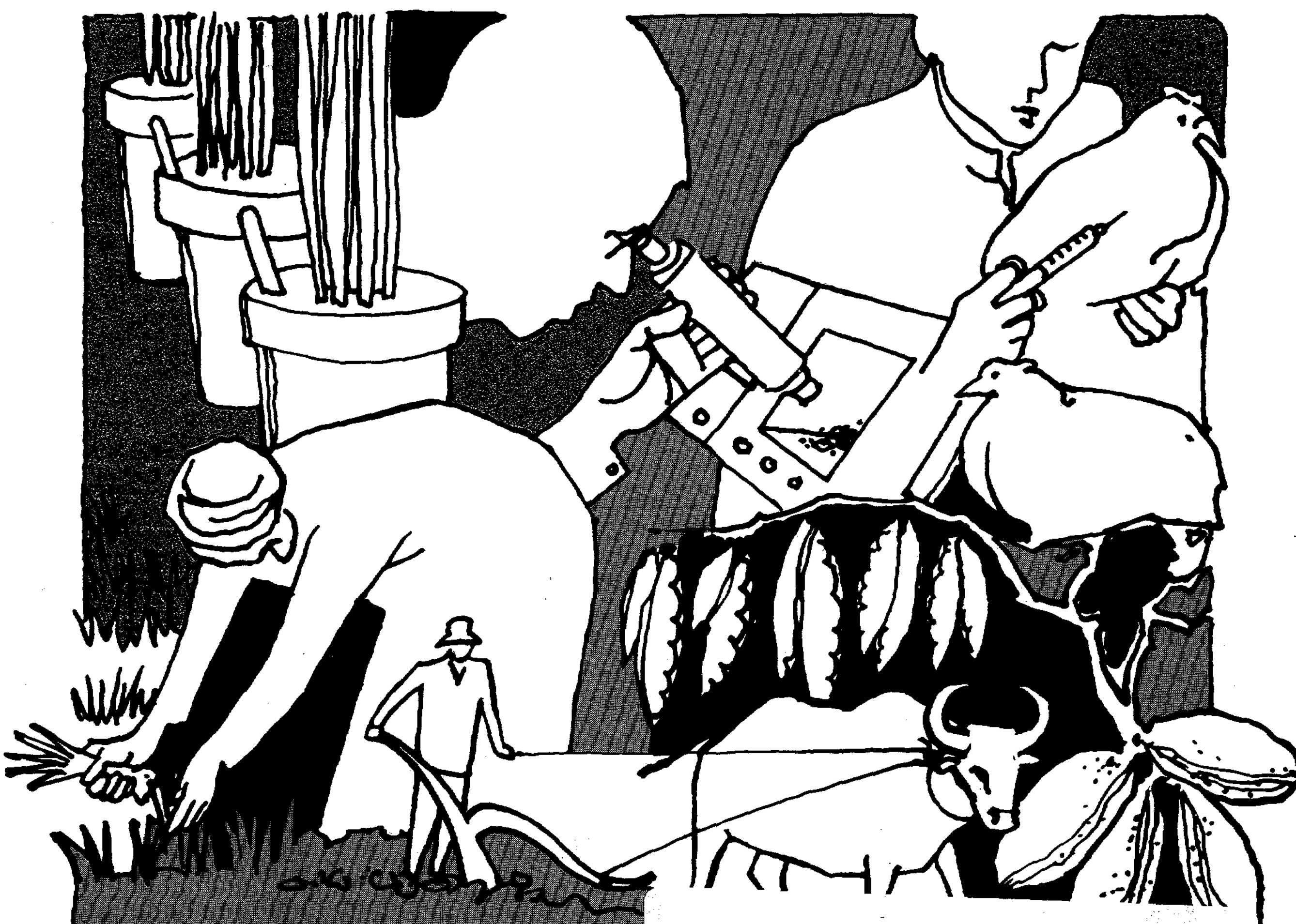
Consultative Group on International Agricultural Research
CGIAR
Study Paper Number 10

CGR-10

# Indonesia and the CGIAR Centers

## A Study of Their Collaboration in Agricultural Research

Barry Nestel



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## A Study of Their Collaboration in Agricultural Research

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At its annual meeting in November 1983 the Consultative Group on International Agricultural Research (CGIAR) commissioned a wide-ranging impact study of the results of the activities of the international agricultural research oganizations under its sponsorship. An Advisory Committee was appointed to oversee the study and to present the principal findings at the annual meeetings of the CGIAR in October 1985. The impact study director was given responsibility for preparing the main report and commissioning a series of papers on particular research issues and on the work of the centers in selected countries. This paper is one of that series.

The judgments expressed herein are those of the author(s). They do not necessarily reflect the views of the World Bank, of affiliated organizations, including the CGIAR Secretariat, of the international agricultural research centers supported by the CGIAR, of the donors to the CGIAR, or of any individual acting on their behalf. Staff of many national and international organizations provided valued information, but neither they nor their institutions are responsible for the views expressed in this paper. Neither are the views necessarily consistent with those expressed in the main and summary reports, and they should not be attributed to the Advisory Committee or the study director.

This paper has been prepared and published informally in order to share the information with the least possible delay.

Barry Nestel is a consultant in international agriculture and chairman of the Board of Trustees of ILCA.

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## SUMMARY

Indonesia is a large country with a population of over 160 million, of which 80% live in the rural areas and over half are employed in agriculture. Since the start of its first 5-Year Plan in 1969, it has enjoyed a long period of development and sustained growth. The growth rate has slowed since 1982 due to weaker oil prices, but there has been an increase in real per capita income in every year since 1967. The agricultural sector, which provides about 26% of the GDP, has shared in this growth. The sector is dominated by rice, which occupies most of the best lands, provides half of the human protein and calorie intake and contributes about a third of the total value of the agricultural component of the GDP.

Major efforts have been made to increase the production of rice and, over the past 15 years, modern technology has had a significant impact on rice production. Both yields and production have increased steadily as a consequence of several interdependent factors. Improvements in expanding irrigation systems have created a physical environment conducive to high productivity. Modern rice varieties, with yield potential substantially above that of traditional varieties, have been introduced through the varietal improvement program. The national seed production program has rapidly multiplied these varieties to meet the demand for new cultivars. Through the BIMAS program, improved varieties, fertilizer, insecticides, and production credit have been made available to a large portion of the nation's farmers. All of these developments resulted from governmental investment in irrigation, agricultural research, seed production, plant protection, extension, and policies that have supported the price of rice and subsidized the price of inputs.

The collective impact of these efforts has been that rice production grew from 12.2 million MT in 1969 to 25.5 million MT in 1984, during which time Indonesia changed from being the world's largest importer of rice to becoming a small exporter. At the same time the per capita availability of rice for domestic consumption rose from 107 kg p.a. to 154 kg p.a., with an associated rise in calorie and protein intakes.

It is not realistic to attempt to apportion the contribution to this remarkable change in production to the different components contributing to it and, indeed, many of them are interdependent. However, it is generally recognised that the new high yielding varieties of rice have been an important contributory factor with over 50 such varieties, tailored to a variety of needs, being released since the early 1970's. These now cover over 80% of the planted rice area, on which average yields have increased by over 70%.

It is widely recognised in Indonesia that IRRI has played a very significant role in helping to provide this new technology which, superimposed on the Government's infrastructural and supportive measures, has made the growth in rice production possible.

IRRI's impact has been felt in a number of ways. Its early successes with IR5 and IR8 are credited with demonstrating the potential impact of agricultural research and this is believed to have helped influence and encourage the Government to invest heavily in agricultural research through the establishment of AARD in 1974. Since 1972 IRRI has had a team of between 2 and 7 scientists in Indonesia working directly in the national program. Throughout this time it has supplied new germplasm and collaborated closely in Indonesia's own germplasm improvement program. But, more than anything else, it has trained Indonesian scientists, over 400 of them, not only in rice research but in rice based cropping systems and in the dissemination of new technology. Many of the key people in AARD, including the directors of five of the six research institutes of the Food Crop Research Centre, are IRRI-trained Ph.D.s. The partnership between IRRI and AARD is well illustrated by the flow of new rice varieties, some of which are direct IRRI material whilst others are Indonesian lines bred from IRRI parents by AARD's IRRI-trained personnel. This partnership, and the results that it has achieved, indicate the sort of beneficial contribution that an IARC can make when it collaborates with a highly motivated and professionally competent NARS which is strongly and consistently backed by its own government.

The partnership has recently been further cemented through AARD and IRRI signing a new agreement which recognises the growing competence of the NARS, whose post-graduate trained staff have increased from 42 in 1975 to 399 in 1984 (with a further 449 currently undergoing higher degree training). This agreement involves a new type of working relationship about which AARD is very enthusiastic. It calls for IRRI to collaborate by filling defined and agreed gaps in AARD's program and capability, rather than by AARD cooperating in IRRI activities. The distinction is subtle but extremely important in terms of building confidence and capability into a relatively large NARS which, notwithstanding the past gains in rice productivity, envisages a key role for IRRI to play in the future in assisting AARD to move into frontier areas of research relating to upland and swamp rice, hybrid rice and high risk new technology.

It is not yet possible to relate a similar story for the activities of any of the other IARCs, all of whom have had to operate in Indonesia within a framework of weaker infrastructural support and with local counterpart personnel who were less in numbers and often less well trained than the scientists with whom IRRI has worked. For this reason, some commodity based IARCs have had to be less active than they themselves wished. This situation is expected to change with the build-up in AARD staff and with the Government now giving high priority to food crops other than rice. Much of the new production will have to come from upland areas, often on poor soils, in areas as yet lacking the support services that have been available to rice farmers. In such circumstances AARD is seeking a greater and more 'collaborative' type input from CIMMYT, ICRISAT and CIP, and possibly, from IITA and CIAT. For some commodities, such as maize, AARD now has the human resource base from which to build a collaborative program fairly rapidly, and CIMMYT is already responding to a request to this effect.

Since many of the IARC inputs are likely to be components of complex systems of farming, AARD sees an urgent need for the different centres to coordinate their separate inputs, if several of them are to play simultaneous roles in AARD's research on crops other than rice (and on the farming systems of which these crops are components). The lack of such coordination at the present time is seen as a flaw in the CGIAR system.

There is strong support in Indonesia for the non-commodity IARCs, all three of which are regarded as having made useful contributions. It was suggested that IPBGR should now be more active in advising NARS about new crop and variety potentials for non-CGIAR crops, based on results from NARS germplasm collections with which this centre is associated. For ISNAR and IFPRI to fulfill their important mandates, it was recommended that they should concentrate in depth in a limited number of countries where they should involve as broad a spectrum as possible of persons engaged in research policy and management. Through their professionalism and independence, both centres have the potential to contribute significantly to strengthening research policy and management, which AARD sees as an important need in many NARS, particularly rapidly growing ones.

The success of AARD's partnership with IRRI has given rise to considerable expectations within Indonesia as to the role that other CGIAR centres might play. Given the many demands on all centres, the problems of geographical separation, plus the much weaker infrastructural support and personnel resources currently available for research in Indonesia on crops other than rice, it will prove a major challenge for the IARCs to meet these expectations. However, the story of rice in Indonesia has generated local confidence that this sort of challenge can be met and there is a widely-held view that the IARCs can, and indeed must, play a key and even more active role in partnering AARD in the future.

## ACKNOWLEDGEMENTS

The conduct of this study required more than fifty interviews with agricultural scientists and administrators. All of them are busy people but gave willingly and graciously of their time. A list of persons interviewed, to all of whom I am indebted, is given in Annex 2.

I would particularly like to record my appreciation of the logistics support provided by Dr. Ibrahim Manwan, the Secretary of AARD, who also provided the commentary on which those parts of this report relating to ISNAR are based. Dr. Joko Budianto from the Secretariat assisted me in many ways and conducted the field interviews in Malang, Maros, Lembang and Sukamandi. He and Dr. B. H. Siwi, the Director of the Food Crop Research Centre, also discussed the first draft of the manuscript and made many useful observations which have been incorporated in this text. The errors and omissions remain, however, my responsibility.

The local office of IRRI provided me with secretarial support and their representative, Mr. W. Tappan, also reviewed my first draft and made valuable comments on it. I was also fortunate in being able to have comprehensive discussions about the IARCs at the local offices of AARD (and the IARCs) and with two major donor supporters, namely USAID and IBRD. Both of them and Dr. Siwi also made available to me valuable background material.

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AAETE | - Agency for Agricultural Education, Training and Extension |
| AARD | - Agency for Agricultural Research and Development |
| AARP | - Applied Agricultural Research Project (USAID Supported) |
| ADAP | - Australian Development Assistance Bureau |
| AVRDC | - Asian Vegetable Research and Development Centre |
| BAPPENAS | - Badan Perencanaan Pembangunan Nasional - National Development Planning Board |
| BIMAS | - Bimbangan Massal Swa Sembada Bahan Makanan - Mass Guidance Program for Self-Sufficiency in Foodstuffs |
| BPH | - Brown Plant Hopper |
| BULOG | - Badan Usaha Logistik - National Logistics Body (Rice Procurement Agency) |
| BUUD | - Badan Usaha Unit Desa - Village Unit Cooperatives |
| CGPRT | - Coarse Grain Pulse and Tuber Crop Research Centre of ESCAP |
| CRIFC | - Central Research Institute for Food Crops |
| DGFC | - Director Generalate of Food Crops |
| DOLOG | - Depot Logistik - Provincial Office of BULOG |
| GEU | - Genetic Evaluation Unit |
| GOI | - Government of Indonesia |
| HYV | - High Yielding Variety |
| IARC | - International Agricultural Research Centre |
| IBSRAM | - International Bureau for Soil Research and Management |
| IFDC | - International Fertilizer Development Centre |
| IGGI | - Inter-Governmental Group for Indonesia |
| IMRI | - Irrigation Management Research Institute |
| INIBAP | - International Network for Banana and Plantain Research |
| INMAS | - Intensifikasi Massal - Mass Intensification for Self Sufficiency in Foodstuffs |
| INSUS | - Intensifikasi Khusus - Special Intensification Program |
| IPB | - Institut Pertanian Bogor - Bogor Agricultural University |
| IRTP | - International Rice Testing Program |
| KUD | - Koperasi Unit Desa - Village Unit Cooperatives |
| LBN | - Lembaga Biologi Nazional - National Biological Institute |
| LIPI | - Lembaga Ilmu Pengetahuan Indonesia - Indonesian Institute for Science |
| LON | - Lembaga Oceanografi Indonesia - National Oceanographic Institute |
| MT | - Metric ton |
| NAR I-II-III | - National Agricultural Research Projects supported by the World Bank |
| NARS | - National Agricultural Research System |
| (RE)PELITA | - Pembanguhan Lima Tahun - Five Year Development Plan |
| PPL | - Penyuluh Pertanian Lapangan - Field Extension Worker |
| PPM | - Penyuluh Pertanian Madia - Middle Level Extension Worker |
| PPS | - Penyuluh Pertanian Spesialis - Subject Matter Specialist |
| PUSKUD | - Pusat Koperasi Unit Desa - Provincial Level Cooperative Organisation |
| PUSRI | - Pupuk Sriwidjaja - Fertilizer Company |
| REPELITA | - See PELITA |
| SARP | - Sumatra Agricultural Research Project (USAID) |
| TSP | - Triple Super Phosphate |
| VU | - Village Unit |

## CURRENCY AND MEASUREMENTS

### Before August 1971

| | | |
|---|---|---|
| US$1.00 | = | Rp 378 |
| Rp 1.00 | = | US$.0026 |
| Rp 1 million | = | US$2646 |

### Before November 15, 1978

| | | |
|---|---|---|
| US$1.00 | = | Rp 415 |
| Rp 1.00 | = | US$.0024 |
| Rp 1 million | = | US$2,410 |

### After November 15, 1978

| | | |
|---|---|---|
| US$1.00 | = | Rp 625 |
| Rp 1.00 | = | US$0.0016 |
| Rp 1 million | = | US$1,600 |

Since November 1978 the Rupiah floated and was around 700+ when devalued in March 1983.

### After March 1983

| | | |
|---|---|---|
| US$1.00 | = | Rp 960 |
| Rp 1.00 | = | US$0.00104 |
| Rp 1 million | = | US$1042 |

After March 1983 the Rupiah has floated

Current rate US$1.00 = Rp 1080

## CONVERSION FACTORS FOR RICE

| | |
|---|---|
| 1 tonne 'dry stalk paddy' | = 800 kg paddy (paddy gabah) |
| | = 520 kg milled rice |
| 1 tonne paddy (gabah) | = 630 kg milled rice |

## INDONESIAN FISCAL YEAR

April 1 - March 31

# CHAPTER 1

# BACKGROUND

## 1.1 THE COUNTRY

### 1.1.1. NATURAL AND POLITICAL SETTING

The Republic of Indonesia is a highly diverse country spread across an archipelago of more than 13,000 islands, straddling the equator with a distance of over 5,000 kilometres from east to west and 2,000 kilometres from north to south. These vast distances and differences in geological structure lead to great variations in the seasons, weather conditions, soil types and vegetation. The total land mass is about 1.9 million $km^2$, surrounded by 7.9 million $km^2$ of territorial waters (including an economic exclusion zone).

Indonesia became independent in 1945 and is governed by a Constitution in which sovereignty is exercised by the Peoples Consultative Assembly (MPR), which determines the Constitution and the guidelines of State Policy and elects both the President and the Vice President, who are the highest executives of government. The MPR consists of members of the House of Representatives (most of whom are elected on a constituency basis) plus nominated representatives of regions and of functional groups in society. The foundation of the Constitution is the concept of Panca Sila, the five principles of nationalism, humanitarianism, democracy, social justice and belief in God.

Administratively the country is divided into 27 provinces, 246 regencies, 54 municipalities, 3,517 districts and 66,154 villages, each of which is linked in a system of local government which permits a considerable degree of delegation of responsibility.

### 1.1.2 POPULATION

With an estimated population of 165 million in 1985, Indonesia is the fifth most populous country in the world, after the People's Republic of China, India, the USSR and the USA.

This population, however, is very unevenly distributed over the islands of the archipelago as a result of differences in soil fertility, density of vegetation and accessability of the land, the proportion of unhealthy tidal swamps and, not least, position on trade routes (Annex 1 Table 1). Java with the neighbouring island of Madura has, in historic times, proved to be by far the most favourable area to man; these islands which comprise only 7% of the total area of Indonesia contain over 60% of its population.

With practically all arable land in Java, Bali and Lombok already under cultivation, there is tremendous population pressure on land resources. Destruction of hillside forests, and resulting soil erosion, exacerbates already serious floods and associated damage in coastal areas, and causes heavy silting of irrigation systems. Meanwhile, potentially arable areas, though of low fertility, lie unutilized or underutilized in the other islands. Organized efforts to move people to the other islands began some 75 years ago and today, as a result of officially sponsored transmigration, spontaneous migration, and internal growth, an estimated two and a half million transmigrants are living in other island settlements.

Government attaches high priority to transmigration to promote regional development, create employment, reduce population pressures and increase production of food and export crops. Before the mid-1970's both the size and quality of the transmigration program were limited by a shortage of funds. In 1978, however, with improved resources, coupled with shortfalls in rice production and increasing landlessness, government accelerated the transmigration program. The emphasis on transmigration has continued since this time, and appears likely to do so in the future, given the long term implications of population growth, currently estimated at 2.2% p.a. (although urban growth rates now approach 4% p.a.).

1.1.3 <u>ECONOMY</u>

The economy of Indonesia is based upon the natural resource industries of agriculture (including fisheries and forestry), mining and petroleum (Annex 1 Table 2). A high proportion of these primary resources are located on the sparsely populated islands of Sumatra and Kalimantan, while over 60% of the population live on Java, which has areas with some of the world's highest population densities. The agricultural sector provides 52% of Indonesia's employment and 26% of its GDP.

Agriculture is of paramount importance to the 80% of the nation's population living in rural areas, where it is the major source of employment and income. Because of the dominance of the oil industry, the agricultural sector is no longer the main source of exports, although it still generated US $ 3.3 billion of earnings in 1982. The principal agricultural export products are wood, rubber, coffee and shrimps. The principal agricultural import until recently was rice, but in the last few years rice self sufficiency has been achieved, and the main current agricultural imports are wheat, sugar and soybean seed and cake (Annex 1 Table 3).

During the 1970's the Indonesian economy as a whole grew at about 8% p.a., although declining oil prices have led to a tailing off of this growth rate in the 1980's. In 1982, GNP per capita was estimated to be US $ 580. The dominant factor in the recent high economic growth rate was the high rate of expansion of the oil and gas industries. Net exports from these industries rose from US$ 0.6 billion in 1973/74 to US$ 10.6 billion in 1980/81, when the current account enjoyed a surplus of US$ 2.1 billion. Oil receipts also provided about 60% of central government receipts by 1980/81, and helped finance a sustained increase in demand. The pattern of expenditures has also helped foster diversified growth. Of particular note has been the support for agriculture, through investment in infrastructure, provision of support services and effective use of subsidies to maintain producer incentives. This has supported an agricultural growth rate of almost 4% p.a. over the past decade.

During 1982, the Indonesian economy was affected adversely by the protracted international recession and the accompanying decline in export earnings, especially from oil. These developments led to a sharp turnaround in Indonesia's external resource position, with a balance of payments deficit and a fall in real per capita incomes. In response, the Government acted promptly to ensure that the country's balance of payments situation was manageable and to provide a basis for longer-term structural transformation. Particular attention was paid to reducing Indonesia's dependence on oil for export earnings and public revenues.

These timely actions appear to be having a positive effect, in spite of the continuing weakness of the petroleum sector. The need for such actions is of paramount importance to sustain the process of economic growth because, notwithstanding the strides made in the last fifteen years, much more is still needed in order to meet the government's social and economic goals. For example, although social standards have improved considerably, public health services still reach only 20-30% of the population; the country suffers from high infant mortality (93 per 1,000 live births) and low life expectancy (54); only 18% of the rural and 40% of the urban population have access to potable water. The basic education system has improved significantly, with 89% enrollment in primary schools and 35% in junior secondary schools, and literacy has increased from 57% to 62% over the past decade. However, training at higher levels is still limited, with only 2% of eligible students attending post-secondary school. Added to this, some 40% of the population are stated to be living in poverty (defined as a per capita annual income of under US$ 150), and it can be seen that much still remains to be done.

The government's strategy for tackling these problems is through a series of five year plans (Pelitas), the fourth of which (Repelita IV) was begun in April 1984. This gives priority to investments in agriculture, human resource development, energy, industry and rural development. The investment strategy has as a primary goal the creation of jobs. In addition, it aims to bring about structural transformation of the economy, generate foreign exchange savings and enhance the economy's international competitiveness.

As in the third five year plan (Annex 1 Table 4), about half of the budget is labelled "routine" and comprises personnel and material expenditures, subsidies to regions (provinces), debt service payments and food and oil subsidies. Under the "development" budget comes expenditure on development programs and projects of the departments, subsidies for the special national development programs in the districts (kabupaten) and villages (kampungs), subsidy on the commercial import of fertilizers and on investment through banking systems, the building of primary schools and special presidential development projects (so-called Instruksi President = Inpres), as well as external donor project aid. Agriculture comprised 14% of the development budget in Repelita III and 13% in Repelita IV (Annex 1 Table 5).

Domestic revenues for providing the funds required for the budget are practically entirely of fiscal origin and provide over 85% of the necessary funds. The residue is met from an external inflow, most of which is derived from program and project aid obtained from donor countries in the framework of the Inter-Government Group for Indonesia (IGGI) which was first formed in 1967. This has, in recent years, provided about US$ 2 billion a year in the form of concessional loans used both to support the balance of payments and for development projects (Annex 1 Table 6). Aid provided as grants, such as technical aid and food aid, as well as aid from non IGGI countries, is not included in the totals shown in Annex 1 Table 4.

## 1.2 THE AGRICULTURAL SECTOR

### 1.2.1 STRUCTURE

Indonesia has a dual agricultural structure consisting of around 18.5 million smallholders and just over 1000 large estates. Between them they cultivate under 17 million ha. of Indonesia's total land area of 191 million ha., much of which is in forest or grassland (Table 1.1).

TABLE 1.1

LAND CLASSIFICATION (million ha) [a]

| Region | Total land area | Total forest land area | Scrub, Grass[b] bare lands | Agriculture & Estates | Other uses |
|---|---|---|---|---|---|
| Sumatra | 47.4 | 28.4 | 4.7 | 5.4 | 8.9 |
| Java | 13.2 | 2.9 | 1.2 | 6.2 | 2.9 |
| Kalimantan | 53.9 | 41.5 | 6.4 | 1.9 | 4.1 |
| Bali/Nusa Tenggara | 7.4 | 2.0 | 1.7 | 1.2 | 2.5 |
| Sulawesi | 18.9 | 9.9 | 3.2 | 1.6 | 4.2 |
| Maluku | 7.5 | 6.0 | 0.2 | 0.3 | 1.0 |
| Irian Jaya | 42.2 | 31.5 | 0.1 | - | 10.6 |
| TOTAL | 190.5 | 122.2 | 17.5 | 16.6 | 34.2 |

a) Source: ISNAR 1981

b) Includes only scrub, grass and bare lands outside forest land. A further 15.5 million ha of this class of land are reported to exist within forest land.

Of the 16.6 m. ha. of cultivated land, over 9 million are under annual crops in the smallholder sector, and the residue is under perennial crops on both smallholdings and estates. Nearly half of the land under annual crops is irrigated (Table 1.2).

TABLE 1.2

SUMMARY OF ESTIMATED LAND USE FOR ANNUAL CROPS (1977) <a

| Region | Sawah <b | | | | | |
|---|---|---|---|---|---|---|
| | Irrigated | Rainfed | Swamp | Total | Upland | Total |
| | ('000 ha) | | | | | |
| Java | 2628 | 337 | - | 3004 | 1530 | 4534 |
| Sumatra | 776 | 238 | 169 | 1182 | 712 | 1894 |
| Kalimantan | 54 | 189 | 331 | 575 | 540 | 1115 |
| Sulawesi | 266 | 83 | 1 | 349 | 393 | 742 |
| Maluku and Irian Jaya | n.a. | n.a. | n.a. | n.a. | 130 | 130 |
| Bali and Nusa Tenggara | 301 | 99 | - | 400 | 432 | 832 |
| Indonesia | 4023 | 986 | 501 | 5510 | 3737 | 9247 |

<a Source: ISNAR 1981

<b The term sawah refers to rice fields, irrigated or watered only by rainfall, which have low banks or "bunds" built around them to retain water.

Land ownership in Indonesia is more evenly distributed than in many other developing countries. While farm holdings vary from near landless to large plantations - most consist of a house site, a small yard/garden and about one hectare of tillable land - farm size is generally uneconomic. An estimated 50 percent of the farm families in Java are effectively landless, of which 40 percent derive their income from off-farm work.

Land problems for the most part stem from uneven population distribution, uneconomic farm size and low productivity. On the inner islands of Java, Bali and Madura, limited land area and high population density cause farms to average only 0.5 hectares with an average annual per capita farm income of the order of US $100. Fragmentation of farms has increased dramatically in the last 15 years and is now at a point where an estimated 60 percent of all farms are less than 1 ha., with about 30 percent of these less than 0.25 ha. Java alone has more than 8.6 million farms with an average size of only 0.5 ha. (Annex 1 Table 7).

These small farms are primarily engaged in subsistence food production, especially where population pressure is most intensive and irrigation is most extensive. However, there is a substantial volume of coconut, sugar cane, rubber, coffee and spice produced by smallholders (Annex 1 Table 8), about five million of whom, many being in the poverty group, depend partially or wholly on perennial crops for their livelihood.

Tree crops occupy about a third of total cropped land (coconuts and rubber account for 80% of this), and generate almost half of total non-oil export revenue. Smallholders cultivate 80% of the rubber and coffee areas and virtually all coconuts, cloves and pepper, whereas tea, oil palm and cacao are grown primarily on estates.

Non-food crops in Indonesia have traditionally been classified as "estate" crops (grown mainly on estates - many of which are now state owned), or "industrial" crops (mainly smallholder). Although largely irrelevant today, this classification still persists insofar as the organisation of research, extension and other services to the grower are concerned. "Estate" crop producers pay a levy on their production, part of which is diverted to fund research on these crops, which is therefore, relatively better endowed than that on most other agricultural crops in Indonesia.

The most important crop in Indonesia is rice, which provides over half the national calorie and protein intake and is grown on a wide variety of lands (Table 1.3). Irrigated wetland constitutes about 53% of the rice area, most of it being in Java and Bali. About two thirds of the irrigated area has a well-developed infrastructure and is capable of growing two crops a year. Rice is often followed by a secondary (palawija) crop.

TABLE 1.3

AREAS OF MAJOR RICE GROWING ENVIRONMENTS, INDONESIA, 1976.

| Environment | Java-Bali | Sumatra | Kalimantan | Sulawesi | Nusa Tenaggara | Total |
|---|---|---|---|---|---|---|
| Irrigated wetland | 2505 (72)[b] | 493 (14) | 78 (2) | 234 (7) | 156 (5) | 3466 |
| Rainfed wetland | 925 (54) | 366 (21) | 233 (14) | 157 (9) | 40 (2) | 1721 |
| Rainfed dryland | 254 (22) | 486 (42) | 230 (20) | 100 (9) | 83 (7) | 1153 |
| Tidal swamp | 5 (2) | 103 (41) | 140 (55) | 4 (2) | 1 (0) | 253 |
| TOTAL | 3689 | 1448 | 681 | 495 | 280 | 6593 |

b) Source: Bernstein, Siwi and Beachell (1982)

The importance of rice in the Indonesian agricultural economy and diet has long been reflected in the emphasis placed on the crop in research, extension and production programs.

The introduction and local breeding of high-yielding varieties (HYVs), together with increased fertilizer and pesticide use stimulated by the BIMAS/INMAS program (see section 1.2.2), and greater stability of production through the rehabilitation and extension of irrigation, has led to a very substantial increase in average wet rice yield per hectare. Self-sufficiency in rice, which was a key goal of Repelita I and II, has been attained (Annex 1 Tables 9 and 10).

Government food production policy is now laying much greater stress on increasing the output of "palawija crops" the main one of which are maize, cassava, sweet potato, soybean, groundnut, mungbean and, more recently, sorghum and wheat. These crops in the past, received much less emphasis than rice, and yields and returns per hectare from their production are often well below their potential. Fruits and vegetables are also widely grown in Indonesia, but mainly as home garden crops. The relative importance of these different food crops is shown in Annex 1 Table 11.

Livestock production accounts for less than 10 per cent of the total value of agricultural production. The number of farm animals in Indonesia is small compared to the human population. Here it is the small farmer who keeps livestock. Farm animals are a source of power and are viewed as a major asset to the economic structure of the traditional subsistence farm and to village life. Exceptions to the traditional small-holder livestock systems are limited.

The most valuable components of the livestock sector are cattle and buffalo, most of which are used by small farmers. They are found in herds with only one or two adult animals. They subsist on crop residues and roadside grazing and serve primarily as draught animals, although efforts are now being made to develop a beef industry in the eastern parts of the country. A number of dairy animals have also been imported to develop a milk industry. Pigs are excluded from many areas for religious reasons. There is a large poultry population and a rapidly developing modern poultry industry.

Over 60% of animal protein supplies are, however, derived from fish. Marine fishing provides three-quarters of the 2 million ton fish catch, although only 25% of the sustainable marine yield is harvested. There is a high growth potential in offshore fishing, although there are problems of scale and of marketing. A considerable growth potential also exists for aquaculture which is as yet, very little developed. Apart from its importance as a source of protein, the fishing industry provides employment for about 3 million people and also generates over US$ 250 million of export earnings, mainly through the harvesting of shrimp and, to an increasing degree, tuna.

Forestry is also an important sub-sector in Indonesian agriculture and, next to oil, is the biggest source of export earnings. Approximately 60% of Indonesia's land area is in forest, which comprises the largest concentration of tropical hardwoods found in any country. Since April 1984 forestry has been taken out of the Ministry of Agriculture and it is now in a separate ministry.

