundation of maize and legume breeding that started nearly a decade ago.

Much of the output from the program is in the form of recent documentation some of which is still in the process of local verification by the extension services. In Table 6.1 the published ouput relating to palawija research in Repelita III is shown.

TABLE 6.1

RESEARCH PAPERS PUBLISHED BY CRIFC STAFF DURING 1979-1984

	Commodity				
Publication	Rice	Maize/ Sorghum	Grain Legumes	Root Crops	Total
Ind. J. Agric. Sc.	33	9	9	2	53
Agric. Res. Bulletins	8	3	5	0	16
Other Publications	48	26	24	21	119
	89	38	38	23	188

However, publication is but one stage in the output of the research agency and only describes the germ plasm and techniques that it has developed. In the rest of this chapter we shall discuss the new varieties and techniques emerging from the program and attempt to assess the extent to which they have been adopted by the farmer, since this is the ultimate test of the research agency's impact.

6.2 OUTPUTS FROM THE CEREAL PROGRAM

During the Third Five Year Plan period (1978-1983), six open-pollinated CRIFC varieties and one top-cross hybrid of P.T. Cargill were released by CRIFC (Table 6.2).

TABLE 6.2

MAIZE VARIETIES RELEASED BY CRIFC DURING THE THIRD FIVE YEAR PLAN PERIOD (1978-1983)

Variety	Year of release	Av yield (tonnes/ha)	Maturity (days)
Arjuna	1980	4.3	90
Bromo	1980	3.8	90
Parikesit	1981	3.8	105
Sadewa	1983	3.7	86
Nakula	1983	3.6	85
Abimanyu	1983	3.3	80
Hybrid C_1*	1983	5.8	100

Every year the Institute provides "breeder" seeds to the Directorate of Food Crop Production for the seed chain flow to produce first "foundation" then "stock" and finally "extension" seed for distribution to farmers. The amount of breeder seed provided during 1983 totalled 2300 kg.

* Top cross hybrid of P.T. Cargill

A number of fertiliser trials have been completed with maize and, based on widespread testing general recommendations have been made for use of 200 - 300 kg/ha of urea, 100 - 200 kg/ha of TSP and 0 - 100 kg/ha of KCl. The rates (kg/ha) of N, P_2O_5 and K_2O that usually gave the highest yields were 135, 90 and 60 respectively (Table 6.3).

TABLE 6.3

EFFECTS OF N, P AND K ON YIELD ON VARIOUS SOIL TYPES (1980-1981)

Fertilizer (kg/ha)			Soil type / Grain yield (tonnes/ha)			
N	P	K	Andosol Garut	Latosol Citayam	Regosol Yogyakarta	Red-Yellow Podsolik Lampung
0	0	0	3.2	1.2	2.1	0.5
67.5	45	0	4.5	3.1	4.5	1.7
67.5	0	30	5.6	2.5	3.8	0.9
67.5	45	30	5.7	3.0	3.9	2.1
135	90	60	5.7	4.2	4.7	3.0

Three seasons of tests in Kediri, East Java, indicated that Maize did not respond at this location to phosphate and potash fertilizers. Arjuna yielded about 5 tonnes/ha when fertilized with 200 kg urea/ha. A local variety with a high rate of urea applied by farmers yielded only about 3.5 tonnes/ha.

Tests with phosphatic fertilizer conducted at Sukamandi (Ultisol, pH 4.6 - 4.8), Pleihari substation (South Kalimantan), Rambatan (Andosol) and Sitiung (West Sumatra) indicated that the highest yield was attained when 90 kg P_2O_5 was used and at the Tamanbogo substation, Lampung the maximum yield required 60 to 120Kg P_2O_5/ha.

At Sukamandi, the use of 3.3 tonnes lime/ha without phosphate gave the same yield as the application of 90 kg P_2O_5/ha without liming. At Tamanbogo, liming at the rate of 3 tonnes/ha gave about the same yield as without liming when the base fertilization was 90 N, 60 P_2O_5 kg per ha.

At Hulu Sungai Selatan substation (South Kalimantan) liming at the rate of 1.6 tonne/ha gave the same yield, which was higher than the yield without liming.

At Tamanbogo, Lampung, with 90 kg N + 60 kg P_2O_5 + 30 kg K_2O per ha, the use of 0.5 to 1.0 tonne of lime/ha increased yield significantly. Increasing the rate of lime up to 2.5 tonne/ha did not provide further yield increases.

A greenhouse experiment using yellow-red podsolic soil from Jasinga, Bogor indicated that liming at the rate of 100% based on AL_{dd} increased pH from 4.56 to 6.56, reduced AL_{dd} from 10.50 to 0.50, and increased the absorption of N, P, K, S, Ca, Mg, Fe, Mn, and Na.

In a defoliation experiment cutting all of the leaves of Arjuna at a density of 70,000 plants/ha at the maturing stage did not reduce yields significantly (4.26 t/ha vs 4.69 t/ha) and increased the protein content of the grain from 6.1 to 8.0%. The cut leaves amounted to 1250 kg/ha. The experiment was conducted at Soropadan in the wet season of 1981/82.

In a trial to control downy mildew the use of Apron (Ridomil) / 35 SD at the rates of 1 g/kg seed and 2.5 g/kg seed was as effective as the application of 5.0 g/kg seeds. The experiment was conducted at Cikemeuh using Harapan, Bogor Composite 2 and H6. The infection rate was 53 and 68% for the untreated susceptible and 5% for the resistant varieties. The treated seeds showed only 0 to 0.6% infection. Another test at Tamanbogo showed that RE 26745 50 WP was as effective as Ridomil 35 SD in the control of downy mildew. Apron was found to remain effective on treated seeds stored for up to 9 months.

In work on pests and diseases at Jambegede, Malang, the highest infection rate of Ostrinianubilalis occured during the wet season; while Prodenia litura and Plusiachalcetes were found to be most prevalent during the dry season. Other pests such as Atherigona exigua, Heliotis armigera, Aphis maydis and thrips were prevalent in both wet and dry seasons. The highest yields were obtained from plantings made in April and May during the dry season, and in October plantings during the wet season.

A trial at Manyeti, Subang in the 1981 dry season and 1981/82 wet season found that Isoksation and Monokrotofos were more effective than other insecticides (Karbaril, Diazinon, Sianofenfos, Diklorvos) tested for crop protection against insect damage. Increasing the level of insecticide up to 1.5 times the recommended level did not have any adverse effect.

Reference has been made earlier in this report to the magnitude of post-harvest losses. Research has been carried out to try to reduce insect damage. Silason 25 at a rate of 0.5 g active ingredients/m^2 surface, applied every 2 months, was effective for the protection of stored grain. After 10 months only 5% of grains in the treated gunny bags were damaged, whereas 11% were damaged in untreated bags after four months. The damage level of the treated grain still enabled it to be classified as grade 1 while the untreated grain was down-graded, because of insect damage, to grade 3. Air-tight plastic bags were also found to be of value in grain storage. The required (maximum) grain moisture content was 10% for seed and 12% for grain.

Limited research has also been carried out on post-harvest technology and three types of corn shellers have been developed, these are a modification of the TPI model, a pedal type and a bicyle type. The shelling capacities per hour were 14, 16 and 19 kg of grain, respectively.

The sorghum program is much more recent than the maize program, it has released three full season (90 - 110 days) varieties, Katengu, UPCA-S1 and KD-4, that are widely grown by farmers. In 1983 the variety Keris was released, this matures in 70 - 80 days and was developed in response to farmers requesting an early maturing variety and also to meet the needs of the cropping systems program. Its yield potential on-farm is 2.5 - 3.0 t/ha.

6.3 RESEARCH OUTPUTS FROM THE GRAIN LEGUME PROGRAM

The grain legume breeding program is addressing the requirements of both monoculture and mixed cropping systems. During the period 1980 to 1983 CRIFC released 4 soybean, 5 groundnut and 4 mungbean varieties (Table 6.4). Presently 2 promising soybean and 2 mungbean lines are being proposed for release.

The advantages of the improved soybean varieties include higher yield, earliness, and tolerance to rust disease. These varieties also ripen simultaneously and have good seed quality. Early maturation is particularly valuable for cropping systems in which a short duration crop is desired between rice plantings.

The AARD grain legume program has conducted a large number of agronomic trials in addition to its work on plant breeding. Among the more useful findings are information that:

- Mulching, up to two weeks after planting, using fresh plant residues of mungbean and sweet potato inhibits the germination of soybean seed.

- Lime applied to acidic red-yellow podzolic soil has more effect on groundnut yields in the season following planting than it does in the season when it is applied.

- At higher elevations (1100 m) soybean produces yields 50- 75% higher than they do at lower elevations, but they take 30%

longer to mature. However, seed quality is better at higher elevations.

- Mulching of paddy straw on to newly planted soybeans can increase the soybean yield by 40%.

- Soybean can be cultivated after wet land rice using zero tillage, soybean should be planted after the rice straw has been cut close to the soil surface.

- Soybean responds best to nitrogen fertilizer when this is applied four weeks after planting. Yield increases of 11% were obtained following this practice.

- Fertilizing groundnuts with 45 kg N + 90 kg P_2O_5 + 50 kg K_2O gave a yield of 1.7 t/ha dry pods. This was 51% higher than the unfertilized control.

- A 19% increase in yield (1.7 t/ha day pods) was obtained with groundnuts given 30 cm deep soil cultivation rather than minimum tillage.

- Dolomite is an important source of Mg and Ca. The application 700 kg/ha dolomite increased the yield of mungbean by 100% on a latosol soil (0.8 t/ha).

- Weeding and supplemental irrigation are important for producing high soybean yields in the dry season after wet land rice. Yields of 1.6 t/ha. in the absence of rainfall during the growing season necessitate irrigation every 10 days and 2 weedings.

- <u>Rhizobium</u> innoculation is essential for growing soybeans on newly opened land. On such lands the use of "Nitragin" and "Legin" innoculant improved yields up to 125% (0.62 t/ha).

- Control of the soybean podborer is effective when insecticide is applied during the flowering stage of the plant.

- Bean fly infestation of soybeans can be controlled using 2.4 gm Karbofuran/kg seed, or by spraying with Mefosfolan or Karbofuran 7 - 14 days after planting.

- Scab, Cercospora leaf spot, and powdery mildew of mungbeans can be controlled by spraying Delsene MX 2000, 20 and 40 days after planting.

TABLE 6.4

Grain Legume varieties released by CRIFC during the period 1980 - 1983

Variety	Yield (t/ha)	Maturity (days)
SOYBEAN		
- Galunggung	1.5	84
- Lokon	1.2	78
- Guntur	1.2	78
- Wilis	1.6	88
- B. 14000/B*	1.6	90
- B. 3035*	1.7	88
PEANUT		
- Rusa	2.0	100
- Anoa	2.0	100
- Tupai	2.0	100
- Pelanduk	2.0	100
- Tapir	2.0	100
MUNGBEAN		
- Merak	1.3	58
- Nuri	1.2	58
- Manyar	1.2	58
- Betet	1.3	58

* Galur Harapan

The advantages of the improved soybean varieties include higher yield, earliness, and tolerance to rust disease. These varieties also ripen simultaneously and have good seed quality. Early maturation is particularly valuable for cropping systems in which a short duration crop is desired between rice plantings.

6.4 OUTPUTS FROM THE ROOT AND TUBER PROGRAM

The root crops research program has yielded reasonable results, given the resources available. During the past five years CRIFC has released two cassava varieties, named Adira I and Adira II. The former has a high starch content, moderate yield, high harvest index, short maturity, tolerance to cassava bacterial blight (CBB), the most important cassava disease. It also has low HCN and firm texture after cooking, which is good for the home fermented cassava industry. Superior strains of cassava have also been selected in SARIF from local varieties: Sipucuk Biru and Valenoa.

Adira II has medium starch content, high yield, medium maturity, tolerance to CBB and mites, drought tolerance, and high HCN content. This variety, useful especially for industrialization, has not been widely accepted.

New cassava clones M-30 and M-31, offer 30% to 40% higher yields than the improved variety Adira I, and yield 50% to 70% above local varieties. These clones have not yet been released as varieties.

Results also indicate that cassava yields can be increased by 22% above the present national average through the application of improved cultural practices alone. When improved high yielding varieties are included in the "package" the increase amounts to 73%. When appropriate plant nutrients are also added, yield can be increased by up to 247% of the present average. Thus, it is believed that technology is available for high yields, but it is not likely to be used until markets are firmer, and this in turn, might depend on better processing methods.

The effect of fertilizer on cassava yields in different types of soils has also been studied during the past five years. The results indicate that cassava gave better fertilizer response on latosols than on red-yellow podzolic soils.

Studies indicate that split applications of one-third of the nitrogen and potash at planting and two-thirds at 3 months after planting could increase cassava yields by 20% as compared to a single application at 3 months after planting.

Appropriate methods of fertilizer application could also increase cassava yield. Researchers have found that dibbling application (burying) gave 11% more yield than band application in a circle around the plant.

Physiological studies showed that macro-nutrient uptake of nitrogen, phosphate and potash is very important in cassava. They also showed that the individual roles of nitrogen, phosphate and potash in the cassava yield increase were 20%, 49% and 5% respectively.

During the last Repelita, CRIFC released four high carotene sweet potato varieties, Daya, Karya, Prambanan and Borobudur. These yield 30 to 40% higher than local cultivars, although their taste when cooked is poorer than that of local cultivars because of their carotene content, people like them for fresh consumption in the form of salad ("rujak"). These varieties are also highly resistant to scab disease (Elsinoe sp).

The highest-yielding sweet potato variety, Prambanan, is the one preferred by the sweet potato weevil, Cylas formicarius. Entomological studies indicate that Daya variety is the least preferred by the sweet potato weevil. Resistant or even sufficiently tolerant lines have not yet been identified and may not be possible.

Studies on fertilizer use in different soil types show that application on regosol soil gave the highest sweet potato yield, an increase of 84%, as compared to 73% on latosol and 32% on andosol. On the other hand, mulching with 2 ton/ha of rice can increase sweet potato yield by 11%.

6.5 THE ADOPTION OF TECHNOLOGY

The results from the maize program have been used in formulating packages of technology recommended for intensification. This has raised average maize yields from 1.08 t/ha in 1973 to 1.70 t/ha in 1983, an increase of 4.6% a year. This, in turn, has resulted in a production increase as high as 149,000 tonnes each year (4.1% of the mean production) in spite of a decline in the area under maize of 39,800 ha each year (1.5% of the mean area).

The yield levels attained are, however, far below the potential of the varieties now available and being used. If only 70% of the full potential of these varieties were to be realised average maize yields would rise to between 2.3 and 4.0 t/ha, depending on the variety used. Such yields are well in excess of the Repelita IV 1988 target of 2.0 t./ha.

The constraints to yield increases have been discussed in Chapter 2 which drew attention to the low profitability from maize due to complex marketing linkages, high costs of transportation and the inadequate drying and storage facilities. There is also an inadequate supply of high quality seed of both improved and local varieties. Consequently, many farmers use seed from their own previous crop or from purchase in the local market; this seed is generally of poor quality and gives low germination and yield. In addition to this the market uncertainty leads to inputs being used at levels below which the improved varieties give their optimum yields.

In some areas an additional constraint to the use of improved varieties is that farmers still plant them in the traditional way at a plant density suited to poor quality seed and much in excess of what is required. This makes the cost per hectare of improved seed extremely high and discourages its use. Overcoming this problem is principally an extension task whereas the problems of marketing and demand are more complex and relate more closely to development policy. Certainly the growth of the animal feed and agro-industrial uses of maize would suggest that past and on-going maize research should have an even greater impact on Repelita IV than in Repelita III, providing that adequate quality seed can be produced and market prices do not become less attractive.

Sorghum presents a similarly encouraging picture. In this case the area under the crop increased from 17,600 ha in 1973 to 39,900 ha in 1980, during this period average yields increased by 80% from 600 to 1075 kg/ha and overall grain production rose fourfold. Much of this increase is attributed to the release of new varieties. The main contraints to further adoption of new varieties are the lack of good seed and the low profits from producing this crop; both of which lie outside of the responsibilities of the research staff.

Whilst it is difficult to assess the overall input of the grain legume program it appears that improved legume varieties have replaced the traditional local varieties on about 30% of the total area for soybean, 25% for groundnut, and 75% for mungbean. Given the problems that exist in the supply of adequate seed these figures are most encouraging.

At the provincial level there are some areas where the impact of the new technology is very clear. One example is in Southeast Sulawesi where the new Galunggung variety of soybean has become popular very quickly and is now one of the two most common varieties in use.

In North Aceh it has been possible to quantify the impact of AARD activities more clearly. In this area it is estimated that about 120,000 hectares are available for planting to soybeans after rice. This target of opportunity was identified through research and the constraints to production were determined to be a lack of labour for land preparation, appropriate production technology, availablity of seed and markets for the product. Through research, a no-tillage planting system was introduced. The new varieties were tested and demonstrated yields of over two tons per hectare in the no-tillage production system. A method of field to field seed production was initiated within the Province whose three soybean processing plants in Medan are now soliciting additional raw material. To date the new production technology has spread to 36,000 hectares with a potential spread to another 24,000 hectares. Market prices have remained high and stable and this has undoubtedly contributed to the pace of uptake of the technology.