### 1.2.2 INFRASTRUCTURE AND INSTITUTIONAL SUPPORT [a]

In the early 1960s, Indonesia's population grew rapidly but rice production remained relatively constant. The government sought to change this through a program of technical advice, credit, and inputs to cooperating farmers. After a trial period, this was implemented nationwide in 1965-1966 and named BIMAS, or mass guidance (Birowo 1975).

The basic program has been modified several times. To accomodate farmer participants who no longer needed credit because yields and income had increased, INMAS was initiated in 1967-68. When the first modern varieties (IR5, IR8) became available in 1968, the program was renamed BIMAS Baru (new BIMAS).

At the same time as farmer participation in BIMAS increased, Indonesia suffered from a shortage of foreign exchange which made it difficult to import inputs. Consequently, BIMAS Gotong-Royong (mutual cooperative BIMAS) was introduced in 1968-69. Foreign private enterprises were recruited to provide technical guidance and required inputs to the government on 1-year credit. By the 1970 wet season, however, this assistance was no longer needed.

In 1969-70 Improved BIMAS was started, and the unit village concept was introduced. This represents the current model. The agricultural area was divided into blocks of 600-1,000 ha. Each became the organizational unit for activities to support intensification - including credit, input retailers, extension officers, and product marketing. In 1972-73 the Improved BIMAS program was expanded to include food crops other than rice.

In 1979 the government launched a collective approach to intensification called INSUS (Intesificasi Khusus or Special Intensification). Groups of up to 50 farmers (in many cases users of one tertiary irrigation canal) make collective decisions about land preparation, planting, spraying and harvesting schedules. Orders for inputs under the intensification program are coordinated, and schedules for receiving credit and making payments to the Bank Rakyat (People's Bank) are determined for all BIMAS participants in the group. This collective process of credit approval and loan repayment has been responsible for

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[a] The section is based on Bernstein, Siwi and Beachell (1982)

substantial increases in rice production. In 1980, 9.8% of the total wetland rice area (7.8 million ha) and about 68% of the BIMAS/INMAS area (1.6 million ha) fell under the INSUS program. Most spectacular results (an average of over 12 MT paddy/ha for a group of farmers) have been accomplished in Bali, where the program is coordinated with the traditional community irrigation organization the "subak".

As an incentive to participation, rice produced by INSUS farmers has a support price marginally above rice purchased from non-participants. An INSUS program for corn was started in 1981.

The BIMAS program is built around three principles:

First, participating farmers are encouraged to use modern production practices, including good land preparation, seeds, efficient irrigation practices, fertilizer, and insecticide.

Second, noncollateral credit is made available to obtain a package of inputs that presently includes a recommended modern variety, 100-250 kg urea/ha. and 35-75 kg triple superphosphate/ha. (depending on area), 2 litres of insecticide, 100g of rodenticide, and a nominal cost-of-living allowance. Inputs are provided in kind and the living allowance in cash, with an interest rate of 1% per month charged on the outstanding balance.

Third, technical assistance is provided by extension agents (PPL) through a three-tier system. Each PPL works with 16 master farmers, who in turn are assigned 20 farmers, each of whom has 5 farmers to whom he should communicate new information that is passed down the chain. Ideally, 1 PPL reaches 1,600 farmers through the tier structure.

Farmers accepted the BIMAS program rapidly. Four years after the program was initiated (1968), more than 750,000 hectares were enrolled. That increased to 3,086,000 hectares by 1975. BIMAS participation has declined since, but the total program area (BIMAS plus INMAS) has increased steadily and covered 5.9 million of the slightly more than 7 million hectares of the wetland rice cropped during the late 1970's.

The two most important inputs in the production package are fertilizer and modern varieties. As the program expanded, adoption of fertilizer and modern varieties grew. From 1970 to 1979, urea consumption tripled, the area planted to modern varieties increased fivefold and insecticide use rose markedly (Annex 1 Tables 12,13,27).

As input use increased, yields also rose steadily. Over the 10-year period considered, wetland rice yields climbed from 2.6 to 3.2 MT/ha or by 22%. The actual magnitude of the yield increase in the production program area was probably even greater. While wetland is defined as both rainfed and irrigated areas, the production program was largely confined to irrigated farms.

During the first year of the program, repayment stood at 90% or more. In the 1975 dry season, defaults on loans increased steadily. As of January 1980, only 47% of the 1978-79 wet season loans had been repaid. But even though farmers with outstanding loans cannot obtain additional credit, this has not had a noticeable impact on urea consumption or modern variety adoption because inputs can still be obtained for cash through INMAS.

The rice pricing policy of the government has also stimulated the application of high levels of inputs (Annex 1 Tables 12 and 13). Since 1968 government has supported the price of rice and subsidized the cost of fertiliser and pesticide.

Initially, BIMAS was largely restricted to paddy areas with good water control. The program was expanded in the mid 1970's to include direct seeded rice, maize, sorghum, soybean, groundnut, green beans and cassava. However, its acceptance on secondary crops has been much slower than rice, and only 3% of the area under secondary crops was in the BIMAS program by 1983. On the other hand there has been a significant growth in the palawija area in the INMAS program (i.e. using modern inputs but not BIMAS credit), which covered 39% of the area under palawija crops in 1982 and rose to 49% in 1983. The BIMAS program is implemented via village units (VU). These are defined as 600-1,000 hectares of rice land and comprise 2-3 villages and up to about 1,500 farm families. A fully established VU is supposed to have a People's Bank credit office, a farmers' cooperative (BUUD/KUD) for input supply and purchase of paddy, or a village kiosk to supply inputs, and at least one field extension worker (PPL). The growth of BUUD/KUD farmers' cooperatives, with small-scale drying, storage and milling facilities, has been strongly promoted by the government as a means of linking farmers with the official production, price and stock policies for rice. The average BUUD/KUD has between 750 and 1,000 farmer-members, and covers an area of 600 to 1000 hectares.

The BUUD/KUD system has evolved into the principal economic intermediary between farmers on the one hand and BULOG/DOLOG and private traders on the other. The BUUDs are federations of old village cooperatives, while the KUDs are the next stage of development, when BUUDs are organized and registered formally as cooperatives.

The change from handling and storage of stalk paddy to gabah, resulting from the widespread adoption of HYV's, has created problems in post-harvest operations, i.e. threshing, transportation, drying and storage, both at the farmer level and beyond. This challenge has been met by the Government through channels, such as the Rice Procurement Agency (BULOG) and BUUD/KUD farmers' cooperatives, with the establishment of suitable product quality standards and the adoption of measures for the protection of stocks.

BULOG has recently completed construction of modern storage facilities, with a total capacity of over one million metric tons built at 128 locations throughout Indonesia. The new facilities have enabled BULOG to modernize product handling and to go some way towards covering foreseeable foodgrain storage requirements, although the bumper harvests in 1983 and 1984 created storage problems.

BULOG is also responsible for implementing government's price policy for rice and other foodstuffs, as discussed in section 1.2.3 of this report. In addition, it has the import monopoly of wheat and sugar and charge of their distribution, administration of food aid, import of maize, and the task of assisting the Department of Industry in preparing import papers and tenders for raw cotton and cotton yarn. These responsibilities give BULOG an influential role in Indonesia's food security policy and in food imports. The importance of this role is enhanced by BULOG's management information system, established because of the critical importance of adequate data for fulfilment of its obligations as the national price stabilization, food distribution and rice stock authority.

However, BULOG's most important responsibilities concern rice and may be summarized as follows:

(i) To supply rice regularly to the armed forces, and to most government employees, at reasonable prices which maintain a high degree of stability in the incomes of these key groups;

(ii) To procure rice or gabah from the domestic market so as to support the established minimum floor price for farmers, sufficient to induce them to increase their farm production through use of high yielding varieties, fertilizers and other important farm inputs;

(iii) To be prepared to inject rice into the market to help maintain a stable economy by preventing rice prices from rising above a predetermined ceiling price.

These tasks require direct involvement and technical expertise in training, storage, management, financing, transporting and general organisational skills.

The activities of BULOG, BIMAS and INMAS with respect to the price and stock policy, and the provision of credit and inputs, are supported on the education, extension and research sides by the Director Generalates of Food Crops, Livestock, Fisheries, and Estate Crops, the Agency for Agricultural Education Training and Extension (AAETE) and the Agency for Agricultural Research and Development (AARD).

The Director Generalates are responsible for field and extension services to farmers, and the operational staff for the BIMAS and INMAS programs are, effectively, on secondment from the staff of the relevant Director General (principally food crops). The field extension workers (PPL's) referred to earlier, and the higher level PPM's and PPS's to whom they report, are also on the staff of the relevant director general. These officers provide the usual type of extension services to farmers, including the provision of technical assistance.

The AAETE is primarily a training agency, with a wide network of training centres distributed throughout the country. These are used for training both farmers and extension personnel. The AARD is the research agency whose activities and structure are described in Chapter 2 of this report.

### 1.2.3 PRICING [a]

For the past fifteen years or so four objectives have dominated government thinking on agricultural development. The first has been the attainment of national self-sufficiency in the production of major foodstuffs, with special emphasis on rice. The second has been the improvement of farm incomes in the interest of achieving better income-distribution within the society. A third objective has been to provide urban consumers with rice at a "reasonable" and relatively stable price. The fourth objective has been to control the budget subsidies to producers and consumers which have been given in pursuit of the

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a> This section draws heavily on World Bank (1982) for its content.

first three. These objectives are sometimes in conflict with each other, in the sense that attaining more of one requires some sacrifice of another. The balancing of competing objectives involves "tradeoffs" that depend on both technical and political judgements. A principal instrument in the pursuit of these objectives is pricing policy. This is formulated at cabinet level and executed by BULOG.

Current policy measures mainly concern rice, and comprise BULOG implementation of a national paddy and rice floor price determined by means of relating the benefits gained from using the BIMAS/INMAS package to its cost, bearing in mind the need to establish adequate production incentives. Allowing for regional disparities, and for product quality differentials not fully covered by the existing system, the floor price is applicable nationwide and is particularly effective in areas covered by BIMAS/INMAS. A flexible ceiling price system for rice, at the wholesale and retail levels, takes account of the need for maintaining an adequate margin between ceiling and floor prices so as , in principle, to cover the cost of holding stocks, while protecting the interests of consumers.

The first statement of a comprehensive price policy for rice was made in 1969 (Mears and Saleli Afiff). The basic philosophy of this policy, as summarized by Mears (1981), was: (a) support for floor prices high enough to stimulate production; (b) ceiling price protection assuring a reasonable price for consumers; (c) sufficient range between these two prices to provide traders and millers reasonable profit after holding rice between crop seasons; and (d) appropriate price relationships within Indonesia and internationally. In addition, inter-regional price spreads were intended to be sufficient to enable traders to cover costs of movement from surplus to deficit areas, and domestic prices were to be insulated from world prices to avoid large swings in domestic prices. On the other hand it was intended that there should be a correlation between domestic prices and world prices over time to minimize import subsidies. Since this basic philosophy was first articulated and implemented in the early 1970's,however, its application has evolved in response to changing circumstances and pressures. In particular, substantial economic and budget subsidies, especially for fertilizer, have been introduced, which to some extent involves departures from the original principles for rice price policy. Currently two types of subsidies are utilised, namely, budget subsidies which involve GOI cash payments from the development budget, and economic subsidies which involve economic prices below the opportunity cost as reflected by long-run world prices.

Economic Subsidies

During the period 1970-82, Indonesia generally maintained a domestic price for rice below the import parity price, as shown in Annex 1 Table 14. Only in 1976, 1977, and 1982, when the world price was well below its long-run trend level, was the Indonesian rice price above the import price.

Domestic fertilizer prices are also well below their import parity prices. Annex 1 Table 15 shows the price structure for urea and triple superphosphate (TSP) in 1982. The economic price [a] of urea at the farm-gate was estimated at that time to be Rp 160/kg compared to the official price of Rp 70/kg; and the

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a) What prices would be in the absence of any subsidies.

economic price of TSP, Rp 171/kg compared to Rp 70/kg. Thus, domestic prices were less than half the import parity price in 1982. Since 1982 urea prices to the farmer have not risen in dollar terms. There is also an economic subsidy involved in the domestic production of urea: suppliers of natural gas for urea manufacture receive a price which is lower than the opportunity cost of that gas. This represents a substantial implicit subsidy which is likely to grow if the policy remains unchanged, since by the late 1980's about 53% of Indonesia's total annual urea production of 3.7 MT is expected to be produced using gas feedstock from fields with export potential.

Budget Subsidies

Although economic subsidies may involve efficiency costs for the economy, they do not necessarily involve cash outlays from the GOI budget. In particular, differences between domestic and import parity prices will give rise to budget subsidy only when rice or fertilizer is imported. Thus, throughout the 1970's, imports of these commodities were a substantial burden on the budget. However, Indonesia is likely to be close to self-sufficiency in rice during the 1980's, in which case differences between domestic and world prices would not impose budget costs except in those years in which some imports are necessary to offset poor harvests. Also, because of its plentiful natural gas resources, Indonesia is a competitive producer of urea, and its urea production will continue to grow rapidly in coming years so that no substantial urea imports are predicted. The economic subsidy implicit in the low price of natural gas feedstock for urea plants also does not have a direct budget impact: it simply involves foregone revenues for the gas producer and hence reduced incentives to produce and deliver gas for this purpose. However, there are important budget subsidies in the present pricing structure.

There are two main categories of these that affect food crops: First, there are subsidies on fertilizer. Urea and phosphate fertilizer, in particular, are sold to farmers by PUSRI (the Fertilizer Company) and its agents at prices that are considerably below the full cost of production (or import costs in the case of imported fertilizer) and distribution. The 1981/82 budget cost of these subsidies is given in Annex 1 Table 16. In that year, the total cost was estimated to be US$ 370 million, equivalent to 30% of the development budget for the entire agriculture sector and more than the budget for either health or housing and water. The second type of budgetary subsidy arises because BULOG's selling price for rice does not adequately reflect its full costs of storage and other marketing costs. It was estimated that, in 1982, BULOG lost about Rp 30 for each kilogram of domestic rice distributed in market operations.

## 1.2.4 PAST AND PRESENT PERFORMANCE

During the period 1978-83 the GDP of Indonesia rose by nearly 6% per annum. In the agricultural sector the growth rate was just under 4%. Any discussion on this growth rate is dominated by the influence of rice which comprises about one third of the value of agricultural output.

Rice

Until the mid-1960's, wetland rice yields fluctuated between 1.8 and 2.2 MT/ha. With the introduction and widespread adoption of modern varieties in the late 1960's, wetland yields rose steadily and have averaged over 4 MT/ha since 1982, although dryland yields are less than half this level (Annex 1 Table 9).

Despite a severe drought in 1971/72, and major outbrakes of Brown Plant Hopper (BPH), production has increased every year except for 1972 and 1975.

Between 1968 and 1981 the average rate of growth of rice production, area harvested and yield were 4.4%, 1.1% and 3.3% p.a., respectively. Output growth in recent years has been spectacular. For example between 1978 and 1982 the increase in production was 6.8% p.a.; between 1979 and 1980 it was 12.8%. There have, however, also been some disappointing years. In 1972 there was a 4% decline from the previous year due to a lower yield and area harvested, both caused by widespread drought. Even though production recovered in 1977, production during the period 1973 to 1977 was well below the trend after the rapid rate of growth (5.7%) between 1968 and 1971. (Annex 1 Figure 3). Output returned to the trend rate of growth in 1978, but slumped again in 1979, leading to serious concern for long-term food security. However, 1980 and 1981 production levels (20.2 and 22.3 million MT respectively) implied increases of 13% and 10% p.a., growth slowed again in 1982 and 1983 (23.2 and 23.5 million MT respectively, but surged to 25.5 million MT in 1984).

This growth trend of the last 16 years has resulted in a steady rise in per capita availability of rice from an average of 90.6 kg in 1960-1967 to over 140 kg at the present time.

The impressive strides made by rice have not occured with other basic food crops, particularly palawija crops, which are grown on some 6 million ha, often after rice. The production levels of these crops vary from year to year but have generally stagnated during the period of Repelita III, except for maize, whose production rose strongly in 1983 (Table 1.4).

TABLE 1.4

PRODUCTION OF PRINCIPAL PALAWIJA CROPS 1978-83

| | '000 MT | | | | | | % 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 |

## Maize

Maize is the second most important food crop in Indonesia. In the period 1970-1980 the total area fluctuated between 2.1 and 3.4 m ha., producing between 2.2 and 4.0m. MT with an average yield of about 1400 kg/ha. Average annual consumption is 26 kg per capita but in South Sulawesi, East Nusa Tenggara and East Java it is 71, 58 and 40 kg respectively. Nationally maize provides about 10% of the calorie intake, and 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.

## Cassava

Cassava is grown on about 1.4 m ha., yielding an average of 9.7 MT/ha., to give a total production of over 13m MT 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 cassava 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.

## Soybean

Soybean production has stagnated during Repelita III, and hoped-for sizeable increases have not been realized. Imported varieties of seed have so far not been successful. 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 MT, 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. In 1982 domestic production was about 521,000 MT and imports were 361,000 MT. In 1983 domestic production increased to 568,000 MT and imports rose to 391,000 MT.

## 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 MT 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.

Groundnuts are used mainly for human consumption. Production has been static over the last six years, and a significant level of imports has developed. Repelita IV has set a very high target for growth in production based on the domestic demand. There are, however, both technical and price constraints to be overcome before this target can be met.

## Mungbean

In 1981 150,000 MT 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 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 MT during this period and overall production in 1981 was about 2 million MT, 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 MT, and yields increased from 597 to 1,189 kg/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 this use.

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.

### Wheat

Wheat is a major import into Indonesia, and for several years now, efforts have been made to grow the crop locally. These are still limited and are confined to highland areas. For ecological reasons, the crop is likely to remain a minor one unless major breakthroughs are made in wheat breeding

### Potatoes

The potato is a relatively minor vegetable crop in Indonesia. Production in 1980 was 230,000 MT from 24,000 ha. For historic reasons, and because it fetches a high price in the expatriate market, it is a crop that has generated a lot of interest in recent years. It is, however, of significance in the diet of very few Indonesians and in the income of few farmers.

### Cropping Systems

Although palawija crops are grown in systems of monoculture, they are more frequently found in multiple-cropping systems, either after rice or on non-rice lands. 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. [illegible] 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.

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 availability of suitable seed supplies, the inappropriate use of inputs, the inadequacy of water control, the incidence of pests and diseases, high post-harvest losses, and insecure marketing outlets.

Collectively, whether they are grown in mono or multiple cropping, 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. These percentages change very much from year to year and, for example, the importance of maize increased at the expense of cassava in 1983.

Although there is considerable scope for increasing the yields of palawija crops, yields 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 domestic demand for them and for exports. 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 can be done is likely to be highly dependent on price policies, as there is evidence of high 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.

## Non-food Crops

Outside of the food crop area, Indonesian agriculture has had an uneven performance in recent years. Despite recent higher world prices for major tree crop products, only oil palm has shown sustained large increases in production, due to investment programs by GOI and private estates. Static production levels are a symptom of past low prices and neglect, especially indequate research and extension, and of failure to replant with higher-yielding varieties. In particular, the performance of the rubber and coconut industries, both of which utilise a lot of land, has been particularly disappointing. The growth rate in production of some important tree crops between 1973 and 1983 is shown in Table 1.5.

TABLE 1.5

GROWTH RATE IN TREE CROP PRODUCTION 1973-83

'000 MT

| | 1973 | 1978 | 1983 | % p.a. growth rate |
|---|---|---|---|---|
| Palm Oil | 290 | 525 | 937 | 12.8 |
| Kapok | 29 | 32 | 51 | 5.8 |
| Tea | 67 | 89 | 116 | 5.6 |
| Coffee | 180 | 260 | 230 | 2.5 |
| Coconuts | 1280 | 1578 | 1605 | 2.3 |
| Rubber | 844 | 950 | 981 | 1.5 |
| Cloves | 27 | 21 | 31 | 1.4 |

Source: Statistical Handbook of Indonesia 1983

## Livestock and Fisheries

In the livestock sub-sector, growth is constrained by prevalence of one cow/buffalo units where the growth potential is limited. Nevertheless, there has been a major emphasis on dairy and poultry production and the latter, in particular, has led to an overall growth in livestock production in Repelita III exceeding 5% p.a. Total meat production in Indonesia rose from 435 thousand MT in 1976 to 508 thousand MT in 1980. Milk production increased from 58 to 67 million litres in the same period. The value of the annual output of the livestock sector in 1980 was US $ 881 million.

During the ten year period 1970 to 1979, fish production increased at about 4.5 percent a year. Marine fisheries increased from 735,000 MT to 1,300,000 MT., and inland fisheries from 421,000 MT to about 500,000 MT. Fish culture has increased about 3.6 percent per year. In 1979, about 75 percent of the total fish production was accounted for by marine fisheries and 25 percent by inland fisheries and aquaculture. The increase in marine fisheries' production can be attributed to the use of motorized vessels and modern fishing gear. However, traditional fisheries continue to contribute about 90 percent of the total production.

Productivity from aquaculture remains low because of a lack of inputs, such as fertilizer, inadequate methods of eradicating predators, low stocking rates because of a shortage of fish fry in some areas, and a low level of management.

## 1.2.5 POLICY ISSUES

### Keeping the momentum in rice production

Reference has already been made to the fact that the island of Java with only 7% of the land area of Indonesia contains over two-thirds of the population, with a large number of its farms being under one, or even one half, hectare in size. Land in Java is, to a large degree, a fixed resource. This has had to be taken into account in a national agricultural policy which focussed initially on "rice" self-sufficiency, but now stresses "food" self-sufficiency as a prime goal.

With respect to rice, it is recognised that there are physical constraints to the continuation of the past growth trend in production. Nevertheless a growth potential does exist, particularly on irrigated wetlands and tidal swamplands outside of Java. The development of these areas will, however, require major decisions on investment policy as to where and how the emphasis is to be placed.

For example: in the intensively cultivated irrigated areas where BPH has been a persistent problem, primary reliance on varietal resistance for control has led to the almost total planting of large contiguous areas to the single variety PB36. This has created a potentially dangerous situation in which an insect or disease outbreak could spread rapidly throughout the area.

To reduce the likelihood of disease and pest outbreaks, measures are being taken, and will continue to need to be, to broaden the varietal diversity in contiguous areas, and genetic sources of resistance to major pests and diseases will have to be maintained. At the same time, greater emphasis will have to be placed on reducing the present heavy reliance on varietal resistance. It is anticipated that this can be achieved through implementation of integrated pest control, including cultural controls (synchronized planting, crop rotation), selective sanitation, manipulation of natural enemies, spraying of pesticides only when insect populations reach economic damage thresholds, and an aggressive pest surveillance program (Oka 1979).

Although modern varieties have been widely adopted throughout Indonesia, this has largely occurred in the wetland (irrigated and rainfed) environments. Consequently, substantial portions of the rice-growing areas have not yet benefited from the new technology; including the dryland, high-elevation, and tidal environments. Presently, several candidate varieties are being screened for these areas, and during the past few years several varieties have been released for both dryland and for high-elevation areas. More effort will need to be made to develop modern varieties suitable for farmers in dryland and tidal environments, because they represent the major share of the untapped agricultural potential in Indonesia, and have been targeted for the transmigration of the landless and near-landless farmers of Java-Bali, which forms a prominent feature of Repelita IV. The Plan calls for a 22% increase in rice production over the next five years, with an overall increase in yield of an ambitious 13%, the residual gain being derived from extra land, mostly outside of Java and Bali.

Thus, although rice research has made considerable progress, it is still faced with a number of important challenges and GOI has important policy decisions to make in orienting these challenges in terms of the emphasis and location that it gives to irrigation, swamp and other land and transmigration development programs. It also has to be borne in mind that production is entirely in the hands of small farmers and output depends on the way in which they use the resources made available to them.

Developing Palawija Crop Production

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 its production potential over the long term, and government planners have been giving increasing attention to palawija crops, whose past production record has been sluggish. These crops 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. Maize and cassava yields, for example, are only 53% and 68% respectively those of Thailand; soybean and groundnut yields are half those of Malaysia.

The prospects for palawija crops are, however, constrained by economic factors which are strongly influenced by price and trade policies. In the case of maize, the main demand in Indonesia is as a food 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 growing livestock sector. During Repelita IV, the demand for commercial animal feed is expected to grow rapidly. Currently about 12% of present maize production is used for animal feed (or over half a million MT per year), and 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. At present, its use in this area is sometimes constrained by unattractive price relationships between maize and animal products.

In the case of cassava, the direct human consumption of both fresh and dried roots (gaplek) is widespread in Indonesia. Urban consumption is virtually all for fresh roots 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 as starch. This is the leading commercial starch in Indonesia, being 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.

Cassava is also used for making chips, cubes or pellets which provide an energy component of animal feeds. The prime market for these is in Europe. Indonesia exports between 0.4 and 1.0 million MT of fresh cassava equivalent annually, but in recent years it has not been able to meet its EEC quota, because of price. Although cassava is now widely used in Europe, it is hardly used at all in the Indonesian animal feed industry, although it is not clear to what extent this is due to traditionalism, lack of know-how or prices. It is not a problem of supply, and 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 dependent, 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.

The third important palawija crop is soybean. In this case, growth in production appears to be constrained by technical, rather than economic, factors since demand is strong, prices are high and imports are increasing. Soybean production plus imports are almost entirely consumed directly in the form of tahu (soybean cake) and 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, which 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 MT per year in 1982 to an estimated 200,000 MT in 1984. Total present demand, therefore, for human consumption and animal feed, is about 1.2 - 1.3 million MT 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 an import substitute. 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.

Hence growth in soybean (and also other grain legumes) does require new technology, and particularly an ensured supply of certified high quality seed, whereas for cassava and maize much new technology is being generated (with the use of CIMMYT, IITA and CIAT germ plasm) but growth is constrained by demand factors. The easing of these demand constraints and the provision of greater quantities of legume seeds are both issues amenable to policy changes, and growth in production and use of maize, cassava and soybean could be strongly influenced by such changes.

The Cost of Current Fertilizer and Rice Policies

Growth in production of palawija and other crops would probably also be influenced by changes in the fertilizer and price policies already referred to, both of which date back to the 1960's, and are heavily oriented towards increasing the production of rice. Attention is already being given to controlling subsidies which have an impact on the government budget, such as the fertilizer subsidy. This in the period 1978-83, cost Rp 1283 billion and in 1982/83 alone, represented nearly 6% of the total development budget and was 22 times the development budget of AARD. Any change has to be looked at in terms of the changing world oil economy and its effects on energy requirements for mechanisation, pumps, grain and fertilizer transport as well as the manufacture of urea. All of these factors will influence rice production costs. Thus, before reducing the fertilizer subsidy significantly, a careful economic evaluation is required of the effect of changes in fertilizer price on its use, on production, on farm profits and on the real cost to the GOI. The latter is likely to be falling in terms of the opportunity cost of the natural gas used in the manufacture of nitrogenous fertilizer, given the current state of the world oil and gas market.

Increasing Animal Protein Supplies

In the field of animal protein, growth in production from marine fisheries is limited by the fact that the coastal areas are already heavily fished by artisanal fishermen, who number over one million, whereas the main potential for growth lies in distant waters where capital-intensive larger vessels are required. In social terms, the best prospects lie in the rapid development of aquaculture, in which field Indonesia is far behind its ASEAN associates. Growth in aquaculture will, however, require significant investments in research, extension and training. Repelita IV makes considerable provision for such inputs.

The livestock industry is confronted with a similar dilemma to fisheries regarding economy of scale, in that most of its ruminant stock is in one or two-animal herds on Java, Bali and Madura, whereas the grazing land potential - which is easiest exploited on large-scale livestock operations - lies in the other islands. Any developments in Java, in either large or small ruminants, or in the more promising area of poultry (where national per capita consumption is still under 1 kg/annum) are likely to depend heavily on crop-based foods (such as maize, cassava and soybean). Currently there is no policy for integrating crop/livestock/fish developments, each of them being handled by different Director Generalates. They do come together in AARD, but this agency has no structural unit that deals with farming systems, and it also lies in a grey area in terms of IARC activities. ILCA works on livestock systems, but its mandate does not extend to Asia, and the only Centre engaged in systems research in Indonesia is IRRI, who, with IDRC support, is now embarking on a program of "farming" systems research that includes livestock.

Enhancing the Research Effort on Non-Food Crops

Industrial and estate crops also lie outside of the mandate of the CGIAR centres, although in Indonesia several million small farmers depend heavily on these crops, particularly coconuts and sugar. The stagnation in production of these two commodities is of particular concern to the GOI, although it is recognised that investment in the sugar industry, at a time of global surplus, is a risky prospect. Nevertheless, some success has been attained with smallholder rubber and tobacco schemes, and ultimately it is possible that most of the non-food crops in Indonesia may be produced primarily by smallholders.

If the outcome of the Impact Study indicates that the CGIAR system has markedly influenced the production of food crops on small farms, some consideration may need to be given to channeling or diverting some resources to non-food crops that are of social, as well as economic, importance.

Post-Harvest Utilisation

Another area to which both the GOI and the CGIAR may need to give closer attention in future is that of post-harvest research. At present, the need for this far exceeds the capacity in Indonesia, and responsibilities for this work are spread amongst different organisations, some of which are not closely tied to either producers or consumers. Given the marketing problems with such crops as cassava and maize, and the potential problems of marketing in commodities such as sugar and coconuts should their production come into surplus, plus the prospects for generating employment through the processing sector, this would appear to be a potentially interesting area for positive policies relating to agro-industrial development. It is also an area where the CGIAR may need to re-examine its current approach, given the type of demand constraints that can follow success in increasing productivity.

Employment

An analysis of household expenditures data indicates that Indonesia's rapid economic development has been accompanied by significant progress in reducing poverty (defined as a per capita income of below US$ 150 per annum).

Between 1970 and 1980, the proportion of the population living in poverty declined from 57% to 40%; the decline was particularly rapid in the other islands and in urban areas. The core of the poverty problem continues to be in rural Java, where landless labourers form a large, and possibly rising, proportion of the population and where, for most of the 1970's, there was little evidence of any rise in real agricultural wages. The 1979-80 bumper rice harvest appears to have led to improvements in wages and incomes in Java, while agricultural incomes in parts of the other islands dependent on export crops declined. This situation may have been reversed following the 1983 devaluation, but evidence on this is still inconclusive.

In the future, the availability of productive employment will be a key determinant of income distribution. As compared to the 1970's, the growth in the labour force is expected to increase over the next decade (to about 2.6% p.a.) while economic growth will be lower. The resultant squeeze in the labour market is not expected to lead to a dramatic increase in unemployment, but there is a serious risk of stagnant or declining labour incomes in both rural areas and the urban sector. Given the balance of payments constraint facing the country, Indonesia's employment outlook depends crucially on the pattern of economic growth. Although, over the long term, the structural shift in employment away from agriculture is expected to continue, this sector is still likely to account for half or more of total employment, and the growth in agricultural incomes will be an important determinant of job opportunities elsewhere in the economy. It is, therefore, important to maintain appropriate policies on the use of capital intensive equipment (tractors, harvesters, motorised boats), to spread labour demand on Java throughout the agricultural year (e.g., by improving water resource management and development) and to encourage agricultural development on the other islands. Such policies will necessitate a close look at the policies being adopted with respect to commodity development and also those relating to technological change. Both issues are important in terms of establishing research priorities and programs.

# CHAPTER 2

# THE NATIONAL AGRICULTURAL RESEARCH SYSTEM (NARS)

## 2.1 OVERVIEW

Agriculture was proclaimed to be the sector central to the national development effort in the guidelines on which all four of Indonesia's 5 Year Plans have been based. The role of science and technology for development was proclaimed in the 1973 guidelines, which preceeded the second plan, and this led to the establishment of research and development agencies in most departments of government.