More recently efforts have been made to develop soybean production in West Sumatra where many of the potentially productive soils are red-yellow podzolics which are acid and high in iron and aluminum content. Without lime, soybean production on these soils is near to zero, while with moderate applications of lime, yields of 1.7 to 2.0 tonnes per hectare can be obtained. A government production program in the area has a target of liming 1,200 hectares for production. To date, only 800 hectares have been planted but even this limited area offers prospects for a considerable impact on the well-being of the producers, many of whom are transmigrants.

The newly introduced mungbean varieties are demonstrating their impact through the increased area being planted to the crop, (193 000 ha in 1978 to 267,000 ha in 1983) the increased yields being obtained (520 kg/ha in 1978, 603 kg/ha in 1983) and the increased efficiency that their more uniform maturity provides by requiring only two harvests rather than three or four as previously required. Also, the early maturity of 58 days provides an excellent opportunity for including mungbean in the cropping system.

An example of the impact of the new mungbean varieties is exhibited in the Jatilahur area where they are now the favoured crop between irrigated rice plantings.

The release of the latest varieties of groundnut is too recent for an impact to be demonstrated as yet but their rust tolerance will enhance their adaptation. Groundnuts also respond to lime when grown on the red-yellow podzolic soils of Sumatra and research has demonstrated that yields of 2.6 tons per hectare are possible with liming. A complete system of production and marketing has not yet been developed for groundnuts as it has for soybeans but the team was informed that there is the potential for developing such a system through additional research.

The root crop program has not had either the strong market demand that has encouraged the uptake of the soybean research nor the time span to produce material as superior as that produced by the maize program. It has also, until recently, had very few staff. Nevertheless the Adira 1 variety, which it released in 1978, now covers 25,000 hectares and the newer materials and agronomic techniques are being taken up enthusiastically in the industrial cassava plantations of Sumatra. In addition improved root crop technology is playing a useful role in the cropping systems program which has been adopted by farmers in some areas. Overall, however, the uptake of newer root crop technology has been constrained by market and price factors, as explained in Chapter 2, and adoption rates could continue to be sluggish if progress cannot be made on these fronts.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 BACKGROUND

Palawija crops comprise about 12% of the total value of agricultural production in Indonesia and provide about 25% of total calorie intake. The country imports over US $300 million of palawija crops annually, about half of this is wheat whose imports total 1.5m tonnes a year. The rest is mainly shelled groundnut, soybean and soybean cake, the imports of all three of these products have been rising and about half of the national requirements of soybean and its products are now imported. Exports of palawija crops are limited and consist mainly of dried cassava products for the EEC's animal feed market. The quantity exported varies widely from year to year and represents between about 0.4 and 2.0m tonnes of fresh cassava equivalent with a value of between US $16m and US $72m.

Although rice is the staple food of choice and incomes from its production are difficult to match from other food crops grown in monoculture, the growth in demand for rice appears likely to outstrip the production potential over the long term and government planners have been giving increased attention to palawija crops whose past production record has been sluggish. These crops are expected to help fill the gap from future short-falls in rice production. They can be grown on lands unsuitable for rice, are particularly valuable in the first years of transmigration programs and for cropping systems as practiced on small farms. Furthermore the current levels of technology practiced for palawija crops in Indonesia tend to be below those of other ASEAN countries and the prospects for greater yields are considerable.

These prospects are, however, constrained by economic factors. In the case of cassava and maize, two of the main palawija crops, demand as human food is relatively inelastic, but prices, which already compare relatively badly with rice, are not. So any increase in production will have to find its way into animal feed or into the processing sector to complement or supplement current usage. The extent to which this is done is likely to be highly dependent on price policies as there is evidence of cross elasticity with alternative commodities including ones which are imported. For the grain legumes, particularly soybean, market prices are already attractive, both as human food and for the rapidly growing animal feed market and the major constraints to increasing production are technical ones.

Against this background the government has, over the last few years, invested heavily, with the help of external assistance, in building facilities, training manpower and providing operational funding for palawija crop research. This now utilises over 10% of the national agricultural research budget and approximately 40% of the program of the Central Research Institute for Food

Crops (CRIFC). During 1984/85 over 750 palawija crop experiments are scheduled, spread throughout CRIFC's 2000 ha of land on nearly 50 research stations and experimental farms. These facilities are being developed and now house 47 scientists at the Ph.D. or M.Sc. level working on palawija crops, plus a further 121 at the sarjana level. When staff currently away on training return to CRIFC the number with post-graduate qualifications will rise to 90, and more staff are still being selected for training.

The review team concluded that it was looking at a solid infrastructure, a growing core of competent and dedicated personnel and a scientifically sound research methodology. By 1988 the cereal and grain legume programs should have well rounded teams in most disciplines but additional trainees still need to be identified for certain support disciplines and for the root crop program. However, given the time since AARD has been established the infrastructural development is highly creditable as is the quality of the research now emerging from the program.

The conclusions and recommendations of the review team, which form the rest of this chapter, need to be considered against this background. In most instances they are offered not as criticisms of past or present activities but in the context of the future needs of a rapidly growing and changing organisation.

7.2 PLANNING AND PROGRAM FORMULATION

(i) Because food crops are grown throughout Indonesia, in a wide range of climatic conditions and variable socio-economic circumstances, research on these crops must be widespread, geographically. The many tasks that are necessary have resulted in each balai of the CRIFC undertaking the lead responsibility or "mandate" for a specific commodity or agro-climatic task. These mandates have undergone changes during the past five years. This is inevitable in an organisation that has grown as rapidly as AARD has done. Indeed such flexibility in outlook is a healthy sign but, nevertheless, it has left some problems in its wake. Thus currently MARIF has the mandate to lead palawija research, SURIF has the best developed facilities to do the work and BORIF has the best trained pool of personnel (and the biggest training program). It now requires skilled leadership and coordination and good cooperation from the balai directors to optimise the use of these dispersed resources in palawija research. This will be facilitated if CRIFC balai mandates can be maintained without further changes (other than those currently being processed) for a period of several years and if the national commodity coordinators are permitted to play a role in assisting the Director and Coordinating Centre in ensuring that, at least until MARIF has a much larger pool of trained personnel, the maximum use is made of the skills and expertise of BORIF staff in the implementation of the national program.

Considerable care and effort will also need to be exercised to ensure that the overall work program fulfills the national Palawija mandate, given the fact that each CRIFC balai has a specific lead mandate and is subject to local pressure groups. Here again the role of the national coordinators is crucial and it is essential that they be allowed to exercise it effectively.

(ii) The posts of "national coordinators" for the three major groups of palawija crops are recent innovations based upon the growth in facilities, budgets and staff for palawija research. The review team recommends that the role of national commodity coordinators should be strengthened, modelled on the successful coordination effort in the national rice program (and that used for maize breeding). This will require that coordinators be given some supporting resources and the authority to effectively coordinate all activities in the area in which they are the designated coordinator. Indeed the "coordination" should be seen as a "leadership" role and not merely as a liaison task. In order to do this there will have to be a shift of responsibility in the program area from balai directors to national coordinators. The framework for doing this already exists since each balai has commodity coordinators who advise their directors on commodity matters, but the existing system has two weaknesses in terms of integrated planning. First, the national coordinators have only limited contact with the balai coordinators in their commodity. There is no annual meeting of the national and balai coordinators, for say root crops, at which the progress made nationally in the previous year and the plans of each balai for the next year are collectively reviewed. Nor do the national coordinators automatically see all research reports in their field of interest. Second, the existing channel of program formulation within the balai's is on a disciplinary rather than a commodity basis. The review team feel that the development of national palawija crop strategies would be enhanced were all research activities (RPTP's and research units) to be channelled to the balai directors through the commodity, rather than the disciplinary, coordinator at each balai. Research activities should still receive disciplinary screening, but the approach channel should be scientist - disciplinary coordinator - commodity coordinator - balai director - national commodity coordinator - director of CRIFC. The additional budget required to provide the national coordinators with the logistic support and travel funds needed to fulful the role suggested above might be found from reducing the current number of administrative meetings and focussing more heavily on the type of commodity meetings suggested earlier. This will also permit the national coordinators to make greater inputs to the program formulation process by enabling them to give greater leadership and direction to junior scientists.

(iii) The current priority setting process in CRFIC is informal but includes considerable and widespread consultation. It tends to be highly production oriented and particularly responsive to local needs. Overall it appears to be identifying rational goals particularly in terms of the manpower resources available. Its major weakness is the absence of a strong economic input at the commodity level. This is of considerable importance for certain commodities where the principal constraints to increased production are non technical ones. The review team, therefore, recommends a strengthening of the economic input to the priority setting process. At the present time such an input needs to come from the Centre for Agro-Economic Research (or through the use of outside consultants) but later, as CRIFC builds up its own economic expertise, CRIFC personnel could play an important role in this exercise. The implementation of this recommendation will probably require a more formal priority setting process than at present. This would be beneficial because the increase in staff working on palawija crops is making more research options available and the new mandates of the balai's and the many and complex cropping and farming systems involving palawija crops, both mean that the selection of additional research priorities needs to be done with the utmost of care.

(iv) For all palawija crops, research on post-harvest handling, processing and marketing is important for both identifying and providing the solution to non-technical constraints to increased production. With respect to maize and legumes the questions to be resolved relate to appropriate drying, storage, and pest-control practices, quality control and aflatoxin technology. Knowledge of these topics exists but needs adaptation to Indonesian conditions. This type of post-harvest work can be thought of as a logical part of the research on each grain or legume crop and can be done at the field research institutes as necessary. On the other hand, root and tuber crops are, by nature, short lived and for these crops post-harvest work is necessary to convert perishable raw materials into stable food and feed products. The task is principally one of introducing technology at either the farm or the village level and testing, modifying or adapting it and then tranferring it to farmers. Current post-harvest efforts are scattered and not well coordinated and the precise stage at which AARD's involvement ceases is not well defined. The review team recommends that a clear policy for post-harvest activities (including marketing studies) should be defined. Such a policy should clarify the stage of processing or storage activity at which CRIFC's responsibility ceases. It should also define where this work should be carried out. The team would favour an approach which used BORIF as the "centre of excellence" for this work but included cooperative programs with all CRIFC balais. For such a program to be effective one of the BORIF staff wouild need to be designated "national coordinator" and to be given the same responsibilities and authority proposed for the CRIFC commodity coordinators. Consideration als needs to be given as to what sort of relationships CRIFC will have with the private sector who are both "doers" and "users" of processing research (especially for cereals).

(v) In addition to the technical and economic factors influencing the choice of priorities and post-harvest strategies, the review team urges that nutritional considerations be given more emphasis. In this context the soybean has the potential for becoming the chief source of protein in the Indonesian diet. It is already a traditional food and is already grown as an important palawija crop. We recommend, therefore, that high priority be given by CRIFC to the development of the soybean in Indonesia through intensified research, introduction of new processing techniques, and wider dissemination of low scale technologies, as well as by marketing support, if necessary. Other palawija crops also have a role to play nutritionally, for example, maize can be substituted for rice as a superior food. All of the grain legumes are major sources of protein and B vitamins. Orange-fleshed sweet potatoes are excellent sources of vitamin A & C, while sweet potatoes and Irish potatoes can also be substituted for rice. On the other hand, cassava is contributing little to the diet except calories. The team feels that cassava should be thought of chiefly for its industrial and feed potential, since when it is used as a food, it needs to be heavily supplemented with legumes, vegetables, and fruits.

(vi) The palawija crops are recognised as part of widespread cropping systems used by very large numbers of farmers in distinct climatic zones and soil types. Innovations in technology must fit into existing systems and be acceptable to farmers. To do this effectively it is not enough to send promising new component technology to the extension services. It needs to be packaged for the appropriate cropping system and first tested not only on experimental lands but also at the farm level. The methodology for doing this has been successfully developed in a collaborative program with IRRI and a number of CRIFC scientists have acquired specialist knowledge in this area. Cropping systems is, however, not organised as a major thrust program of either the palawija program or the balais themselves. Most balais in the CRIFC have some expertise in cropping systems but there is no clear coordination or leadership role to pull the various regional activities together in the way that we have proposed for commodity and post-harvest activities. In view of the importance of cropping systems research and of effectively evaluating it before passing it on to the farmer the review team recommends that consideration should be given to appointing a national coordinator with broad responsibilities for leading the work in this field, whether it be financed domestically or from external sources. Such a coordinator should work with both rice and palawija based cropping systems and should interact with all of CRIFC's commodity coordinators.

(vii) At an early stage in the development of a new agricultural technology its potential economic impact should be examined and no new technology should be recommended until it is clearly seen to be of economic benefit to the farmer. In order to do this each balai requires some competence in production economics. This might be met by having at least one junior economist on the staff while the director of CRIFC should have advice from a production economist at the Ph.D. level (possibly located at BORIF). Consideration should be given to the early recruitment of trainees for those posts and/or to the contracting of this work out to university personnel. Again the need for CRIFC-wide coordination is stressed.

7.3 RESEARCH ACTIVITIES

(viii) The review team formed a very positive impression of the research methodology being used in the palawija program. It felt that experiments were well planned, conducted, and reported on. The capacity to carry out all of these functions is being steadily increased. The lay-out of experiments is good as is the appearance of field plots. Staff appeared to relate well in inter disciplinary activities and to have a good understanding of each others role and work. At all of the balais' visited the director and senior staff had a good grasp of the entire program and were providing enthusiastic leadership.

(ix) Given the size and quality of the program that the CRIFC is now undertaking in palawija crops and the expected doubling in size of the trained staff of this program over the next few years the review team recommends that the time is now appropriate to initiate a comprehensive system of monitoring and evaluation of the research program on a regular basis The in-house capacity to do this already exists although there would be considerable merit were external consultants, particularly Indonesian scientists from outside of the CRIFC, to participate in such reviews from time to time.

(x) Once a year each major commodity program should hold an in-house review chaired by the CRIFC director and attended by the national and all balai coordinators and senior scientists working on that commodity. Two days should be given over to reporting and discussing results of the previous year and two days to discussing priorities and plans for the coming year. Such meetings could be used as part of the proposed process of monitoring and evaluating both programs and personnel and should be timed to precede the meetings which finalise balai plans and programs for the subsequent financial year.

(xi) The review team has offered a number of specific recommendations to the three commodity programs and these are presented in the next three sections of this chapter. It also has two recommendations that relate to all commodity programs. The first of these is that more research is needed on mimimum tillage in view of the promising results reported from this low input technology in West Sumatra. The research should cover planting techniques and fertiliser and herbicide use.

(xii) The second, and very major, recommendation relates to seed where it is evident that there are a series of problems comfronting a wide range of palawija crops. These include:

- Problems in the quality of the seed, which mean that farmers often need to use 2-4 times the quantity theoretically necessary to obtain a good stand and they are involved in extra labour for thinning.

- Problems on the quantity of the seed, especially of improved varieties, due in part to the need for large quantities, and in part to the inadequate facilities for multiplication and distribution.

- Problems in the availablity of the seed at the time of planting.

- Problems in pricing. When prices are too high farmers will often use inferior or non-recommended seed because they do not have the cash to purchase quality seed.

The problem of seed production and distribution is, thus, a complex one which is confounded by the number of agencies involved. Nevertheless the lack of adequate seed supply acts as a real constraint to the impact of CRIFC's work. The review team has noted with interest the approach proposed for promoting the production of soybean and cotton seed in South East Sulawesi using a nucleus estate approach. The team believes that this innovative approach justifies strong support and that, if successful, it should be multiplied with the guidance of CRIFC and also used for other seeds in other provinces. It also recommends that AARD should initiate a dialogue with other agencies of government in terms of encouraging subsidies for quality seed, possibly as partial replacements for subsidies on agricultural chemicals.

7.4 SPECIFIC RECOMMENDATIONS REGARDING THE CEREAL PROGRAM

(xiii) There is scope for closely integrating the work on the various cereal crops and these should not be allowed to develop, to any large extent, as separate programs since the same individuals can handle more than one crop. For sorghum the only specialist requirements are in breeding and agronomy and the same is probably true for wheat. For both of these crops the research should be kept at a modest level, particularly for wheat (in view of the relatively low probability of wheat production being successful in the lowland tropics).

(xiv) Maximum use should be made of promising maize and wheat germ plasm from CIMMYT and sorghum material from ICRISAT. Close attention should also be given to the cooperative programs of CIMMYT with IITA and CIAT regarding lowland tropical maize.

(xv) In the field of maize breeding the review team strongly supports the present system of developing back-up germ plasm pools and feeding improved material into advanced populations. It also endorses the current procedures of establishing 3 to 4 maturity ranges of both yellow and white grain and of conducting multi-location progeny testing of both local and exotic seed.