The Agency for Agricultural Research and Development (AARD) was established by presidential decree in 1974, with the statutory reponsibility to establish research and development in agriculture according to the policy stated by the Minister of Agriculture and to manage all technical executive units in agricultural research and development within the ministry. AARD was given the following mandate:

- To plan and prepare programs and coordinate policy for the management of research and development within the ministry;

- To organize and formulate technical policy, give guidance and control for all matters including the setting up of programs and methods that involve personnel recruitment, financial administration/management, equipment supply and maintenance, scientific reports, research and development management, according to the policy stated by the Minister of Agriculture;

- To manage a number of research centres, centres for research and development, institutes, laboratories, experimental farms, and libraries;

- To control and monitor the management, maintenance and development of the research units of the Ministry of Agriculture; and

- To evaluate, and study the findings of research and development performed by these units.

The establishment of AARD represented the creation of a truly national agricultural research system. Prior to 1974 research was conducted separately within each of the Directorate Generalates of Food Crops, Estate Crops, Forestry, Fisheries and Animal Husbandry, all of which had limited research budgets and few trained researchers. Such research resources as did exist were siphoned off to form AARD. This was not done very readily in all instances, and some former research stations still exist in some Director Generalates but, since virtually all of the research staff transferred to AARD, the situation today is that hardly any Ministry of Agriculture research is conducted outside of AARD. (Indeed very little agricultural research in Indonesia is conducted by other agencies except for forestry research, which is now no longer under the Ministry of Agriculture).

Some work on germ plasm conservation is done by the National Biological Institute (LBN) and some on oceanography by the National Oceanographic Institute

(LON), both of which are parts of the Ministry of Science and Technology. Some agricultural research is carried out at different universities, but budgetary constraints severely limit the scale of such activities. In the private sector, applied research is conducted by a seed company (corn) and by some fertilizer and pesticide manufacturers. In nearly all of the above instances, both public and private, the research is carried out in collaboration with AARD. Thus, in Indonesia, the term NARS is virtually synonymous with AARD.

The involvement of CGIAR Centres in agricultural research in Indonesia predates the formation of AARD, in that IRRI has been operating in the country since the 1960's. Given the strong government focus on rice, it is not suprising that IRRI has been very active, and any discussion with Indonesian agricultural scientists on the role of International Centres is dominated by references to IRRI. IBPGR, CIP, CIMMYT and ISNAR are also well recognised and IITA, ICRISAT, IFPRI and CIAT have also had recent links. The five remaining CG Centres - WARDA, CIAT, ICARDA, ILCA and ILRAD - are not mandated to work in Indonesia, although ICARDA has supplied seed of faba bean, on request, for trials in the dry eastern parts of Indonesia.

## 2.2 INSTITUTIONAL STRUCTURE

AARD is one of the 6 main technical units of the Ministry (Department) of Agriculture (Annex 1 Figure 1). It has eleven main organisational units: 1 Secretariat, 2 Research Centres (Soils, Agro-Economics), 2 Centres (Statistics and Data Processing, and the National Library of Agricultural Sciences), 5 Research Coordinating Centres (Food Crops, Horticultural Crops, Industrial Crops, Fisheries, and Animal Science), and a Board of Estate Crops Research Management. It also has 23 research institutes, 42 research stations and 154 experimental farms and ponds (Annex 1 Figure 2 and Table 18). About 90% of the institutes and 20% of the Stations and Farms have been improved in recent years. In order to facilitate location-specific technology adoption and testing, a number of these facilities are grouped in 10 regional research complexes. These serve to ensure the suitability of improved technology for agricultural development throughout the archipelago. The 10 complexes are at Medan, Padang, Palembang, Bogor, Malang, Banjarmarsin, Maros, Manado, Kupang and Ambon. They serve national needs in adjoining areas as well as those needs where they are located. The types of research units in these complexes are germ plasm centres, experimental farms, experimental stations, laboratories and research institutes. The eleven principal units of AARD are as follows:

### SECRETARIAT

The Secretariat is made up of five sections: Program Formulation, Cooperative Research Administration, Financial Administration, Personnel Administration, and General Administration. The Program Formulation Section assists the Director General with research and development management. It coordinates the formulation of research activities, conducts monitoring and evaluation of this research, and prepares reports on program and project implementation. The Cooperative Research Section administers the collaborative and cooperative research activities with foreign and national institutions concerned with agricultural research and development. This cooperation includes multilateral and bilateral donor organizations, universities, and national and international research systems in other countries. The Financial Administration Section manages the financial accounting, monitors expenditure, and evaluates the financial reports of all units of AARD. The Personnel Administration Section carries out manpower planning and manages promotions, transfers, and retirement. The General Administration Section examines, analyzes and evaluates the work rules and procedures of all the units, provides guidance for maintenance of facilities and manages official correspondence.

CENTRES

The Centre for Agricultural Data Processing (CADP) links data collectors and information users, and assists the Director General of AARD in research management through the processing, storage and retrieval of information in a research inventory. It also provides for statistical consultation, and coordination and support of data collection, processing and analysis systems for all the research institutes. It is responsible for the management of a comprehensive computer information system, designed to serve the entire Ministry of Agriculture.

The National Library for Agricultural Sciences (NLAS) serves as a national agricultural library, coordinates the Research Institutes' own collections, serves as the main centre for information exchange with national and, in particular, with International Agricultural Research Centre libraries, and publishes scientific journals, bulletins, reports and other materials.

RESEARCH CENTRES

The Soil Research Centre conducts research to support the in-country characterisation, utilisation and conservation of land resources. It supports research done by all other AARD Research Institutes, as well as providing support to other programs within the Ministry of Agriculture, and other Ministries (i.e. Transmigration). It is responsible for conducting soil, water, and plant analyses in response to requests from other AARD Institutes, and also assists the Director General of AARD in guiding and coordinating soil fertilitiy and productivity research programs carried out by individual research institutes.

Research in support of the transmigration program is supervised by the Centre for Soil Research. The main research activities are to locate suitable areas for transmigration and to develop appropriate farming systems.

The Agro-Economic Research Centre has a major long-term activity, The National Panel of Farmers (PATANAS) program, designed to measure the parameters of agricultural production, income and employment, along with measuring the impact of present and proposed agricultural policies and technological innovations. The program began in East Java in February 1983, and during the 1984-1985 fiscal year is being extended to West Java, West Sumatra and South Sulawesi. By the end of 1988, it will include all ten AARD research complexes in Indonesia.

Additional research activities include agricultural development strategies, production constraints at the farm level, optimum resource utilization, analysis of the implications of various price and marketing policies for agricultural commodities, organization of input supply, and analysis of credit policies. In general, inadequate agricultural economics research has been a major weakness in the past in formulating effective agricultural policies.

## RESEARCH COORDINATING CENTRES

For each major commodity grouping the research centre consists of a group of research institutes managed by a coordinating centre with responsibilities for activities at the group level with respect to equipment, experimental stations, personnel, planning and evaluation. The Estate Crop Centre differs from the other five in that it is managed by a board chaired by the head of AARD rather than by a director appointed by him.

Food Crops. Food crop research is carried out at 6 institutes supported by 15 research stations and 45 experimental farms. Each of the six institutes, located at Bogor, Banjarbaru, Maros, Malang, Sukamandi and Sukarami, has both a regional and a specific mandate (e.g. tidal rice, irrigated rice, upland rice, food crops other than rice) but each supports its five sister institutes in carrying out their specific mandate in its geographical area.

The main focus of research at these food crop institutes has been the breeding of locally adapted varieties of high yielding wetland rice, with attention to earlier maturity, and pest and disease resistance. Distribution of varieties resistant to brown plant hopper has sharply curtailed crop losses. Research on upland rice, which has hitherto been meager, is being expanded. In addition to rice, research is ongoing for corn, soybean, groundnut, mungbean and sweet potato.

Horticultural Crops. Research on these crops was, until recently, carried out within the food crops research institutes. A separate research centre has now been established, with research on vegetable crops and ornamentals, having its headquarters at Lembang, and a new institute for fruit research will be built at Solok in Sumatra. In the past, research on fruit and tropical vegetables has received rather limited attention, the main focus having been on temperate (upland) vegetables such as potatoes, tomatoes and cabbages.

Industrial Crops. Three research institutes have major responsibilities for research on industrial crops. The Institute for Spices and Medicinal Plants, at Bogor, is responsible for research on cloves, pepper and other spices and medicinal plants. The Institute for Tobacco and Fiber Crops at Malang, East Java is working principally on tobacco, cotton, jute, kenaf, and kapok. The Institute for Coconuts at Manado, North Sulawesi has the national mandate for research on coconuts.

Estate Crops. There are seven estate crop institutes. The Research Institute for Estate Crops in Bogor conducts pioneering research and commodity analysis for all estate crops. The Institute at Sungei Putih, N. Sumatra is responsible for rubber production research on estates, and the Institute at Sembawa, S. Sumatra is researching problems of small-holder rubber production. The Institute at Medan, N. Sumatra, has the national mandate for oil palm production and processing problems. At Gambung, West Java, the Institute is focusing on production and processing technology for tea and cinchona. The Institute at Jember, E. Java, has the national mandate for research on coffee and cocoa, and lastly, the Institute at Pasuruan, E. Java has responsibility for sugar production and technology research.

Livestock. Research in animal science focuses upon two major areas - animal diseases and animal production. The Research Institute for Animal Diseases at Bogor is directed at developing integrated disease control programs for improved local or introduced breeds in crop based production systems. It is responsible for developing vaccines, and serves as a national reference centre for all important animal diseases.

The Research Institute for Animal Production at Ciawi near Bogor works primarily on improving livestock productivity, and also concentrates on the introduction of livestock into tree crop based agriculture, improving pastures and making better use of various local by-products as feed.

Fisheries. There are three fisheries research institutes. The one for marine fisheries at Jakarta studies marine resources, fishing methods (craft and gear use), mariculture and socio-economics. It has field stations at Semarang (Central Java) for demersal fisheries resource stock assessment surveys, and at Serang (West Java) for mariculture.

The Institute for Freshwater Fisheries at Bogor, conducts research on fish culture, shell fish farming, and fry production. It has a small field laboratory at Jatiluhur for work on man-made reservoirs and a freshwater prawn hatchery at Pasar Minggu.

The Institute for Brackishwater and Coastal Fisheries at Maros (South Sulawesi) conducts research on brackishwater and coastal fish, prawns and shellfish. Both it and its brackishwater research station at Gondol (Bali) are currently under construction.

Responsibility for research on fish technology is allocated to each of the three research institutes within their respective area of jurisdiction.

RESEARCH REVIEW AND COORDINATION

There are extensive arrangements for the review and coordination of research policy, funding proposals, and research programs. These include:

1. Monthly meetings of the head of AARD with the Minister, the three Junior Ministers, the Secretary General, the Inspector General, the Director General and the Head of AAETE;

2. Regular consultations outside the framework of the monthly meeting with other Director Generals in the Ministry;

3. Regular consultations with leaders from the provinces, frequently in the form of provincial agricultural advisory committees, set up under either the Governor or Head of the Office of Provincial Agriculture (Kananwil);

4. Technical meetings on research in relation to development goals in fields such as transmigration, land use, etc.;

5. Monthly meetings with the Minister for Science and Technology;

6. Periodic research management workshops;

7. Integrated national research programs in key areas (i.e. rice, agro-economics, soils).

8. Reviews of research programs and projects; and

9. Reviews of research institutes and centres.

## 2.3 Financial Resources

During the period 1978-1983, AARD received about 3% of the development budget and 20% of the routine budget of the Ministry of Agriculture. However, this ministry only receives about 20% of the total public sector budget for agriculture (large sums for subsidies and price supports and for BULOG being administered by the Office of the President, and irrigation being handled by the Ministry of Public Works). In terms of the total public sector budget for agriculture, AARD's allocation appears to be between 3 and 4% of the total. In terms of the agricultural component of the GDP, the allocation to agricultural research during 1978-83 averaged 0.22% per year (Annex 1 Table 19).

In real terms, GOI expenditure on agricultural research grew by over 11.5% p.a. from 1975/76 through 1982/83. There was a reduction in budget of 21.2% in 1983/84 and 8.8% in 1984/85, in part a result of the removal of the forestry budget to a separate ministry (Table 2.1).

In addition to this national contribution, AARD has received considerable donor support. During the period from its inception until April 1985 this totalled US$ 175m, or 33% of AARD's total income of $524m during the 11 years. Until 1982/83 the external component was generally of the order of 25-30%, but in that year it rose to 34%, in 1983/84 to 48% and in the last year to 51% (Table 2.1). Of the external funds given in these last three years about 25% was grant and 75% loan money, and about half of the total, or over US$ 40m, was from the World Bank. These external funds mean that the total expenditure on agricultural research in recent years has been closer to 0.3% of the agricultural GDP rather than to the 0.22% mentioned earlier, and that the national contribution has fallen below 0.2% in the last two years.

TABLE 2.1

AARD BUDGETS 1974-85

| YEAR | GOI (US $ m) | EXTERNAL (US $ m) | TOTAL (US $ m) | GOI Contribution in billion Rp. |
|---|---|---|---|---|
| 1974/74 | 12.7 | 4.0 | 16.7 | 5.3 |
| 1975/76 | 17.7 | 4.3 | 22.0 | 7.3 |
| 1976/77 | 24.7 | 8.5 | 33.2 | 10.2 |
| 1977/78 | 30.7 | 12.7 | 43.4 | 12.6 |
| 1978/79 | 36.1 | 12.3 | 48.4 | 15.0 |
| 1979/80 | 27.4 | 9.2 | 36.6 | 17.1 |
| 1980/81 | 41.4 | 16.0 | 57.9 | 25.9 |
| 1981/82 | 47.2 | 19.2 | 66.4 | 30.5 |
| 1982/83 | 47.7 | 24.1 | 71.8 | 26.7 |
| 1983/84 | 34.5 | 31.4 | 65.9 | 33.4 |
| 1984/85 | 29.4 | 32.8 | 62.2 | 32.7 |
| | 349.5 | 174.5 | 524.0 | 221.5 |

Because of the fact that AARD underwent major structural changes in 1979, and again in 1983, it is difficult to present budget allocation time series on a *research* centre or a research institute basis. Budget analysis is complicated still further by the fact that there are four components to the budget: routine, development, estate crop cess and foreign aid, with the latter being allocated on a funtional rather than a structural basis (Annex 1 Table 20). It is possible to show the routine and development budgets by research centre, and this is done for 1982/83 in Annex 1 Table 21. The table is not, however, easy to interpret because it includes intersectional programs such as aid counterpart funds.

It is also difficult to disaggregate budgets to identify how much of the expenditure is for items such as personnel emoluments, because these are spread over a number of headings. Likewise, operational research costs cannot be identified in conventional terms, because this term is used in AARD to cover a wide range of activities.

An effort has been made by Salmon (1983) to look at congruence in agricultural research in Indonesia. Although recent studies (AARD 1984 b, 1984 c) raise some questions about his data base, they do tend to support his conclusions that there is a fairly high degree of congruence in food crop allocations. The AARD studies have gone into considerable depth in an effort to disaggregate the research expenditure on specific commodities. They show a relatively high level of expenditure on livestock and fisheries at the expense of rice and horticulture (Table 2.2). Bearing in mind that non-food crops are also supported by a special cess, which is not shown in the table below, the research support given to them is extremely high in terms of their relative value (and, perhaps, their research output). Rice, on the other hand, although its research output is very high, does not overdominate the resource allocation picture.

TABLE 2.2

COMMODITY COMPONENTS OF AARD'S DEVELOPMENT
BUDGET IN RELATION TO VALUE OF COMMODITY PRODUCED

| Commodity | % Development* Budget | % Contributed by Commodity to Agricultural GDP |
|---|---|---|
| Rice | 21 | 34 |
| Other cereals | 6 | 5 |
| Grain legumes | 7 | 4 |
| Root crops | 2 | 4 |
| Horticulture | 8 | 11 |
| Fisheries | 15 | 8 |
| Livestock | 19 | 9 |
| Non Food Crops | 23 | 24 |
| | 100 | 100 |

* Excludes allocations to develoment projects and to support services

## 2.4 HUMAN RESOURCES

AARD's professional staff has grown from 220 in 1975 to over 1500 on site on December 1st 1984, with a further 450 away training at that time. In addition, there is a support staff of over 5000 and approximately 100 foreign technical specialists are currently assigned to AARD. The former dependence on part-time 'contract' staff (mainly university faculty) has declined considerably as the number of trained permanent staff has increased.

In December, 1984, AARD had 102 Ph.D.s and 296 M.Sc.s on its research staff, and a further 144 and 305 scientists away undergoing training at the Ph.D. and M.Sc. levels respectively (Table 2.3). A long-term master plan for training calls for a staffing of 510 Ph.D.s and 1130 M.Sc.s by 1995.

Although these figures may seem ambitious, the training achievements to date are impressive. The training program is already ahead of schedule, with the number of trainees identified for 1983/84 being in excess of the target for that year. Adequate funds are available from external sources to cover training costs over the next few years.

TABLE 2.3

GROWTH IN PROFESSIONAL
STAFF OF AARD 1975 - 84
AND TARGETS FOR 1995

| | Ph.D. | M.Sc. | Sarjana | Total |
|---|---|---|---|---|
| **AARD Staff 1975** | **16** | **26** | **178** | **220** |
| AARD Staff July 1979 | 27 | 44 | 626 | 697 |
| Honorary Staff July 1979 | 0 | 0 | 177 | 177 |
| **TOTAL Staff July 1979** | **27** | **44** | **803** | **874** |
| AARD Staff Dec 1984 | 102 | 296 | 965 | 1363 |
| Honorary Staff Dec 1984 | 0 | 1 | 169 | 170 |
| **TOTAL Staff Dec 1984** | **102** | **297** | **1134** | **1533** |
| Staff away on training 12/84 | 144 | 305 | 0 | 449 |
| **TOTAL Staff and Trainees 12/84** | **246** | **602** | **1134** | **1982** |
| No of trainees planned 1984-95 | 264 | 528 | 0 | 792 |
| **TOTAL Staff target 1995** | **510** | **1130** | **1000** | **2640** |

Most of the incremental growth in staff with post-graduate qualifications during the period from 1974 to 1984 has come from AARD's own training program rather than from recruiting personnel with higher degrees. A massive and coordinated training program has been funded by the IBRD with major support from USAID, ADAB and other donors.

A major component of this training program has taken place at seven selected local universities (particularly IPB Bogor). This has graduated 17 of the additional 86 Ph.D.s and 182 of the increase in numbers of 270 M.Sc.s.

Currently about 90 of the 144 trainees doing Ph.D. theses and most of the 305 doing M.Sc.s are at local universities rather than overseas.

The staffing pattern varies between organisational units, with the food crops and animal husbandry centres being relatively well staffed with post-graduate personnel, due partially to their past USAID/IRRI and ADAB support, respectively, whereas the fisheries and industrial crops centres, which have received limited external support in the past, have relatively few trained researchers in terms of the value of the commodities covered by these centres (Annex 1 Table 22).

Detailed data on training plans and targets for selected commodities are not readily available, although a recent review of the food crop program (AARD 1984c), which covers most commodities (other than potatoes) in which the IARCs are involved in Indonesia, has attempted to do this (Table 2.4).

TABLE 2.4

CURRENT STAFF IN FOOD CROP RESEARCH EITHER WITH OR UNDERGOING POST GRADUATE TRAINING

| | Current Staffing | | Likely Staffing when current trainees complete (1987-88) | |
|---|---|---|---|---|
| | Ph.D. | M.Sc. | Ph.D. | M.Sc. |
| Rice | 15 | 49 | NA | NA |
| Other cereals | 5 | 6 | 8 | 21 |
| Grain legumes | 4 | 16 | 9 | 24 |
| Root crops | 1 | 2 | 1 | 5 |
| Palawija farming systems | 4 | 5 | 5 | 8 |
| | 29 | 78 | NA | NA |

The table indicates how much of the skilled manpower resources have gone into rice research (where the staff build-up is now tapering), the more recent development of a growing degree of specialisation in cereals and grain legumes (although still small in terms of the importance of these crops, especially maize), and a major shortfall in expertise in root crops (in spite of the fact that Indonesia is one of the world's largest producers of cassava.

Until recently, AARD has not had a central manpower development plan. Its policy has been to offer post-graduate training in their field of choice to all staff whose grades made them eligible. As a result, there is some lack of balance in the growth and station location of expertise on both a disciplinary and a commodity basis. Steps are now being taken to review this in terms of the long-term manpower targets.

Manpower is, perhaps, an inappropriate word, because about a quarter of AARD's professional staff are women. A detailed breakdown is available for the six major commodity centres which contained 1067 of the 1367 tenured staff in December 1984. The percentage of professional staff who were women in each research centre was: food crops 17, horiculture 24, industrial crops 28, livestock 26, fisheries 32, estate crops 10, overall 24%.

## 2.5 EXTERNAL INFLUENCES (INCLUDING CGIAR CENTERS)

Reference has already been made to the fact that about one third of the funds received by AARD during the past eleven years have been from external sources, of which the largest is the World Bank.

Since its inception, AARD has received support from 8 donors other than the Bank through 34 projects, of which 18 are completed (Annex 1 Table 23). The portfolio for these projects was US$ 110m, of which US$ 80m, or the major part of the ongoing external assistance, flows through two USAID projects (one for expanding and improving a network of 9 agricultural research stations in Sumatra, and the other for strengthening applied agricultural research generally), three Australian projects (animal health, animal production and pastures), and one Dutch project (secondary crops at Malang). These six projects, plus smaller ones supported by Belgium, Holland, Japan, FAO/UNDP and the UK, are all closely linked into AARD mainstream activities. All long-term training is now consolidated through the Bank project (except for some training in one Australian project). A number of donors also provide technical assistance specialists and 102 such persons were attached to AARD in April 1984 (Annex 1 Table 24).

The World Bank has provided its support through two major projects, National Agricultural Research I (NARI) and NARII, and is currently negotiating a third project (NAR III). NARI was involved with the establishment of AARD and provided funds for physical resources (including four major new Institutes), technical assistance and manpower. It was followed in 1980 by a larger NARII, whose goal was to strengthen the research capability of AARD in subsectors in addition to those included in NARI (rice, secondary food crops, highland vegetables and rubber), in order to ensure continued growth of the research effort following the accomplishments of NARI. The NARII Project, therefore, added support for fruit, lowland vegetables, livestock, fisheries, forestry, and estate crops other than rubber and industrial crops. It is expected to complement the Sumatra Agricultural Research (SAR) and the Applied Agricultural Research (AARP) projects of USAID and other World Bank projects relating to extension, rubber, coconuts, seeds and transmigration, so that agricultural research can keep in step with the overall agricultural development program. Between 1975 and 1982, NARI and II were responsible for funding the Ph.D. training of 69 Indonesians (33 overseas) and M.Sc. training of 342 persons (32 abroad).

NARIII, which is now under discussion, seeks to complement past and ongoing donor support by further consolidating research efforts and should, to a large degree, take AARD to a state of full development in terms of infrastructure and trained personnel.

Apart from the World Bank and bilateral donors, AARD has received support from various international centres. These include ACIAR and IDRC who have provided operational funds for research, mainly in post-harvest and fisheries, AVRDC, IFDC and several CGIAR Centres. AVRDC has been active in vegetable research and has undertaken collaborative activities funded by the Asian Development Bank. IFDC has collaborated on rice policy research in a joint IFPRI/IRRI/IFDC activity.

Of the CGIAR centres, IRRI has been the one most actively involved in Indonesia. Its program dates back to 1967, when the HYVs IR5 and IR8 were introduced into the country. In the early 1970's it became formally involved in three ways: First, through Dutch bilateral aid, a pathologist and a soils specialist were based at Maros; second, with USAID support, a breeder, an economist and a farming systems specialist were based at Bogor; and third, a formal cooperative research and technical assistance contractual arrangement between the Ministry of Agriculture and IRRI was signed in 1972 and lasted until 1982. The core of this arrangement was that IRRI rendered technical support to strengthen rice reseasrch at the Sukamandi Food Crop Research Institute. IRRI provided technical experts in the fields of plant breeding, plant pathology, entomology and agricultural engineering, in addition to a training program with seminars, workshops and training in both Indonesia and at IRRI. The Sukamandi institute was established with funding from two World Bank (IDA) loans and was expanded using NARI funds. It is located at the centre of the rice growing area of West Java and is within three hours drive of 0.5 million ha of wetland rice, or about 10% of the area (allowing for double cropping) under rice in Indonesia.

IRRI has, however, collaborated with Indonesia in many ways. Training has been a critical element and, between 1962 and 1982, 401 Indonesian scientists (1 post-doctoral fellow, 32 M.Sc., 24 Ph.D., 41 non-degree and 307 short course participants) have been trained at IRRI. Five of those with Ph.D.s now head up food crop research institutes. The GOI and IRRI have, since 1965, collaborated in the Genetic Evaluation and Utilisation Program (GEU), with IRRI maintaining Indonesia's germ plasm collection, assisting in screening for brown plant hopper and grassy stunt virus resistance, evaluating eating quality and providing other information not readily attainable in Indonesia at the present time. IRRI also arranges screening of Indonesian deepwater varieties in Thailand and cold tolerance testing in Korea. Indonesia has reciprocated by screening materials for IRRI and other countries for rice tungro virus, blast and gall midge. AARD has also been actively involved in IRRI's International Rice Testing Program, entering more than 50 strains annually in IRTP nurseries for evaluation, and it has used several hundred IRTP entries as parents in its national breeding program.

In 1984, after the conclusion of the 1972-82 IRRI/AARD program, a new collaborative program was signed in which IIRI's involvement is to be focused on upland rice improvement and upland farming systems, research on brown plant hopper, green leaf hopper and tungro virus and on irrigation water management. It is envisaged that germ plasm transfer and training will continue to play key roles in the program, but that rather than AARD <u>cooperating</u> in IRRI's program, IRRI will now <u>collaborate</u> in those parts of AARD's program where it posseses specialised expertise which does not yet exist within AARD.

Since 1977 IRRI has had an agricultural engineer posted in Indonesia working mainly in Sumatra and Sulawesi, where there is often a shortage of labour, on developing a domestic industry for the manufacture of agricultural machinery designed at IRRI. This program is carried out through the extension services of the DGFC and has led to an increase in local manufacturers of small-scale machinery, particularly threshers, where the number of local manufacturers has increased from 2 to 13. The Government envisages an expanding role for selective mechanisation, even in parts of Java, because of the importance in communal irrigation systems of timely planting and harvesting, and because of periodic shortages of labour.

Indonesia's links with IRRI have been enhanced for a number of years by the presence on the IRRI Board of Trustees of a senior agricultural scientist from Indonesia (since 1978 from AARD).

CIMMYT works in Indonesia mainly through its regional office in Bangkok, although maize and wheat germ plasm is received directly from Mexico for screening and evaluating locally. The maize program works with both open-pollinated and hybrid varieties. The only hybrid released to date is a commercial one (Cargill) whose field testing and evaluation was done by AARD. 5000 ha were planted in 1984 and the 1985 target is 68,000 ha. AARD also participates in CIMMYT's international testing program. Staff have attended meetings and workshops organised by CIMMYT and have undertaken sponsored trips to other Asian maize programs and to CIMMYT. The six open-pollinated new maize varieties released in the period 1980-1983 were all locally bred. CIMMYT has trained twelve AARD staff at its headquarters in various types of courses, and CIMMYT publications are fairly widely distributed within AARD. There is also a link with CIMMYT's tropical wheat program. Four AARD staff from the new wheat program visited CIMMYT in 1981, and germ plasm has been received from CIMMYT.

CIP has been active in Indonesia for more than six years. Progress was initially constrained by constant local staff changes but more recently the situation has stabilised. Several aspects of CIP's involvement are of particular interest.

1) CIP was asked to review the complete potato research strategy for Indonesia, which was carried out in September 1983. There are indications that the results of this mission are beginning to bear fruit, and that the internal organisation will be developed which will permit CIP to work more efficiently with national scientists.

2) CIP posted a senior scientist to Indonesia for approximately five months in 1983 to work with AARD, specifically on research aimed at solving problems of potato production in warm conditions.

3) In 1982, Indonesia became a part of a collaborative research network, SAPPRAD, consisting of five countries in South East Asia in which Indonesia has assumed the lead role for the work in tropical potato agronomy. This includes bacterial wilt control, mulching, intercropping etc.

4) CIP has supplied AARD with germ plasm with bacterial wilt and late blight resistance and with true potato seed for evaluation in the national program.

5) CIP has also been instrumental in making it possible for an Indonesian scientist to visit Vietnam, on USAID funding, in order to study the use of village level techniques of potato tissue culture.

Ten AARD staff have participated in CIP training activities. Six of them have attended one to two week courses at CIP's regional office in the Philippines and four have been to courses or workshops at CIP headquarters. Several AARD staff have also visited CIP headquarters.

In 1976 Indonesia established a National Committee for Plant Genetic Resources, chaired by a senior AARD staff member, which was charged with advising the GOI on all matters relating to plant genetic resources. The Committee oversees a number of collections, which are located at universities and AARD facilities. In its early years it worked closely with IBPGR who, since 1977, have sponsored eight germplasm collections from the remoter parts of Indonesia (fruit trees, tuber crops (twice), bananas (twice), coconuts (twice) and soybean) with grants for this from the IBPGR totalling US$ 149,250.

IBPGR has also funded (US$ 23,300) the translation into English of Indonesian books on tuber crops, fruits and vegetables and three regional training courses on plant genetic resources evaluation ($75,000) at which there were a total of fifty participants, forty-one of them coming from other South East Asian countries. These courses were held at the National Biological Institute at Bogor (LBI), whose director is the secretary of the National Committee for Plant Genetic Resources.

Ten Indonesian scientists have taken the IBPGR sponsored M.Sc. course at Birmingham University on the conservation and utilisation of plant genetic resources. The IBPGR has also assisted Indonesia in the participation of about thirty scientists at a number of IBPGR sponsored workshops and training courses outside of Indonesia, with staff from AARD, LBI and Universities as participants (see Annex 1 Table 25).

The leader of IITA's root and tuber program has visited AARD on a number of occasions and has supplied them with both cassava and sweet potato germ plasm. This is being grown with that of CIAT, and although some shows promise, none is yet ready for release. The AARD root crop program coordinator did his M.Sc. training at IITA and is very familiar with their program. Six Indonesians have been trained at IITA. The training has involved staff from both the root crop and the grain legume programs of AARD. A number of AARD staff reported seeing IITA publications. There is , however, a recognised risk in using IITA germplasm because African cassava mosaic is not found in Indonesia and, in light of this and also because of the regional responsibility agreement signed by CIAT and IITA in June 1984, IITA may have a limited role to play in Indonesia.

Since 1977 AARD had received eight visits from CIAT's cassava program staff and has also received planting stakes which are showing some promise in field trials, but no CIAT lines or their progeny have yet been released. The AARD root crop program coordinator has visited CIAT and participated in a CIAT regional meeting in Thailand. Twelve Indonesians have participated in CIAT root crop training courses.

CIAT is constrained in what it can do by the shortage of trained manpower in AARD's root crop program, and has devoted part of its effort in Indonesia to Brawijaya University at Malang where a small pool of root crop expertise has been developed with Dutch and IDRC funding. There is a close working relationship between root crop researchers at the Malang Food Crop Research Institute and the university. A recent workshop sponsored jointly by CIAT and the U.N. Economic and Social Commission for Asia and the Pacific (ESCAP)'s Regional Coordination Centre for Research and Development of Coarse Grains, Pluses, Roots and Tuber Crops (CGPRT) had two AARD and five Brawijaya participants plus one Brawijaya-trained private sector plantation manager who has a collaborative screening program with AARD. CGPRT's director (who is located at Bogor) is a CIAT Board of Trustee and is keen to develop CIAT-AARD-

CGPRT links.