(xvi) With respe: , to sorghum breeding, the review team endorses both the varietal development efforts and the plans for hybrid breeding. It recommends that germ-plasm pools and populations be established through the use of male sterile lines. This will permit a large amount of genetic recombination to occur by natural cross-pollination and will save many man days of laborious hand crossing.

(xvii) In the wheat breeding program the team recommends that varieties and segregating(F_2 to F_4 generations) populations be actively exchanged between Indonesia and CIMMYT and other Asian (especially the Phillipine and Thai) National Programs.

(xviii) The making of hand crosses in the cereal program would be greatly augmented were a supply of appropriate good quality bags to be available. There is a need to explore whether local paper companies could manufacture satisfactory pollen tector and glassine bags.

(xix) Screening against downy mildew was discontinued in the maize program a few years ago, apparently on the premise that sufficient resistance was present in the currently used cultivars and that an effective systemic fungicide (Apron/Ridomil) for use on seed was also available. The review team is concerned that the omission of screening may lead to vulnerable situations since genetic drift and tolerance Apron to developed by the causal fungus could lead to recurrences of the same type of severe epidemics as were experienced prior to 1978. We recommend that breeding for resistance to downy mildew should become a high priority again.

(xx) The hybrid maize program at Sukamandi is being conducted on poor, highly heterogenous land which is not suitable for good testing and selection procedures. We recommend that this program should be moved , to MARIF or BORIF We also recommend that the breeding procedure for developing parental inbred lines and F_1 hybrids should be broadened from breeding only for downy mildew resistance to encompass the establishment of heterotic pools then inbreeding these and retaining only the vigorous lines so that the production of F_1 hybrid seed will be economically feasible. A test for combining ability should be made in the S3 or S4 generation. Attention should be paid to developing early, medium and full season maturity hybrids of yellow and white grain colour. However, two classes, an early-medium (80-85 days) and a medium-full (95-100 day) season maturity would quite likely satisfy most of the country's needs.

(xxi) Bearing in mind the varieties and fertiliser levels used average yields of maize should be much higher than they are at present. For example, if only 70% of the potential of existing varieties were realised national average yields would average 2.3 - 4.0 tonnes/ha rather than the current 1.7 t/ha, and the Repelita IV goal for 1989 would already be met. This situation needs to be investigated in depth by a strengthened agronomy and physiology component of the maize program collaborating closely with the Centre for Soil Research. Particular attention needs to be given to micro and macro-elements, soil AL content and to the effect of liming.

5 SPECIFIC RECOMMENDATIONS REGARDING THE GRAIN LEGUME PROGRAM

(xxii) Legumes are particularly difficult plants to improve because they involve two separate biological systems, each with differing requirements. These differences are frequently exacerbated under stressful conditions where one organism (usually the plant) is subject to improvement while the other (*Rhizobium*) is not. AARD's grain legume program can be served by current expertise in this area because the director's of both MARIF and SURIF have advanced training in *Rhizobium* and N-fixing technology. Since both of these scientists now have heavy administrative responsibilities there is a need to employ one scientist, possibly under their direction, to work full time in the Rhizobium field to cover the collection, screening, evaluation and production of innoculum for soybean, groundnut and mungbean. Linkages with the international NIFTAL program and appropriate IARCS should be developed to support this program in its initial efforts to accumulate germplasm and to provide specialized training for CRIFC staff in technologies for the several target host species.

(xxiii) The review team endorses the current strategy of distributing segregating populations of improved legume genetic materials from the breeding program at BORIF to the balais. It believes that this not only assists the process of the national program serving the regional needs but also acts as an excellent training device for scientists at the balais who are not only able to work with a wide range of material but also have the opportunity to work closely with the senior legume breeder in the selection, multiplication and evaluation of the material. To optimise the training element of this strategy AARD needs to develop a more formal system of in-service training for junior personnel through the use of a system of strict crosses.

(xxiv) While the grain legume breeding program has made some progress in breeding for resistance to diseases, viruses still remain a problem. To overcome this the program requires additional manpower with higher training in pathology and entomology to work on the biology of viruses and their vectors and to collaborate with the plant breeders in developing screening techniques.

(xxv) The yields of grain legumes grown on red-yellow podzolic soils, which are widely distributed in Indonesia, are disappointing. But research has indicated that they can be significantly increased, in the case of soybeans and groundnuts, through the use of limited applications of lime. However, although a lot of work has been done in Indonesia on this subject by various agencies there are still a number of questions to be answered in terms of the optimum liming strategy to be practiced on the small farm. The grain legume program should provide leadership in this important area by treating this problem as a high priority and endeavouring to coordinate the various institutes working in this field.

(xxvi) Although the development of field-to-field seed production schemes is helping to resolve the problem of the storage of good quality soybean seed due to its short viability period, this still remains a major problem and a top research priority. Improved physical facilities for seed storage are required to work on this topic.

(xxvii) Such improved storage facilities would also be of valur for groundnut research where shortage of good seed is also a problem although here the research area which requires the most attention relates to the relatively low seed multiplication factor per cycle.

7.6 SPECIFIC RECOMMENDATIONS REGARDING THE ROOT CROP PROGRAM

(xxviii) The top priority for cassava research, in view of the market situation which this crop faces is to expand the work in post-harvest processing using low and intermediate technology, aimed at the household or village factory level, to produce long lasting stable products of high value. Such research should have as its aims the production of high quality human food as cassava meal; the production of starch in powdered form and as tapioca; and the production of chips and pellets. The technologies for these processes are already advanced elsewhere in the world but need to be introduced, tested, adapted, and transferred to the farmer in Indonesia. Furthermore, the elaboration of processed meal into more nutritious products including tempe and into fortified products (such as wheat flour) also needs investigation by the appropriate agency.

(xxix) A similar strategy is necessary for sweet potatoes although here it is not of such high priority as for cassava and the technology is less well known and will need more work on product development.

(xxx) The germplasm base for cassava breeding should be cautiously expanded and suitable techniques should be employed to screen for early maturity (6-7 months). The cassava program should also emphasize the production of industrial varieties of cassava maturing in 10 - 11 months as principal crops in dry areas.

(xxxi) The danger of spread of cassava bacterial blight (Xanthomonas) dictates immediate efforts to describe the distribution, screen existing varieties for resistance, import resistant germplasm, develop resistant varieties, and make these varieties available in all major cassava production areas

(xxxii) Increased research is needed on location specific production technologies for both sweet potato and cassava, designed for the most important recommendation domaines.

(xxxiii) Research is also needed on improving the technology for producing both cassava and sweet potato propogative material in order to make improved varieties more accessible to farmers.

(xxxiv) Consideration should also be given to establishing tissue culture facilities to clean existing root crop germ plasm collections and to facilitate the importation and distribution of new cassava germ plasm. In this respect the review team commends the careful approach being adopted towards the importation of improved cassava germ plasm at the current time.

(xxxv) In the case of sweet potato the review team recommends that high priority should be given to cautiously introducing white fleshed germ plasm (both vegatative material and seed) from overseas and to testing both this material and indigenous white fleshed sweet potatoes for scab resistance, quality and yield

(xxxvi) Another important area in sweet potato research is to import, verify and transfer to farmers the technology for control of Cylas developed at AVRDC.

(xxxvii) Although the potato is regarded as a horticultural rather than a palawija crop, the possibility of its large scale cultivation is now under investigation in

Indonesia and has excited considerable interest. The team feels that the breeding and technological problems still to be solved limit the areas of production at the present time to highland condition, this restricts potatoes to being a luxury food for the middle and upper classes (which is not the case with respect to lowland root crops). It is important to bear this in mind in terms of allocating resources for root crop research.

(xxxviii) The team did, however, feel that root crop research might be expanded to incorporate some investigation of some rather neglected tropical root crops particularly yam, taro and giant swamp taro.

7.7 RESEARCH RESOURCES

(xxxix) Given the wide range of commodities with which AARD works, palawija crops appear to be getting an appropriate share of total available resources. Following the recent redistribution of mandates it is important to ensure that the resources for research on palawija crops are allocated in line with farmers needs and growth potentials and that they are not over-concentrated at the mandated balai (MARIF) or the one which currently has the resources (BORIF). It will require effective liaison between the national commodity coordinators, balai directors and the director of CRIFC to ensure that this is done.

(xxxx) The review team recognises that there is somewhat of an inconsistency in having commodity oriented mandates for 5 CRIFC balais and a support function mandate for BORIF whose activities have recently been redefined to cover genetic evaluation, pest and disease management, agricultural economics, communications, physiology, biotechnology and utilisation for all food crops. Given the current status of development of CRIFC this mandate is a rational one. The disciplinary oriented topics in which BORIF will assist the other five balais are all of importance to both the palawija and the rice programs. Yet the specific problems needing to be investigated within these disciplines are highly variable, often technologically difficult and sometimes not specific to one region. Thus they can be well served by a strong central facility at BORIF, providing that the other balais provide junior scientists to work on site specific problems and to generate a flow of information to and from the senior workers at BORIF. As a corollary to this the directors of CRIFC and of BORIF must ensure that work carried out at BORIF should always be directly related to national goals and priorities. There is no place in CRIFC for research that seeks only to aquire knowledge just for the sake of knowledge - such basic research should be left to other institutions.

(xxxxi) The review team has no major changes to recommend regarding the location or structure of the physical facilities for palawija research, recognising that many of these are currently in various stages of improvement. Overall the work that is under way or approved should give the palawija program most of the physical resources that it needs. Small improvements to some research stations and experimental farms would, however, be useful (particularly improvements to the irrigation system at Muneng). Some additional experimental farms are needed in the eastern islands and, possibly, in one or two areas elsewhere that could be important for future transmigration programs. But massive capital investment in physical resources is not required.

(xxxxii) Equipment available on the balais that have been developed in the past few years (BORIF, SARIF, SURIF) is excellent but inflation has led to costs over-running original budgets and this makes it difficult to be precise about whether on-going development programs at MORIF, BARIF and MARIF contain sufficient provisions for all the necessary equipment at current price levels. There could be a need for assistance here in any follow up to the NAR II and AARP projects.

(xxxxiii) The review team was told of a well-conceived link between the CRIFC balais and the Central Library in Bogor which would provide the balais with the type of documentation and information service which is essential for any research institute. This service does not yet seem to be fully operational It is important that it should be brought to this stage as early as possible.

(xxxiv) The palawija program has made remarkable progress in its manpower development activities through advanced education, both in Indonesia and abroad. However, as outstanding as this accomplishment is to date, the attention and priority to manpower development cannot be relaxed. While the numbers of trained persons in the more traditional disciplines of plant breeding and agronomy are impressive, other disciplines such as post-harvest and agroeconomics are in short supply in the palawija crop area. The review team recommends that increasing attention be paid to these and more specialized disciplines in the selection of trainees. In order to ensure that the manpower available at the end of the decade is balanced in terms of training levels, disciplines, commodities, and balais. Towards this end the planning and programming office of CRIFC should prepare a draft manpower plan for 1990 or 1995 and should reconcile this with the manpower currently available or undergoing training. Efforts should then be made to restrict the number of trainees entering those fields where CRIFC's needs are already being met and to encourage trainees into less fashionable fields (possibly through the use of either promotional or incentive actions). In those disciplines where CRIFC is deficient CRIFC might solicit assistance from university faculty in identifying trainee candidates. The important issue is that CRIFC should seek to channel trainees into the areas of need and not to let them all become maize breeders or legume agronomists.

(xxxxv) The most disturbing feature of the manpower situation in CRIFC (and indeed in AARD) is the low salary levels paid to professional staff.
While the review team recognizes that the AARD must abide by government regulations on staff salaries and benefits, we also feel compelled, in the interest of professionalism in scientific research, to strongly recommend continuing review and repeated addressing of this problem. The Government of Indonesia has invested millions of Rupiahs in both domestic and foreign loan currency to build a large and impressive research structure, organization, and management system as well as training Indonesian scientists and employing overseas experts. It is highly unlikely to optimise this investment unless the scientists working on palawija crops are conducting research on a full time basis. However, at current salary and support levels it is impossible to insist on this.

7.8 RESEARCH LINKAGES

(xxxxvi) The importance of the palawija program appears to be well recognised at the policy making level and this is exemplified by the publicity which the government has given to this activity and by the fact that the percentage of AARD's budget devoted to palawija crop research relates closely to the share of total agricultural value provided by palawija crops.

(xxxxvii) Within the CRIFC the review team found a high level awareness of the palawija program and about the role played by individual scientists. On the balai farms the scientists working on palawija crops had a good awareness of each others research. Much of the communication is informal and the team felt that with the build up in staff members that is currently taking place and the increase in numbers of young staff with advanced training, a more formal type of in-service communication would be desirable as a training tool. The team noted that this is already structured at one balai and is beginning at others. We would wish to specifically recommend the institution of frequent and regular staff seminars as a standard practiceat all balais. Institute directors and program leaders should make every effort to attend such seminars regularly in order to provide information and guidance to younger staff. At the same time these seminars should not be seen only as opportunities for senior staff to speak but younger professionals should be encouraged to use them to discuss their work and to seek advice.

(xxxxviii) There are a number of linkages between the balais and the Universities. These involve CRIFC staff serving as lecturers or undergoing higher level training at the universities and university students doing their theses in the palawija program. However, they do not involve academic staff conducting consultancy or collaborating research on behalf of the CRIFC. Given the current shortages of trained personnel in certain aspects of palawija research at some balais the team recommends that this type of link with the universities should be encouraged. Not only could it lead to a more comprehensive research program but it could also result in a wide range of effective collaboration. At the present time the review team could see a potential for using one of IPB's senior economists as an advisor to the director of CRIFC in research planning. Likewise the needs of BORIF in terms of post-harvest technology, food processing and agricultural economics could all be met, at least on a short term basis, by consultants from the strong groups working on these topics at IPB. Similar types of links should be encouraged at the other balais such as MARIF which is located close to Brawijaya University, MORIF with Hasanuddin University etc.

(xxxxix) The link with extension was difficult to assess from only a limited number of contacts. The review team gained the impression that there was a sensitivity about researchers being involved in extension and on-farm trials. Nevertheless it was clearly evident to the team that the staff of individual balais had excellent relations with the local Kanwil and his immediate staff. But linkages between researchers and extension workers appeared to be more tenuous and less direct, only at one balai did we find an extension information officer in residence. At none of our four meetings with Kanwils were there any PPS's present and, unless we directed specific questions, the role of AAETE was not mentioned. Indeed most people we questioned on the topic implied that the PPS system was working well in rice but was still weak for palawija crops. Overall we had the impression that the research-extension link was pursued agressively by individual research staff at the local level. But the formal linkage seems weak and Kanwils indicated concern that each AARD balai linked with the extension services independently. Given the specific mandates of individual balai this raises questions as to whether there is an adequate mechanism for AARD responding to local needs in a holistic manner - an important concept when dealing with farmers who practice a "systems" approach. Another concern that we had about the extension link in terms of balai mandates was that while it is very important to relate to local needs, it must be remembered that farmers' visits and pressure will be in inverse proportion to the distance that they live from the balai, and the felt needs of the institute's neighbours may not necessarily be the priorities of the area mandated to the balai.

(1) Against this difficult background the review team recognised that the strengthening of the research-extension link lay primarily in the strengthening of the extension services, particularly its PPS component where a current training program is very active. It is necessary for each balai to have an information specialist who links with an extension service PPS to interpret and translate research results into information usable by extension services. At present the degree to which this is done is very variable but CRIFC and BORIF do it very well and their experience and expertise needs to be used to train information officers and PPS's from the other balais.

7.9 EXTERNAL ASSISTANCE

(li) The palawija crop program has benefited considerably from donor assistance since AARD was created and the CRIFC now either has or is in the process of acquiring significant physical and manpower resources for palawija research. There are still gaps, but given the short time since AARD's inception and the problems of building one of the worlds largest national agricultural research services virtually from scratch, the progress made has been remarkable. To a large extent, it is now within the capability of AARD to carry this program forward to maturity without major external inputs. There are, however, two areas where external support could make a major contribution.

(lii) The first of these is in providing expertise, training and operational funds for strengthening activities in the three fields of agro-economics, post harvest activities and cropping systems (or rather farming systems since livestock and fish both play an important role in many on-farm systems). Donor inputs in all three of these fields need to be perceived not in isolation but as integral components of the whole

CRIFC mandate (palawija and rice).

(liii) The second area where external assistance could play a very major role is in the provision of operational research funds. This is not an area where most donors tread comfortably. But it is unrealistic to expect any developing country government to be able to expand its domestic research budget at the same rate that donors have assisted Indonesia to build up its research infrastructure. The situation is approaching when there could well be a period of several years of difficulty in maintaining the research facilites and also having sufficient operational costs to keep the new and highly trained staff fully occupied. In the long term the answer to this must come from Indonesian resources but, in the short run, when laboratories are being completed and personnel trained at a faster rate than the government is able to increase AARD's budget, donors might usefully re-examine their aid strategies for research. If their long term goal is to help create a strong and viable national agricultural research system they may find that this is best done by a judicious mix of capital and operational support rather than by providing capital alone. The total cost of each approach can be identical but the benefits from a smaller and well funded research service are likely to exceed those from one with lots of laboratories, farms and staff and limited funds for them to operate with.