Two scientists from CIAT's forage program also visited AARD in June 1984 to explore a basis for possible future collaboration.

ICRISAT has been visited by the leader of AARD's grain legume program who participated in a Consultative Group meeting for Asian regional research on grain legumes in 1983. Several visits to AARD have been made by ICRISAT staff and sorghum, groundnut and pigeon pea germ plasm has been supplied. Two AARD staff have received research scholarships (2 and 11 weeks) from ICRISAT and seven persons have gone there as in-service trainees, mainly in the cropping systems program, on courses of 6-8 months duration.

ICRISAT is also closely linked to CGPRT, which is funding a regional training program for agricultural economists at ICRISAT with one participant from AARD. Discussions are under way regarding a senior ICRISAT staff member doing a sabbatical at CGPRT which, if it materialises, should help to strengthen AARD-ICRISAT links.

IFPRI has a collaborative program with IFDC and IRRI on rice policies in South East Asia. This program is not with AARD but is linked to the Planning Unit in the office of the Secretary General of the Ministry of Agriculture.

ISNAR has had a link with AARD since 1981, when at AARD's request it staffed AARD's first Quinquennial Review. Since the review, one member of the review team has visited AARD approximately every three months to assist AARD in developing methodology for implementing some of the review recommendations in the areas of priority setting, planning, monitoring and evaluation. The former Director General of AARD is a member of the Board of Trustees of ISNAR (and at one time was a TAC member - the only person from Indonesia to be so appointed).

In terms of mandates IRRI is clearly the IARC of most importance to Indonesia, given the role of rice in the national economy. The other food crops covered by the IARCs, in order of importance according to the value of their production, are listed in Table 2.5.

TABLE 2.5

COMPARATIVE FARM-GATE VALUE OF SOME
FOOD CROPS PRODUCED IN 1981 (AARD, 1984 b,c.)

| | (billion Rupiahs) | Relevant CGIAR (or other) Centre |
|---|---|---|
| Rice | 4400 | IRRI |
| Corn | 600 | CIMMYT |
| Cassava | 420 | IITA/CIAT |
| Soybean | 210 | |
| Groundnut | 200 | ICRISAT |
| Sweet Potato | 95 | IITA/(AVRDC) |
| Potato | 30 | CIP |
| Other food crops | 260 | |
| Fruits | 750 | |
| Vegetables | 720 | (AVDRC) |
| | 7745 | |

In interpreting the above table in terms of the current level of IARC activities note must be taken of the non-technical constraints to production, particularly the question of market demand, which have been referred to in Chapter 1 of this report and will be mentioned again later. However, it is, perhaps, worth noting that 76% of the value of IARC mandated crops produced in Indonesia is represented by rice. Nevertheless the size of the country is such that the other mandated crops still represent over 2 billion US dollars of agricultural GDP each year.

## 2.6 EFFECTIVENESS AND PROBLEMS

AARD has existed a short time, especially when measured in the context of time in the continuing, accumulative process of generation of knowledge through research. The eventual effects of AARD, in terms of increased output of food and fibre in Indonesia, cannot be judged yet. More appropriate criteria for judging its effectiveness now are related to its assembling of resources, its base for expansion of research activity, and the continuation and strengthening of programs that were already in existence. In particular, the expansion and development of human resources, described earlier in this chapter, represents a noteworthy achievement.

There are, nevertheless, numerous reports that furnish detailed information about specific contributions of AARD. Perhaps the most comprehensive is the AARD (1981) publication Five Years of Agricultural Research and Development for Indonesia 1976 - 1980. Other reports on selected programs of AARD also furnish evidence of its progress and accomplishments. Of special significance is the resume prepared in June 1982 of the National Rice Research Program, initiated with cooperation from IRRI and funded by the USAID, the Ford Foundation, and other donors (IRRI 1984a). The NRRP was integrated into the NARII and contributed to - as well as benefited from - the organizational stability provided by the emerging AARD.

The most impressive accomplishment of AARD is the role that it has played in the transformation of rice production, which has turned Indonesia from being the world's largest rice importer in 1980 to an exporter of nearly 300,000 MT in 1984. Within the short life span of AARD, annual milled rice production has grown from 15.5 to 25.5 million MT with new varieties and technology playing a key role in the increased production.

Since rice is the most important crop, and the one to which most resources have been devoted, it is not suprising that it has made the most progress in research. But important new varieties have been bred in a number of other crops, as will be related later, and useful advances have been made in research on farming systems and integrated pest control. In the food crop area alone 188 research papers were published by AARD staff in the period 1979-1984. A number of these are short communications and are in the local language but amongst them, in both the Indonesian Journal of Agricultural Research and referred international publications, are papers of a very high standard. Table 2.6 summarizes this published output.

TABLE 2.6

RESEARCH PAPERS ON FOOD CROPS PUBLISHED BY AARD STAFF DURING 1979-1984

| Publication | Rice | Maize/ Sorghum | Grain Legumes | Root Crops | Total |
|---|---|---|---|---|---|
| Ind. J. Agric. Sci. | 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 |

As in any new and rapidly growing agency there are problems, the most serious of which are financial. These lay in three main areas:

a) the extremely low salary levels paid to professional staff mean that many of them have to take on administrative tasks and other work to earn sufficient 'honoraria' to make a reasonable living,
b) the shortage of funds for operational research, because the major part of the budget is devoted to salaries and capital development, restricts the amount of research that can be carred out,
c) the level of funding for maintaining buildings and equipment is not keeping pace with the development of new physical resources, and some of the newer equipment is already suffering from lack of funds for maintenance.

None of the above problems has seriously affected AARD to date, but they do represent a major risk in the foreseeable future as skilled staff numbers rapidly build up. Funding shortages could lead to frustration and staff wastage which, to date, has been negligible. The situation could well change as agricultural development, in general, creates career opportunities for skilled agricultural scientists outside of the research area. At present few such opportunities exist in Indonesia.

The heavy dependence of AARD on foreign funds, which are provided mainly for development activities, could also represent a problem in future when expenditure shifts more from developmental to operational activities. AARD's two major donors, USAID and IBRD, appear to be very conscious of this and in new projects currently under consideration are both reviewing the possibility of a greater degree of operational support. Ultimately, however, to effectively utilise the resources that it is developing, AARD will probably require to _at least_ double its current budget level relative to both agricultural sector expenditure and to the agricultural GDP.

A problem that is probably less enduring, but currently exists, is the shortage of skills in research management, particularly planning, programming and evaluation. This arises from the fact that many of AARD's research managers are newly-trained Ph.D.s with limited training or experience in the managerial tasks that are now being thrust upon them. AARD has made considerable effort at providing in-service training for its senior staff and has plans to intensify this activity, although in the long run it will probably be necessary to provide such training more formally at a local university.

# CHAPTER 3

# THE IMPACT OF IARCS ON THE NARS

## 3.1 OVERVIEW

Since 1969, the most spectacular change in Indonesian agriculture has been the transformation of the rice economy. This has been brought about as a result of concerted efforts by the government to make Indonesia self-sufficient in rice. The successful attainment of this goal in the early 1980s was due to the interaction of a number of key factors. In Repelita I and II alone, about US$1.5 billion was spent on rehabilitating or expanding a total of nearly 3m ha, of irrigation systems, with an even larger sum and a similar area planned for Repelita III. Both rice and fertilizer prices were subsidised, enabling farmers to apply modern technology, and the use of nitrogenous fertilizer increased ten-fold between 1969 and 1984. Procurement and storage were reorganised through BULOG in order to create market stability and the BIMAS program took research results to farmers fields and provided both credit and effective organisation of farmers' groups and the supply of inputs. All of these supportive activities, plus the opening up of new lands off Java, are likely to have helped increase production. But superimposed upon them was the new technology provided by the agricultural research agency (AARD) whose personnel, from before the date of establishment of AARD, collaborated closely with IRRI. This collaboration has been most fruitful and has led to the production of over fifty new and high-yielding varieties of rice which now cover over 6 million hectares, or more than 70%, of the planted area. Total yield of milled rice has increased by 10 million MT per annum since 1974.

Whilst such an increase is theoretically possible from the IRRI-based Pelita varieties first released in 1971, in practice this appears to be highly unlikely because of their susceptibility to new pest biotypes that thrive on well-watered and fertilized rice, and the area under these two varieties fell from 1.56 m ha in 1975/76 to only 0.11 m ha in 1982/83, as new and resistant varieties came on stream from either AARD's IRRI-trained staff of from IRRI itself.

The professional competence of the AARD scientists has been instrumental in the rapid adaptation, testing and release of both locally produced and IRRI varieties. To attempt to isolate or apportion the contribution made by AARD, IIRI or the supportive mechanisms supplied by government is not realistic since all three components are interdependent. However, in the next chapter an attempt is made to quantify the effects of the new varieties as a whole, without attributing these effects. At this point, suffice to say that the rice story in Indonesia, and the strong and close relationship that exists between AARD and IRRI, both indicate the sort of beneficial contribution that an IARC can make when collaborating with a strong, motivated and effective NARS.

Apart from the roles played by IRRI in terms of technology and training, many of the senior policy makers interviewed felt that IRRI had made a significant contribution to rice policy in the early 1970's by demonstrating the potential that existed in rice research. It was felt that an awareness of IRRI's early successes opened the eyes of Indonesian planners and policy makers to the horizons that could be reached in rice productivity and that this influenced the government in creating AARD and in supporting it so strongly. There is justifiable national pride in the increase that has taken place in rice production, and the important role played in this by IRRI is well recognised and openly acknowledged.

It is not yet possible to relate a similar story for any of the other eight CGIAR centres working in Indonesia, none of whom have very large programs. Given the sucess of IRRI, the attainment of a rice surplus in a difficult export market and the stagnation in production of most other food crops, plus the emphasis now being given to upland crops, the climate is now very favourable for a greater involvement of other centres. In the interviews carried out for this report the need for this was frequently expressed. This need was allied with a comment on the nature of the relationship that AARD is now seeking with the IARCs.

The evolution of manpower and facilities over the last decade has led to AARD becoming a much larger and very different organisation than what it was a few years ago. The nature of the dynamic changes that have taken place has led to a new form of relationship with IRRI, in which, rather than AARD 'cooperating' in IRRI's program, IRRI 'collaborates' with AARD's program. This is important in that it means that AARD is a full partner in the work and IRRI's program in Indonesia is based on priorities defined by the NARS. AARD does not yet have this type of relationship with the other IARCs (other than, perhaps, ISNAR). Many scientists feel that some of the IARCs have not fully comprehended the changes that have taken place within AARD and which have increased its capacity and opened up new opportunities. They believe that there is no need to repeat the 20 year period of "cooperation" that they had with IRRI and that this could and should be short-circuited, especially with CIMMYT and ICRISAT, by moving quickly into the type of collaborative agreement they now have with IRRI.

These perceptions appear to have strongly influenced the answers given to the two Impact Study Questionnaires which were completed (to differing degrees) by nearly 60 persons. The sample interviewed was a mix of selected research leaders plus a random sample of scientists available on visits made to four of the six food crop research institutes and to the horticulture research institute. However, it included about 25% of the total scientists at the Ph.D. or M.Sc. levels involved in food or horticultural crop research.

A brief commentary on the findings of these surveys is of interest in assessing the perceptions that Indonesian agricultural specialists have about the IARCs and their value to Indonesia. The questions below were given to 33 AARD scientists in the food and horticultural food crop research institutes.

Q1. <u>What is your knowledge of the CGIAR system?</u>:

| | |
|---|---|
| None | 0 |
| Slight | 15 |
| Considerable | 17 |
| Very thorough | 1 |

Q2. <u>What is the level of IARC activity in your country?</u>:

| | |
|---|---|
| Dont Know | 0 |
| Inactive | 2 |
| Moderately Active | 28 |
| Very Active | 3 |

Q3. <u>In Indonesia which centres have been:</u>

| | MOST ACTIVE | | | MOST PRACTICAL USE | | MOST HELPFUL IN BUILDING RESEARCH CAPACITY | |
|---|---|---|---|---|---|---|---|
| FIRST | IRRI 29 | | | IRRI 27 | | IRRI 27 | |
| CHOICE | CIP 4 | | | CIP 4 | | CIP 3 | ISNAR 2 |
| | | | | CIMMYT 2 | | | |
| SECOND | ICRISAT 5 | IBPGR 2 | | IRRI 2 | ICRISAT 4 | IRRI 2 | ICRISAT 2 |
| CHOICE | CIP 1 | ISNAR 1 | | CIP 2 | | CIP 2 | ISNAR 2 |
| | CIMMYT 11 | IITA 1 | | CIMMYT 11 | IITA 2 | CIMMYT 8 | IITA 3 |
| THIRD | ICRISAT 1 | | | ICRISAT 2 | | ICRISAT 2 | |
| CHOICE | CIP 1 | ISNAR 4 | CIAT 1 | CIP 2 | CIAT 1 | ISNAR 1 | CIAT 1 |
| | CIMMYT 1 | IITA 1 | | CIMMYT 3 | IITA 1 | CIMMYT 6 | |

The overall perception of the respondants is that they do know quite a lot about the CG system and that it is fairly active in Indonesia. The answers, however, may be biased by regarding IRRI as "the system", although the responses to the third question do show that amongst the individuals interviewed were those with knowledge of all of the centres operating in Indonesia (apart from IFPRI) who have worked with the planning bureau of the ministry rather than with AARD. The survey is, however, not representative in that there was a bias in favour of rice in the persons interviewed, although some researchers working on maize, root crops and grain legumes were included as can be seen from the responses to the next question.

Q4. <u>List your contacts with the Centres:</u>

| | IRRI | CIP | CIMMYT | ICRISAT | ISNAR | IITA | IBPGR | CIAT |
|---|---|---|---|---|---|---|---|---|
| MOST CONTACT | 20 | 6 | 3 | 1 | 0 | 2 | 0 | 1 |
| SOME CONTACT | 4 | 0 | 6 | 6 | 2 | 4 | 1 | 1 |
| <u>NATURE OF CONTACT</u> | | | | | | | | |
| VISIT TO IARC | 21 | 5 | 4 | 3 | 0 | 3 | 1 | 1 |
| ATTENDED WORKSHOP | 19 | 4 | 3 | 1 | 0 | 1 | 0 | 1 |
| ATTENDED TRAINING | 12 | 3 | 0 | 0 | 0 | 1 | 0 | 0 |
| RECEIVE GERM PLASM | 20 | 7 | 4 | 4 | 0 | 3 | 1 | 1 |
| RECEIVE PUBLICATIONS | 23 | 7 | 5 | 6 | 1 | 3 | 1 | 1 |
| VISITS FROM STAFF | 24 | 8 | 11 | 5 | 7 | 8 | 2 | 4 |

If we average these figures between the 33 repondents, each one had received visits from the staff of 2.1 Centres, received publications from 1.4 Centres, germ plasm from 1.2 and had visited 1.1 Centres. But only 88% of them had attended workshops and under 50% had received training. It is difficult to interpret such figures from a random sample, even though it contained a number of AARD's most active research workers.

Q5. What is the importance of the IARCs to your work?

| | Importance | | | |
|---|---|---|---|---|
| | Minor | Some | Very | The Most Important |
| Attending workshops/conferences | 1 | 7 | 19 | 4 |
| Participating in training courses | | 3 | 15 | 8 |
| Receiving materials (germ plasm) | | 9 | 23 | 15 |
| Receiving publications | 1 | 10 | 21 | 2 |
| Visits by staff | 2 | 21 | 10 | 0 |
| Research methodology | 3 | 12 | 7 | 4 |

The final column in this last question was also put to the policy makers interviewed. Their answers were: training 15, germ plasm 4 and research methodology 4 (possibly a proxy for training). In addition, a number of them felt that IRRI had helped establish the credibility of agricultural research in the eyes of senior policy makers and that this had encouraged the Indonesian government to invest in research. In general, there was a tendency for the research leaders to regard "training", and research scientists "germ plasm", as the most important role of the IARCs. The lower priority given to IARC staff visits may be of interest to the centres, especially since the responses to Question 4 showed a high frequency of IARC staff visits.

These observations set the framework for the rest of this chapter and explain, in terms of both impact and perceptions, why the chapter is focussed so heavily on IRRI, about whose impact in Indonesia much has, and can, be said.

## 3.2 BIOLOGICAL MATERIALS

Joint research between Indonesia and IRRI has been in operation since 1972. Even before that time IRRI was using Indonesian germ plasm as a source for sturdy stems, erect leaves and plant vigour and a high percentage of the improved plant type varieties released by IRRI and other NARS in the 1960s and 1970s trace back to Indonesian parents.

The national program was considerably strengthened in 1975, after the creation of AARD, by the establishment of a national multidisciplinary varietal improvement program known as the Genetic Evaluation and Utilisation program (GEU). This was formed as a result of the need to coordinate breeding activities for better response to outbreaks of brown planthopper, (the carrier of ragged stunt and grassy stunt virus), that occured in the mid-1970s.

The GEU program now provides varieties for the more than 8 million ha of Indonesia's extremely diverse rice-growing environments. Because it is impossible to breed a single variety suitable for all environments, research goals were established for each major eco-system.

Indonesian rice scientists are capable of screening breeding lines for most of the characteristics to be incorporated into improved varieties. Due to a shortage of greenhouses and personnel, Indonesia has been assisted by IRRI in screening for brown planthopper and grassy stunt virus resistance, eating quality evaluation, and other information. Some cold-tolerance screening of Indonesian lines is done in Korea and the Philippines. Thailand has assisted in screening deepwater breeding material for elongation ability and submergence tolerance. In turn, Indonesia has reciprocated by screening materials from IRRI and other countries for rice tungro virus, blast, and gall midge.

The strong organisational foundation laid through the establishment of the GEU program has enablesd CRIFC to produce an extremely large amount of breeding material. In 1979, the program produced 711 crosses, 4,116 bulk hybrid populations, 91,472 pedigree nursery entries, 2,018 observational trial entries, and 501 replicated yield trial entries grown in varietal improvement nurseries.

An important component of the GEU program is its participation in the International Rice Testing Program (IRTP), which annually distributes about 20 uniform nurseries for growing in more than 50 countries. The participating countries and IRRI provide the entries for the nurseries. IRRI coordinates the preparation and distribution of seed from the nurseries to interested countries, summarizes the results, and reports them to the participating countries. The nurseries are divided into yield trials, observational trials, and stress screening trials (disease and insects, low temperature, drought, salinity-alkilinity, and other soil deficiencies or toxicities). Since 1976 Indonesia has annually grown an average of 9 yield trials, 9 observational trials and 20 stress screening trials (Table 3.1). Over the years more than 40 Indonesians engaged in the rice program have participated in the annual 4 month GEU training course at IRRI.

TABLE 3.1

INTERNATIONAL RICE TESTING PROGRAM NURSERIES GROWN IN INDONESIA, 1976-80

| | No. Grown | | | | |
|---|---|---|---|---|---|
| Nursery Type | 1976 | 1977 | 1978 | 1979 | 1980 |
| Yield trials | 6 | 9 | 9 | 7 | 12 |
| Observational trials | 8 | 9 | 10 | 6 | 12 |
| Stress screening Cold, drought, problem soils | 4 | 4 | 2 | 2 | 6 |
| Diseases, insects | 16 | 21 | 12 | 13 | 19 |
| TOTAL | 34 | 43 | 33 | 28 | 49 |

The fact that IRTP nurseries are grown in many countries each year gives country programs the benefit of varietal reactions to insects, and diseases and stress tolerances that would require several years' testing if each country had to depend only on its own facilities. Indonesia has entered more than 50 strains annually in IRTP nurseries for evaluation throughout the network. This has considerably reduced the number of years required for the evaluation of promising lines.

Indonesia has used several hundred IRTP entries as parents in the national breeding program. Many IRTP entries have also been evaluated for new variety potential and with good success. These included IR26, IR28, IR29, IR30, IR32, IR34, IR36, IR38, and IR42, all IRTP entries that were ultimately released as varieties in Indonesia.

Two paths have been concurrently followed in varietal improvement: (1) continued breeding of local varieties, and (2) the direct use of new IRRI varieties. IRRI lines/crosses were also used in Indonesian breeding programs. IR8 and IR5, renamed PB8 and PB5, were released in 1967. C-4-63 was also introduced from the Philippines in 1968 and released in 1969. In 1971, Pelita I-1 and I-2, selections from a cross between IR5 and national improved Syntha, were released.

Numerous other varieties in both categories were subsequently released by the government (Annex 1 Table 26). Except for Semeru, none of the varieties have exceeded the yield potential of IR5 and Pelita I-1 and I-2. The Indonesian varieties tend to be somewhat taller than the IRRI varieties. A principal advantage of the newer varieties is in disease resistance. The eating quality of the Indonesian varieties is much more apt to be rated 'good' than is the case of the IRRI varieties, where only IR54 and IR56 have earned this classification.

A principal factor influencing the introduction and diffusion of the new varieties is their resistance to the brown plant hopper (BPH). This pest was first recorded in 1854 but did not become a serious problem until the early 1970's when more intensive methods of production (heavier fertilization, elimination of fallow) created favourable conditions for its spread. As all varieties grown in Indonesia before 1975 were susceptible, new sources of resistance had to be found. This was done, but the process had to continue because new biotypes developed. Varieties involved were:

- Resistant to Biotype 1. PB26, PB28, PB30, PB34
  Brantus, Serayu, Citarum, Asahan.
- Resistant to Biotypes 1 and 2. PB32, PB36, PB38
  Semeru, Cisadane, Cimandiri, Ayung.

Biotype 2 appeared in the mid-1970's. Biotype 3 was noted in North Sumatra in 1983; IR(PB)56 was found to be resistant and was shipped in February 1983. Two Indonesian varieties have also been found to be resistant. To date, the successive waves of BPH biotypes have tended to limit the use of the traditional varieties. The result has been successive waves of modern varieties.

The overall area planted to the modern varieties of rice - including Indonesian varieties developed since 1968 and the IRRI varieties - has expanded sharply over time, as is shown in Annex 1 Table 27 and Figure 4. From 60 to 65 percent of the total modern rice area is grown in the wet season and 35 to 40 percent in the dry season; since 1975/76 the dry season proportion has been increasing slightly.

In terms of varietal breakdown, the situation has, as noted, changed sharply over the years. The most recent breakdown is summarised in Table 3.2.

TABLE 3.2

HIGH YIELDING RICE VARIETIES IN INDONESIA 1981-83

| Category | 1981 Dry | 1981/82 Wet | 1982 Dry | 1982/83 Wet |
|---|---|---|---|---|
| | Percent | | | |
| All PB(IR) varieties | 55.3 | 52.5 | 48.7 | 48.6 |
| - PB(IR)36 | (35.2) | (40.6) | (30.7) | (41.8) |
| All modern Indonesian varieties | 12.7 | 21.9 | 31.2 | 36.8 |
| - Cisadane | (5.4) | (11.3) | (15.1) | (19.4) |
| All modern varieties | 68.1 | 74.5 | 79.9 | 85.4 |
| Traditional varieties | 31.9 | 25.5 | 20.1 | 14.6 |
| Total | 100 | 100 | 100 | 100 |

The magnitude of the area planted to IR36 has been a source of some concern, but will probably decline as the importance of BPH biotype 3 increases and with it the use of PB56. The next most popular PB varieties are PB38 and PB42, but they cover a much smaller land area than PB36. Among the Indonesian varieties, Cisadane increased from 585,000 ha in the 1981/82 wet season to 812,000 ha in 1982/83.

With respect to crops other than rice, no biological material has yet been released as a result of germ plasm inputs from the IARCs (although three tomato varieties do have AVRDC parentage). Germ plasm from CIMMYT, CIAT, CIP, IITA and ICRISAT is currently being screened and evaluated by staff who have undergone training at these centres, but within the immediate future no new varieties with IARC parentage are anticipated for release. However, one CIMMYT maize gene pool appears very promising and could be the source of future releases.

## 3.3 IDEAS, TECHNIQUES, METHODS AND RESEARCH ORGANISATION

Although a multidisciplinary commodity research approach has been practiced in Indonesian transmigration programs since as long ago as the late 1950s, this type of approach has been strengthened and enhanced in the last decade through collaboration with the IARCs. Starting with rice in 1975, the food crop research institutes (and later the horticulture research institute which grew from them) have organised their work approach very much along the lines of the IARCs, with multidisciplinary national teams for each commodity. As yet, rice is the only commodity with an adequately staffed national team and even it lacks key personnel at some research institutes, but progress on staffing is being made in the maize, sorghum and grain legume programs and in some areas of industrial crops, livestock and fisheries.

A great deal of the methodology used is identical to that at the IARCs, but since much of this is standard internationally the only credit that the IARCs can take for this is the number of persons that they have trained. In the case of germ plasm evaluation, the IARCs have, in many instances, pioneered interna tional testing and evaluation programs and Indonesia has collaborated closely in these. Its own testing methods for cereals, grain legumes and root crops are closely allied to those of the relevant centres. The IARCs have been particularly active in bringing AARD into regional networks for rice, maize and potatoes, with AARD taking the lead in specific aspects of the IRTP disease and pest screening network and the CIP coordinated SAPPRAD network on tropical potato agronomy.

In 1983 AARD reorganised its system of research protocols, programing and reporting on a basis very similar to that used at many IARCs. Whilst this cannot be attributed to any specific IARC action, it appears as a likely invisible effect of the CG system in that those responsible for initiating this change were people who work extremely closely with the IARCs.

Four specific examples of IARC involvement in research organisation may be cited. These involve IRRI, ISNAR, IBPGR and IFPRI.

The first activity relates to the role played by a small team of IRRI scientists, based at Bogor for 12 years, in developing the methodology and organisation for cropping systems research. Their strategies for cropping intensification are simple technologies, conceptually easy to demonstrate, but sometimes difficult to implement in farmers' fields. Consequently, the cropping systems research in lowland rice producing areas has actively involved local government officials and extension personnel in the research processes. The introduction of BPH resistant and early maturing rice varieties served as the catalyst for more intensive rice production in these irrigated, and partially irrigated, areas. In addition to this, cropping systems research has been carried out in upland rice areas where food crop production is not as stable and profitable as rice production in the lowlands.

This cropping systems research has had considerable impact on research organisation and methodology including:

(1) The acceptance of a systems approach to research and to increasing agricultural output. This is demonstrated by the increasing demands made on CRIFC and AARD for their services in conducting cropping/farming sytems research throughout the country.

(2) The reorientation of commodity research goals. Feedback from cropping systems research activities has resulted in greater emphasis being placed on screening legumes for tolerance to low pH soils, corn for resistance to downy mildew, and upland rice for resistance/tolerance to blast and brown plant hopper etc.; and

(3) The creation of interdisciplinary research teams. As a consequence of the systems emphasis, research at CRIFC now involves teams of scientists trained in soils, entomology, breeding, agronomy, and economics. These teams jointly plan, conduct and evaluate AARD research throughout the country. Recently the traditional separation between CRIFC and the Centre for Soils Research has been broken down and both centres now work together on a number of major activities.

A second IARC activity in the field of organisation and management is the program of ISNAR. This centre's first involvement in Indonesia was in August 1981 when at AARD's request it provided a team of eight to carry out an in-depth review which made recommendations about AARD methods of setting priorities, organising and managing its programs, allocating resources and defining its needs for external support. In general the review was regarded by AARD as a success, although AARD felt that any future reviews of this type would need to be of longer duration and to include both external consultants and AARD staff in order to have a better feel for the background.

Following the review, AARD then requested ISNAR to assist in implementing its recommendations, in the first instance by helping to prepare NAR III, the next major stage of World Bank support. ISNAR did this, not through a traditional technical assistance role, but through working with AARD staff to strengthen their management capacity through the joint development of appropriate methodology. This was done through a series of quarterly visits which developed an iterative approach, which was then also used to prepare a loan proposal to the Asian Development Bank in horticulture, one of the areas highlighted for priority assistance by the ISNAR review.

The ISNAR review made a number of recommendations aimed at strengthening AARD's planning, monitoring and evaluation capacity, which were strongly supported by AARD's major donor, the World Bank, whose NAR II loan called for the establishment of an in-house monitoring and evaluation unit. In 1983 AARD asked ISNAR to assist in developing a methodology for use by such a unit through a program of applied research. AARD decided to evaluate its programs and activities over a three year period through nine sub-sector reviews carried out by joint teams of external consultants and AARD staff. It requested ISNAR to initially take a lead role in these reviews but to train AARD staff and gradually phase down its involvement so that by the end of the review period AARD had the internal capacity to carry out this task. Reviews of horticulture, palawija crops and fisheries were carried out in 1984 (see AARD 1984b, AARD 1984c).

Involvement in these evaluation reviews is not only enabling ISNAR to fulfil that part of its mandate that "helps national systems identify and make better use of other resources available from donors by helping national leaders identify their needs which might be met by external aid but, through involvement of donors and IARCs in the review process, ISNAR is also covering its mandate, "to serve an intermediary role in improving cooperation between NARS and IARCs".

The research program evaluation methodology is also part of the process of strengthening local management capacity. The degree of AARD research centre involvement in the reviews has progressively increased. The first review evaluated one of the weaker units of AARD and local inputs were limited. For the second review AARD mounted a much stronger team and this process was continued at the third. Both of the last two reviews also illustrated the growing capacity of the research units within AARD to use the information and data methodology which ISNAR has helped to develop, and ISNAR has now been asked to help prepare a follow-up system to ensure that the reveiw recommendations are being implemented. The major current problem in doing this is a shortage of staff in the AARD Secretariat which has overall responsibility within AARD for programming and evaluation.

The local office of the World Bank has specifically requested AARD to incorporate the continuation of the review process as a component of NAR III. USAID, AARD's other major donor, has had exploratory discussions with ISNAR about a 'Special Project' in which ISNAR would provide some research management training inputs in a new USAID loan which is expected to follow AARP in 1986.

In addition to its specific involvement in evaluation reviews, ISNAR's Training and Conference Program has been specifically involved in efforts to strengthen management skills by organising a new approach for the annual meeting of AARD senior staff in 1983. This focussed on management rather than on administration, as in previous meetings, and was the precursor of locally arranged meetings with a similar structure.

The third example of an IARC role in the general area of research organisation and methods is offered by IBPGR. The strong support given by this centre in the period 1977 to 1980 is regarded as having helped to establish local credibility for the National Committee for Plant Genetic Resources. This led to the Committee being granted adequate funds by GOI in Repelita III so that it has now become self sufficient. Since 1980 Indonesia has required little funding from the IBPGR, although it has continued to play an active role in regional networks.

The final example in this general field relates to IFPRI's work on rice policies in South East Asia. This regional project is highly regarded by those who are aware of it, although knowledge of the project and its output do not seem to be widespread. However, the responsibility for this may lie with the Indonesian counterparts who have yet to produce a completion report. The work done to date, and the results from IFPRI's work in the Philippines, have encouraged the Planning Bureau of the Ministry of Agriculture to seek IFRI participation in a follow-up project relating to investment policy in irrigation development. The local directors of the first IFPRI project felt that IFPRI had played an important role in training Indonesian planners in rationalising their approach to policy options in making difficult decisions about large-scale investments. IFPRI's professionalism and independence were regarded as important attributes in their work in Indonesia.

## 3.4 INFORMATION AND TRAINING

The responses to the questionnaire referred to in Section 3.1 of this report make it clear that training is regarded as one of the most important roles of the IARCs, particularly by the senior Ministry and AARD personnel interviewed, many of whom felt that it was the single most important contribution made by the IARCs to Indonesia.

Whilst the number of persons receiving advanced training at the centres (mainly IRRI but also IITA) is small in terms of the massive training programs now funded by IBRD, USAID and ADOTB, it is noteworthy that a significant number of the persons who are now the top research managers in AARD were trained at IRRI. These are the people who played a paramount role in the development of the new rice varieties which did so much to establish AARD's credibility in Indonesia.

During the course of the survey a number of interesting comments, criticisms and suggestions were made about IARC training programs. Many of these comments were based on the feeling that the IARCs need to consider evolving their information and training approaches to parallel the way in which IRRI's research approach has evolved to take account of AARD's changing manpower numbers and capability. Thus it was suggested that:

1. There should be a heavier stress on in-country training which can both involve more people and be more relevant to local conditions.
2. There should be less large workshop 'jamborees' and more short-term

individual visits to IARCs by AARD staff in order to better capitalize on their increasing degree of specialisation.

3. IARCs should provide more facilities for post-doctorals (but should not, as some do, use post-doctorals as technical assistants).
4. IARCs should consider a sabbatical visiting scientist program for NARS staff, possibly through exchange visits with an IARC staff member doing a sabbatical in the program of the NARS. This would help the NARS senior staff keep up to date and would increase the familiarity of the IARC staff with field problems.

In the information field it was observed that many relevant scientists never see IARC publications although these are highly regarded and widely distributed. There is a particular problem in finding IARC documentation at the working level and at institutes of stations located away from Bogor. This topic is discussed in more detail in the next section of this chapter.

## 3.5 RELATIONSHIP BETWEEN IARCS AND NARS

The earlier parts of this chapter have dealt with a number of aspects of IARC/NARS relationships, but have not covered all of the questions posed in the two questionnaires. Of these questions three, in particular, stimulated answers and comments that justify discussion.

1. Have the IARCs influenced national research policy or been in any way a drain on national resources?
2. Are there alternative agencies that duplicate the CGIAR IARCs?
3. How can the IARCs increase their effectiveness in the future?

### 3.5.1 Influence on Research Policies

There was a unanimous opinion expressed that collaboration with the IARCs have not imposed additional burdens on the scarce national resources available for research. It was also agreed by all that the IARCs have not influenced funding allocations or relative emphasis between commodities nor have they influenced the overall organisation of research or research policies. There has been some influence on methodology, particularly with respect to farming systems, and an influence on the agro-sociological basis for orienting research, as well as an impact on the way funds have been allocated within commodity programs,but these have been indirect, through peer discussions, rather than by IARCs trying to directly influence policy. Overall the message was very clear that Indonesia feels that the IARCs (i.e. IRRI) have responded positively to Indonesia's agricultural goal (rice self-sufficiency) by providing what the country most needed, i.e. training, germ plasm, information and methodology.

### 3.5.2. Alternatives to the CGIAR IARCs

The role of the IARCs is regarded as unique. Technical assistance has been provided by personnel from multilateral agencies (FAO, IAEA, IBRD-NAR II) and bilateral projects (Dutch, U.S. Japanese, IDRC, ACIAR, ADAB etc.), and germ plasm has been obtained directly from other NARS such as those in India, Pakistan, Thailand and the Philipinnes. But these other contacts have lacked the long-term continuity and back-up provided by the IARCs, and their technical personnel sometimes lacks the research expertise of centre staff. However, some technical assistance staff on long-term assignment in Indonesia, particularly on some of the bilateral and multilateral projects, have made a major contribution to Indonesian research. Furthermore, their agencies can often provide capital or operational funds for local research, which IARCs can rarely do. But overall, alternative agencies do not fill the slot into which the IARC fit. This is not unexpected since many of these agencies are themselves members of the CGIAR which funds the IARCs.

An exception to this generalisation is AVRDC which is well regarded in Indonesia. The many persons who mentioned AVRDC consider its mandate to be very important in Indonesia, want it to be more active and either think it is a CG centre or that it should be one. Most look upon it as a 'sister institute' of the CGIAR centers. A second 'centre' which was singled out for special mention was ACIAR whose grain legume (mainly groundnut and pigeon pea) initiatives in Indonesia in the past were noted as being "more vigorous than that of ICRISAT" although favourable comment was made of the fact that on a recent visit to Indonesia the ACIAR person concerned with the legume program was accompanied by a grain legume specialist from ICRISAT.

### 3.5.3 Increasing the Effectiveness of the IARCs

Both of the questionnaires conducted during the preparation of this report invited comments and criticisms of the existing CGIAR system, and most respondents completed these sections. The few impractical comments have been ignored and the rest are covered below in a narrative that attempts to emphasise the issues that were raised either by the most senior policy makers or were repeated by several people. As throughout this report, the attitude to the responses tends to be dominated by perceptions of IRRI as being "the system" and tends, perhaps, to overlook the GOI support for rice which gave IRRI such an excellent framework in which to work. This in no way decries the excellence of its work or the degree of local self confidence that it has helped to build, but it may mean that a somewhat optimistic attitude is being taken regarding the potential for other IARCs, given the human resources and infrastructural services that exist for crops other than rice, and the many conflicting demands for their services on all IARCs.

The predominant opinion expressed in answer to questions about the service provided by the IARCs was that it has been excellent but that all IARCs now need to follow IRRI's example and change their approach from a "cooperative" or "outreach" one to a "collaborative" one based on AARD's definition of its national priorities. With the emergence of what they now regard as a strong national system in Indonesia, AARD scientists feel that the role of the IARCs needs to move away from "promoting" outreach into "complementing" local capability.

In order to do this effectively and to take adequate cognizance of the changing rice situation in Indonesia, it was felt that there needed to be a greater input from commodity-oriented centres other than IRRI, particularly CIMMYT and ICRISAT. It was felt that AARD had been relatively neglected by these two centres in the past and, for example, there had been less CIMMYT activity and trainees in Indonesia than in Thailand or the Philippines, although Indonesia grew more maize than either of these two countries. In August 1984 the Head of AARD and the Director of CRIFC had the opportunity to visit CIMMYT and to express their concerns and their wishes for both a more active CIMMYT training program for Indonesians and for the participation of AARD in the International Wheat Testing Program. They were pleased with CIMMYT's positive response to both requests and anticipate much closer linkages in the future.

Much of the future growth in agricultural production in Indonesia will have to come from the 70% of its cultivated lands that are not irrigated, especially from upland and transmigration areas where soils are often poor (with water management a major problem), fertilizer efficiency is likely to be low and the infrastructure for supporting farmers is deficient. In such areas the only way that a satisfactory income can be generated, and the GOI's equity goals met, is by having multiple enterprise farms which practice a "system" involving a range of crops and trees, as well as livestock and fish, rather than the monoculture of the irrigated lowlands.

Many of the crops that are likely to be important in such "farming systems" in Indonesia are ones that are mandated to CGIAR centres. But to package the various commodities together in appropriate farming systems is a task that is likely to require a great deal of skill, cooperation and coordination. Currently various centres have "farming" or "cropping systems" programs but of these only that of IRRI is active in Indonesia. However, as the research on such systems moves further away from wetland rice areas, and rice becomes a less dominant crop in the newer areas, there will be increasing need for inputs from IARCs other than IRRI (from centres such as IBSRAM, IFDC and IMRI), and also for these efforts to be appropriately coordinated. Unless this is done there will be a risk of both duplication and of doing location-specific work that may not be cost-effective. But to get the IARCs to work together in a "collaborative" (the buzz word) systems approach will require some heroic methodology and very careful coordination. AARD does not believe that a NARS could do this and feels that the IARCs need to designate a coordinating centre, possibly ISNAR, possibly another, to undertake this task. But it needs doing without much delay.

Another subject that caused a great deal of discussion was the role of the non-commodity centres, IBPGR, IFPRI and ISNAR. With respect to IBPGR, it is felt that it has done an excellent job internationally but that there is a real danger that much of its past efforts will languish in underutilised collections unless a mechanism can be evolved for following up IBPGR's evaluation work. AARD, for example, has very limited experience on which to base the choice of crop germ plasm which it might use to open up the arid eastern parts of Indonesia. It has received material from ICARDA and wonders whether IBPGR has a role to play in assisting countries to get into new crops and to gain access to germ plasm from crops that are not mandated to IARCs. For example, could or should IBPGR be encouraging Indonesia to use material from any of the banana collections that it has assisted? These comments were offered in the positive vein of "Here is a centre that has done an excellent job. Can it now move into a second generation task", and not in any negative sense.

ISNAR's association with AARD has already been referred to. A feature of this about which AARD was very positive is the continuity of the link maintained mainly through a single person. It was suggested that for ISNAR to fulfil its difficult mandate it should focus on a limited number of countries in some depth. In this context, ISNAR's involvement in very small countries is questioned. It is felt that the impact of this centre would be maximised by focussing on countries with large populations and possibly using these as training grounds for passing research management experience and skills to smaller nations. To do this it might need to locate staff in countries where it had a major collaborative activity.

IFPRI's role was also considered to be one where there was a need for an IARC.

There were some concerns expressed within AARD about IFPRI working outside of AARD , which tends to be proud (and a little possessive) of its association with the CGIAR. Inter-institutional barriers can be quite rigid in Indonesia, even within the same ministry, and there would seem to be both a genuine desire within AARD, and a real value to that agency, for IFPRI to involve the AARD Centre for Agro-Economic Research (CAER) in whatever work it does in Indonesia. The CAER has a number of staff with new post-graduate qualifications who could benefit greatly from contact with IFPRI, and IFFPRI may need to be more sensitive to the views of AARD.

On the subject of management, the questionnaire elicited a few comments regarding IARC management. It was suggested that there should be a stronger developing-country NARS representation on IARC Quinquennial Reviews and it was also commented on by a number of people that the IARCs lose too much valuable time by being over-reviewed. The lack of a career structure within the CGIAR system was raised on several occasions. It was suggested that there should be more opportunities for NARS staff to actually conduct research at IARCs and some provision for this should be made in centre budgets. Concern was expressed about the varying levels of staff productivity at the IARCs, with some of them felt to be carrying 'passengers'.

The three most widespread suggestions for changes that needed to be made in the CG system (all of which have already been discussed) are:

(a) The need for other Centres to adopt the IRRI "collaborative" approach;
(b) The need for relatively greater IARC involvement in Indonesia on crops other than rice; and
(c) The need for a coordination of CGIAR and related IARC activities.

At the technical level, given the increasing competence of the NARS, some scientists feel that the level of IARC involvement in fertilizer and variety trials might be reduced, and that more emphasis should be given to producing early generation materials rather than advanced breeding lines or fixed varieties. But these are not universal views and are offered only as examples of the wide range of dialogue that took place.

There was, however, fairly widespread support for the view that commodity-oriented centres should increasingly emphasise tropical plant physiology and seed production in legumes. The former because it offers the chance to open new frontiers and the latter because the absence of enough legume seed is a major current contraint in Indonesia.

A number of questions were raised about IARC publications. The quality of these was highly praised but the distribution was not. It is recognised that the IARCs need to maintain an image with donors and national policy makers, but it is felt that sending them expensive and highly technical publications, which they have neither the time nor the expertise to read, while failing to get such publications to the research scientists who badly need them is not a satisfactory situation. The publication and contact lists sent to the writer by some centres supports this view, as does a look at the literature available in libraries and offices away from Bogor. The current system for disseminating IARC publications and newsletters in Indonesia does not seem to be either technically or cost effective and would seem to warrant re-examination.

Although the training programs, particularly those of IRRI, were universally praised, it was suggested that there was a need for more in-country training because of the big increase in staff of many NARs and the high costs of overseas training. For centres located outside of Asia, such as CIP, CIAT, IITA and CIMMYT, the regional training course appears to be a very acceptable alternative.

Apart from suggesting changes in the CG system that might be amenable to early implementation, a number of respondents commented on the long-term needs of the system. One of the more provocative replies was that "new rice technology was being adopted in Indonesia at a faster rate than it was being generated, and growth would soon plateau, so that unless some dynamic changes in thinking and approaches took place, IRRI would be obsolete (for Indonesia) in 10 to 20 years". Most respondents were not quite so blunt but all recognized the pace of recent change and many felt that whilst most IRRI activities should be maintained, there should be some cut-backs to provide funds for careful probing into newer, more basic and higher-risk areas, all of which NARS were not readily able to move into. Greater emphasis on plant physiology has already been mentioned. A lot of replies suggest stepping up the work on hybrid rice and almost every respondent mentions biotechnology, although none give a clear answer to the question as to whether IRRI had comparative advantages over developed country laboratories for doing this. There is, however, a genuine concern about developed country biotechnology being patented, and for this reason it is felt that IRRI and other IARC's should keep at the forefront of this new technology.

Given the progress made with rice, and the non-technical constraints which raise questions about the future of other food crops, some time was devoted to discussing other commodity options currently not covered by the CG system. The three areas of particular importance in Indonesia, especially from the standpoint of growth potential and equity considerations, and which are not covered by CGIAR activities, are, first, horticulture, then aquaculture and third coconuts. The point was repeatedly made that if there were inadequate funds for establishing new centres for these commodities, they might cost-effectively be added to existing centres. This would save on infrastructural costs and offer some staffing flexibilty.

Another option for change in the sytem would be to increase the level of post-harvest research carried out by the IARCs and to initiate product-utilisation research. The general feeling on this topic is that IARCs should not do processing work, although there would be considerable merit in their liaising more with centres of excellence in post-harvest utilisation. Support for such centres from without the CGIAR budgetary system should be encouraged.

# CHAPTER 4

# THE IMPACT OF AGRICULTURAL RESEARCH IN INDONESIA

## 4.1 RICE RESEARCH

Part of the increase in rice production has been due to an increase in the area under the crop. But more important has been the increase in yields from 1.74 MT of milled rice per hectare in 1973 to 2.62 MT/ha in 1983. Farmers have achieved these yield increases because they have been willing to adopt modern technology that has been developed and tested to a large extent by AARD, supported by government intensification programs, and disseminated through the extension system. Much of this increase in rice production may be attributed to improved varieties and more effective use of fertilizer (see Annex 1 Figures 4 & 5). But this explanation is too simple. First of all, the development of these technologies (such as new varieties and more effective use of fertilizer) are complex and involve expertise from several disciplines. Secondly, these technologies must be adaptable to field conditions and implemented on a large scale if they are significantly to affect national production. Consequently, considerable technical expertise is needed not only for the development of scientific innovations but also for their implementation and management.

One of the research strategies has been to develop high-yielding, intermediate amylose, and pest and disease-resistant varieties suitable for irrigated lowland; rainfed, high elevation, non-irrigated upland; and tidal swamps.

For irrigated lowlands, which make up about 53 percent of the rice area, the research strategy has been to develop varieties with strong seedling vigor, moderately high tillering ability, erect leaves, intermediate to short height (100-130 cm), resistance to lodging, 90-135 days maturity, intermediate threshability and responsiveness to 90-135 kg/ha of nitrogen. Since increased disease and pest problems have developed with intensified production, high priority is placed on developing resistance to bacterial leaf blight, grassy stunt, rice ragged stunt, tungro virus and brown plant hopper.

The strategy for the rainfed lowlands, which cover about 26 percent of the total rice land, is similar. But there are some important differences. Because the water supply is unreliable, weed problems are usually greater. Hence, varieties with moderately erect leaves and intermediate height are needed to shade out the weeds. Also, risks associated with uncertainty of water supply imply the need for varieties responsive to lower fertilizer rates (60-90 kg/ha of nitrogen), and drought and submergence tolerance. For dry seeded environments, early seedling vigor, early maturity, drought and submergence tolerance are especially important.

Non-irrigated upland rice amounts to 17 percent of the land planted in rice. Most of this area lies in Sumatra (42 percent), followed by Java, Bali and Kalimantan. The research strategy is similar to that for rainfed environments, except that varieties are needed with slightly drooping leaves to compete against weeds, responsive to 45-90 kg/ha of nitrogen, and resistant to blast disease. For the intensive cropping systems being developed, very early (90-105 days) varieties of moderate height (110-120 cm) that respond to nitrogenous fertilizers are required.

Indonesia has extensive areas of tidal swamp that can be developed for rice cultivation. Presently, only about 4 percent of the rice is in tidal swamp areas. About 55 percent of this is located in Kalimantan and 41 percent in Sumatra. Research strategy for this environment calls for developing varieties tolerant to low pH and acid sulphate soils, and submergence, drought, and salinity tolerance.

The development of new varieties is pursued through the genetic evaluation and utilisation program discussed in the last chapter. This involves screening and listing for yield, disease and insect resistance, environmental stress and eating and milling quality as has already been described. This program has led to the release of more than 50 new varieties since 1970 (Annex 1 Table 26) which now cover most of the rice lands, especially in the wetlands. Nevertheless, pests and diseases remain a continual problem, particularly BPH of which three biotypes have evolved. However, varieties resistant to each of these have been produced. Tungro virus is also a problem and has caused losses in IR36 and Cisadene, two widely planted varieties, although varieties with a higher level of tolerance are now being released.

Not many varieties of upland rice have been developed so far, since many promising lines are susceptible to blast. It is necessary that new varieties with resistance to different races of blast be systematically released and five such varieties were put out in 1983 and 1984. Several new varieties perform well under tidal swamp conditions; one from Thailand was released in 1981, a locally-based one in 1983 and another in 1984. All this reflects a dynamic research program constantly trying to keep one step ahead of the problems.

However, research is only one part of the story. Another is extension, for which AARD does not have responsibilty, this task being performed mainly by the Directorate Generals of food crops, fisheries etc. In order to foster closer linkages with the extension services of these agencies, AARD has established a communications unit in each research coordinating centre. It is responsible for assisting in the organization of training courses for extension workers, technical meetings, seminars and publication of technical bulletins and papers dealing with all aspects of agricultural production.

To further strengthen the linkages, extension subject matter specialists (PPS's) belonging to the five directorates general have access to selected research institutes, stations and farms as home bases. PPS's have the opportunity to interact directly with multidisciplinary research teams working at the research institutes and stations. At the same time, researchers are also able to contribute to problem solving in the field, assisting the provincial agricultural services in carrying out verification trials.

The research institutes periodically hold field days which are open to the public. A special effort is made to secure the attendance of key farmers, and provincial and local agricultural officers concerned with the commodities studied in the research institutes' programs. These field days provide the opportunity to demonstrate significant research findings in a field situation.

Regularly structured consultations between research institute staff and provincial agricultural officers provide the opportunity for a two-way flow of information on research results and current problems and needs in the area.
The production intensification programs including BIMAS, INMAS, INSUS, NESS, TRANSMIGRATION, etc. are all involved in extension work in the country and have effective linkages with agricultural research.

This is a considerable change from the situation a decade ago when the research effort was weak, and there was little information available to be communicated. This is reflected in Table 4.1 which shows the area covered by the BIMAS and INMAS programs from 1970 to 1983 with their steady build up in the INMAS (farmers own cash for purchasing inputs) area under HYV, fertilizer use and yields per ha. Both INMAS and BIMAS get their technical advice from staff of the Director General of Food Crops.

TABLE 4.1

PRODUCTION PROGRAM COVERAGE AND COMPLEMENTARY INPUT USE, 1970-83.
SOURCE: BIMAS OFFICE, PASAR MINGUU, AND BIRO PUSAT STATISTICS.

| Year[a] | Program Area (1,000 ha) | | | Urea[b] | Modern varieties[c] | Wetland yield[d] |
|---|---|---|---|---|---|---|
| | BIMAS | INMAS | TOTAL | (1,000 t) | (1,000 ha) | (t/ha) |
| 1970 | 1,235 | 849 | 2,084 | 342 | 1,072 | 2.6 |
| 1971 | 1,419 | 1,467 | 2,886 | 413 | 1,848 | 2.7 |
| 1972 | 1,243 | 2,020 | 3,263 | 485 | 2,279 | 2.7 |
| 1973 | 1,889 | 2,223 | 4,112 | 669 | 3,226 | 2.8 |
| 1974 | 2,996 | 1,094 | 4,090 | 604 | 3,244 | 2.9 |
| 1975 | 3,086 | 1,161 | 4,247 | 670 | 3,784 | 2.8 |
| 1976 | 2,974 | 1,500 | 4,474 | 666 | 4,151 | 3.0 |
| 1977 | 2,509 | 2,775 | 5,284 | 919 | 4,801 | 3.0 |
| 1978 | 2,235 | 3,348 | 5,583 | 975 | 5,216 | 3.2 |
| 1979 | 1,802 | 4,607 | 5,869 | 1,096 | 5,552 | 3.2 |
| 1980 | 1,374 | 4,142 | 5,516 | - | - | 3.6 |
| 1981 | 1,384 | 4,802 | 6,186 | - | - | 3.8 |
| 1982 | 1,296 | 5,047 | 6,343 | - | 6,537 | 4.0 |
| 1983 | 1,315 | 5,617 | 6,926 | - | 6,797 | 4.2 |

a/ Year includes wet and dry season data, i.e. 1970 includes data for 1969-70 wet season and 1970 dry season.
b/ Program farmers only.
c/ Wetland area including nonprogram hectares.
d/ Rainfed and irrigated paddies.

Apart from the rice program itself, an important start has been made in realising the potential for rice-based cropping systems in areas unsuitable for very intensive rice production in both wetlands and uplands.

A joint AARD-IRRI program has shown how cropping systems could be further intensified through use of earlier maturing crop varieties, use of gogo rancah (direct seeding of rice on aerobic soil, followed by flooding as the rains increase) in partially irrigated and rainfed areas, and reduction in turn-around time. Component research developed more appropriate fertilizer rates and methods of application, insect control measures and weed management.

The patterns of "lowland rice - lowland rice - legume" have been successfully and profitably grown in the fully and 7-9 months irrigation categories. A combination of gogo rancah rice and lowland rice in the pattern "gogo rancah -

lowland rice - cowpea" has permitted the production of three crops in one year, where previously only one crop was grown, in the areas which received only 5 months or no irrigation.

The adoption of this technology was slow from 1973-1977. The longer maturing Pelita varieties, which were vigorous and high-yielding varieties of good quality, were widely accepted by farmers. But because of maturity and tradition only one good crop could be grown per year in the partially irrigated and rainfed areas. Farmers were reluctant to change to earlier maturing varieties until they were forced to change during the brown plant hopper epidemic in 1977. The introduction and use of IR36, which has a field duration of only 90 days when tranplanted, removed much of the risk for intensifying cropping patterns. Consequently, after adoption of earlier maturing varieties, rice production has drastically increased because two crops can be grown with little risk in irrigated and partially irrigated areas. One good crop can be grown in the rainfed areas. Programs for production of legume crops after rice are being implemented. These include soybeans in the irrigated areas, mungbean in partially irrigated areas and cowpeas in the rainfed areas. The major constraint to widespread and rapid adoption is the availability of sufficient quantities of viable and vigorous seed of adapted varieties. The experience of the last few years is encouraging, although still small in scale (Table 4.2).

TABLE 4.2

ADOPTION OF GOGO RANCAH IN LAMPUNG. 1976-1983.

| Year | Nambahdadi | Way Seputih | Lampung |
|---|---|---|---|
| | hectares | | |
| 1976-77 | 0.1 | - | - |
| 1977-78 | 4.0 | - | - |
| 1978-79 | 30.0 | - | - |
| 1979-80 | 212.5 | - | - |
| 1980-81 | 262.0 | - | - |
| 1981-82* | 640.0 | 5,517 | 7,000 |
| 1982-83 ** | | 8,000 | 72,000 |

* INSUS program
** Target

Source: Siwi (1985)

Various authors have attempted to estimate the contribution of different factors to the growth in rice production in recent years. These have been reviewed in a report (World Bank, 1982) which suggests that 25% of the increase in production between 1968 and 1982 was due to area effects and 75% to yield increases. 16% of the production growth was attributed specifically to improvements in the quality of irrigation, about 4% to fertilizer and 5% to improved varieties (although in Java this effect accounted for 9% of the production growth). However, 75% of the yield was due to the interaction or joint efforts of fertilizer, irrigation and HYV's. The major impact of the HYV's was not really felt until the late 1970's and an unpublished USAID (Jakarta) study covering the period 1976-81 attributes 13.5% of the growth in yield during this period to new varieties. This same study, by assuming a five year lag between research investment and returns, calculates an internal rate of return of more than 60% for investment in rice research between 1974 and 1979. Whilst five years may be too short a time span for this type of analysis, it must be borne in mind that AARD breeding work started with selected material (and IRRI's input to this has not been costed) and also that production in 1984 was 14% higher than in 1981. If a ten-year horizon is placed on the time lag, and 1983 production is related back to research in the early and mid-1970's, the rate of return (even including a generous allocation for IRRI costs) would probably be much higher. Clearly there has been a very high return to investment in rice research in Indonesia.

## 4.2 RESEARCH ON CROPS OTHER THAN RICE

Apart from rice, the best documented changes in production over recent years are in the food crop area, particularly maize, where new varieties and cultural practices (AARD 1984c) have helped raise average yields from 1.08 MT.ha in 1973 to 1.70 MT/ha in 1983, an increase of 4.6% a year. This, in turn, has resulted in an average increase of 149,000 MT 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 new 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 MT/ha, depending on the variety used. Such yields are well in excess of the Repelita IV 1988 target of 2.0 MT/ha.

The main constraint to yield increases is the low profitablity 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 a 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 planting 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. 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 in Repelita IV than in Repelita III, providing that adequate quality seed can be produced and market prices do not become less attractive.

Sorghum, although a minor crop, 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 constraints 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 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 problem that exists in the supply of adequate seed, these figures are encouraging.

Although the uptake of AARD's cropping systems research is not yet widespread, it is starting to have an impact. Two examples of this involving soybean are:

1. In North Aceh, paddy rice is grown only once a year and the fields are left fallow until the following rainy season. There are about one million ha of lowlands under this condition, with an average farm size just over 1 ha. The introduction of zero-tillage (after experimentation) has led to an increase in the soybean planted area from less than 10,000 ha in 1981 to more than 40,000 ha in 1984, and a doubling of the corn area. Zero-tillage techniques reduced the cost of production by about US$ 70 per ha and increased the yield of soybean from 1 to 2 MT/ha and corn from 2 to 3 MT/ha. These zero-tillage upland crops were planted after lowland (unirrigated) rice.

2. The Sitiung area in West Sumatra is characterised by marginal soils with low pH, poor nutrients and low organic matter contents. Average farm size is again just over 1 ha. The introduction of lime and fertilizer (P) increased the yield of corn from 0.5 to 4 MT/ha. The same inputs plus Rhizobium increased the yield of soybean from 0.4 to 1.6 MT/ha. To date only 800 ha have benefited from the new technology but even this is significant in a transmigration community.

These technologies improved farmers' incomes from US$ 1,200 to US$ 1,780 in Aceh and from US$ 900 to US$ 1,470 in Sitiung. These incomes could be further improved if farmers cultivated more land and had supplemental farm equipment. To further extend these technologies, better seed availability and reliable market outlets are also required. But a start has been made and with a strong government committment to developing these types of areas, the future impact of cropping systems research looks promising.

Newly introduced mungbean varieties are also having an impact through the increased area planted to the crop (193,000 ha in 1978, 267,00 ha in 1983), the increased yields 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 required previously. The early maturity (58 days) of the new varieties 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 Jatiluhur 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 should enhance their adoption. Groundnuts also respond to lime when grown on the red-yellow podzolic soils of Sumatra. Research has demonstrated that yields of 2.5 MT per hectare are possible with liming, whereas average national yields are only 470 kg.

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 where the plantations' own factories offer an assured market. Overall, however, the uptake of newer root crop technology has been constrained by market and price factors, and adoption rates could continue to be sluggish if progress cannot be made on these fronts.

In horticulture a number of new varieties, especially potatoes and tomatoes, have been released, most of them from imported seed, but it is not possible to quantify their impact. The same comment applies to most commodities outside the food crop sector, although this study has not attempted to look in any depth at non-food crops. The greatest observable growth has been in oil palm where a doubling of area in the 1970's and the introduction of new hybrids in 1976 has led to a growth rate in output of over 12% p.a. This and other early results of AARD's work are well described in a publication which celebrated AARD's first five years (AARD 1981).

In livestock and fisheries the marine capture has increased through the use of bigger boats and better equipment, and poultry meat production has increased through the expansion of the modern, western-type, intensive poultry industry and through the use of better vaccines, but the wider use of better husbandry practices makes it difficult to quantify the impact of research per se.

## 4.3 THE IMPACT ON HUMAN NUTRITION

It is difficult to analyse the effects of changes in agricultural production on human nutrition in Indonesia because there are considerable differences in consumption patterns by region, by urban or rural residence, by season and by income group. Aggregation of data hides important variations, although disaggregation provides a confusing mass of numbers, patterns and exceptions. Any comments must, therefore, be very general.

Nevertheless, it can be stated that, in the country as a whole, about 98% of the energy and 90% of the protein intake is based on plants, principally rice, corn, cassava and sweet potato. Of the data for these crops, that for rice is the most reliable, and this is important both because rice provides around 50% of the total energy and 50% of the protein intake. Furthermore, per capita rice availability has increased overall from 104 kg in 1968 through 117 kg in 1976 to 148 kg in 1983.

The significance of this, in nutritional terms, has to be interpreted with care because the available evidence (Dixon 1982) suggests that overall national calorie intake was more than sufficient, and protein intake adequate, in 1978. Aggregate figures are, however, misleading in terms of income groups and a 1976 survey showed that even though the lower income groups spent 75% of their income on food, the energy and protein intakes for the lowest 40% of the population were below the recommended FAO/WHO levels.

In terms of individual foods, data are available from a series of food balance sheets prepared from production estimates. Although the limitations of such FBS's, especially for crops other than rice, are well recognised they do provide a broad picture of consumption and capture major changes. The data over the last fifteen years (Table 4.3) show a steady trend of increase in average rice consumption with little change in corn and sweet potato and fluctuations in cassava. Regional studies show that the increase in rice intake has fluctuated around a rising trend but has taken place both on and off Java and in both urban and rural areas.

TABLE 4.3

AVERAGE NATIONAL ENERGY INTAKE FROM STAPLE FOODS IN DIFFERENT YEARS

Kilocalories

| Crop | 1968/70(%) | 1971/73(%) | 1975/78(%) | 1979/80(%) |
|---|---|---|---|---|
| Rice | 1040 (53) | 1117 (55) | 1190 (52) | 1290 (51) |
| Corn | 206 (11) | 200 (10) | 209 (9) | 228 (9) |
| Cassava | 154 (8) | 137 (7) | 192 (8) | 187 (7) |
| Sweet Potato | 47 (2) | 43 (2) | 41 (2) | 49 (2) |
| Total | 1447 (74) | 1497 (74) | 1632 (72) | 1754 (70) |
| Total Calories | 1953 (100) | 2018 (100) | 2278 (100) | 2506 (100) |

Source: Central Bureau of Statistics Food Balance Sheets and FAO FBS 1975-1977

Note that the same agency publishes a set of population consumption expenditure (SUSENAS) data which show lower intake levels for palawija crops and an overall energy intake level that was lower in 1975/78 than in the above table. Dixon (1982) attributes the error in 1976 and 1978 to an underestimate of the population. However the 1979/80 data are based on the 1980 census and do not suffer from this error.

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When the consumption data were disaggregated in income terms, the rice consumption of the poorer half of the population was shown to have risen between 1970 and 1976. More recent detailed data on income groups have not been found but given: the trend of 1970-76; the rising average per capita consumption of rice; the low energy intake of the poorer 40% of the population, as recently as 1976; the growth rate of the GDP; and an expenditure elasticity of 0.5 for rice (in the rural areas where most of the population lives), it is not unreasonable to expect that the energy intake of the lower income groups has risen further since 1976. In average national terms, the rise in the per capita availability of rice was only 5% between 1970 and 1976 but 27% between 1976 and 1983 when the full impact of the HYV's was felt. In 1976 rice contributed about 1200 calories and 22 grams of protein daily on a per capita national basis; by 1983 the increase in rice production should have contributed significantly towards improvement of the nutritional status of the lower income groups. Follow-up studies are, however, necessary to confirm this point. It should also be noted that the effects of increased rice intake are, to some degree, likely to be reduced by the fact that part of the new technology package has been the introduction of many compact small mills and this has led to the virtual elimination of hand pounding, as a result of which there is now less bran in the milled rice which is, therefore, of lower nutritional value than hitherto.