AN EVALUATION OF THE PALAWIJA CROP RESEARCH PROGRAM OF AARD

Volume II - Maps, Charts and Tables

August 1984

Agency for Agricultural Research and Development

Jalan Ragunan 29 Pasar Minggu
Jakarta, Selatan Indonesia

TABLE OF CONTENTS

VOLUME 2 - MAPS CHARTS AND TABLES

NOTE: 1] The series of tables C4/C5, D4/D5 to H4/H5 are incomplete as the review team were unable to obtain manpower plans for palawija crops drawn up on a commodity basis. Manpower targets for palawija crops combined are shown in table 2.8.

2] Tables C2, D2, F2, G2 and H2 are also incomplete.

A MAPS AND ORGANISATION CHARTS

Figure A1

Organizational Structure of the Agency for Agricultural Research and Development

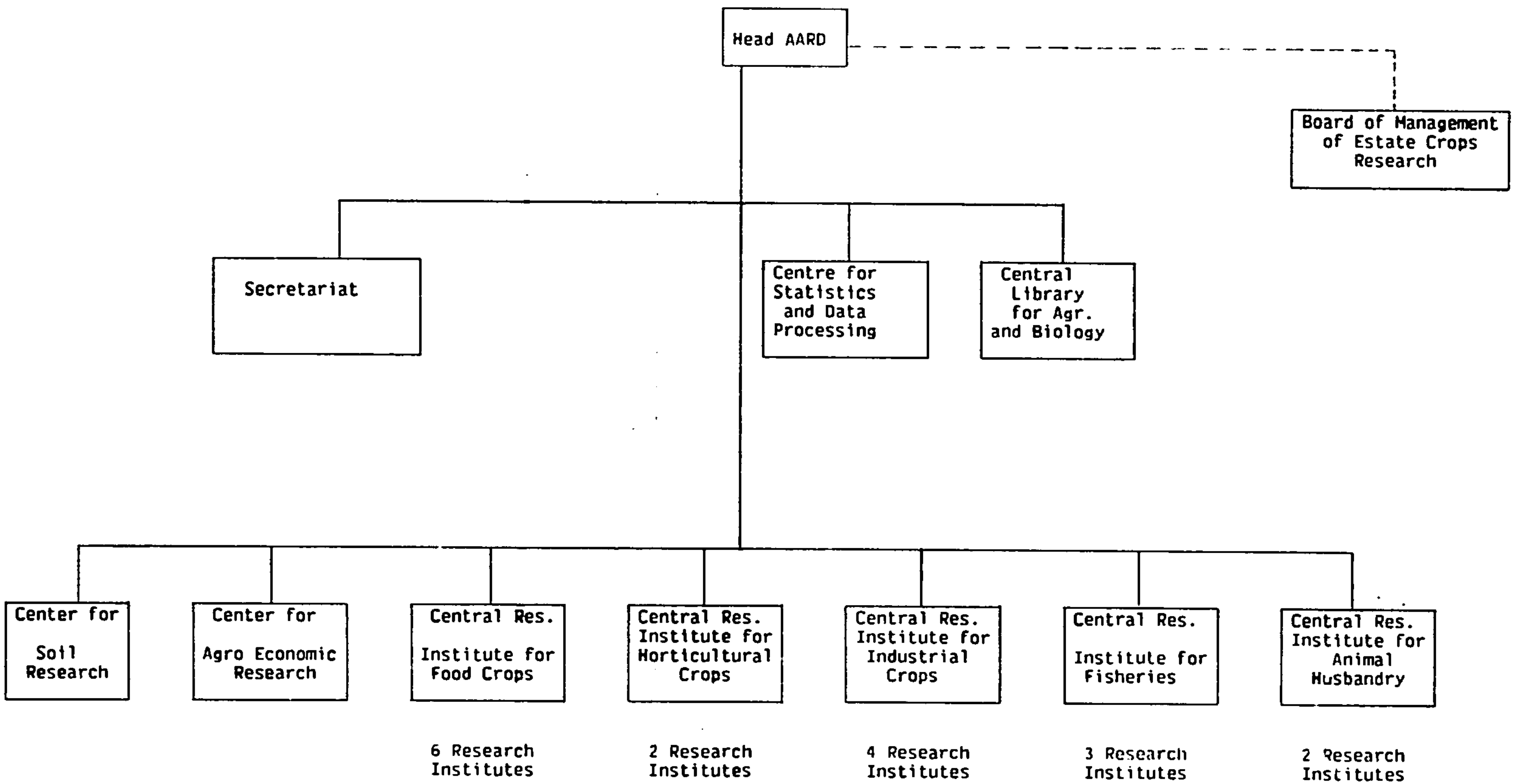


Figure A2

Organizational Structure of the
Central Research Institute for Food Crops
(responsible for both rice and palawija crops)

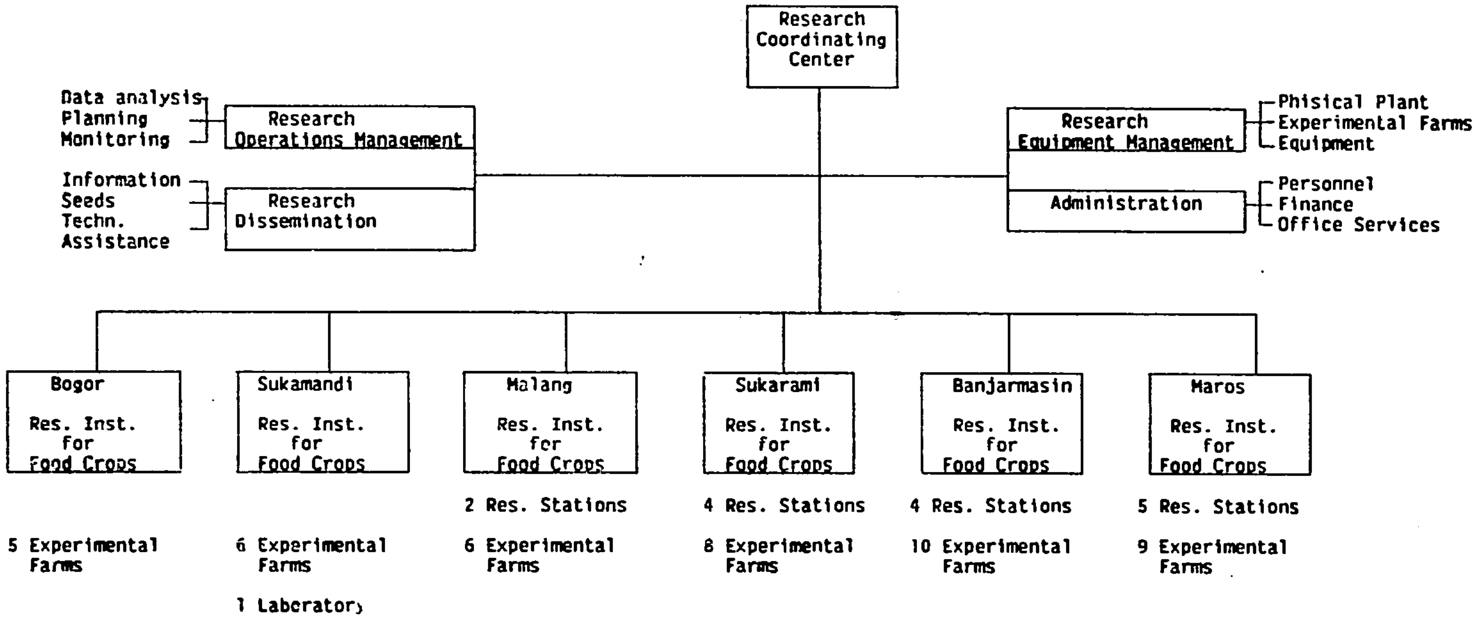


Figure A3

Location of
CRIFC Research Institutes in Indonesia

Figure A4

Location of Central Research Institute
for Food Crops
Experimental Farms

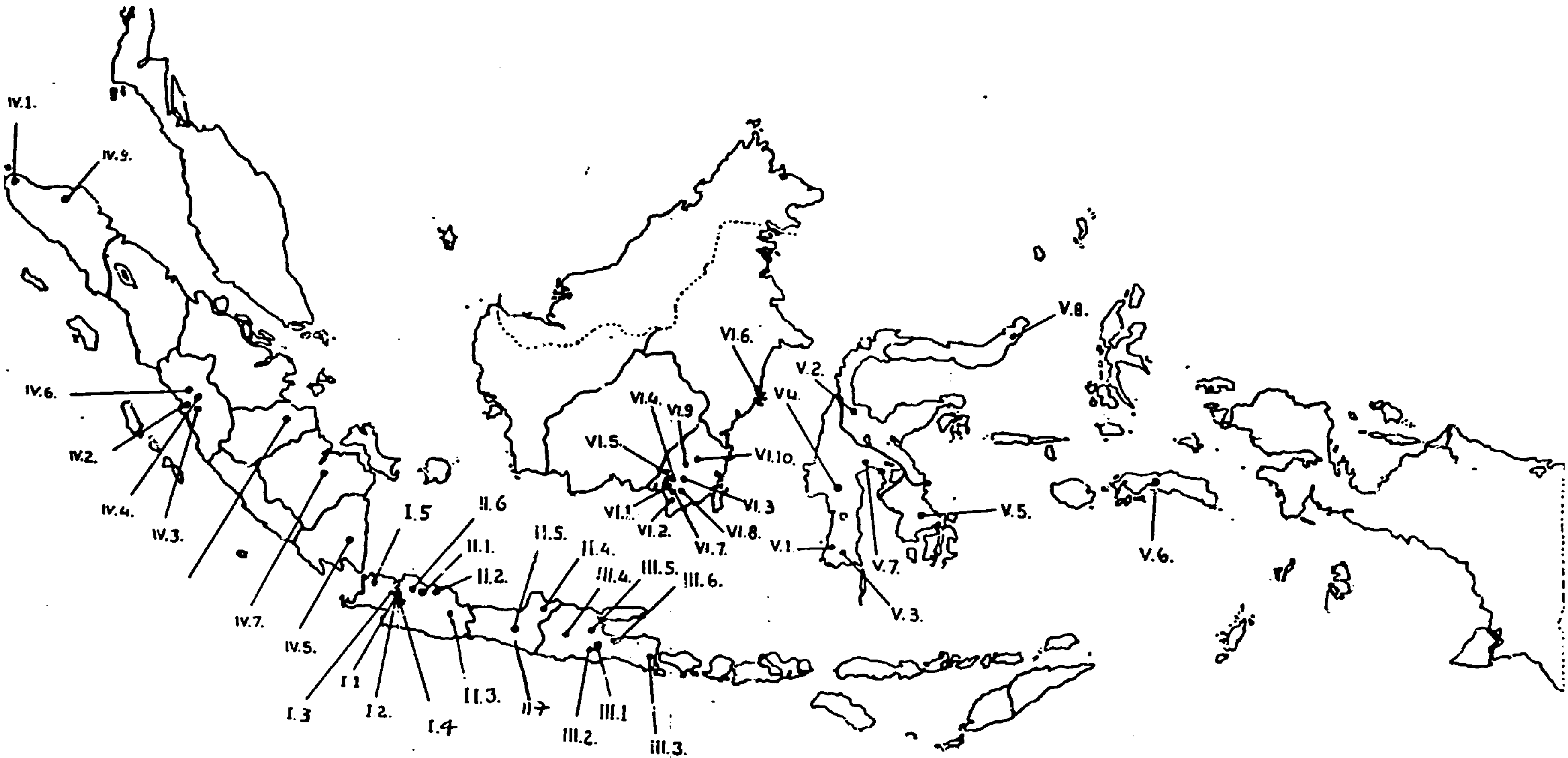


TABLE A5 KEY TO FIGURE A4

RESEARCH INSTITUTE (BALITTAN) -----------B
RESEARCH STATION (SUB-BALITTAN) --------SB
EXPERIMENTAL FARM (KEBUN PERCOBAAN)-----KP

I	BOGOR B
I.1	Cikeumeuh KP
I.2	Murra KP
I.3	Citayam KP
I.4	Pacet KP
I.5	Singamerta KP

II	SUKAMANDI B
II.1	Sukamandi KP
II.2	Pusakanegara KP
II.3	Kunigan KP
II.4	Jakenan KP
II.5	Mertoyudan KP
II.6	Karawang (Laboratory)
II.7	Yogjakarta (Office)

III	MALANG B
III.1	Kendalpayak KP
III.2	Jambegede KP
III.3	Genteng KP
III.4	Ngale KP
	Mojosari SB
III.5	Mojosari KP
	Muneng SB
III.6	Muneng KP

IV	SUKARAMI B
IV.1	Lampineung KP
IV.2	Bandarbuat KP
IV.3	Sukarami KP
IV.4	Rambatan KP
IV.5	Tamanbogo KP
	Sitiung SB
IV.6	Sitiung KP
	Kayu Agung SB
IV.7	Kayu Agung KP
	Sumani SB
IV.8	Sumani KP
	Pasar Miring
IV.9	Pasar Miring KP

V	MAROS B
V.1	Maros KP
V.2	Dolage KP
V.3	Bontobili KP
	Lanrang SB
V.4	Langrang KP
	Wawotobi SB
V.5	Wawotobi KP
	Makariki SB
V.6	Makariki KP
	Mariri SB
V.7	Mariri KP
	Kalasey SB
V.8	Kalasey KP

VI	BANJARMASIN B
VI.1	Banjarmasin KP
VI.2	Pleihari KP
VI.3	Binuang KP
VI.4	Balandean KP
VI.5	Tatas KP
VI.6	Lempake KP
	Handil Manarap SB
VI.7	Handil Manarap KP
	Banjarbaru SB
VI.8	Banjarbaru KP
	Tanggul SB
VI.9	Tanggul KP
	Barabai SB
VI.10	Barabai KP

Note:

The above information was correct until August 16 1984 when a number of stations and farms were re-allocated amongst the six research institutes.

PRODUCTION, CONSUMPTION, TRADE AND VALUE OF PALAWIJA CROPS

TABLE B.1

AREA, YIELD AND PRODUCTION OF PRINCIPAL PALAWIJA CROPS IN INDONESIA IN 1980 AND 1988 PRODUCTION TARGETS OF REPELITA IV

			1980	1988
rop	Area ('000 ha)	Yield (t/ha)	Production ('000 t	Target ('000 t)
orn	2735	1.46	3991	6656
orghum	61	0.92	56	?
otal Cereals	2796	-	4047	6700+
roundnut	506	0.93	470	724
ungbean	252	0.56	141	340
oybean	732	0.89	653	1370
otal Grain Legumes	1490	-	1264	2434
issava	1412	9.7	13726	17756
veet Potato	276	7.5	2079	2564
otal Root Crops	1688	-	15805	20320

urce : Statistical Yearbook of Indonesia 1982, Repelita IV and Director General of Food Crops

tes : 1. 1980 data are used in preference to later data as they are more consistent with other sets of available statistics than are the data for later years and 1982 was an atypically dry year.

2. Mungbean data are 1979.

TABLE B2

PER CAPITA CONSUMPTION OF PRINCIPAL PALAWIJA CROPS IN INDONESIA 1980

Crop	Per Capita Consumption Kg/annum	Daily Per Capita Intake in Calories
Corn	23.6	233
Wheat (Flour)	7.2	69
Sub-total cereals	30.8	302
Groundnut (Shelled)	3.0	45
Mungbean	(0.6)	(7)
Soybean	4.7	52
Sub-total grain legumes	8.3	103
Cassava	71.7	198
Sweet Potato	12.5	33
Sub-total roots	84.2	231
GRAND TOTAL PALAWIJA	--	636
TOTAL ALL FOODS	--	2570

Source : Statistical Yearbook of Indonesia 1982 and Repelita IV

Note : Figures in brackets are team estimates

TABLE 23

IMPORTS OF PRINCIPAL PALAWIJA CROPS 1978-1982

	1978		1979		1980		1981		1982	
	000 t	US$ m	000 t	US$ m	000 t	US$ m	000 t	US$ m	000 t	US$ m
Corn	46	6.3	83	13.7	34	7.3	2	0.7	76	13.2
Wheat (and flour)	796	78.6	772	91.2	1486	163.4	1420	152.3	1487	151.1
Groundnuts (shelled)	0	0.0	5	3.2	7	4.8	9	6.4	63	43.6
Mungbean	--	--	4	1.9	4	2.1	1	0.6	20	11.6
Soybean and Cake	130	37.1	177	55.8	101	33.1	364	100 +	361	100 +
Cassava (and Products)	--	--	--	--	13	3.3	0	0.0	--	--
TOTAL	972	122.0	1041	165.8	1645	214.0	1796	260.7	2007	320.0

Source : Director General of Food Crops

Note : -- denotes under 1000 tunnes.