Another aspect of nutrition in relation to HYV's that needs mentioning is that of palatibility. Indonesian consumers prefer non-chalky translucent grains since chalkiness leads to the rice hardening after cooking and this makes the cold rice lunch of many labourers not very tasteful. Chalkiness is associated with immature grain. It is common in IR36 fertilized late in the growing period which stimulates new panicle development and leads to the harvesting of immature grain (especially now that harvesting is done with the sickle rather than the ani-ani). The chalkiness is further aggravated by the tendency to harvest many HYV's earlier because of their tendency to shatter. For this reason local varieties often fetch a higher price and tend to be consumed on-farm (one survey showed only 14% of traditional varieties, but 58% of HYV produced, as being marketed). However, the higher yields and better pest resistance of the HYV's has meant that their production increases farm income and for that reason they dominate the rice lands.

Apart from rice there are no significant changes or trends in production that relate to nutritional status other than a very small but consistent trend in higher animal protein intakes, mainly as a result of the marine fish catch increasing at a faster rate than the GDP.

## 4.4 THE IMPACT ON RURAL WOMEN

There have been several studies and comments on the effects of technological change in rice in Indonesia on the role of women. Stoler (1977) has drawn attention to the fact that one of the most rapid and widespread changes in Indonesia in recent years has been the replacement of traditional home pounding by rice hullers. The use of these reduces costs and, more important, preserves rice better than pounded rice, and this facilitates sale. Thus, although a few landowners still hire client women for daily pounding, hulling machines have almost completely replaced this labour. Rice pounding for a wage was formerly a major and regular source of income for women in poor households, with returns per hour comparable to those from harvesting. For women who do not cultivate enough rice even for subsistence, let alone enough to sell, the rice hullers, then, serverely limit employment opportunities. In recent years the necessity of seeking alternative sources of income has, on one hand, set off an influx of these women into local small-scale trade, and on the other, has increased the importance of their harvesting incomes.

This was important in that about 75% of households in Stoler's study had to meet their subsistence needs through sources other than the cultivation of rice. This was done through a variety of different activities. But planting and harvesting rice, the most labour intensive of all agricultural activities, was traditionally the role of women and required three times as much effort per land unit as did land preparation which was predominately a male activity. For women in poor households rice harvesting was the most productive source of income and was one of the primary means of supporting their families. During the harvesting season many of the women temporarily stopped trading and men even took over part of the womens' non-farm work, such as child care and cooking. This situation has been influenced by the introduction of high-yielding rice varieties and technology changes.

For example, rotary and toothed weeders have been introduced and their spread has displaced women workers. The new weeders tend to be used by men and eight man-days using a weeder displace 20 woman-days of hand weeding (Collier 1981). There has also been a change in the traditional harvesting pattern in which women using a small knife, the ani-ani, cut individual stalks of rice. This was not a very efficient instrument and about 10% of the rice was left in the fields. But harvesting was a social custom deeply embedded in the cultural traditions and any woman in the community had the right to join in harvests in her village and to claim her share in kind. In recent years population increases have led to a large number of landless labourers moving from village to village for the harvest. This has put unacceptable pressures on the traditional system, and in combination with the need for land-owners to adopt a more commercial attitude to harvesting in order to repay the higher costs of inputs associated with the HYV's, has led to the need for a more efficient, harvesting system. This has been achieved through the use of the hand sickle to replace the ani-ani. Gangs of men are now hired by middlemen to carry out harvesting and little rice is left in the field. The new harvesting method has enabled the employment pattern to be changed. Harvesting is more efficient, but female employment has been reduced, particularly that for landless women who relied on rice harvesting for a major part of their income. However, these women are versatile in that they also derive income from trade and handicrafts, so a loss of harvesting income is leading to alternate income generating activities.

The implications of this for household income as a whole are not known. However, the point is very clear that new agricultural technology can and does affect men and women in different ways, especially in a culture in which different tasks are normally carried out by women and men.

## 4.5 THE IMPACT ON EMPLOYMENT AND EQUITY

A guaranteed floor price for rice linked to the cost of production from subsidised inputs has certainly meant that farm incomes have risen alongside higher rice yields, especially on those farms able to utilise the HYV's. This does not, however, seem to have been reflected in real wages paid to landless labourers and marginal farmers for their hired labour in agriculture. Although these wages have, in the last few years, begun to rise, halting the decline observed in the early 1970's (Collier et al 1982), the new technology has not led to a great deal of employment generation in agriculture. Indeed, as has been seen in the last section of this chapter, some technological changes have been labour displacing. For example, a hectare of rice cut with the sickle utilises only 75 man-days as opposed to 200 days when cut with the ani-ani. Likewise the introduction of small mills has deprived rural women of the opportunity to work in pounding rice.

In spite of the extra work entailed in the new technology and in handling the larger tonnage of rice produced, agricultural employment grew only at 1.0% p.a. in Indonesia in the 1970's as opposed to 1.4% in the 1960's. The slow growth is even more striking in Java where the figures were only 0.9% and 0.5% respectively, only half of that of the rest of the country in the 1970s (World Bank 1983). Since the new rice technology has had its major impact in Java, it would appear that its employment generating activities in agriculture, judged overall, are not very great. Given the size of the agricultural labour force in Java and the projected growth in total labour force of 2.6% p.a. in the 1980s, there are clearly considerable needs for employment generation. The prospects for this may lie more in developing agro-industries based on increased production than in the production itself.

A more prosperous agriculture has also generated more employment in other secondary and tertiary industries, and all of these, particularly construction and services, have had a good record in the rate of growth of employment (8.2 and 7.8% p.a. respectively) in the 1970's. Some of this is undoubtedly a spin-off from the new agricultural technology, as is apparent to anyone who has visited rural Java regularly over the past fifteen years and seen the improvements in housing and dress and the increased availablity of consumer items, all of which are very obvious.

The benefits of the new technology for equity have, however, been questioned not only in terms of the labour contract and mechanisation mentioned earlier, but also as a consequence of other factors. For example, new community level management techniques, such as synchronous planting, which can increase water use efficiency and pest control, often have associated with them consequences which affect equity adversely. Synchronised planting schedules mean that the poorest farmers cannot delay planting to supplement their incomes while working on larger farms. As has clearly been seen, there is also a tendency to displace females by males and to reduce labour's share in production and processing.

The new HYVs are scale neutral in terms of farm size but they do require cash inputs. The widespread participation in the INMAS scheme suggests that many farmers are finding these inputs, although the suggestion has been made that this may not apply to landless and near landless farmers who may now be worse off, particularly as a result of the breakdown in the traditional communal harvesting system (Soetrisno 1982).

## 4.6 INNOVATIONS WITH POTENTIAL IMPACT

A number of new varieties are in the pipeline and two new rice and two new maize varieties have already been identified for release in 1985 as well as one new soybean introduction from AVRDC. The latter could have a useful impact on production, especially if adequate seed supplies can be developed, because the market and price for soybean are both so strong.

Overall, no outstanding changes are anticipated until the late 1980s by which time it is hoped that AARD bred maize hybrids and IRRI based rice hybrids will be available for release. In the main, progress in the years immediately ahead is seen as being brought about by steady improvement in all crop yields, especially rice on newly opened swamp and upland areas, and by developing better farming systems in rainfed areas that will result in higher incomes, more varied and balanced diets and an even spread of labour requirements.

The massive build up in staff over the next decade (Table 2.3) is expected to materially contribute to the attainment of these goals. These staff will have access to excellent newly-constructed facilities and in a number of programs and institutes will be led by colleagues whose research ability has been proven in the rice program. This is particularly true for food crops, and an extremely strong animal science team has also been developed with ADAB support. In some of the other subsectors it will, however, be some years before the capability approaches that of crops or animals. Nevertheless, outside of rice, the existing yield levels are sufficiently low to offer excellent long term prospects for impact by a NARS as large and competent as AARD is in the process of becoming.

# CHAPTER 5

## CONCLUSIONS

Agriculture plays a dominant role in the economy of Indonesia and for the past fifteen years four objectives, sometimes contradictory, have dominated government thinking on agricultural development. The first has been the attainment of self-sufficiency in the production, of rice initially followed by other major food stuffs. The second has been the improvement of farm incomes from the equity standpoint. A third objective has been to provide urban consumers with rice at a 'reasonable' and relatively stable price. The final objective has been to control the producer and consumer subsidies necessary to meet the first three goals. The last goal has proved the hardest to achieve, although the first three have been met insofar as rice is concerned. This has entailed the provision by government of a set of supports for credit, inputs, land and water development, marketing and so forth, all of which have been discussed in some detail in this report. It has also entailed a consistent policy of strong support for meeting the above goals and one which has not wavered throughout the fifteen years.

An important component of government support has been the creation of a large multidisciplinary research agency which now has a professional staff of 1500, 200 research sites and an annual budget of over US$60 million. In parallel with this, the extension services have been strengthened and expanded to more than fifteen thousand persons. In collaboration with IRRI a massive effort has been applied to bring high technology to rice farmers, many of whom cultivate 0.5 ha or less. This effort has met with a very large measure of success given all the support measures offered by government, and yields, production and income have all increased, especially in the wetland environments. There are residual problems, particularly in keeping ahead of new pest biotypes, but in the main, until perhaps hybrid rice or new technology causes a quantum leap in rice yields, these may be expected to start to plateau on the wetlands.

This is not the case for upland and swamp rice where there is still considerable scope for improving yields. However, much of the upland area is not suitable for rice and will need to go under other crops. This need is not only ecological but is also relevant in terms of both income and equity, particularly for transmigrants who are often located in such areas. To resolve problems of agricultural production in these areas will require many of the types of support already provided for rice. Amongst them is a major research effort to determine the varieties and husbandry that are necessary to make agriculture viable and attractive in upland and swamp areas. There are no delusions in Indonesia about the difficulty of such a task, given the many technical and non-technical constraints which confront it. In examining the prospects for change in these non-rice areas, it is instructive to see what lessons can be learnt from the rice story, particularly the link with an IARC, since that is the theme of this report.

Five main interactions with IARCs were identified. The precursor of all others was the demonstration by IRRI in the 1960s that widely-adapted new rice technology could be developed and that agricultural research had a major role to play in national development. IRRI gave credibility to food crop research conducted in an Asian country, and the government of Indonesia took up the challenge and planned and established a NARS appropriate for the size and importance of agriculture in the country. At a more modest level IBPGR appear to have played a similar role in helping establish the credibility for germ plasm conservation and evaluation that led to the establishment of the National Committee for Plant Genetic Resources.

The second, and most important, interaction which took place throughout the 1970s was the role played in training AARD staff at all levels particularly M.Sc. and Ph.D. training at IRRI carried out in conjunction with the University of the Philippines at Los Banos. The more than fifty AARD staff, either with post-graduate qualifications or undertaking post-graduate degrees, who underwent training at IRRI, form the core of the research leadership in many AARD programs and institutes today. Only one IARC (IITA), apart from IRRI, was identified as providing this level of training for Indonesians.

Formal academic training is considered vital for the long-term strengthening of AARD and considerable funds for this, both local and overseas, are provided by various donor projects in Indonesia. In view of the impact that the IRRI-trained staff have had it is, perhaps, a little disappointing that few of the more than five hundred scientists who have been involved in AARD's post-graduate training program funded by IBRD and USAID appear to have done their post-graduate work at other IARCs.

Short-course training appears to be accepted as a useful training adjunct, especially in the early stages of commodity programs and nearly all IARCs have provided such training for AARD staff. A number of scientists favour such training being held regionally, rather than at the IARCs, where courses sometimes tend to cram too much into a short time.

There was also a fairly strong feeling in AARD that once a NARS had developed to a certain size and capacity the short term training of its staff should be in-country, so that local scientists could participate in its organisation, and participants could work on local problems under the supervision of national and international scientists.

To some degree this has been a permanent feature and a great strength of the IRRI approach. It has had staff in the field working alongside NARS personnel throughout the last twelve years. Furthermore, these IRRI staff have been able to maintain contact with ex-IRRI trainees after their return home, which is often the time when the traineees are most in need of guidance in terms of planning and formulating their research. This type of support appears to have been particularly valuable for IRRI's cropping systems research program. Both this and ISNAR's inputs have been important in strengthening research methodology, the former at the field level and the latter in terms of central management. ISNAR's impact might have been even greater had it had the same strong local counterpart support that IRRI has had as a result of some major training inputs in the early and mid 1970s.

Another frequently mentioned aspect of training related to the maturity of both the IARCs and the NARS. A number of senior AARD staff felt they would benefit from a period of further education in an IARC sufficient to complete a 'sabbatical' period of research. This would help them avoid professional isolation after they had been working in Indonesia for a period of years. They felt that the IARCs should consider this as a line item in their training programs. It was also suggested that with the development of large NARS such as AARD the IARCs should give more emphasis to outposting staff in the way that

IRRI had done in Indonesia. This two-way exchange of personnel was seen as another aspect of AARD's 'collaborative' philosophy.

The third most important interaction identified is the interchange of germ plasm. This interchange, which varies from program to program, is a function of the maturity of the research program, its capacity to manage early materials, the personal relationship between the staff of the IARC and the program, and the compatability of objectives in the two research groups. The interchange of genetic material may be evaluated by the development status, its quality and adaptability, or its quantity. It seems that there is a good adjustment between the IARCS and the respective programs in relation to the development status of the promising lines - those programs that have the capacity to manage early lines receive them but those that do not have it receive fewer, more advanced, lines. The quality and adaptability of the material is related mainly to the regional location of the IARC program and the compatibility of its objectives with the needs of Indonesia. Materials coming from IARCs located outside of Asia are less likely to succeed, while materials developed within a regional program have a better chance. This is, however, not always recognised by the AARD scientists who sometimes tend to base their expectations from all germ plasm on what they receive from IRRI, with its rather longer established and stronger Asian program than that of most IARCs. There is also a feeling in some programs that the results from material sent to them for evaluation may be of more interest to the IARC than to the NARS. This argument is one that features prominently in the felt need for other centres to adjust their approach to the 'collaborative' one of IRRI which takes account of national goals. However, it has to be recognised that not all AARD programs are yet strong enought to be a partner in collaborative research, even if this is undoubtedly the approach that Indonesia wishes to pursue in the future, as and when it becomes practical.

The fourth interaction is the interchange of information. Most AARD scientists regard IARC publications as being of considerable value. The flow of technical and logistical information received by AARD varies from program to program, and is mainly determined by the degree of association between the IARC and the local researchers. In general there is a complaint that not enough information is being received by AARD scientists. Many of the publications, including technical ones, distributed by IARCs finish up on the bookshelves of administrators and remain unread. There is a particular lack of IARC reports and bulletins at research stations away from Bogor where if one copy is received, it is usually taken by the director. There would seem to be scope for the IARCs to relate their publication distribution more closely to client needs, since so many of their clients (and not only in Indonesia) are chronically short of up-to-date literature.

The final form of interaction is through the personal technical support given by IARC researchers to the national programs, which occurs through visits by IARC personnel to Indonesia. The value of this varies from program to program and depends on the degree of cooperation between the IARC and the local program. At one extreme is the international scientist who only visits to check on the development of his/her international nurseries, usually at harvest time, or the visitor from an IARC who is on a familiarisation tour. Both of these cases provide little support to the NARS but can be a drain on senior staff time. In contrast to this, AARD values highly the cases where international researchers make sustained efforts to keep in contact with a national. This could either be by locating in the country, as IRRI has done for a number of years, or by the same scientist visiting regularly (CIP, ISNAR), maybe several times a year, to provide continuity to his inputs. Such personnel are regarded as effective partners in the NARS. They understand the constraints and the culture and do not require lengthy familiarisation briefings before they can start to be productive.

Against this background of past experience, AARD feels that the IARCs have much to offer as the agency shifts its emphasis from rice to other cereals, grain legumes and root crops. Nevertheless, the growth in population implies that there will be a steady, if less spectacular, need for an increase in the production of rice. Thus, there is a felt need expressed by AARD to continue its close links with IRRI, especially in areas of potential new growth such as swamp and upland rice, and hybrid rice. At the same time, AARD is seeking new collaborative research arrangements with other IARCs, especially CIMMYT and ICRISAT and, to a lesser extent, CIP, CIAT and IITA. All of these centres have supplied germ plasm, advice and training in the past but only on a modest scale. AARD wishes these centres to capitalise on the potential which is now realisable in AARD's rapidly expanding manpower resources by developing more active 'collaborative' programs on the same pattern as that which now exists with IRRI (and CIMMYT has already started moves in this direction).

'Collaboration' implies that rather than AARD <u>cooperating</u> in the IARCs programs, the IARCs will <u>collaborate</u> in those parts of AARD's program where they posses expertise still lacking in AARD. It calls for a structured approach which optimises the comparative advantages of both partners with respect to resource utilisation. Such an approach was previously only possible with rice, but with ever increasing numbers of AARD staff returning from advanced training to join programs other than rice, AARD considers that it is now timely to broaden this approach to other programs and commodities. However, because of the emphasis that Indonesia is now giving to areas where farming systems, rather than monoculture, are the normal pattern of land use, there will need to be not only close collaboration between AARD and individual IARCs in this research, but also between the IARCs themselves in order to put together packages of appropriate component technologies for the many different ecosystems which exist in the country.

In addition to the problems that it faces with developing new component technology and packages of it, the success of the rice program and the rapid growth of AARD have confronted Indonesia with two problems in the areas of research policy and management. On the policy front it is necessary to define the optimum approach to developing the appropriate infrastructure for supporting the growth of crops other than rice, often on poor soils, in relatively isolated areas. With respect to research management, the problem lies in the fact that few of AARD's 500 scientists have prior management experience.

IFPRI is assisting in analysing the options which cover the policy issue and ISNAR in the strengthening of research management. There is considerable interest in Indonesia in these two IARCs as their current approach, in both instances, conforms with AARD's 'collaborative' concept, and the work that the two centres have done to date has been well received.

Within the framework of 'collaboration' there is very strong support for the IARCs in Indonesia. However, given the past and expected growth in AARD's trained manpower (42 post graduate degree staff in 1975, 397 today and a further 449 already undergoing training) it is envisaged that this collaboration will require a greater input from the IARCs in the future and also a very flexible approach in order to optimise their impact in this large NARS. The needs of the country, and the past performance of IRRI, (and to a lesser degree some other IARC's) have generated a great deal of local confidence that such a collaboration can be attained and for this reason there is very strong and positive support for the CGIAR system.

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ANNEX 1

TABLE 1

POPULATION DISTRIBUTION IN INDONESIA (1980)

| Islands/Main Groups | Land area % of Total | Population % of Total | Density Per Sq. Km. |
|---|---|---|---|
| Sumatra | 24.7 | 19.0 | 59 |
| Java and Madura | 6.9 | 61.9 | 690 |
| Bali and Nusatenggara | 4.6 | 5.8 | 96 |
| Kalimantan | 28.0 | 4.6 | 12 |
| Sulawesi | 9.8 | 7.1 | 55 |
| Moluccas | 4.0 | 1.0 | 19 |
| Irian Jaya | 22.0 | 0.8 | 3 |
| Indonesia | 100.0 | 100.0 | 77 |

Source: Census of Indonesia 1980.

TABLE 2

GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN AT CURRENT MARKET PRICE (1982)

| | Rp. Billion | % | % of Agriculture |
|---|---|---|---|
| AGRICULTURE | 15,668 | 26 | 100 |
| Food Crops | 9,961 | (17) | 63 |
| Non Food Crops | 1,227 | ( 2) | 8 |
| Estate Crops | 1,026 | ( 2) | 7 |
| Livestock | 1,418 | ( 2) | 9 |
| Forestry | 983 | ( 2) | 6 |
| Fisheries | 1,053 | ( 2) | 7 |
| MINNING/PETROLEUM | 11,708 | 20 | |
| MANUFACTURING | 7,681 | 13 | |
| UTILITIES | 380 | 1 | |
| CONSTRUCTION | 3,507 | 6 | |
| COMMERCE | 8,865 | 15 | |
| TRANSPORT/COMMUNICATIONS | 2,795 | 5 | |
| BANKING | 1,604 | 3 | |
| RENTS | 1,703 | 3 | |
| PUBLIC ADMIN AND DEFENSE | 4,429 | 7 | |
| SERVICES | 1,293 | 2 | |
| GDP | 59,633 | 100 | |

Source: Statistical Year Book of Indonesia 1983.

TABLE 3

AGRICULTURAL TRADE (1982)

US $ m

| | IMPORTS | EXPORTS |
|---|---|---|
| ALL TRADE | 16,859 | 22,328 |
| AGRICULTURE | 1,211 (9%) | 3,287 (15%) |

KEY AGRICULTURAL ITEMS

| | IMPORTS | | EXPORTS |
|---|---|---|---|
| Sugar | 426 | Forestry Products | 630 |
| Wheat | 284 | Rubber | 602 |
| Rice | 103 | Coffee | 342 |
| Other Foods * | 51 | Shrimp | 181 |
| 'Others'* | 347 | Palm Oil | 97 |
| | | Tea | 90 |
| | | Pepper | 45 |
| | | Tobacco | 38 |
| | | Copra | 36 |
| | | Cassava | 16 |
| | | Others | 1226 |

* Note: These figures include over US$100 of Soybean and its cake

Source: Statistical Yearbook of Indonesia 1983.

TABLE 4

SUMMARY OF GOVERNMENT
INCOME AND EXPENDITURE IN REPELITA III

Rp. billion

| REVENUE | 1978/79 | 1979/80 | 1980/81 | 1981/82 | 1982/83 |
|---|---|---|---|---|---|
| Domestic | 4266 | 6697 | 10227 | 12213 | 12418 |
| External Aid | 1036 | 1381 | 1494 | 1709 | 1940 |
| Total Revenues | 5302 | 8078 | 11721 | 13922 | 14358 |
| EXPENDITURE | | | | | |
| Routine Budget | 2744 | 4062 | 5800 | 6978 | 6996 |
| Development Budget | 2556 | 4014 | 5916 | 6940 | 7360 |
| | 5300 | 8076 | 11716 | 13918 | 14356 |

Source: Statistical Yearbook of Indonesia 1983

TABLE 5

SECTORAL DEVELOPMENT BUDGETS IN REPELITA III AND IV (PROJECTED)

(Billions of Rupiah)

| Code Number | Sector | Repelita III | (%) | Repelita IV | (%) |
|---|---|---|---|---|---|
| 1. | Agriculture and Irrigation | 3,049 | (14.0) | 10,014 | (12.7) |
| 2. | Industry | 1,174 | ( 5.4) | 4,282 | ( 5.4) |
| 3. | Mining and Energy | 2,944 | (13.5) | 12.126 | (15.4) |
| 4. | Communication and Tourism | 3,384 | (15.5) | 9,923 | (12.6) |
| 5. | Trade and Cooperatives | 192 | ( 0.9) | 969 | ( 1.2) |
| 6. | Manpower and Transmigration | 1,241 | ( 5.7) | 4,552 | ( 5.8) |
| 7. | Regional, Rural and Urban Development | 2,143 | ( 9.8) | 5,379 | ( 6.8) |
| 8. | Religion | 152 | ( 0.7) | 507 | ( 0.6) |
| 9. | Education, Youth, Culture, and Belief in the Almighty God | 2,277 | (10.4) | 11,539 | (14.7) |
| 10. | Health, Social Welfare, Role of Women, Population and Family Planning | 829 | ( 3.8) | 3,516 | ( 4.5) |
| 11. | Housing and Human Settlement | 532 | ( 2.4) | 2,981 | ( 3.8) |
| 12. | Law | 193 | ( 0.9) | 629 | ( 0.8) |
| 13. | National Defence and Security | 1,484 | ( 6.8) | 5,239 | ( 6.7) |
| 14. | Information, Press and Social Communication | 151 | ( 0.7) | 499 | ( 0.6) |
| 15. | Science, Technology and Research | 448 | ( 2.0) | 1,758 | ( 2.2) |
| 16. | State Apparatus | 580 | ( 2.6) | 1,047 | ( 1.3) |
| 17. | Development of Business Enterprises | 370 | ( 1.7) | 1,690 | ( 2.1) |
| 18. | Natural Resources and Environment | 707 | ( 3.2) | 1,959 | ( 2.5) |
| | Total | 21,849 | (100) | 78.609 | (100) |

Source: Repelita III and Repelita IV.

TABLE 6

ESTIMATED IGGI DONOR CONTRIBUTIONS TO INDONESIA

FY 83/84 - FY 84/85

(Millions US$)

| Bilateral Donors: | FY 83/84 | FY 84/85 |
|---|---|---|
| Australia | 40.7 | 39.8 |
| Belgium | 6.9 | 6.4 |
| Canada | 32.4 | 30.7 |
| France | 51.0 | 51.2 |
| Italy | - | 30.0 |
| Japan | 279.3 | 321.3 |
| Netherlands | 56.1 | 53.2 |
| Switzerland | - | 4.1 |
| United States | 106.5 | 115.0 |
| West Germany | - | 37.4 |
| U.K. | - | 5.9 |
| Bilateral sub-total: | 572.9 | 695.0 |
| **Multilateral Donors:** | | |
| Asian Development Bank | 400.0 | 500.0 |
| EEC | 16.0 | 14.0 |
| UNDP | 39.0 | 38.0 |
| UNICEF | 12.5 | 12.4 |
| World Bank | 1,200.0 | 1,200.0 |
| Multilateral sub-total: | 1,667.5 | 1,764.4 |
| TOTAL DONOR CONTRIBUTIONS: | 2,240.4 | 2,459.4 |

Source: USAID in Indonesia (1984)

TABLE 7

DISTRIBUTION OF PADI FARMS BY SIZE

1973 AGRICULTURAL CENSUS

| Farm Size (Ha) | No. of Farms (000) | % Total Area Harvested | % Total Number Farms |
|---|---|---|---|
| < .1 | 263 | < 1 | 2 |
| .1 - .5 | 4,358 | 17 | 40 |
| .5 - .75 | 1,807 | 13 | 17 |
| .75 - 1.0 | 1,086 | 10 | 10 |
| Under 1.0 | 7,277 | 40 | 69 |
| 1.0 - 2.0 | 2,085 | 27 | 19 |
| 2.0 - 3.0 | 684 | 13 | 6 |
| 3.0 - 4.0 | 264 | 6 | 2 |
| Over 4.0 | 382 | 14 | 4 |
| Total | 10,930 | 100 | 100 |

TABLE 8

NON FOOD (INDUSTRIAL AND ESTATE) CROP PRODUCTION [a]

(1982)

| | ESTATES | | | SMALLHOLDERS | |
|---|---|---|---|---|---|
| ESTATE CROPS | NO. | 000 Ha | MT | '000 Ha | MT |
| Rubber | 436 | 430 | 302 | 1996 | 549 |
| Palm Oil | 127 | 292 | 834 (Oil<br>149 (Kernel | 6 | 1.1<br>0.6 |
| Sugar Cane | 58 | 207 | 1609 | 134 | 1505 |
| Coffee | 133 | 43 | 20 | 730 | 245 |
| Tea | 101 | 63 | 74 | 47 | 18 |
| Tobacco | 41 | 15 | 11 | N/A | N/A |
| Cocoa | 78 | 24 | 13 | 16 | 1.5 |
| Cinchona | 17 | 4 | 1.5 | - | - |
| Ramie | 3 | 6 | 5 | - | - |
| INDUSTRIAL CROPS | | | | | |
| Coconut | | | | 2847 | 1711 |
| Clove | | | | 540 | 31 |
| Kapok | | | | 348 | 51 |
| Pepper | | | | 75 | 38 |
| Cassiavera | | | | 77 | 16 |
| Nutmeg | | | | 58 | 19 |
| Rosella | | | | 7.2 | 3.2 |
| Castar | | | | 1.2 | 0.2 |
| Citronella | | | | 7.0 | 0.8 |
| Vanilla | | | | 0.6 | 0.6 |
| Cotton | | | | N/A | N/A |
| | | 1085 | | 6890[b] | |

a) Source: Statistical Yearbook of Indonesia 1983

b) Much of this area is double cropped.

TABLE 9

**Luas panen, produksi, dan hasil rata-rata padi (gabah kering) di Indonesia, 1969-1983**

*Harvested area, production and average yield of dry unhusked rice in Indonesia, 1969-83*

| Tahun *Year* | Padi ladang *Dryland rice* Luas panen *Harvested area* (000 ha) | Padi ladang *Dryland rice* Produksi *Production* (000 t) | Padi ladang *Dryland rice* Hasil rata-rata *Average yield* (t/ha) | Padi sawah *Wetland rice* Luas panen *Harvested area* (000 ha) | Padi sawah *Wetland rice* Produksi *Production* (000 t) | Padi sawah *Wetland rice* Hasil rata-rata *Average yield* (t/ha) | Padi ladang + sawah *Dryland + wetland rice* Luas panen *Harvested area* (000 ha) | Padi ladang + sawah *Dryland + wetland rice* Produksi *Production* (000 t) | Padi ladang + sawah *Dryland + wetland rice* Hasil rata-rata *Average yield* (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| 1969 | 1 470 | 1 592 | 1,08 | 6 544 | 16 442 | 2,51 | 8 014 | 18 013 | 2,25 |
| 1970 | 1 456 | 1 622 | 1,11 | 6 679 | 17 702 | 2,65 | 8 135 | 19 324 | 2,38 |
| 1971 | 1 432 | 1 594 | 1,11 | 6 893 | 18 588 | 2,70 | 8 324 | 20 182 | 2,42 |
| 1972 | 1 311 | 1 497 | 1,14 | 6 673 | 18 070 | 2,71 | 7 983 | 19 567 | 2,45 |
| 1973 | 1 340 | 1 674 | 1,25 | 7 064 | 19 807 | 2,80 | 8 404 | 21 481 | 2,56 |
| 1974 | 1 168 | 1 411 | 1,21 | 7 340 | 21 053 | 2,87 | 8 509 | 22 464 | 2,64 |
| 1975 | 1 161 | 1 481 | 1,28 | 7 334 | 20 850 | 2,84 | 8 495 | 22 331 | 2,63 |
| 1976 | 1 139 | 1 449 | 1,27 | 7 229 | 21 852 | 3,07 | 8 368 | 23 301 | 2,78 |
| 1977 | 1 157 | 1 539 | 1,33 | 7 202 | 21 808 | 3,03 | 8 360 | 23 347 | 2,79 |
| 1978 | 1 231 | 1 599 | 1,30 | 7 698 | 24 172 | 3,14 | 8 929 | 25 772 | 2,89 |
| 1979 | 1 128 | 1 551 | 1,37 | 7 675 | 24 732 | 3,22 | 8 804 | 26 283 | 3,00 |
| 1980 | 1 181 | 1 659 | 1,41 | 7 824 | 27 993 | 3,58 | 9 005 | 29 652 | 3,29 |
| 1981 | 1 191 | 1 785 | 1,50 | 8 191 | 30 988 | 3,78 | 9 382 | 32 774 | 3,49 |
| 1982 | 1 116 | 1 808 | 1,62 | 7 873 | 31 775 | 4,04 | 8 988 | 33 583 | 3,74 |
| 1983* | 1 162 | 2 027 | 1,75 | 7 941 | 33 210 | 4,18 | 9 102 | 35 237 | 3.87 |

*Data sementara *Provisional data*

Lihat juga Tabel 2; Gambar 3, 4, 5/*See also Table 2; Figures 3, 4, 5*

Source: CRIFC

TABLE 10
***Milled rice production in Indonesia, 1964-83***

| Tahun *Year* | Produksi *Production* (000 t) Padi sawah *Wetland* | Padi gogo *Dryland* | Jumlah *Total* |
|---|---|---|---|
| **Sebelum Pelita I *Before Pelita I*** | | | |
| 1964 | 7 275 | 1145 | 8 420 |
| 1965 | 7 783 | 1094 | 8 877 |
| 1966 | 8 069 | 1270 | 9 339 |
| 1967 | 7 950 | 1047 | 9 047 |
| 1968 | 10 441 | 1225 | 11 667 |
| **Rata-rata *Average*** | **8 301** | **1158** | **9 459** |
| **Pelita I** | | | |
| 1969 | 11 167 | 1082 | 12 249 |
| 1970 | 12 037 | 1103 | 13 140 |
| 1971 | 12 640 | 1084 | 13 724 |
| 1972 | 12 169 | 1014 | 13 183 |
| 1973 | 13 469 | 1138 | 14 607 |
| **Rata-rata *Average*** | **12 296** | **1084** | **13 381** |
| **Pelita II** | | | |
| 1974 | 14 316 | 960 | 15 276 |
| 1975 | 14 178 | 1007 | 15 185 |
| 1976 | 14 859 | 986 | 15 845 |
| 1977 | 14 830 | 1046 | 15 876 |
| 1978 | 16 437 | 1087 | 17 524 |
| **Rata-rata *Average*** | **14924** | **1017** | **15 941** |
| **Pelita III** | | | |
| 1979 | 16 818 | 1054 | 17 872 |
| 1980 | 19 035 | 1128 | 20 163 |
| 1981 | 21 072 | 1214 | 22 286 |
| 1982 | 21 607 | 1229 | 22 836 |
| 1983* | 22 582 | 1378 | 23 961 |
| **Rata-rata *Average*** | **20 222** | **1201** | **21 395** |
| **Pelita IV Proyeksi *projection*** | | | |
| 1984 | | | 25 146 |
| 1985 | | | 26 430 |
| 1986 | | | 27 386 |
| 1987 | | | 28 367 |
| 1988 | | | 29 362 |
| **Rata-rata *Average*** | | | **27 338** |

*Data sementara *Provisional data*
Lihat juga Tabel 3; Gambar 3, 4, 5/*See also Table 3; Figures 3, 4, 5*

TABLE 11

RELATIVE IMPORTANCE OF

DIFFERENT AGRICULTURAL COMMODITIES (1981)[a)]

| | Value of Output billion Rp | % Agricultural GDP | '000 Ha of land |
|---|---|---|---|
| Wet land Rice | | | 8191 |
| Dry land Rice | | | 1191 |
| Rice | 4.600 | 33.7 | 9382 |
| Corn | 630 | 4.6 | 2955 |
| Cassava | 460 | 3.4 | 1388 |
| Sweet Potato | 100 | 0.7 | 275 |
| Grand nut | 210 | 1.5 | 508 |
| Soybean | 220 | 1.6 | 810 |
| Mung bean | 60 | 0.5 | 250 |
| Other annual crops | 270 | 2.0 | N/A |
| Fruits | 775 | 5.7 | 551 |
| Vegetables | 775 | 5.7 | 409 |
| Non food crops | 2.230 | 16.3 | 6000+ |
| Livestock | 1.257 | 9.2 | - |
| Fisheries | 912 | 6.7 | - |
| Forestry | 1.140 | 8.4 | N/A |
| | 13.642 | 100 | - [b)] |

a) Sources: Statistical Yearbook of Indonesia 1983 and AARD 1984 b and c

b) No total because much in final column is multiple cropped including much of the land in palawija crops and part of that in rice.

TABLE 12

CONSUMPTION OF FERTILISERS

1961 - 1982

Thousand Metric Tonnes

| Year | Nitrogen | Phosphate | Potash |
|---|---|---|---|
| 61 | 85 | 47 | 4 |
| 62 | 99 | 46 | 5 |
| 63 | 96 | 30 | 4 |
| 64 | 79 | 14 | 3 |
| 65 | 84 | 8 | 2 |
| 66 | 110 | 31 | 4 |
| 67 | 105 | 16 | 6 |
| 68 | 198 | 66 | 7 |
| 69 | 105 | 64 | 8 |
| 70 | 202 | 32 | 7 |
| 71 | 196 | 26 | 5 |
| 72 | 347 | 73 | 30 |
| 73 | 350 | 93 | 40 |
| 74 | 345 | 121 | 33 |
| 75 | 342 | 122 | 25 |
| 76 | 351 | 111 | 30 |
| 77 | 465 | 112 | 38 |
| 78 | 549 | 138 | 76 |
| 79 | 620 | 151 | 84 |
| 80 | 851 | 231 | 91 |
| 81 | 997 | 320 | 136 |
| 82 | 981 | 356 | 133 |

Source: Statistical Yearbook of Indonesia 1983.

TABLE 13

CONSUMPTION OF PESTICIDES

1975 - 1982

M.T.

| Year | Insecticides | Fungicides | Rodenticides | N.E.S. |
|---|---|---|---|---|
| 75 | 2464 | 3208 | 84 | 81 |
| 76 | 3432 | 1885 | 159 | 90 |
| 77 | 4260 | 998 | 113 | 41 |
| 78 | | | | |
| 79 | 4191 | 612 | 79 | 268 |
| 80 | 6389 | 464 | 78 | 363 |
| 81 | 8943 | 1273 | 110 | |
| 82 | 11089 | 93 | 94 | |

Source: Statistical Yearbook of Indonesia 1983.

TABLE 14

TRENDS IN IMPORTED AND ACTUAL RICE PRICES IN JAKARTA/a

| Year | Imported rice: FOB Bangkok (25% broken) | Imported rice: Cost to retail Jakarta/b | Actual Jakarta retail |
|---|---|---|---|
| | US$ per ton | | |
| 1970 | 125.3 | 148.64 | 112.4 |
| 1971 | 93.9 | 115.45 | 109.3 |
| 1972 | 103.6 | 127.45 | 119.0 |
| 1973 | 116.3 | 175.76 | 205.2 |
| 1974 | 493.2 | 558.69 | 242.2 |
| 1975 | 311.8 | 380.49 | 262.7 |
| 1976 | 222.3 | 263.37 | 209.6 |
| 1977 | 237.4 | 287.33 | 319.6 |
| 1978 | 327.9 | 382.22 | 318.8 |
| 1979 | 308.3 | 362.00 | 272.5 |
| 1980 | 403.9 | 466.40 | 319.0 |
| 1981 | 416.4 | 470.10 | 325.0/c |
| 1982 | 271.6 | 320.90 | 348.0/c |
| Projected | | | |
| 1985/d | 378.6 | 438.60 | (329.5)/e |
| 1990/d | 378.6 | 438.60 | (329.5)/e |

Source: World Bank 1982

/a Table taken from Mears, 1981 as modified by World Bank (1982). Rp converted at Rp. 415 = $1 until November 1978; 1979-1982 at Rp. 625 = $1. Figures for 1980 and thereafter estimated using regression analysis.

/b FOB Bangkok + freight + 10% to cover costs to Jakarta retailer. Figures for 1980 and thereafter estimated using regression analysis.

/c From Bank Indonesia, weekly report.

/d Figures in terms of constant 1982 dollars. Projections of Bangkok prices based on World Bank Commodity Price Projections.

/e Assumes no change in real price in terms of rupiah, but conversion at Rp 660 = $1.

TABLE 15

PRICE STRUCTURE FOR UREA AND TRIPLE SUPERPHOSPHATE 1982

| Fertilizer prices | (US$/ton) | (Rp/kg)/c |
|---|---|---|
| Urea | | |
| World export price, f.o.b. Europe | 185 | |
| Ex-factory price, Palembang/a | 198 | |
| Handling and distribution to retail level | +40 | |
| Transport to farm | +4 | |
| Farm-gate price (economic price) | 242 | 160 |
| (Financial farm-gate price)/b | (106) | (70) |
| Triple Super Phosphate (TSP) | | |
| World export pı ce, f.o.b. Florida | 160 | |
| Ocean freight and insurance | +60 | |
| Handling and distribution to retail level | +35 | |
| Transport to farm | +4 | |
| Farm-gate price (economic price) | 259 | 171 |
| (Financial farm-gate price)/b | (106) | (70) |

/a Urea is valued at ex-PUSRI factory, Palembang; IBRD world market price projections for bagged urea, f.o.b. Europe have been adjusted for Southeast Asia markets with a US$15 transport premium.

/b Producers may pay more or less depending on circumstances, e.g. location.

/c Assumes Rp 660 = US1.

TABLE 16

BUDGET COST OF FERTILIZER SUBSIDY (1981/82)

| | Quantity (000 tons) | Subsidy (Rp. billion) | Subsidy ($ million)/a |
|---|---|---|---|
| Domestically Produced | | | |
| Urea | 1,758 | 76,289 | 115.6 |
| TSP | 487 | 93,445 | 141.6 |
| Ammonium sulphate | 120 | 8,594 | 13.0 |
| Subtotal | 2,365 | 178,328 | 270.2 |
| Imported | | | |
| Urea | 200 | 27,633 | 41.9 |
| TSP | 150 | 20,724 | 31.4 |
| Ammonium sulphate | 100 | 10,296 | 15.6 |
| Potassium chloride | 50 | 6,824 | 10.3 |
| Subtotal | 500 | 65,477 | 99.2 |
| Total /b | 2,865 | 243,805 | 369.4 |

/a Converted at Rp 660 = $1

/b The fertilizer subsidy of about $500 million which is recorded in the GOI budget includes subsidies on pesticides, costs of BIMAS administration and seed subsidies.

Source: Ministry of Finance.

## TABLE 17

## INDEX NUMBERS OF PRICES

## PAID AND RECEIVED BY FARMERS

## 1976 - 1982

(1976 = 100)

| PRICES RECEIVED | 76 | 77 | 78 | 79 | 80 | 81 | 82 |
|---|---|---|---|---|---|---|---|
| All agricultural products | 100 | 114 | 122 | 143 | 164 | 178 | 201 |
| Crops | 100 | 114 | 123 | 144 | 166 | 180 | 206 |
| PRICES PAID | | | | | | | |
| All items incl. house hold | 100 | 107 | 113 | 131 | 155 | 176 | 195 |
| Production requisites | 100 | 105 | 110 | 118 | 136 | 152 | 167 |
| Fertilisers | 100 | 90 | 91 | 92 | 95 | 96 | 99 |
| Pesticides | 100 | 100 | 101 | 106 | 117 | 123 | 125 |
| Seed | 100 | 112 | 119 | 124 | 137 | 151 | 164 |

Source: FAO Production Yearbook 1983.

TABLE 18

AARD RESEARCH CENTERS, COORDINATING CENTERS/RESEARCH INSTITUTES THEIR LOCATIONS, MAJOR COMMODITIES AND AREAS RESEARCHED /1

| CENTER/RESEARCH COORDINATING CENTER/ RESEARCH INSTITUTE | MAJOR COMMODITIES AND AREA RESEARCHED |
|---|---|
| A. Center for Soil Research, Bogor, W. Java (CSR) | Soil management and utilization |
| B. Center for Agro-Economic Research, Bogor, W. Java (CAER) | Agricultural economics |
| C. Research Coordinating Center for Food Crops, Bogor, W. Java (CRIFC) | |
| 1. Research Institute for Food Crops, Bogor, W. Java (BORIF) | Pioneering research on food crops; commodity analysis |
| 2. Research Institute for Food Crops, Sukarami, W. Sumatra (SARIF) | Food crops, upland, wet climate, high elevation area |
| 3. Research Institute for Food Crops, Sukamandi, W. Java (SURIF) | Food crops, irrigated area |
| 4. Research Institute for Food Crops, Malang, E. Java (MARIF) | Food crops, special emphasis on palawija crops |
| 5. Research Institute for Food Crops, Banjarbaru, S. Kalimantan (BARIF) | Food crops in tidal land and swamp areas |
| 6. Research Institute for Food Crops, Maros, S. Sulawesi (MORIF) | Food crops in upland, dry climate area |
| D. Research Coordinating Center for Horticultural Crops, Jakarta (CRIHC) | |
| 1. Research Institute for Horticultural Crops, Lembang, W. Java (LERIH) | Vegetables or ornamentals |
| 2. Research Institute for Horticultural Crops, Solok, W. Sumatra (SORIH) | Fruits |

| CENTER/RESEARCH COORDINATING CENTER/ RESEARCH INSTITUTE | MAJOR COMMODITIES AND AREA RESEARCHED |
|---|---|
| E. Research Coordinating Center for Industrial Crops, Bogor, W. Java (CRIIC) | |
| 1. Research Institute for Spices and Medicinal Plants, Bogor, W. Java (BORII) | Cloves, pepper, other spices, and medicinal plants |
| 2. Research Institute for Tobacco and Fiber Crops, Malang, E. Java (MARII) | Tobacco, cotton, jute, kenaf, kapok and other fibers |
| 3. Research Institute for Coconuts, Manado, N. Sulawesi (MORII) | Coconuts |
| F. Research Coordinating Center for Animal Science, Bogor, W. Java (CRIAS) | |
| 1. Research Institute for Animal Production, Ciawi, W. Java (RIAP) | Animal production |
| 2. Research Institute for Veterinary Science, Bogor, W. Java (RIAD) | Animal disease |
| G. Research Coordinating Center for Fisheries, Jakarta (CRIFI) | |
| 1. Research Institute for Fresh Water Fisheries, Bogor, W. Java (BORIFI) | Fresh water fisheries |
| 2. Research Institute for Marine Fisheries, Jakarta (JARIFI) | Marine fisheries |
| 3. Research Institute for Brackish Water and Coastal Fisheries, Maros, S. Sulawesi (MORIFI) | Brackish water and coastal fisheries |

Cont.

TABLE 18 (continued)

| CENTER/RESEARCH COORDINATING CENTER/ RESEARCH INSTITUTE | MAJOR COMMODITIES AND AREA RESEARCHED |
|---|---|
| H. Board of Estate Crops Research Management | |
| 1. Research Institute for Estate Crops, Bogor, W. Java (BORIE) | Pioneering research on estate crops, commodity analysis |
| 2. Research Institute for Estate Crops, Sungei Putih, N. Sumatra (SPURIE) | Rubber |
| 3. Research Institute for Estate Crops, Sembawa, S. Sumatra (SERIE) | Smallholder rubber |
| 4. Research Institute for Estate Crops, Medan, N. Sumatra (MERIE) | Oil palm |
| 5. Research Institute for Estate Crops, Gambung, W. Java (GARIE) | Tea and cinchona |
| 6. Research Institute for Estate Crops, Jember, E. Java (JERIE) | Coffee and cocoa |
| 7. Research Institute for Estate Crops, Pasuruan, E. Java (PARIE) | Sugarcane |

/1 Research Station, Experimental Farms and Ponds associated with these Institutes are listed in Annex 2.

TABLE 19

NATIONAL EXPENDITURE ON AGRICULTURAL RESEARCH

(billion Rupiahs)

| | 1978/79 | 1979/80 | 1980/81 | 1981/82 | 1982/83 |
|---|---|---|---|---|---|
| TOTAL GOVERNMENT EXPENDITURE | | | | | |
| Routine Budget | 2744 | 4062 | 5800 | 6978 | 6996 |
| Development Budget | 1568 | 2698 | 4486 | 5276 | 5435 |
| External Aid | 987 | 1316 | 1430 | 1664 | 1925 |
| Total | 5300 | 8076 | 11716 | 13918 | 14356 |
| ALLOCATION TO AGRICULTURAL RESEARCH | | | | | |
| Routine | 3.3 | 3.6 | 5.5 | 7.4 | 8.1 |
| Development (including estates cess) | 11.7 | 13.5 | 20.3 | 23.1 | 28.7 |
| Total | 15.0 | 17.1 | 25.8 | 30.5 | 36.8 |
| AGRICULTURAL G.D.P | 6706 | 8996 | 11290 | 13642 | 15668 |
| AGRIC. RES AS % AGRIC GDP | 0.23 | 0.19 | 0.23 | 0.22 | 0.23 |

Source: Statistical Yearbook of Indonesia 1983 and AARD.

TABLE 20

AARD TOTAL BUDGET AND SOURCES 1974 - 1985

Million Rupiahs

| | Routine | Development | Estates | External | Total |
|---|---|---|---|---|---|
| 1974/1975 | 1,146 | 2,361 | 1,413 | 1,646 | 6,934 |
| 1975/1976 | 1,827 | 3,799 | 1,730 | 1,774 | 9,129 |
| 1976/1977 | 2,104 | 8,124* | - | 3,548 | 13,776 |
| 1977/1978 | 2,663 | 9,992* | - | 5,251 | 17,907 |
| 1978/1979 | 3,256 | 11,704* | - | 5,113 | 20,074 |
| 1979/1980 | 3,644 | 13,501* | - | 5,720 | 22,846 |
| 1980/1981 | 5,525 | 16,563 | 3,778 | 10,025 | 35,890 |
| 1981/1982 | 7,408 | 18,646 | 4,405 | 12,370 | 42,830 |
| 1982/1983 | 8,070 | 21,203 | 7,447 | 13,521 | 40,240 |
| 1983/1984 | 8,745 | 16,225** | 5,438 | 30,493 | 63,902 |
| 1984/1985 | 7,598 | 19,035** | 6,027 | 34,504 | 67,164 |
| Total | 41,986 | 139,177 | 30,639 | 124,235 | 345,737 |

* Includes estates crop cess in these years

** Includes research operations consignment from estates crop cess.

TABLE 21

AARD BUDGET BY INSTITUTE

1982/83

| Research Institute, Center of Office | Development budget | Routine budget | Total budget | Equivalent in million US$ |
|---|---|---|---|---|
| | -------- million Rp -------- | | | |
| AARD Headquarters/Secretariat | 60 | 1,208 | 1,253 | 1.82 |
| Agricultural Research Programming (3) | 50 | (2) | 50 | 0.07 |
| Data Processing | 350 | (2) | 350 | 0.51 |
| Library | 600 | 280 | 880 | 1.27 |
| Quarantine (4) | 600 | 824 | 1,424 | 2.06 |
| Research Centers: | | | | |
| Agro-Economics | 275 | (2) | 275 | 0.40 |
| Soils | 600 | 301 | 901 | 1.31 |
| Commodity Institutes: | | | | |
| Food Crops | 4,984 | 2,272 | 7,258 | 10.52 |
| Horticultural Crops (5) | | | | |
| Industrial Crops | 1,615 | 990 | 2,605 | 3.77 |
| Forestry (6) | 1,210 | 712 | 1,922 | 2.79 |
| Animal Husbandry | 2,450 | 746 | 3,196 | 4.63 |
| Fisheries | 1,990 | 736 | 2,726 | 3.95 |
| Estate Crops (1) | 1,375 | 0 | 1,375 | 1.99 |
| Intersectorial Programs | | | | |
| NAR II | 1,675 | 0 | 1,675 | 2.43 |
| AARP | 1,799 | 0 | 1,799 | 2.61 |
| Conservation/Ecology | 200 | 0 | 200 | 0.29 |
| Transmigration | 1,500 | 0 | 1,500 | 2.17 |
| Total | 21,335 | 8,070 | 29,405 | 42.60 |

(1) In addition to this figure Estate Crops received 9,568 million Rps. from PNP/PTP
(2) Included in Secretariat's budget
(3) Integrated with AARD Secretariat April 1, 1983
(4) Transferred from AARD to Sec. Gen of Agriculture April 1, 1983
(5) Established as a separate unit from Food Crops April 1, 1983
(6) Transferred from AARD to Ministry of Forestry April 1, 1983

Source: AARD

TABLE 22

PERMANENT RESEARCH STAFF OF AARD

April, 1984

| RESEARCH INSTITUTE, CENTER OR OFFICE | Ph.D. | M.Sc. | Sarjana | Total |
|---|---|---|---|---|
| Secretariat | 2 | 2 | 29 | 33 |
| Data Processing | 1 | 10 | 25 | 36 |
| Library | 1 | 1 | 23 | 25 |
| RESEARCH CENTERS | | | | |
| Agro Economics | 4 | 23 | 36 | 63 |
| Soil Sciences | 5 | 17 | 52 | 74 |
| Research Coordinating Center for Food Crops | 2 | 4 | 14 | 20 |
| Banjarbaru Research Institute for Food Crops | 1 | 2 | 29 | 32 |
| Bogor Research Institute for Food Crops | 13 | 35 | 88 | 136 |
| Malang Research Institute for Food Crops | 2 | 4 | 62 | 68 |
| Maros Research Institute for Food Crops | 3 | 12 | 49 | 64 |
| Sukamandi Research Institute for Food Crops | 7 | 12 | 38 | 57 |
| Sukarami Research Institute for Food Crops | 3 | 13 | 75 | 91 |
| Research Coordinating Center for Horticultural Crops | 2 | 1 | 10 | 13 |
| Lembang Research Institute for Horticultural Crops | 2 | 8 | 34 | 44 |
| Solok Research Institute for Horticultural Crops | 1 | 5 | 15 | 21 |
| Research Coordinating Center for Fisheries | 0 | 1 | 10 | 11 |
| Bogor Research Institute for Fisheries | 0 | 6 | 33 | 39 |
| Jakarta Research Institute for Fisheries | 2 | 8 | 60 | 70 |
| Maros Research Institute for Fisheries | 0 | 1 | 40 | 41 |
| Research Coordinating Center for Animal Husbandry | 0 | 4 | 13 | 17 |
| Ciawi Research Institute for Animal Production | 10 | 45 | 67 | 122 |
| Bogor Research Institute for Veterinary Science | 2 | 7 | 37 | 46 |

| RESEARCH INSTITUTE, CENTER OR OFFICE | Ph.D. | M.Sc. | Sarjana | Total |
|---|---|---|---|---|
| Research Coordinating Center for Industrial Crops | 2 | 1 | 5 | 8 |
| Malang Research Institute for Tobacco and Fiber Crops | 0 | 8 | 30 | 38 |
| Manado Research Institute for Coconut | 2 | 0 | 18 | 20 |
| Bogor Research Institute for Spices and Medicinal Plants | 2 | 13 | 71 | 86 |
| Management Board for Estate Crops Research | | | | |
| Bogor Research Institute for Estate Crops | 7 | 9 | 29 | 45 |
| Medan Research Institute for Estate Crops | 3 | 4 | 24 | 31 |
| Sungei Putih Research Institute for Estate Crops | 3 | 13 | 16 | 32 |
| Gambung Research Institute for Estate Crops | 2 | 1 | 14 | 17 |
| Jember Research Institute for Estate Crops | 2 | 2 | 16 | 20 |
| Pasuruan Research Institute for Estate Crops | 4 | 4 | 49 | 57 |
| Sembawa Research Institute for Estate Crops | 1 | 4 | 23 | 28 |
| T O T A L* | 91 | 280 | 1,134 | 1,505 |

*Of these totals, 169 Sarjanas and 1 M.Sc. were on honorary status.

TABLE 23

NON-BANK EXTERNAL SUPPORT FOR AARD SINCE ITS FORMATION

| LOCATION | PROJECT | DURATION | DONOR | GRANT/ LOAN | US$ m |
|---|---|---|---|---|---|
| AARD (General) | Applied Agricultural Research | 80 - 85 | U S A | G | 6.5 |
| | Applied Agricultural Research | 80 - 85 | U S A | L | 18.9 |
| | Agricultural Development Planning and Administration (Agro data processing) | 78 - 83 | U S A | L | 1.3 (26.7) |
| SOILS | Benchmark Soils | 77 - 83 | U S A | G | 0.4 |
| | Fertilizer Use | 82 - 85 | Australia | G | 1.6 |
| | Soil Research | 74 - 79 | Holland | G | 0.4 |
| | Soil - Zoning | 74 - 80 | Belgium | G | 0.8 |
| | Land Resources | 79 - 83 | FAO/UNDP | G | 2.1 |
| | Land Capability | 72 - 76 | FAO/UNDP | G | 1.2 |
| | Tropsoils Project | 82 - 86 | U S A | G | 5.4 (11.9) |
| FOOD CROPS | Sumatra Agricultural Research | 78 - 83 | U S A | G | 2.5 |
| | Agricultural Research | 72 - 82 | U S A | G | 2.96 |
| | Regional Rice Research | 72 - 82 | U S A | G | 1.1 |
| | Rice/Soybean/Corn | 74 - 77 | Holland | G | 1.1 |
| | Horticulture | 74 - 78 | Holland | G | 0.9 |
| | Secondary Crops (Malang) | 81 - 86 | Holland | G | 5.2 |
| | Sweet Potato | 80 - 81 | U K | G | 0.2 |
| | Food Legumes | 78 - 83 | Japan | G | 2.3 |
| | Food Crops | 71 - 78 | Japan | G | 1.5 |
| | Sumatra Agricultural Research | 78 - 84 | U S A | L | 7.0 |
| | Grain Handling and Storage | 77 - 79 | Australia/ ASEAN | G | 0.14 |
| | Tropical Agronomy for Potato (SAPPRAD) | 82 - 87 | Australia | G | 0.23 |
| | Tissue Culture for Virus free Potato | 82 - 84 | U S A | G | 0.15 |
| | Hybrid Rice Project | 82 - 84 | U S A | G | 0.55 (25.43) |

| LOCATION | PROJECT | DURATION | DONOR | GRANT/ LOAN | US$ m | |
|---|---|---|---|---|---|---|
| ANIMALS | Small Ruminant R & D | 80 - 84 | U S A | G | 2.5 | |
| | Animal Disease Research | 80 - 85 | Australia | G | 5.52 | |
| | Animal Production Center | 74 - 89 | Australia | G | 33.0 | |
| | Pasture & Fodder Crops | 82 - 87 | Australia | G | 6.3 | |
| | Animal Health | 78 | U K | G | 0.3 | |
| | Epidemiology Laboratory | 80 - 85 | U K | G | 1.1 | (48.72) |
| ESTATE CROPS/ INDUSTRIAL CROPS | General | 70 - 80 | Australia | G | 0.06 | |
| | Tea and Conchona | 78 - 81 | Holland | G | 1.8 | |
| | Pepper | 81 - 86 | Holland | G | 0.3 | |
| | Cloves | 75 - 83 | U K | G | 0.7 | |
| | Rubber and Oil Palm Research | 72 - 77 | FAO/UNDP | G | 0.2 | |
| | Coconut Research | 73 - 83 | FAO/UNDP | G | 2.4 | |
| | Rubber Research | 79 - 83 | Holland | G | 0.25 | |
| | Rubber Technology | 80 - 83 | Japan/ASEAN | G | 0.5 | (6.21) |
| FISHERIES | Post Harvest | 77 - 79 | U K | G | 0.2 | |
| | Mariculture | 79 - 81 | Japan | G | 2.5 | |
| | Fish Parasites | 76 - 79 | Canada | G | 0.2 | |
| | Inland Fisheries | 81 - 84 | IDRC/Canada | G | 0.25 | |
| | Fish Parasites (Phase II) | 83 - 86 | IDRC/Canada | G | 0.2 | (3.35) |
| FORESTRY | Saw Use | 80 - 83 | FAO/UNDP | G | 0.2 | (0.2) |
| | TOTAL | | | | 122.51 | |

TABLE 24

LONG TERM TECHNICAL ASSISTANCE TO AARD

April 1984

| RESEARCH INSTITUTE, CENTER OR OFFICE | RESIDENT SPECIALIST non-PhD | RESIDENT SPECIALIST PhD | HOME NATION |
|---|---|---|---|
| Secretariate | | | |
| USAID | 3 | 1 | America |
| World Bank | 2 | | Philippines |
| | | 2 | America |
| Center for Agricultural Data Processing (CADP) | 2 | 1 | America |
| National Library for | 1 | | Australia |
| Agricultural Sciences (NLAS) | 1 | | America |
| Center for Soil Research (CSR) | 1 | 2 | Australia |
| | | 1 | England |
| | 1 | | Bangladesh |
| | 1 | | Pakistan |
| | | 3 | America |
| Center for Agro-Economic | | 1 | America |
| Research (CAER) | | 1 | Malaysia |
| Research Coordinating Center | 1 | 10 | America |
| for Food Crops | | 1 | Colombia |
| | | 1 | India |
| | | 1 | Sri Lanka |
| | | 1 | Thailand |
| | | 6 | Japan |
| | 3 | | England |
| | | 2 | Philippines |
| | 2 | 5 | Netherlands |
| Research Coordinating Center | 19 | 11 | Australia |
| for Animal Science | | 2 | Netherlands |
| | | 1 | Canada |
| | | 2 | England |
| Research Coordinating Center | | 1 | France |
| for Fisheries | 3 | | Japan |
| | | 1 | America |
| | | 1 | Canada |
| Research Coordinating Center | | 1 | India |
| for Industrial Crops | | 3 | England |
| TOTAL | 40 | 62 | |

TABLE 25

IBPGR TRAINING COURSES

ATTENDED BY INDONESIAN SCIENTISTS

| SUBJECT | LOCATION | YEAR | INDONESIAN TRAINEES |
|---|---|---|---|
| Collection | Indonesia | 77 | 9 + 1 |
| | Indonesia | 78 | 3 |
| | Indonesia | 79 | 6 + 4 |
| | India | 80 | 1 |
| Conservation | Indonesia | 75 | 3 + 4 |
| Perennial Crops | | | |
| Coll./Cons. | Thailand | 80 | 3 |
| | Malaysia | 82 | 2 |
| Charact. and Eval. | Thailand | 83 | 3 |
| Eval. Root/Tubers | Philippines | 80 | 2 |
| | Philippines | 81 | 2 |
| Documentation | USA | 77 | 1 |
| | USA | 78 | 1 |
| | Philippines | 79 | 2 |
| Tissue Cultures | China | 81 | 1 |
| | Philippines | 81 | 1 |
| Seed Technology | UK | 78 | 1 |
| | UK | 81 | 2 |

TABLE 26

RICE VARIETIES RELEASED IN INDONESIA SINCE 1970

| Variety | Maturity Days | Year released |
|---|---|---|
| I. Lowland | | |
| Pelita I-1 | 135 | 1971 |
| Pelita I-2 | 135 | 1971 |
| Serayu | 135 | 1978 |
| Asahan | 135 | 1978 |
| Brantas | 135 | 1978 |
| Citarum | 135 | 1978 |
| Cisadane | 140 | 1980 |
| Cimandiri | 130 | 1980 |
| Ayung | 135 | 1980 |
| Cipunegara | 128 | 1981 |
| Krueng Aceh | 125 | 1981 |
| Barito[1/] | 135 | 1981 |
| Atomita 1 | 125 | 1982 |
| Atomita 2 | 125 | 1983 |
| Sadang | 125 | 1983 |
| Bahbolon | 125 | 1983 |
| Parang | 110 | 1983 |
| Bogowonto | 115 | 1983 |
| Lelara | 105 | 1983 |
| Citanduy | 120 | 1983 |
| Mahakam[1/] | 140 | 1983 |
| Kapuas [1/] | 125 | 1984 |
| Cikapundung | 115 | 1984 |
| II. High Elevation | | |
| Adil | 140 | 1976 |
| Makmur | 140 | 1976 |
| Gemar | 140 | 1976 |
| Semeru | 120 | 1980 |
| Batamg Agam | 150 | 1981 |
| Batang Ombilin | 140 | 1984 |

| Variety | Maturity Days | Year released |
|---|---|---|
| III. Upland | | |
| Gati | 105 | 1976 |
| Gata | 115 | 1976 |
| Sentani | 115 | 1983 |
| Tondano | 115 | 1983 |
| Singkarak | 115 | 1983 |
| Arias | 135 | 1984 |
| Ranau | 105 | 1984 |
| IV. IRRI Introductions | | |
| Lowland | | |
| IR 20 | 120 | 1974 |
| IR 26 | 125 | 1975 |
| IR 28 | 110 | 1975 |
| IR 30 | 110 | 1976 |
| IR 32 | 140 | 1976 |
| IR 34 | 130 | 1976 |
| IR 36 | 115 | 1977 |
| IR 38 | 125 | 1978 |
| IR 42 | 135 | 1980 |
| IR 50 | 105 | 1981 |
| IR 52 | 115 | 1981 |
| IR 54 | 125 | 1981 |
| IR 56 | 125 | 1983 |
| IR 46 | 130 | 1983 |

[1/] Also for tidal swamp

Source: Siwi (1985)

TABLE 27

Luas penyebaran varietas padi (000 ha), musim tanam 1975/76-1982/83

*Area planted to rice varieties in Indonesia (000 ha), 1975/76-1982/83*

| Musim tanam *Season* | | Lokal *Local* | Unggul lokal *Improved local* | Galur lain *Others* | Varietas unggul baru peka wereng coklat[a] *Modern varieties susceptible to brown planthopper*[a] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PI/1 | PI/2 | PB 5 | PB 8 | C4-63 | Lain *Others* | Jumlah *Total* |
| 1975/76 | *wet* | 1 770,9 | 441,3 | 105,0 | 834,9 | 228,7 | 449,2 | 51,6 | 359,4 | - | 1 923,8 |
| 1976 | *dry* | 943,1 | 169,6 | 20,5 | 387,0 | 109,4 | 166,9 | 16,7 | 173,0 | - | 853,1 |
| 1976/77 | *wet* | 1 694,4 | 399,7 | 89,0 | 694,9 | 145,6 | 237,5 | 26,4 | 248,3 | - | 1 352,8 |
| 1977 | *dry* | 779,2 | 167,3 | 19,9 | 244,8 | 58,8 | 111,8 | 13,9 | 126,6 | - | 555,9 |
| 1977/78 | *wet* | 1 861,7 | 342,6 | 80,6 | 408,3 | 112,5 | 177,3 | 20,1 | 213,6 | - | 931,7 |
| 1978 | *dry* | 936,2 | 119,9 | 62,4 | 150,3 | 45,5 | 90,2 | 14,2 | 116,2 | 5,8 | 422,2 |
| 1978/79 | *wet* | 1 811,6 | 293,8 | 178,2 | 378,0 | 88,8 | 140,1 | 18,5 | 205,2 | 34,5 | 865,1 |
| 1979 | *dry* | 832,8 | 79,7 | 38,1 | 89,0 | 34,0 | 48,0 | 4,0 | 66,0 | 11,9 | 252,9 |
| 1979/80 | *wet* | 1 525,9 | 122,3 | 93,0 | 157,0 | 60,0 | 89,0 | 8,0 | 58,0 | 13,4 | 385,4 |
| 1980 | *dry* | 849,8 | 75,1 | 80,5 | 76,6 | 25,1 | 33,1 | 1,8 | 49,3 | 13,9 | 199,8 |
| 1980/81 | *wet* | 1 414,9 | 97,3 | 226,1 | 167,4 | 36,3 | 43,1 | 4,4 | 110,3 | 9,0 | 370,5 |
| 1981 | *dry* | 841,8 | 42,2 | 44,4 | 95,7 | 40,3 | 29,7 | 4,4 | 48,0 | 16,2 | 234,3 |
| 1981/82 | *wet* | 1 241,8 | 83,6 | 44,4 | 83,1 | 49,2 | 34,9 | 8,5 | 51,4 | 10,6 | 237,7 |
| 1982 | *dry* | 516,0 | 35,8 | 15,2 | 25,8 | 14,9 | 8,9 | 0,6 | 18,0 | 5,2 | 73,4 |
| 1982/83 | *wet* | 608,4 | 29,5 | 89,2 | 47,8 | 22,9 | 15,0 | 1,5 | 30,6 | 9,4 | 127,2 |

Source: DGFC

Cont.