TABLE 24

EXPORTS OF PRINCIPAL PALAWIJA CROPS 1978-1982

	1978		1979		1980		1981		1982	
	000 t	US$ m	000 t	US$ m	000 t	US$ m	000 t	US$ m	000 t	US$ m
Corn	21	2.4	7	0.8	15	2.1	5	0.7	1	0.1
Sorghum	5	0.2	3	0.1	13	1.0	14	0.6	N/A	N/A
Groundnut (shelled/ unshelled)	3	0.3	3	0.6	3	0.7	3	0.6	1	0.5
Cassava (dried)	308	19.4	710	68.5	387	42.7	502	72.7	284	16.0
TOTAL	338	22.3	723	70.4	418	46.5	524	74.6	286	16.6

Source : Director General of Food Crops

TABLE B5

COMPARATIVE VALUE OF FOOD CROPS PRODUCED IN 1981

Crop	Production (million t)	Price (Rp/kg)	Total Value (billion Rp)	% Agricultural GDP	
Rice	22.0	200	4400	34.0	
Corn	4.6	110	600	4.6	
Cassava	14.0	30	420	3.4	
Sweet Potato	2.1	45	95	0.7	12.4%
Groundnut	0.5	400	200	1.5	
Soybean	0.7	300	210	1.6	
Mungbean	0.2	300	60	0.5	
Other crops	--	--	260	2.0	
Fruits	5.0	150	750	5.8	
Vegetables	5.0	150	750	5.8	
TOTAL VALUE FOOD CROPS			7745	60.0	

Note : These data are taken from a range of sources plus team estimates. The "total" figure is consistent with national data on GDP. The palawija crop data are derived figures and require refining.

C PALAWIJA CROP RESEARCH AT FOOD CROP RESEARCH INSTITUTE BOGOR (BORIF)

TABLE C1

BORIF RESEARCH INSTITUTE, STATION AND EXPERIMENTAL FARMS

			Ha experimental lands
COORDINATING CENTER	:	Bogor	
RESEARCH INSTITUTE	:	Bogor (BORIF)	
EXPERIMENTAL FARMS	:	Cikeumeuh	17.5
		Muara	34.5
		Citayam	11.3
		Pacet	3.2
		Singamerta	6.3
			72.8
		Buildings, Roads, Houses etc. (ha)	35.8
		Total area	108.4

These units carry out work on rice and farming systems as well as palawija crops and some of the land is used by the Central Research Institute for Horticulture. Currently about 40% of the experimental program is used for palawija crop research.

Table C2

Current resources of PORIF

Physical Infrastructure	Unit	Institute & Farms				Total
Area of Land	Ha	108.4				108.4
1. Offices	M2	9269				9269
2. Laboratories	M2	4331				4331
3. Library	M2	274				274
4. Auditorium	M2	700				700
5. Green/Screen house	M2	3341				3341
6. Stores/Garage	M2	9750				9750
7. Drying Yards		N/A				N/A
8. Guest Houses	M2	3572				3572
9. Houses (Scientists)	M2	5674				5674
10. Houses (Staff)	M2	3471				3471
11. Vehicles	M2	99				99

Status of facilities (Ranking: 5 is excellent; 0 is absent)

1. Sufficient land area					
2. Adequacy of buildings					
3. Adequacy of farm equipment					
4. Adequacy of office equipment					
5. Adequacy of laboratory equipment					
6. Availability of literature					
7. Reliability of utility service					

Table C3

PERSONNEL RESOURCES OF BORIF

PROGRAM	DISCIPLINE	Ph.D	M.Sc.	Sar.	B.Sc.	High Sch.	Total
Corn/ Sorghum/ Wheat	Breeding	2	1	3		3	9
	Agronomy			3	1	7	11
	Physiology		1	1		3	5
	Entomology			1			1
	Pathology					2	2
	sub-total	2	2	8	1	15	28
Grain Legumes	Breeding	1	2	2	1	5	11
	Agronomy		5	2	1	2	10
	Physiology			2			4
	Entomology	1	3	1		2	7
	Pathology	1				3	4
	sub-total	3	10	7	2	14	36
Cassava/ Sweet Potato	Breeding	1		2		2	5
	Agronomy			2		1	3
	Physiology		2	1		1	4
	Entomology						
	Pathology						
	Post Harvest			5			5
	sub-total	1	2	10	0	4	17
Farming Systems		1	1	13	0		14
Total Palawija/Farming Systems		7	15	38	3	36	96
Rice	Breeding	1	5	4	2	23	35
	Agronomy		2	6	2	5	15
	Physiology	1	5	2	5	13	26
	Entomology	2	3	9	5	7	26
	Pathology	1		6	2	10	19
	Socio.Econ.		2	8	5	2	18
		5	17	35	21	60	139

Table C4

TRAINING PLANS AND TARGETS OF BORIF BY LEVEL OF TRAINING

Program	Level of Training	Current Numbers (A)	Already Training (B)	Total (A+B)	1990 Target	Number to be Identified
Corn	Ph.D.	2	2	4		
	M.Sc.	2 (-2)	4	4		
	Sub-total	4 (-2)	6	8		
Grain Legumes	Ph.D.	3	4	7		
	M.Sc.	10 (-4)	2	8		
	Sub-total	13 (-4)	6	15		
Root Crops	Ph.D	1	0	1		
	M.Sc.	2	2	4		
	Sub-total	3	2	5		
Farming Systems and Post Harvest	Ph.D.	1	1	2		
	M.Sc.	1 (-1)	3	3		
	Sub-total	2 (-1)	4	5		
Total	Ph.D.	7	7	14		
	M.Sc.	15 (-7)	11	19		
Grand	Total	22 (-7)	18	33		

Note: Figures in brackets are existing staff undergoing training for higher degrees

Table C5

TRAINING PLANS AND TARGETS OF BORIF FOR STAFF AT THE Ph.D. OR M.Sc. LEVEL*

PROGRAM	DISCIPLINE	CURRENT NUMBERS	ALREADY TRAINING	SUB TOTAL	1990 TARGET	TO BE IDENTIF.
CORN ETC.	Breeding	3 (-1)	2	4		
	Agronomy		2	2		
	Physiology	1 (-1)	1	1		
	Entomology		1	1		
	Pathology					
	Other					
	sub-total	4 (-2)	6	8		
GRAIN LEGUMES	Breeding	3 (-2)	2	3		
	Agronomy	5 (-2)	3	6		
	Physiology		1	1		
	Entomology	4 (-1)		3		
	Pathology	1		1		
	Other					
	Sub-total	13 (-5)	6	14		
ROOT CROPS	Breeding	1		1		
	Agronomy		2	2		
	Physiology	2		2		
	Entomology					
	Pathology					
	Other					
	Sub-total	3	2	5		
FARMING SYSTEMS ETC.		2	4	6		
TOTAL		22	18	33		

Note:

1) * Numbers shown are Ph.D. plus M.Sc.
2) The farming systems personnel are in various disciplines - mainly agronomy.

Table C6

BORIF BUDGET 1980-85

(Routine and Development)

Y e a r	GOI, Rp million		Foreign	Total
	Routine	Development	(US $ Thousand)	Rp. Million
1980/81	674 *	780	463.334 (1$ = Rp 625,-)	1,743
1981/82	956 *	1.054	400.160 (1$ = Rp 625,-)	2,261
1982/83	734	941	598.227 (1$ = RP. 625,-)	2,053
1983/84	774	813	427.000 (1$ = Rp. 700,-)	1,887
1984/85	743	650	600.000 (1$ = Rp. 970,-)	1,975
Total	3,881	4,239	2,488,721	9,918

Note: * Includes coordinating center costs.

Table C7

Major Functional Components of BORIF local budget (Routine and Development) 1984/1985.

Sources	Routine		Development		Total	
	Rp. million	%	Rp. million	%	Rp. million	%
1. Salaries	595	80	318	49	913	65
2. Maintenance of facilities	36	5			36	3
3. Provision of facilities	108	14.5	40	6	147	11
4. Research operations			181	28	181	13
5. Others	4	0.5	111	17	116	8
Total	743	100%	650	100%	1.393	100%

Note: This budget includes rice, post-harvest and farming systems activities as well as those for plalwija crops. The type of breakdown shown above is not available for palawija crops separately but Table C8 attempts to present total budgets for individual palawija crops.

TABLE C8

PALAWIJA CROP BUDGET OF BORIF 1984/85

Total budget of BORIF	1393 m Rp
Palawija crop work as % of program	40%
Budget allocated (by team) to palawija crops	557 m Rp

D PALAWIJA CROP RESEARCH AT FOOD CROP RESEARCH INSTITUTE MALANG (MARIF)

Currently 71% of the experimental units at Malang are used for palawija crop research and another 8% are in farming systems research.

TABLE D1

MARIF RESEARCH INSTITUTE, STATIONS AND EXPERIMENTAL FARMS

		Ha experimental lands
COORDINATING CENTER :	BOGOR	
RESEARCH INSTITUTE :	(Malang (MARIF)	3.6
	(Kendelpayak (with farm)	28.0
RESEARCH STATIONS (with farms) :	Mojosari	30.4
	Muneng	30.5
EXPERIMENTAL FARMS :	Jambegede	10.0
	Ngale	45.5
	Genteng	30.8
	Buildings, Roads, Houses etc. (ha)	27.0
	Total area	205.7

These units have a mandate to work with rice as well as palawija crops although Malang has recently been designated as the focus for palawija research. Currently about 75% of the MARIF program is used for palawija crop research and related farming systems activities.

Note : It is likely that the original MARIF facilities at Malang will be handed over to the Central Research Institute for Horticulture and new institute facilities will be constructed. Currently the Research Institute is divided between Malang and Kendalpayak.

Table D2

Current resources of MARIF

Physical Infrastructure	Unit	Malang/Kendelpayak	Mojosari	Muncnjri	Jambegede EF	Nga'e EF	Genteng EF	Total
Area of Land	Ha	31.6	30.4	30.5	10.5	48.5	33.8	205.7 *
1. Offices	M2	1653	111	48	100	100	295	2307
2. Laboratories	M2	185						185
3. Library	M2	100						100
4. Auditorium	M2	100						100
5. Green/Screen house	M2							
6. Stores/Garage	M2	768	849	638	350	690	881	4276
7. Drying yards	M2	640	1261	1350	1100	977	1924	7252
8. Guest Houses	M2	190	267	83	117	-	312	905
9. Houses (Scientist)	M2	1075	631	454	116	594	203	3078
10. Houses (Staff)	M2							
11. Vehicles	M2							N/A

Status of facilities (Ranking: 5 - excellent; 0 - absent)

1. Sufficient land area						
2. Adequacy of buildings						
3. Adequacy of farm equipment						
4. Adequacy of office equipment						
5. Adequacy of laboratory equipment						
6. Availability of literature						
7. Reliability of utility service						

* This total includes land in buildings, roads, houses etc.

Table D3

Personnel resources of MARIF

Program	Discipline	Ph.D	M.Sc.	Sor.	B.Sc.	High Sch.	Total
Corn/ Wheat/ Sorghum	Breeding	1		2			3
	Agronomy			2		1	3
	Physiology						0
	Entomology			2			2
	Pathology			1			1
	Post Harvest			1			1
	sub total	1	0	8		1	10
Grain Legumes	Breeding			4		1	5
	Agronomy	1		7		1	9
	Physiology		1	3			4
	Entomology		1	1			2
	Pathology			2			2
	Post Harvest			1			1
	sub total	1	2	18		2	23
Cassava/ Sweet Potato	Breeding						0
	Agronomy			1		1	2
	Physiology						0
	Entomology						0
	Pathology						0
	sub total	0	0	1		1	2
Farming systems Soc.Ec. and Post Harvest				2	2		4
Total Palawija/FS/Post Harvest		2	2	29	2	4	39
Rice	Breeding			1	1	4	6
	Agronomy			7		4	11
	Physiology			1			1
	Entomology			1			1
	Pathology			3		1	4
	Sociology						
	Total Rice	0	0	13	1	9	23

Table D4

Training Plans and Targets of MARIF by Level of Training

Program	Level of Training	Current Numbers (A)	Already Training (B)	Total (A+B)	1990 Target	Numbers to be Identified
Corn Etc.	Ph.D.	1		1		
	M.Sc.		1	1		
	sub-total	1	1	2		
Grain Legumes	Ph.D.	1	1	2		
	M.Sc.	2 (-1)	5	6		
	sub-total	2 (-1)	6	8		
Root Crops	Ph.D					
	N.Sc.					
	sub-total	0	0	0		
Farming Systems & P. Harvest	Ph.D.					
	M.Sc.					
	sub-total	0	0	0		
Total	Ph.D.	2	1	3		
	M.Sc.	2 (-1)	6	7		
	Grand total	4 (-1)	7	10		

Note: Figures in brackets denote exisiting staff with M.Sc currently upgrading to Ph.D.

Table D5

Training plans and Targets of MARIF for Staff at the Ph.D. or M.Sc. Level *

Program	Discipline	Current Numbers	Already Training	Sub-Total	1990 Target	To be Identified
Corn etc.	Breeding	1	1	2		
	Agronomy					
	Physiology					
	Entomology					
	Pathology					
	Other					
	sub total	1	1	2		
Grain Legumes	Breeding	1 (-1)	3	2		
	Agronomy	1	1	2		
	Physiology	1	1	2		
	Entomology	1	1	2		
	Pathology					
	Other					
	sub total	3 (-1)	6	8		
Root Crops	Breeding					
	Agronomy					
	Physiology					
	Entomology					
	Pathology					
	Other					
	sub total	0	0	0		
Farming systems/etc.		0	0	0		
	Total	4 (-1)	7	10		

* Numbers shown are Ph.D. plus M.Sc.

Table D6

MARIF Budget 1980 - 85

(Routine and Development)

Year	GOI, RP million		Foreign (US $ Thousand)	Total Rp. million
	Routine	Development		
1980 / 81	187	205	-	392
1981 / 82	325	330	875.000 (1$ = Rp 625,-)	1,202
1982 / 83	327	380	1,250.000 (1$ = Rp 625,-)	1,488
1983 / 84	344	349	939.000 (1$ = Rp. 700,-)	1,350
1984 / 85	355	306	459.340 (1$ = Rp 970,-)	1,107
Total	1,538	1,570	3,522,340	5,539

Table D7

Major functional components of MARIF local budget 1984/1985

(Routine and Development)

Sources	Routine		Development		T o t a l	
	Rp million	%	Rp million	%	Rp million	%
1. Salaries	304	85,5	149	49	453	68
2. Maintenance of facilities	21	6	-	-	21	3
3. Provision of facilities	27	7,5	52	17	79	12
4. Research operations			70	23	70	11
5. Others	3	1	35	11	38	6
Total	355	100	306	200	661	100

Note: This budget includes rice, post harvest and farming systems activities as well as those for palawija crops. The type of breakdown shown above is not available for palawija crops separately but table D8 attempts to

TABLE D8

PALAWIJA CROP BUDGET OF MARIF 1984/85

Total Budget of MARIF	661 m Rp
Palawija crop work as % of program	75%
Budget allocated (by team) to palawija crops	496 m Rp

E PALAWIJA CROP RESEARCH AT FOOD CROP RESEARCH INSTITUTE SUKAMANDI (SURIF)

Currently just under 30% of the experimental work at Sukamandi relates to palawija crops, irrigated rice being the principal research activity at this institute.

TABLE E1

SURIF RESEARCH INSTITUTE, STATIONS AND EXPERIMENTAL FARMS

			Ha experimental lands
COORDINATING CENTER	:	BOGOR	
RESEARCH INSTITUTE (with farm)	:	SUKAMANDI	455.7
RESEARCH LABORATORY	:	KARAWANG	0.4
EXPERIMENTAL FARMS	:	Yogjakarta (Office)	0.4
		Pusakanegara	40.0
		Kuningan	30.0
		Jakenan	30.0
		Mertoyudan	1.1
		Buildings, Roads, Houses etc. (included above)	
		Total area	557.6

These units have a mandate to work with rice as well as palawija crops. Currently about 24% of the program at SURIF is used for palawija crops and another 5% is used for closely related farming systems research.