TABLE 27 (continued)

| Musim tanam *Season* | | Varietas unggul tahan wereng coklat[b] *Modern varieties resistant to brown planthopper*[b] PB 26 | PB 28 | PB 30 | PB 32 | PB 34 | PB 36 | PB 38 | PB 42 | Cita-rum | Semeru | Cisa-dane | Lain *Others* | Jumlah *Total* | Jumlah *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1975/76 | *wet* | 295,6 | 5,1 | 3,5 | - | 0,2 | - | - | - | - | - | - | 89,3 | 393,7 | 4 634,7 |
| 1976 | *dry* | 328,3 | 21,7 | 49,6 | 0,7 | 8,1 | - | - | - | - | - | - | 79,9 | 488,3 | 2 474,6 |
| 1976/77 | *wet* | 609,8 | 114,2 | 249,6 | 8,0 | 194,3 | 5,2 | - | - | - | - | - | 43,5 | 1 244,6 | 4 781,5 |
| 1977 | *dry* | 330,8 | 96,3 | 245,7 | 49,9 | 90,9 | 13,9 | 0,3 | - | - | - | - | 59,8 | 887,6 | 2 409,8 |
| 1977/78 | *wet* | 371,5 | 119,8 | 446,3 | 389,4 | 128,6 | 421,2 | 26,3 | - | - | - | - | 75,1 | 1 978,2 | 5 194,6 |
| 1978 | *dry* | 191,3 | 64,1 | 231,7 | 157,3 | 41,4 | 487,4 | 95,2 | - | 0,4 | - | - | 57,2 | 1 326,0 | 2 866,7 |
| 1978/79 | *wet* | 185,9 | 71,9 | 236,3 | 273,5 | 59,8 | 1 041,4 | 229,5 | - | 11,2 | - | - | 48,9 | 2 158,4 | 5 307,0 |
| 1979 | *dry* | 81,6 | 29,1 | 88,3 | 200,3 | 17,6 | 892,0 | 304,9 | - | 45,8 | 2,9 | - | 60,8 | 1 723,3 | 2 926,8 |
| 1979/80 | *wet* | 52,0 | 17,0 | 54,0 | 230,0 | 19,0 | 1 804,7 | 517,9 | - | 108,6 | 6,3 | - | 64,1 | 2 873,6 | 5 000,3 |
| 1980 | *dry* | 35,5 | 13,6 | 32,2 | 248,3 | 7,9 | 1 128,3 | 293,3 | 39,2 | 36,9 | 28,4 | 3,6 | 43,2 | 1 910,4 | 3 115,7 |
| 1980/81 | *wet* | 26,3 | 13,9 | 26,7 | 226,2 | 12,0 | 1 945,0 | 337,7 | 72,9 | 54,9 | 87,3 | 96,2 | 62,2 | 2 961,3 | 5 077,4 |
| 1981 | *dry* | 14,5 | 10,1 | 18,9 | 128,9 | 5,9 | 1 154,6 | 207,0 | 211,1 | 20,9 | 109,2 | 179,1 | 60,7 | 2 120,9 | 3 283,6 |
| 1981/82 | *wet* | 8,5 | 6,2 | 7,6 | 138,6 | 14,2 | 2 107,8 | 183,0 | 174,1 | 32,4 | 107,2 | 584,7 | 179,8 | 3 544,1 | 5 189,5 |
| 1982 | *dry* | 3,2 | 3,9 | 3,4 | 36,6 | 36,2 | 787,1 | 105,2 | 221,5 | 13,2 | 67,1 | 385,8 | 257,7 | 1 920,9 | 2 561,2 |
| 1982/83 | *wet* | 7,9 | 1,5 | 4,4 | 29,2 | 1,7 | 1 747,4 | 154,3 | 88,1 | 5,0 | 93,9 | 812,4 | 381,2 | 3 327,0 | 4 181,3 |

[a]Beberapa varietas lain seperti IR 22, Gata, Gati, Gemar, Makmur, Adil, dan IR 24, areal tanamnya tidak pernah melebihi 25.000 ha.

[b]Beberapa varietas seperti PB 20, IR 29, Brantas, Serayu dan Asahan areal tanamnya tidak pernah mencapai 100.000 ha, sedangkan varietas PB 50, PB 52, PB 54, PB 56, Cimandiri, Cipunegara, Barito dan Krueng Aceh karena relatif masih baru dilepas areal pertanamannya masih di bawah 100.000 ha.

[a]*Other varieties, including IR22, Gata, Gati, Gemar, Makmur, Adil and IR24, did not exceed 25.000 ha.*

[b]*Other varieties, including IR20, IR29, Brantas, Serayu and Asahan did not exceed 100.000 ha. The varieties IR50, IR52, IR54, IR56, Cimandiri, Cipunegara, Barito and Krueng Aceh have been released relatively recently, and so far have not exceeded 100.000 ha.*

Lihat juga Tabel 6, 7, 8, 9./ *See also Tables 6, 7, 8, 9.*

FIGURE 1

Organization of Ministry of Agriculture

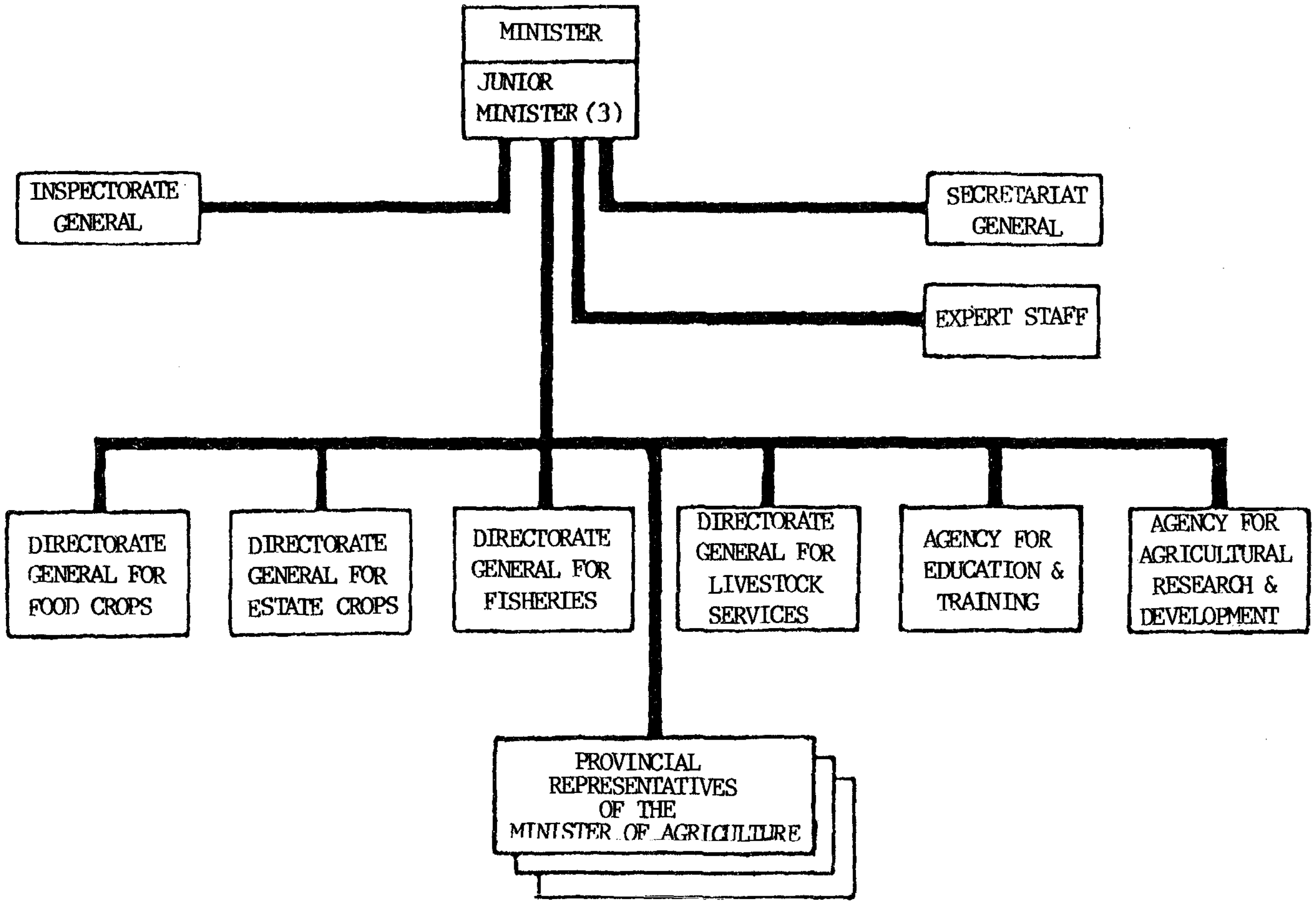


FIGURE 2

ORGANIZATIONAL STRUCTURE

AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT

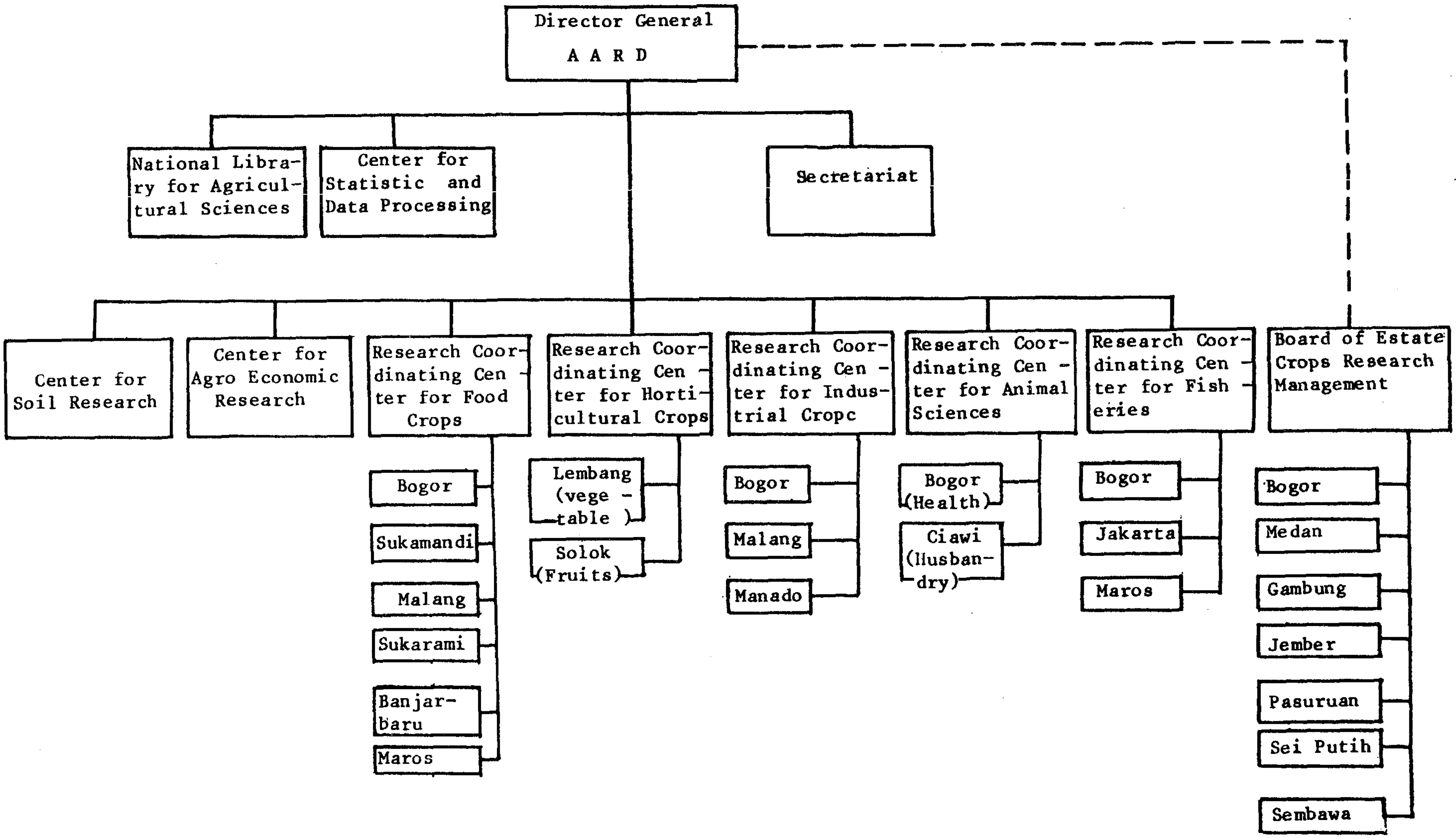
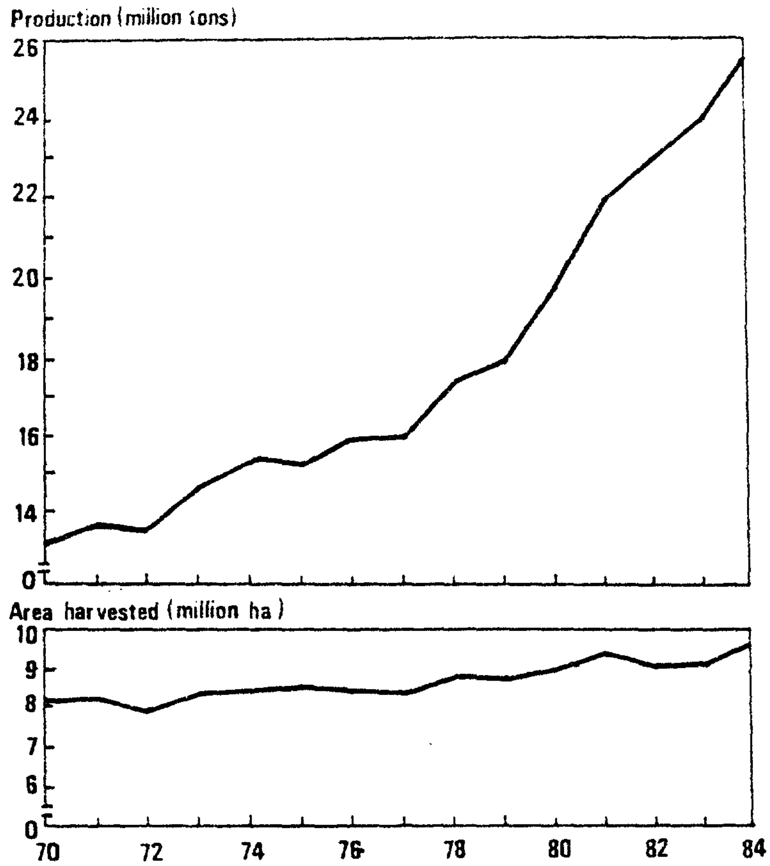


FIGURE 3

**Milled rice production in Indonesia, 1970–1984.**

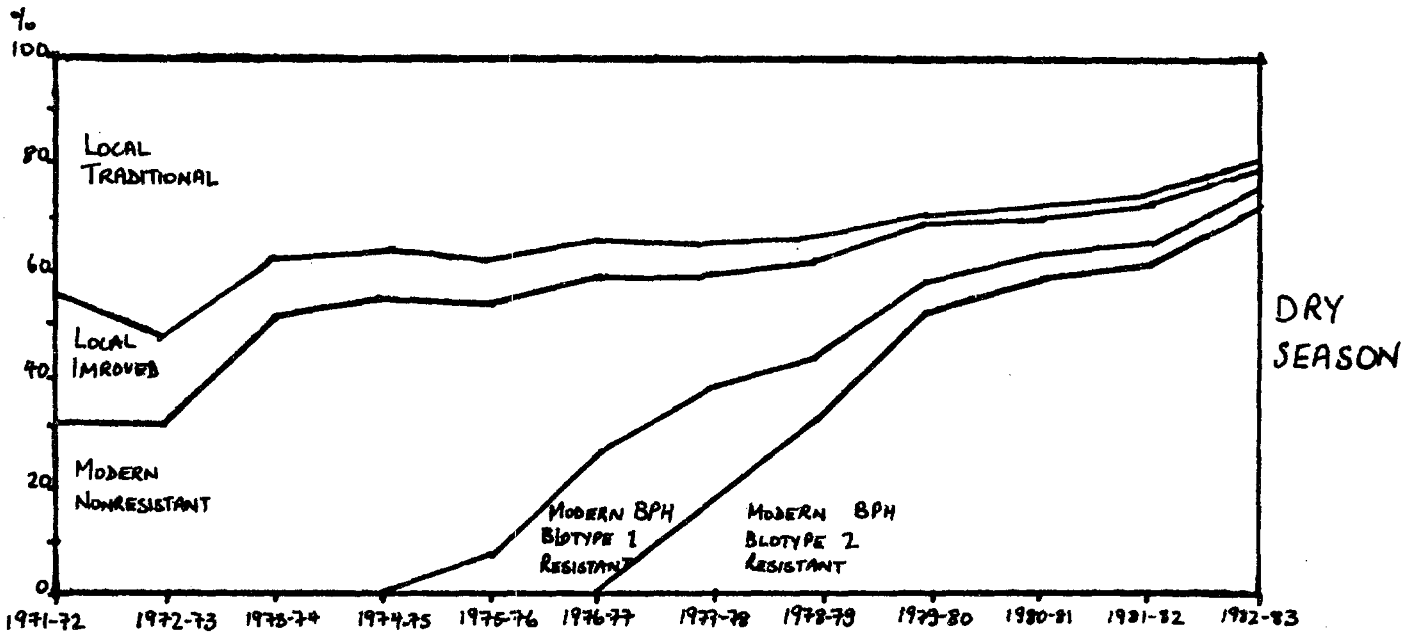



Source: CRIFC

FIGURE 4

PERCENTAGE OF REPORTED AREA IN DIFFERENT RICE

VARIETIES 1971/72 TO 1982/83



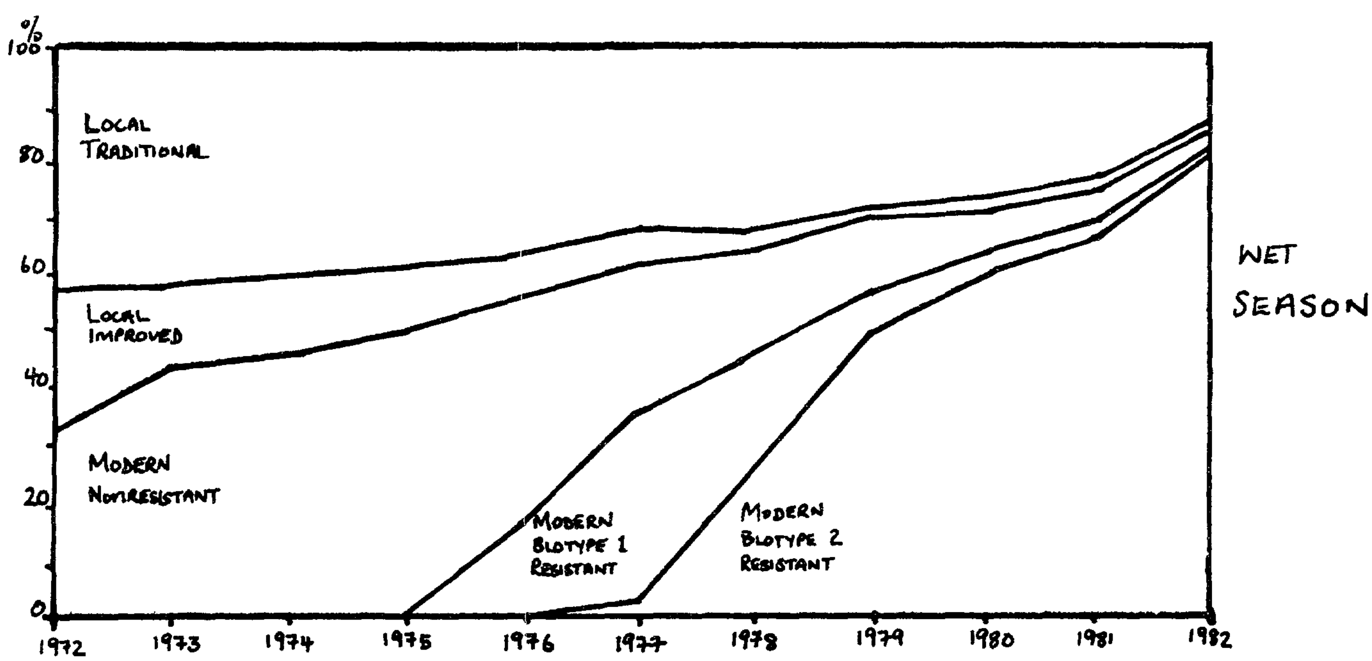



FIGURE 5

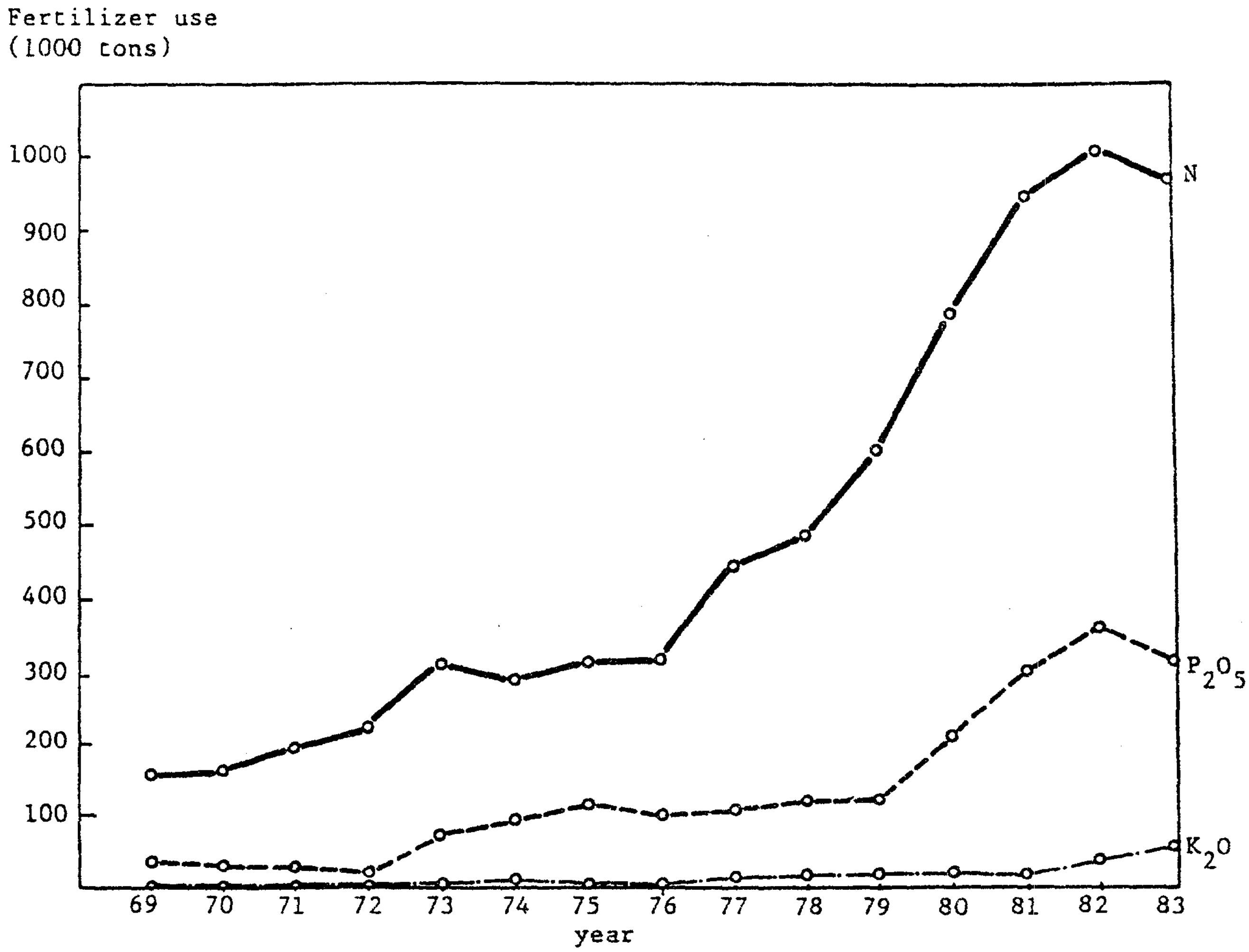



Figure 5: Fertilizer use for food crops from 1969-1983

Source: Siwi (1985)

ANNEX 2

## LIST OF PERSONS INTERVIEWED

Ministry of Agriculture:

Ir. Wardoyo (Junior Minister for Food Crops)

Dr. Sjarifuddin Baharsjah (Secretary General)

Dr. Soetatwo Hadiwigeno (Director of Planning Bureau)

Dr. A.T. Birowo (Special Assistant to the Minister of Agriculture for Institutional & Regional Development - Former Director of Planning Bureau)

Agency for Agricultural Research and Development - Research Managers

Dr. Gunawan Satari* (Head of AARD)

Mr. Sadikin Sumintawikarta* *** (AARD Head 1974-1984)

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Dr. Faisal Kasryno (Director of Center for Agro-Economics)

Dr. B.H. Siwi (Director of Food Crops Research Center)

Dr. S. Subiyanto (Director of Horticulture Research Center)

Dr. Prabowo Tjitropranoto (Director of National Library for Agricultural Sciences)

Dr. I.N. Oka** (Head of Plant Protection)

Dr. Farid Bahar (Director of Maros Research Intstitute)

Dr. Soetaryo Brotonegoro (Director of Malang Research Institute)

Mr. Omar Hidayat (Acting Director of Sukamandi Research Institute)

Dr. Azis Azirin (Director of Lembang Research Institute)

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Dr. Rudolf Sinaga (Socio-Economics Department, Bogor Agricultural University and Special Adviser to Deputy Minister for Livestock and Fisheries)

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Dr. Samedi Sumintaredja (Secretary AAETE)

Private Sector

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Mr. R. Cobb (USAID - Director, Office of Agriculture)

Mr. A. Hurdus (USAID - Research Advisor)

Mr. P. Johnson (ADAB - First Secretary)

Dr. W. Young (IADS - Executing Agency NAR II)

Dr. W. Collier (RMI - Executing Agency AARP)

Mr. W. Tappan (IRRI Representative in Indonesia)

Dr. J. McIntosh (IRRI Farming Systems Specialist based at Bogor)

Agency for Agricultural Research and Development - Research Scientists

Bogor

Dr. Sridodo (Head of Programming - Food Crops Research)

Mr. Sadikin Somaatmadja (Coordinator National Grain Legume Program)

Dr. Roberto Soenarjo (Coordinator, National Root Crop Program)

Dr. Subandi (Coordinator, National Maize and Sorghum Research Program)

Mr. Mahyuddin Syam (Research Communication Department)

Dr. D.M. Tantera (Plant Pathologist - Rice)

Dr. Moh Iman (Entomologist - Food Crops)

Mr. Dandi Soekarna (Plant Pathologist - Food Crops)

Dr. Mukelar Amir (Plant Pathologist - Rice)

Mr. Soetjipto Partohardjono (Agronomist - Rice)

Dr. M. Ismunadji (Plant Physiologist - Rice)

Malang

Mr. Kasyadi (Agronomist - Fruit Crops)

Mr. Yudi Widodo (Agronomist - Root Crops)

Dr. Marsum Dahlan (Plant Breeder - Corn)

Mr. Soejitno (Plant Breeder - Grain Legumes)

Mr. Tatile Wardiyati (Physiologist - Root Crops)

Maros

Mr. Mamiek Slamet (Entomologist - Corn and Grain Legumes)

Mr. Saleh Pandang (Cropping Systems Research)

Mr. Syahruddin Rahman (Pathologist - Rice)

Lembang

Mr. Syarifuddin Satjadipura (Plant Breeder - Potatoes)

Mr. Iteu Hidayat (Tissue Culture - Potatoes)

Mr. Eri Sofiari (Plant Breeder - Potatoes)

Sukamandi

Dr. A.M. Fagi (Agronomist - Rice-based Cropping Systems)

Dr. Tohar Danakusumah (Plant Breeder - Rice/wheat)

Mr. Taryat Tjubaryat (Plant Breeder - Rice)

Dr. Bambang Suprihatno (Plant Breeder - Rice)

Dr. Muhadji Moentono (Plant Breeder - Corn)

ANNEX 3

## PROGRAM OF THE STUDY

This study was carried out by the author assited by Dr. Joko Budianto of AARD who did most of the field interviews and Dr. Ibrahim Manwan, also of AARD, who drafted the comments on ISNAR.

Preliminary work was done in Indonesia during November 1984 and the main field work carried out between January 19th and February 5th 1985. During the course of this, visits were made to a number of AARD Research Centres, Institutes and Stations at Bogor, Jakarta, Lembang, Malang, Sukamandi and Maros, to Universities at Bogor and Malang and to Government and Donor Agency offices in Bogor and Jakarta.

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