Table E2

Current resources of SURIF

Physical Infrastructure	Unit	Sukamandi RI	Karawang (Lab.)	Yogjakarta (office)	Pasakanegra EF	Kuningan EF	Jakenan/ Mertoyadan EF	Total
Area of Land	Ha	4557	0.4	0.4	40.0	30.0	31.1	557.6
1. Office	M2	1899	299	226	1500	216	180	4320
2. Laboratories	M2	3035	299	56				3390
3. Library	M2	260						260
4. Auditorium	M2	260	200			128		588
5. Green/Screen house	M2	1970	200					2170
6. Stores/Workshop	M2	1120	112	15	20			1267
7. Drying yards	M2	N/A	N/A					N/A
8. Guest Houses	M2	3612			421	408		4441
9. Houses (Scientist)	M2	1138	630					1768
10. Houses (Staff)	M2	4048	702		791	192	227	5960
11. Vehicles		-	-					N/A

Status of facilities (Ranking: 5 is excellent; 0 is absent)

1. Sufficient land area	4	2	1	3	3	4/1
2. Adequacy of buildings	4	3	1	3.5	2.5	2/0
3. Adequacy of farm equipment	3	3	0	2	2.5	2/0
4. Adequacy of office equipment	4	3	1	3	3	2/0
5. Adequacy laboratory equipmment	4.5	2	0	0	0	2/0
6. Availability of literature	3	0	0	0	0	0/0
7. Reliability of utility service	4.5	0	0	0	0	0/0

Table E3

Personnel Resources of SURIF

Program	Discipline	Ph.D	M.Sc	Sar.	B.Sc	High Sch.	Total
Corn/ Wheat/ Sorghum	Breeding	2		2	1	3	8
	Agronomy		1	1		1	3
	Physiology						0
	Entomology			1		1	2
	Pathology			1			1
	sub total	2	1	5	1	5	14
Grain Legumes	Breeding		1	3	1	3	7
	Agronomy			1			1
	Physiology						
	Entomology		1		1	1	2
	Pathology		1	1			1
	sub total	0	3	5	2	4	14
Cassava/ Sweet Potato	Breeding						
	Agronomy				1	2	3
	Physiology						
	Entomology					1	1
	Pathology			1			1
	sub total	0	0	1	1	3	5
Farming systems				1			1
Post Harvest		1	2	4		1	8
Total Palawija/ FS/Post Harvest		3	6	16	4	13	42
Rice	Breeding	1	1	3		19	25
	Agronomy	3	2	6	4	3	16
	Physiology						
	Entomology			4		4	10
	Pathology		1	2		4	8
	Sociology						
	Total Rice	4	4	15	4	30	57

Table E4

Training plans and targets of SU RIF by level of training

Program	Level of Training	Current Numbers (A)	Already Training (B)	Total (A+B)	1990 Target	Numbers to be Identified
Corn etc.	Ph.D M.Sc	2 1	0 3	2 4		
	sub-total	3	3	6		
Grain legumes	Ph.D M.Sc	0 3	0 2	0 5		
	sub-total	3	2	5		
Root crops	Ph.D M.Sc	0 0	0 1	0 1		
	sub-total	0	1	1		
Farming systems Post Harvest	Ph.D M.Sc.	3 6	0 0	3 12		
	sub-total	3	0	3		
Total	Ph.D M.Sc	3 6	0 6	3 12		
	Grand total	6	6	15		

Table E5

Training plans and targets of SU RIF for staff at the Ph.D or M.Sc Level *

Program	Discipline	Current Numbers	Already Training	Sub-Total	1990 Target	To be Identified
Corn etc.	Breeding	2	1	3		
	Agronomy	1	1	2		
	Physiology					
	Entomology					
	Pathology		1	1		
	Other					
	sub-total	3	3	6		
Grain Legumes	Breeding	1	1	2		
	Agronomy					
	Physiology					
	Entomology	1	1	2		
	Pathology	1		1		
	Other					
	sub-total	3	2	5		
Root Crops	Breeding					
	Agronomy					
	Physiology					
	Entomology					
	Pathology		1	1		
	Other					
	sub-total	0	1	1		
Farming systems / Post harvest		3	0	3		
	Total	9	6	15		

* Numbers shown are Ph.D plus M.Sc

Table E6

SURIF Budget 1980-85
(Routine and Development)

Year	GOI, Rp Million		Foreign (US $ Thousand)	Total Rp. Million
	Routine	Development		
1980 / 81	70	418	-	488
1981 / 82	93	580	-	673
1982 / 83	102	650	-	752
1983 / 84	203	660	-	863
1984 / 85	209	660	-	860
Total	678	2.968	-	3,646

Table E7

Major functional components of SURIF local budget 1984/1985

(Routine and Development)

Sources	Routine		Development		Total	
	Rp million	%	Rp million	%	Rp million	%
1. Salaries	177	85	251	38	428	49
2. Maintenance of facilities	21	10	-		21	2.5
3. Provision of facilities	9	4	220	33	229	26.5
4. Research operations	-		114	17	114	13
5. Others	3		76	12	79	9
Total	209	100	660	100	869	100

Note: This budget includes rice, post harvest and farming systems activities as well as those for palawija crops. The type of breakdown shown above is not available for palawija crops separately but Table E8 attempts to present total budgets for individual palawija crops.

TABLE E8

PALAWIJA CROP BUDGET OF SURIF 1984/85

Total Budget of SURIF	869 m Rp
Palawija crop work as % program	30%
Budget allocated (by team) to palawija crops	261 m Rp.pa

F PALAWIJA CROP RESEARCH AT FOOD CROP RESEARCH INSTITUTE SUKARAMI (SARIF)

Currently this institute has 22% of its research activities devoted to palawija crops, 22% to farming systems and 54% to upland rice.

TABLE F1

SARIF RESEARCH INSTITUTE, STATIONS AND EXPERIMENTAL FARMS

			Ha experimental lands
COORDINATING CENTER	:	BOGOR	
RESEARCH INSTITUTE (with farm)	:	SUKARAMI	192.6
RESEARCH STATIONS (with farm)	:	Sitiung	102.0
		Kayu Agung	31.1
		Sumani	25.1
		Pasar Miring	20.0
EXPERIMENTAL FARMS	:	Lampineng	10.0
		Bandarbuat	26.9
		Rambatan	6.5
		Tamanbogo	20.1
		Buildings, Roads, Houses etc.	27.0
		Total land area	443.1

These units have a mandate to work with rice as well as palawija crops. Currently just over 20% of the program at SARIF is used for palawija crops and the farming systems program is similar in size, and in which palawija crops play a major role.

Plans exist to increase the size of Tamanbogo by 30 ha and to upgrade it to research station status.

Table F2

Current resources of SARIF

Physical Infrastructure	Unit	Sukarami	Sumani	Ps Miring	Sitiung	K. Agung	Total
Area of Land	Ha	192.6	25.1	20.0	102.0	31.1	443.1 *
1. Offices	M2	801	320	342	315	244	2022
2. Laboratories	M2	449		183	261	183	1075
3. Library	M2	230	-	63	92	60	440
4. Auditorium	M2	150	-	41	44	41	276
5. Green/Screen house	M2	550	300	290	290	150	1580
6. Stores / garage	M2	-	-	-	-	-	-
7. Drying yards	M2	-	-	-	-	-	-
8. Guest Houses	M2	860	-	-	120	120	1180
9. Houses (Scientist))	M2	8184	120	120	3910	1374	13708
10. Houses (Staff))	M2						
11. Vehicles	M2	-	-	-	-	-	50

Status of facilities (Ranking: 5 is excellent; 0 is absent)

1. Sufficient land area						
2. Adequacy of buildings						
3. Adequacy of farm equipment						
4. Adequacy of office equipment						
5. Adequacy of laboratory equipment						
6. Availability of literature						
7. Reliability of utility service						

* This total includes the experimental farms at Lampineg, BandaBuat, Rambatan and Tamanbogo, which have very limited construction although Tamanbogo has a small offfice and guest house.

Table F3

Personnel Resources of SARIF

Program	Discipline	Ph.D	M.Sc	Sar.	B.Sc	High Sch.	Total
Corn/ Wheat/ Sorgeum	Breeding			1			1
	Agronomy			3			3
	Physiology			3			3
	Entomology		1	1			2
	Pathology			1			1
	sub total	0	1	9	1		10
Grain Legumes	Breeding			1			1
	Agronomy		1	2			3
	Physiology			1			1
	Entomology					1	1
	Pathology			2		1	3
	sub total	0	1	6		2	9
Cassava/ Sweet Potato	Breeding						
	Agronomy						
	Physiology						
	Entomology						
	Pathology						
	sub total	0	0	0			
Farming systems		1		5		27	33
Post Harvest				2		2	4
Total Palawija/ FS/Post Harvest		1	2	22	31	13	56
Rice	Breeding			4		6	10
	Agronomy		8	6		4	19
	Physiology		3	3		2	7
	Entomology		1	2		1	4
	Pathology			5			5
	Sociology			3			3
	Total Rice	0	12	23		13	47

Table F4

Training plans and targets of SARIF by level of training

Program	Level of Training	Current Numbers (A)	Already Training (B)	Total (A+B)	1990 Target	Numbers to be Identified
Corn etc.	Ph.D M.Sc	1	6	7		
	sub-total	1	6	7		
Grain legumes	Ph.D M.Sc	1	2	3		
	sub-total	1	2	3		
Root crops	Ph.D M.Sc					
	sub-total	0	0	0		
Post Harvest	Ph.D M.Sc.	1	 1	1 1		
	sub-total	1	1	2		
Total	Ph.D M.Sc	1 2	 9	1 11		
	Grand total	3	9	12		

Table F5

Training plans and targets of SARIF for staff at the Ph.D or M.Sc Level *

Program	Discipline	Current Numbers	Already Training	Sub-Total	1990 Target	To be Identified
Corn etc.	Breeding					
	Agronomy		2	2		
	Physiology		2	2		
	Entomology	1	1	2		
	Pathology		1	1		
	Other					
	sub-total	1	6	7		
Grain Legumes	Breeding					
	Agronomy	1		1		
	Physiology					
	Entomology					
	Pathology		2	2		
	Other					
	sub-total	1	2	3		
Root Crops	Breeding					
	Agronomy					
	Physiology					
	Entomology					
	Pathology					
	Other					
	sub-total	0	0	0		
	Post harvest	1	1	2		
	Total	3	9	12		

* Numbers shown are Ph.D plus M.Sc

Table F6

SARIF Budget 1980 - 85

(Routine and Development)

Year	GOI, RP million		Foreign ** US $ Thousand	Total Rp. million
	Routine	Development		
1980 / 81	39	699	2,044.000 (1$ = Rp 625,-)	2.015
1981 / 82	62	898	1,891.000 (1$ = Rp 625,-)	2.142
1982 / 83	69	1.250	862.000 (1$ = Rp 625,-)	1.858
1983 / 84	77	1.537	358.607 (1$ = Rp. 700,-)	1.866
1984 / 85	111	857	2.127.700 (1$ = Rp 970,-)	3.031
Total	358	5.241	7,283.307	10,913

Table F7

Major functional components of SARIF local budget 1984/1985

(Routine and Development)

Sources	Routine		Development		Total	
	Rp million	%	Rp million	%	Rp million	%
1. Salaries	91	82	226	27	316	33
2. Maintenance of facilities	10	9	-		10	1
3. Provision of facilities	8	7	387	45	395	41
4. Research operations	-		96	11	96	10
5. Others	2	2	148	17	150	15
Total	111	100	857	100	968	100

Note: This budget includes rice, post harvest and farming systems activities as well as those for palawija crops. The type of breakdown shown above is not available for palawija crops separately but Table F8 attempts to

TABLE F8

PALAWIJA CROP BUDGET OF SARIF 1984/85

Total Budget of SARIF	968 m Rp
Palawija crop work as % of program	40%
Budget allocated (by team) to palawija crops	387 m Rp

G PALAWIJA CROP RESEARCH AT FOOD CROP RESEARCH INSTITUTE MAROS (MORIF)

TABLE G1

MORIF RESEARCH INSTITUTE, STATIONS AND EXPERIMENTAL FARMS

			Ha experimental lands
COORDINATING CENTER	:	BOGOR	
RESEARCH INSTITUTE (with farm)	:	MAROS	150.0
RESEARCH STATIONS (all with farms)	:	Lanrang	43.0
		Wawotobi	10.0
		Makariki	50.0
		Mariri	50.0
		Kalasey	50.0
EXPERIMENTAL FARMS	:	Dolage	8.0
		Bontobili	23.0
		Buildings, Roads, Houses etc (ha) and lands not yet taken up	46.3
			430.3

These units have a mandate to work with rice and farming systems as well as palawija crops. Currently 40% of the program is for palawija crops, most of it being cropping systems research, in addition another 13% of the MORIF program is designated farming systems (including those based on rice).

Table G2

Current resources of MORIF

Physical Infrastructure	Unit	Maros	Langrang	Makariki	Bontobili	Wawo Tobi/Kariri and Kalasey	Dolage	Total
Area of Land	Ha	150.0	44.3	50.0	28.0	155.0	8.0	430.3 *
1. Office	M2	1510	175	340	35	no completed construction		2060
2. Laboratories	M2	392	-	60	1			452
3. Library	M2	96	-	.-	-			96
4. Auditorium	M2	92						92
5. Green/Screen house	M2	1280	900	200				2380
6. Stores/Workshop	M2	1240	240	100	210			1790
7. Drying yards	M2	720	110	200	720			2750
8. Guest Houses	M2	120	120					240
9. Houses (Scientist)	M2	4217	124	280	90			4711
10. Social Amenities	M2	220						220
11. Vehicles/motocycles		25/2	1/-	4/-	1/-	5/5		36/7

Status of facilities (Ranking: 5 is excellent; 0 is absent)

1. Sufficient land area						
2. Adequacy of buildings						
3. Adequacy of farm equipment						
4. Adequacy of office equipment						
5. Adequacy laboratory equipmment						
6. Availability of literature						
7. Reliability of utility service						

* Total includes land in roads, buildings, houses etc.

Table G3

Personnel Resources of MORIF

Program	Discipline	Ph.D	M.Sc	Sar.	B.Sc	High Sch.	Total
Corn/ Wheat/ Sorghum	Breeding		1			3	4
	Agronomy			2			2
	Physiology		1	1			1
	Entomology						
	Pathology						
	sub total	0	2	3		3	8
Grain Legumes	Breeding			3		3	6
	Agronomy			4		2	6
	Physiology						
	Entomology			1			1
	Pathology			2		1	3
	sub total	0	0	10		6	16
Cassava/ Sweet Potato	Breeding						
	Agronomy			1		1	2
	Physiology						
	Entomology						
	Pathology						
	sub total	0	0	1		1	2
Farming systems				2		3	5
Post Harvest			2	7		3	12
Palawija/FS/Soc.Ec. and Post Harvest		0	4	24		16	43
Rice	Breeding	1	1	11		11	24
	Agronomy	1	1	5	2	6	15
	Physiology			2			2
	Entomology		1	4		6	11
	Pathology			5			5
	Mechanization	1	1				2
	Total Rice	3	5	24	2	25	59

Table G4

Training plans and targets of MORIF
by level of training

Program	Level of Training	Current Numbers (A)	Already Training (B)	Total (A+B)	1990 Target	Numbers to be Identified
Corn etc.	Ph.D M.Sc	 2 (-1)	1 2	1 3		
	sub-total	2 (-1)	3	4		
Grain legumes	Ph.D M.Sc		 2	 2		
	sub-total	0	2	2		
Root crops	Ph.D M.Sc					
	sub-total	0	0	0		
Farming Systems Socio/econ.	Ph.D M.Sc.	 2				
	sub-total	2	0	2		
Total	Ph.D M.Sc	 4 (-1)	1 4	1 7		
	Grand total	4 (-1)	5	8		

Note: Figures in brackets denote existing M.Sc undergoing training for Ph.D.

Table G5

Training plans and targets of MORIF for staff at the Ph.D or M.Sc Level *

Program	Discipline	Current Numbers	Already Training	Sub-Total	1990 Target	To be Identified
Corn etc.	Breeding	1 (-1)	1	1		
	Agronomy		2	2		
	Physiology	1		1		
	Entomology					
	Pathology					
	Other					
	sub-total	2 (-1)	3	4		
Grain Legumes	Breeding					
	Agronomy		2	2		
	Physiology					
	Entomology					
	Pathology					
	Other					
	sub-total	0	2	2		
Root Crops	Breeding					
	Agronomy					
	Physiology					
	Entomology					
	Pathology					
	Other					
Farming Systems / Economics		2	0	2		
	Total	4 (-1)	5	8		

* Numbers shown are Ph.D plus M.Sc

Table G6

MORIF Budget 1980 - 85
(Routine and Development)

Year	GOI, RP million		Foreign ** US $ Thousand	Total Rp. million
	Routine	Development		
1980 / 81	142	419	-	561
1981 / 82	185	515	-	700
1982 / 83	182	575	-	757
1983 / 84	633	555	-	1,188
1984 / 85	262	575	(1$ = Rp 970,-)	837
Total	1,405	2,639		4.044

Table G7

Major functional components of MORIF local budget 1984/1985
(Routine and Development)

Sources	Routine		Development		Total	
	Rp million	%	Rp million	%	Rp million	%
1. Salarics	174	66	242	42	415	50
2. Maintenance of facilities	39	15	-		39	5
3. Provision of facilities	45	17	95	16	140	17
4. Research operations	-		153	27	153	18
5. Others	3	2	86	15	89	10
Total	262	100	575	100	937	100

Note: This budget includes rice, post harvest and farming systems activities as well as those for palawija crops. The type of breakdown shown above is not available for palawija crops separately but Table G8 attempts to present total budgets for individual palawija crops.

TABLE G8

PALAWIJA CROP BUDGET OF MORIF 1984/85

Total Budget of MORIF	827 m Rp
Palawija crop work as % program	40%
Budget allocated (by team) to palawija crops	335 m Rp

PALAWIJA CROP RESEARCH AT FOOD CROP RESEARCH INSTITUTE BANJARMASIN (BARIF)

TABLE H1

BARIF RESEARCH INSTITUTE, STATIONS AND EXPERIMENTAL FARMS

			Ha experimental lands
COORDINATING CENTER	:	BOGOR	
RESEARCH INSTITUTE (with farm)	:	BANJARMASIN	1.6
RESEARCH STATIONS (with farms)	:	Manarap	21.6
		Banjarbaru	50.0
		Tanggul	49.0
		Barabai	9.9
EXPERIMENTAL FARMS		Pleihari	12.0
		Binuang	25.0
		Balandean	25.0
		Tatas	25.0
		Lempake	11
Buildings, Roads, Houses etc (ha)			24.2
Total land area			230.1

These units have a mandate to work with rice and farming systems as well as palawija crops. Currently 35% of the program is in palawija (and some farming systems) experiments.

Table H2

Current resources of BARIF

Physical Infrastructure	Unit	Banjarmasin	Masarap	Banjarbaru	Tanggul	Barabai	Farms (5)	Total
Area of Land	Ha	1.6	21.6	50.0	49.0	9.9	98.0	230.1
1. Office	M2	450	372		100	140	220	1282
2. Laboratories	M2						56	56
3. Library	M2	108					56	164
4. Auditorium	M2	265						265
5. Green/Screen house	M2	172	150				150	472
6. Stores/Workshop	M2							N/A
7. Drying floors	M2							N/A
8. Guest Houses	M2	318						318
9. Houses (Scientist)	M2	330						330
10. Houses (Staff)	M2	70			120	120	311	621
11. Vehicles	M2							N/A

Status of facilities (Ranking: 5 is excellent; 0 is absent)

1. Sufficient land area						
2. Adequacy of buildings						
3. Adequacy of farm equipment						
4. Adequacy of office equipment						
5. Adequacy laboratory equipment						
6. Availability of literature						
7. Reliability of utility service						

Table H3

Personnel Resources of BA RIF

Program	Dicipline	Ph.D	M.Sc	Sar.	B.Sc	High Sch.	Total
Corn/ Wheat/ Sorghum	Breeding			1		3	4
	Agronomy			2		1	3
	Physiology			1			1
	Entomology						
	Pathology						
	sub total	0	0	4		4	8
Grain Legumes	Breeding					1	1
	Agronomy						
	Physiology			1			1
	Entomology						
	Pathology						
	sub total	0	0	1		1	2
Cassava/ Sweet Potato	Breeding						
	Agronomy				3		3
	Physiology			1			1
	Entomology			1			1
	Pathology						
	sub total	0	0	2	3		5
Farming systems		1				1	2
Soc. Ec. and Post Harvest				7		1	8
Total Palawija		1	0	14	3	7	25
Rice	Breeding		1	1		2	4
	Agronomy		1	5			6
	Physiology			1	1		2
	Entomology			1		2	3
	Pathology			1			1
	Sociology						
	Total Rice		2	9	1	4	16

Table H4

Training plans and targets of BARIF by level of training

Program	Level of Training	Current Numbers (A)	Already Training (B)	Total (A+B)	1990 Target	Numbers to be Identified
Corn etc.	Ph.D M.Sc		 2			
	sub-total	0	2	2		
Grain legumes	Ph.D M.Sc					
	sub-total	0	0	0		
Root crops	Ph.D M.Sc					
	sub-total	0	0	0		
Farming Systems	Ph.D M.Sc.	1				
	sub-total	1	0	0		
Total	Ph.D M.Sc					
	Grand total	1	2	3		

Table H5

Training plans and targets of BA RIF for staff at the Ph.D or M.Sc Level *

Program	Discipline	Current Numbers	Already Training	Sub-Total	1990 Target	To be Identified
Corn etc.	Breeding Agronomy Physiology Entomology Pathology Other		2	2		
	sub-total	0	2	2		
Grain Legumes	Breeding Agronomy Physiology Entomology Pathology Other					
	sub-total	0	0	0		
Root Crops	Breeding Agronomy Physiology Entomology Pathology Other					
		0	0	0		
Farming Systems		1	0	1		
	Total	1	2	3		

* Numbers shown are Ph.D plus M.Sc

Table H6

BARIF Budget 1980 - 85
(Routine and Development)

Year	GOI, RP million		Foreign US $ Thousand	Total Rp. million
	Routine	Development		
1980 / 81	51	199	-	250
1981 / 82	72	220	-	292
1982 / 83	78	236	-	314
1983 / 84	84	193	-	277
1984 / 85	108	279	-	387
Total	392	1,127	-	1.519

Table H7

Major functional components of BARIF local budget 1984/1985
(Routine and Development)

Sources	Routine		Development		Total	
	Rp million	%	Rp million	%	Rp million	%
1. Salaries	86	79,5	140	50	227	59
2. Maintenance of facilities	11	10	-		11	3
3. Provision of facilities	10	9	36	13	45	12
4. Research operations	-		70	25	70	18
5. Others	2	1,5	32	12	32	8
Total	108	100	279	100	387	100

Note: This budget includes rice, post harvest and farming systems activities as well as those for palawija crops. The type of breakdown shown above is not available for palawija crops separately but Table H8 attempts to present total budgets for individual palawija crops.

TABLE H8

PALAWIJA CROP BUDGET OF BARIF 1984/85

Total Budget of BARIF	387 m Rp
Palawija crop work as % of program	35%
Budget allocated (by team) to palawija crops	135 m Rp

MAJOR COMMODITY RESEARCH PROGRAMS ON PALAWIJA CROPS - BY INSTITUTE

Table 31

Summary of Maize Research Activities in CRIFC Institutes

Activity	Bogor	Sukamandi	Malang	Maros	Banjarmasin	Sukarami
Varietal Improvement	x	x	x	x	x	x
Seed Production	x	x	x	x	x	x
Crop Management						
- Agronomy	x	x	x	x	x	x
- Physiology	x	-	-	-	-	-
Plant Protection						
- Pests	x	-	x	x	x	x
- Diseases	x	-	x	x	-	x
Post Harvest						
- Production	x	-	x	-	-	-
- Waste Products	x	-	x	-	-	-
Seed Technology	x	-	x	-	-	-

Table J2

Details of maize research activities by subject and institute.

Activity	Bogor	Suka-mandi	Malang	Maros	Banjar-masin	Suka-rami
1. Varietal improvement						
a. Germplasm coll.and introduction	x	x	(x)	x	x	x
b. Gene pool development	(x)	-	x	x	x	x
c. Population improvement	x	-	(x)	x	-	x
d. Specific selection	x	x	x	x	x	x
e. Regional testing	(x)	x	x	x	x	x
f. Production of breeder seed	x	x	(x)	x	x	x
g. Genetic and breeding methods	(x)	-	-	-	-	-
2. Crop management						
-. Agronomy						
a. Soil fertility	x	x	x	x	x	x
b. Soil cultivation	x	-	-	x	-	x
c. Cultural practices	x	-	x	-	-	-
d. Cropping Systems	x	x	x	x	x	x
e. Weed control	x	-	x	-	-	x
-. Physiology						
a. Plant nutrients	x	-	-	-	-	-
b. Physio-encology/environmental stress	x	-	-	-	-	-
c. Agroclimatology	x	-	-	-	-	-
3. Plant protection						
-. Field pests						
a. Taxonomy	x	-	x	x	x	x
b. Eco-biology of major pests	x	-	-	-	-	-
c. Seedling fly control by cultural methods	x	-	x	x	-	x
Screening for resistance	x	-	x	x	-	x
Natural enemies	x	-	-	-	-	-
Pesticides	x	-	x	-	-	-
d. Integrated pest management	x	-	x	x	x	x

Table J2 (cont'd)

Activity	Bogor	Suka-mandi	Malang	Maros	Banjar-masin	Suka-rami
-. Storage pests						
a. Taxonomy	x	-	-	-	-	-
b. Eco-biology of major pests	x	-	-	-	-	-
c. Control						
Varietal screening	x	-	x	-	-	-
Natural enemies	x	-	-	-	-	-
Pesticides	x	-	x	-	-	-
Integrated pests management	x	-	x	x	x	x
-. Diseases						
a. Identification	x	-	x	x	x	x
b. Population dynamics	x	-	-	-	-	-
c. Fungicides	x	-	x	-	-	-
d. Screening for resistance	x	-	x	x	-	x
4. Post Harvest						
-. Production						
a. Reduction of losses	x	-	x	-	-	-
b. Improving storability	x	-	x	-	-	-
c. Improving yield use efficiency	x	-	x	-	-	-
-. Waste products						
a. Identification	x	-	x	-	-	-
b. Use efficiency	x	-	x	-	-	-
5. Seed technology						
a. Influence of agronomic, Physiology, pest and disease factors on quality	x	-	x	-	-	-
b. Influence of harvesting, drying, storage and transport on germinability	x	-	x	-	-	-

( ) - Coordination/center of activity.

Table 13

Summary of Sorghum Research Activities in CRIFC Institutes

Activity	Bogor	Sukamandi	Malang	Maros	Banjarmasin	Sukarami
Varietal Improvement	x	-	x	x	-	x
Seed Production	x	-	x	-	-	-
Crop Management						
- Agronomy	x	-	x	x	-	x
- Physiology	-	-	-	-	-	-
Plant Protection						
- Pests	-	-	x	-	-	-
- Diseases	-	-	x	-	-	-
Post Harvest						
- Production	x	-	-	-	-	-
- Waste products	x	-	-	-	-	-
Seed Technology	x	-	-	-	-	-

Table J4

Summary of Sorghum research activities by subject and Institute

Activity	Bogor	Suka-mandi	Malang	Maros	Banjar-masin	Suka-rami
1. Varietal improvement						
a. Germplasm collection and introduction	x	-	(x)	-	-	-
b. Hybridization and selection	(x)	-	x	-	-	-
c. Testing of lines	(x)	-	x	x	-	x
d. Production of breeding seed	x	-	(x)	-	-	-
e. Genetic and breeding methods	(x)	-	-	-	-	-
2. Crop management						
-. Agronomy						
a. Soil fertility	x	-	x	-	-	-
b. Soil cultivation	-	-	-	-	-	-
c. Cultural practices	x	-	x	-	-	-
d. Cropping systems	x	-	x	x	-	x
e. Weed control	x	-	-	-	-	-
-. Physiology						
a. Plant nutrition	-	-	-	-	-	-
b. Physiology/environ-mental stress	-	-	-	-	-	-
c. Agroclimatology	-	-	-	-	-	-
3. Plant protection						
-. Field pests						
a. Taxonomy	x	-	x	-	-	-
b. Eco-biology of major pests	x	-	-	-	-	-
c. Control						
Varietal screening	x	-	x	-	-	-
Natural enemies	-	-	-	-	-	-
Pesticides	x	-	x	-	-	-
d. Integrated pest management	x	-	x	-	-	-
-. Storage pests						
a. Taxonomy	-	-	-	-	-	-
b. Eco-biology of major pests	-	-	-	-	-	-
c. Control						
Varietal screening	-	-	-	-	-	-
- Natural enemies						
Pesticides						
Integrated pest management						

Table J4 (cont.)

Activity	Bogor	Suka-mandi	Malang	Maros	Banjar-masin	Suka-rami
- Disease						
a. Identification	-	-	x	-	-	-
b. Population dynamics	-	-	-	-	-	-
c. Fungicides	-	-	-	-	-	-
d. Screening for resistance	-	-	-	-	-	-
4. Post Harvest						
- Production						
a. Reduction of losses	x	-	-	-	-	-
b. Improving storability	x	-	-	-	-	-
c. Improving yield use efficiency	x	-	-	-	-	-
- Waste products						
a. Identification	x	-	-	-	-	-
b. Use efficiency	x	-	-	-	-	-
5. Seed technology						
a. Influence of agronomics, physiological, pest and disease factors on quality	x	-	-	-	-	-
b. Influence of harvesting, drying, storage and transport on germination	x	-	-	-	-	-

Table J5

Summary of legume research activities in CRIFC Institutes

Activity	Malang	Bogor	Sukamandi	Sukarami	Maros	Banjarmasin
1. Crop improvement						
a. Germplasm	x	x	x	-	-	-
b. Breeding	x	x	x	-	-	-
c. Testing	x	x	x	x	x	x
d. Seed bank	x	x	x	x	x	x
2. Crop management						
a. Fertilization/ liming	x	x	-	x	x	x
b. Water management	x	x	x	-	-	-
c. Planting methods	x	x	x	x	x	x
d. N fixation	x	x	x	-	x	x
e. Weed control	x	x	x	-	x	x
3. Plant protection						
a. Major pests	x	x	x	x	x	x
b. Major diseases	x	x	x	x	x	-
c. Epidemics	x	x	-	-	x	-
4. Physiology						
a. Nutrient use efficiency	x	x	x	-	x	x
b. Growth analysis	x	x	-	x	-	x
c. Eco-physiology	x	x	-	x	-	-
5. Pigeon pea	x	x	-	-	x	-
6. Post harvest	x	x	x	-	-	-

Table J6

Details of legume research activities by subject and institute.

Activity	Malang	Bogor	Sukamandi	Sukarami	Maros	Banjarmasin
1. Crop improvement						
a. Germplasm	x	x	x	-	-	-
b. Hybridization/ mutation	x	x	x	-	-	-
c. Selection of lines	x	x	x	x	-	-
d. Selection for desease resistance	x	x	x	x	x	-
e. Selection methods	-	x	x	-	-	-
f. Selection for low pH tolerance	-	x	-	x	-	-
g. Breeder seed production	x	x	x	-	-	-
h. Yield tests	x	x	x	x	x	x
i. Seed bank	x	x	x	x	x	x
Crop management						
a. Macro & micro fertilizers	x	x	-	x	x	x
b. Liming	x	x	-	x	x	x
c. Water management	x	x	x	-	-	-
d. Soil cultivation	x	x	x	-	-	-
e. Plant population & spacing	x	x	x	-	-	-
f. Biological N fixation	x	x	x	-	-	-
g. Weed control	x	x	x	-	x	x
Plant protection						
a. Screening soybean for resistance to podborer, podsucker and beanfly	x	x	x	-	-	-
b. Bio-ecology of podborer, pod-sucker, beanfly and leafeater	x	x	x	-	-	-
c. Chemical pest control	x	x	x	x	x	x
d. Epidemiology of major pests	x	x	x	-	-	-

Table J6 (cont.)

Activity	Malang	Bogor	Sukamandi	Sukarami	Maros	Banjarmasin
e. Biology & pathogenics of mosaic and mottle viruses	-	x	x	x	x	-
f. Screening for resistance of viruses	x	x	x	-	x	-
g. Research on strains of bacterial wilt and resistance tests	-	x	-	-	-	-
h. Epidemiology of rust and *Cercospora* on soybean & peanut	x	x	x	x	x	-
i. Fungicide control	x	x	-	x	x	-
j. Side effects of pesticides	-	x	-	-	-	-
4. Physiology						
a. Shading	x	x	x	x	x	-
b. Water stress and flooding	x	x	x	x	-	x
c. Effectiveness of *Rhizobium* & *Mycorhiza* strains	x	x	x	-	-	-
d. Toxicities and low pH	-	x	-	x	x	x
e. Growth and metabolism analysis	x	x	-	-	-	-
f. Source-sink linkages	x	x	-	-	-	-
g. Hormones, leaf fertilizers	x	x	x	-	-	-
5. Pigeon pea						
a. Varietal adaptation	x	x	-	x	-	-
b. Planting time	x	-	-	x	x	-
c. Planting methods	x	-	-	x	x	-
6. Post harvest						
a. Optimal harvest time	x	x	-	-	-	-
b. Storage	x	-	-	-	-	-
c. Drying	x	-	x	-	-	-

Table J7

Program for Root and Tuber Crop Research, 1985-95, by Institute

Activity	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1. Crop Improvement											
a. Collection, conservation	2	2	1,2	1,2	1	1	1	1	1	1	1
b. Introduction	2	2	2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
c. Population improv.	2	2	2	2	1,2	1,2	1	1	1	1	1
d. Specific Selection	2	1,2,3,4	1 s/d 6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6
e. Testing	2	2	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6
2. Crop Management											
a. Soil fertility	1,2,3	1-3	1-3	1-4	1-5	1-6	1-6	1-6	1-6	1-6	1-6
b. Fertilization	1,2	1,2	1-3	1-4	1-5	1-6	1-6	1-6	1-6	1-6	1-6
c. Weed control	1,2	1,2	1,2,3	1,2	1,3	1,3	1,4	1,4	1,5	1	1
d. Problem Soils	2	2	2	1,2	1,2,3	1-4	1-5	1-5	1-6	1-6	1-6
3. Crop Protection											
a. Varietal screening	2	2	1,2	1,2	1,2	1	1	1	1	1	1
b. Varietal resistance	2	2	1,2	1,2	1,2	1	1	1	1	1	1
c. Inventarization	2	2	1,2	1,2	1	1	1	1	1	1	1
d. Control	2	2	1,2	1,2	1	1	1	1	1	1	1
4. Post harvest											
a. Harvest timing	2	1,2	1,2	1,2	1	1	1	1	1	1	1
b. Processing & storage	2	1,2	1,2	1,2	1	1	1	1	1	1	1
c. Quality standards	2	1,2	1,2	1,2	1	1	1	1	1	1	1
d. Nutritive Quality	2	1,2	1,2	1,2	1	1	1	1	1	1	1

--- Each number refers to an Institute: 1. Malang; 2. Bogor; 3. Sukarami; 4. Maros; 5. Banjarmasin; 6. Sukamandi.

K DONOR ASSISTANCE FOR PALAWIJA RESEARCH

TABLE K1 Recent and Current Palawija Crop Research Assisted by Donor Programs

The figures shown exclude support from NAR I, NAR II and AARP much of which has gone to the CRIFC for palawija crops and rice.

TABLE K1

RECENT AND CURRENT PALAWIJA
CROP RESEARCH ASSISTED BY DONOR PROGRAMS

No	Title	Donor	US$m	Main Activities
ATA 110	Increasing food crop production (1973-80)	Holland	1.04	Malang area
ATA 218	Legume research in farming systems (1978-85)	Japan	2.32	Sumatra
	Sumatra Ag.Res. Project (including rice and livestock) (1978-84)	USA	9.5	Sumatra
ATA 272	Strengthening Malang RIFC	Holland	3.50	East Java
ATA 275	ESCAP Regional Coordination Centre for Palawija and other food crops - mainly agro-economic inputs in Indonesia	multi donor	3.16 (to Region)	S.E. Asian Region

L WHEAT IMPORTS AND CONSUMPTION IN INDONESIA

Figure L1

Imports of wheat grain and flour, Indonesia

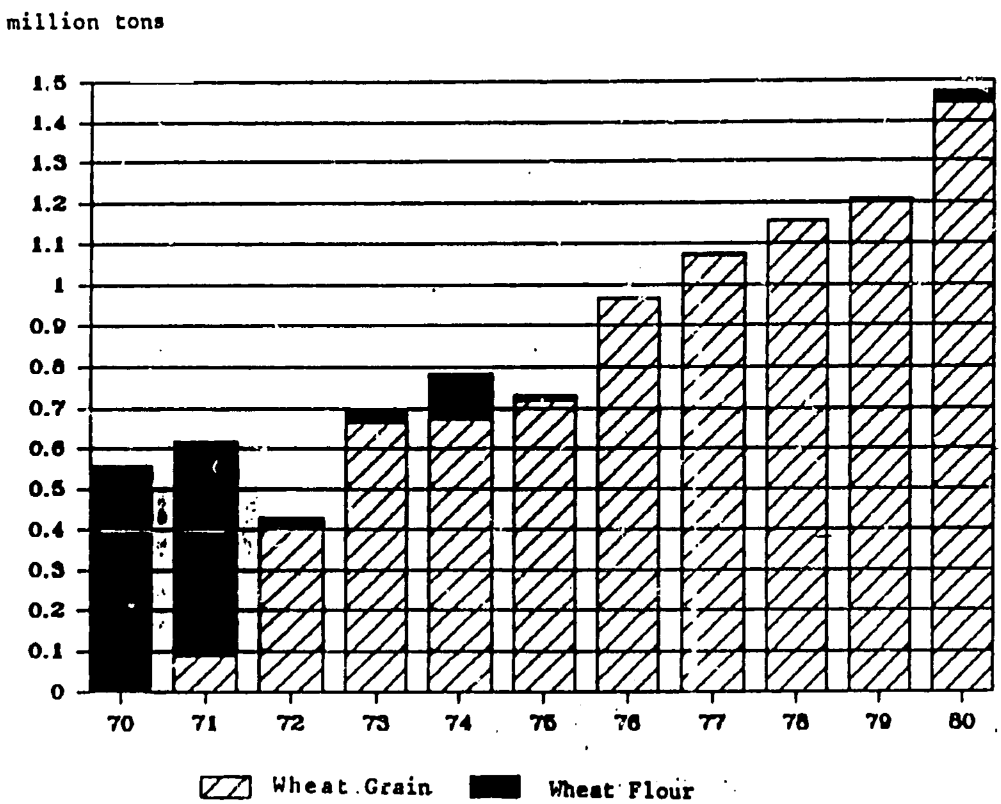


Figure L2

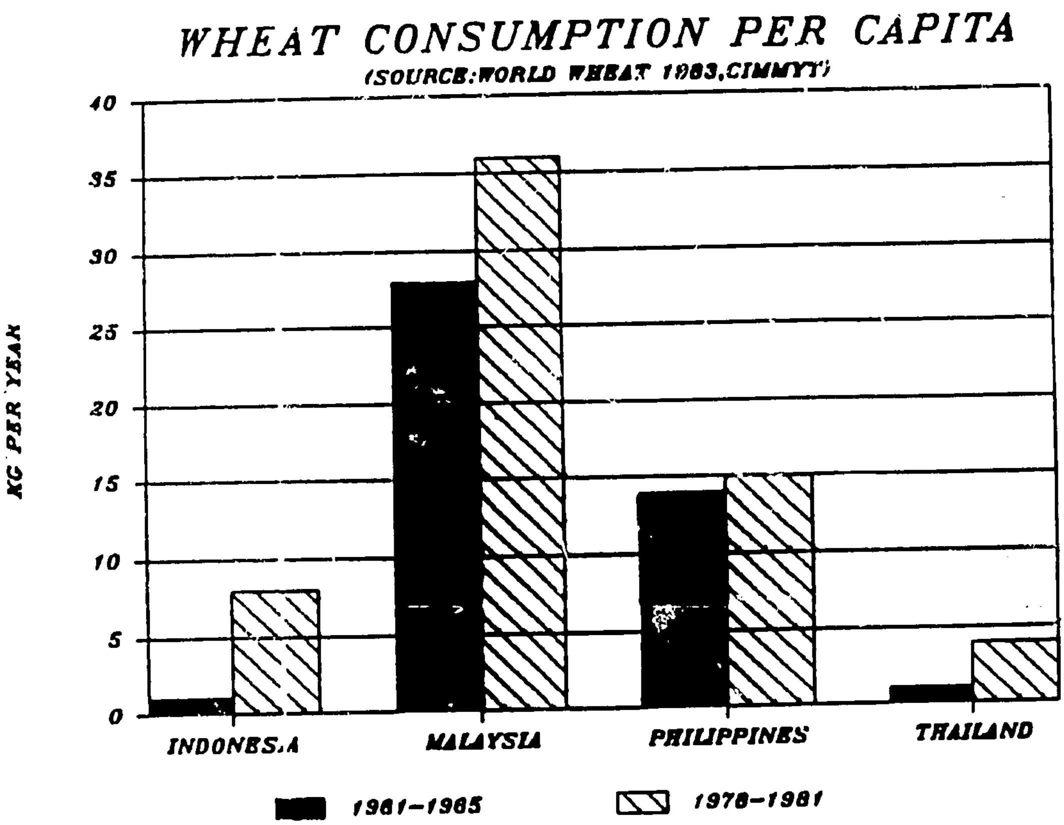
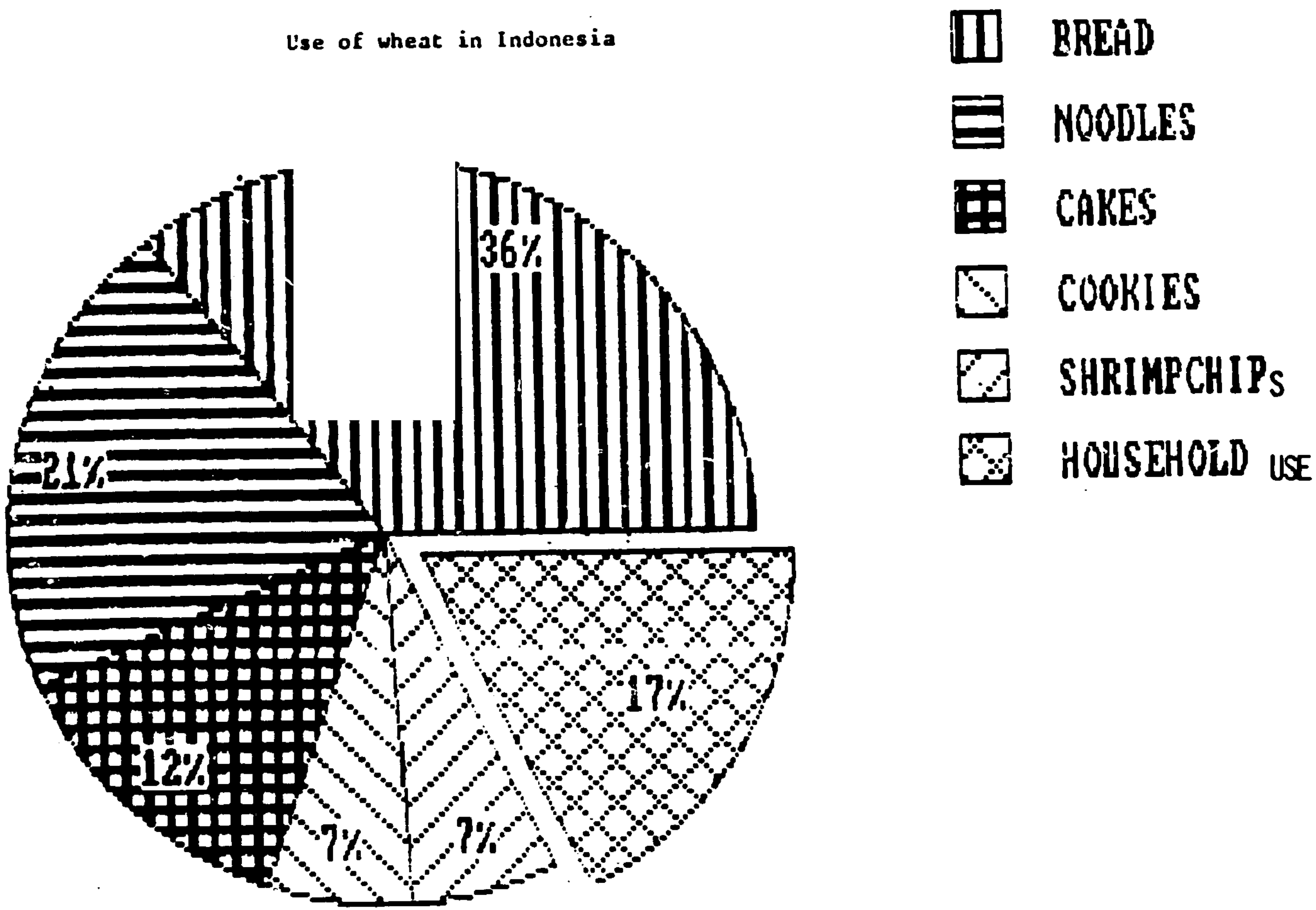

WHEAT CONSUMPTION PER CAPITA
(SOURCE:WORLD WHEAT 1983,CIMMYT)
KG PER YEAR
40
35
30
25
20
15
10
5
0
INDONESIA
MALAYSIA
PHILIPPINES
THAILAND
1961–1965
1978–1981

Figure L3


Use of wheat in Indonesia
36%
21%
12%
7%
7%
17%
BREAD
NOODLES
CAKES
COOKIES
SHRIMPCHIPs
HOUSEHOLD USE

M SUMMARY TABLES FOR RESEARCH PROGRAMS HUMAN RESOURCES AND BUDGETS

TABLE M1

SUMMARY OF RESEARCH PROGRAMS AT CRIFC INSTITUTES 1984/85

	BOGOR			MALANG			SUKAMANDI			SUKARAMI		
	RPTP	Experiments		RPTP	Experiments		RPTP	Experiments		RPTP	Experiments	
		no	%		no	%		no	%		no	%
Rice	8	222	46	1	24	11	6	170	48	24	142	54
Corn/Sorghum	8	62	13	3	60	28	2	44	12	4	18	7
Grain Legumes	4	75	15	3	78	37	1	41	12	7	30	11
Root Crops	5	42	9	1	12	6				3	11	4
Farming Systems	3	29	6	1	18	8	1	15	4	4	59	22
Soc-Econ	1	24	5									
Post-Harvest	1	13	3									
Others	2	17	3	1	20	9	8	85*	24	1	5	2
TOTAL	32	484	100%	10	212	100%	18	355	100	43	265	100%

Note: 1. RPTP denotes program areas e.g. plant breeding (see tables J for details)

2. Experiments includes replicates

3. The large number of "others" at Sukamandi is associated with the ESCAP program (see table K1)

TABLE M1 continued

	MAROS			BANJARMASIN			TOTAL			
	RPTP	Experiments		RPTP	Experiments		RPTP	Experiments		
		no	%		no	%		no	%	
Rice	7	135	34	12	53	53	58	746	41	
Corn/Sorghum)				4	11	11	22)	198)		(14% excluding
Grain Legumes)	8	163	41	7	16	16	23)+6	246) +154	37	(18% MAROS
Root Crops)				4	6	6	13)	71)		(5%
Farming Systems	1	52	13	4	6	6	14	179	10	
Soc-Econ							1	24	1	
Post-Harvest				2	8	8	3	21	1	
Others	3	50	12				15	167	9	
TOTAL	19	400	100%	33	100	100%	155	1802	100%	

TABLE M2

CURRENT STAFFING BY INSTITUTE

Palawija and Systems/Economics/Post-harvest staff

	Ph.D.	M.Sc.	Sarjana	Total
BORIF	7	15	38	60
MARIF	2	2	29	33
SURIF	3	6	16	25
SARIF	1	2	22	25
MORIF	0	4	24	28
BARIF	1	0	14	15
	14	29	143	186

TABLE M3

CURRENT STAFFING BY COMMODITY PROGRAM

	Ph.D.	M.Sc.	Sarjana	Total
Corn/Sorghum	5	6	37	48
Legumes	4	16	47	67
Root Crops	1	2	16	19
Farming Systems etc.	4	5	43	52
	14	29	143	186

TABLE M4

CURRENT STAFFING BY DISCIPLINE

	Ph.D.	M.Sc.	Sarjana	Total
Plant Breeding	7	5	24	36
Agronomy	1	7	33	41
Physiology	0	5	15	20
Entomology	1	6	9	16
Pathology	1	1	11	13
Soci-economics	0	2	13	15
Post-harvest	1	2	16	19
Farming systems	3	1	22	26
	14	29	143	186

TABLE M5

SUMMARY OF CRIFC BUDGET 1984/85

million Rp

Unit	Routine	Development	Foreign	Total
Coordinating Center	279	250	-	529
BORIF	743	650	582	1975
MARIF	355	306	446	1107
SURIF	209	660	-	869
SARIF	111	857	2063	3031
MORIF	262	575	-	837
BARIF	108	279		387
TOTAL	2067	3577	3091	8735
in US $	$2.0 m	$3.5 m	$3.0 m	$8.5 m

TABLE M6

SUMMARY OF FUNCTIONAL
COMPONENTS OF CRIFC BUDGET 1984/85

(excluding foreign component)

m Rp

	Salaries	Maintenance	Research Operations	Other	Capital	Total
Coordinating Center	280	23	0	188	37	529
BORIF	913	36	181	111	147	1393
MARIF	453	21	70	38	79	661
SURIF	428	21	114	79	229	869
SARIF	316	10	96	150	395	968
MORIF	415	39	153	89	140	837
BARIF	227	11	70	32	45	387
TOTAL	3032	161	684	687	1072	5644
%	54%	3%	12%	12%	19%	100%

TABLE M7

ESTIMATED BUDGET FOR PALAWIJA RESEARCH 1984/85

Institute	Total Local Budget (Rpm)	% estimated as[1] palawija	Estimated palawija budget in Rp[2]	% Total Palawija
BORIF	1393	40	557	23
MARIF	661	75	496	21
SURIF	869	30	261	11
SARIF	968	40	387	16
MORIF	837	40	335	14
BARIF	387	35	135	6
Res. Coord. Center	529	42 [3]	222	9
	5644	42 [3]	2393	100%

Notes: 1) Based on Table M1 see also notes on Tables C8, D8, E8, F8, G8, H8

2) Based on 37% Palawija plus half of farming systems (ie. 5%) in Table M1

3) The breakdown of palawija research in Table M1 is 39% corn/sorghum 46% grain legumes 15% root crops. If this is pro-rated against the final column of this table the commodity allocations become:
corn/sorghum - 933 m Rp
grain legumes - 1101 m Rp
root crops - 359 m Rp