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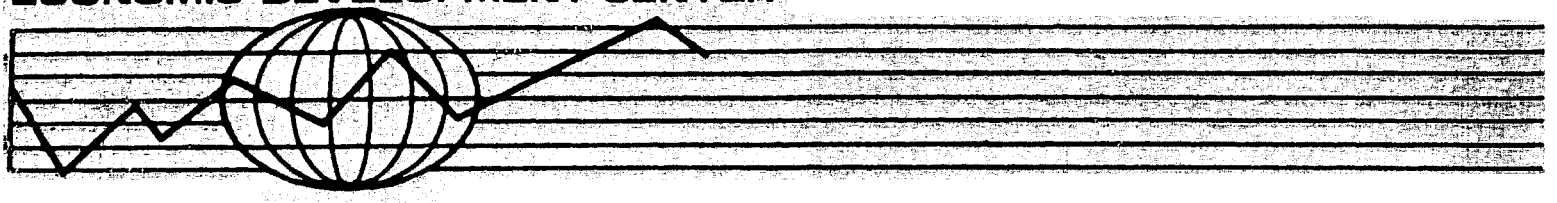

AGRICULTURAL RESEARCH AND TECHNOLOGY TRANSFER BY THE PRIVATE SECTOR IN INDONESIA

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EXECUTIVE SUMMARY

This survey is part of a University of Minnesota study financed by AID/Washington on private sector research in the Third World. The second phase of this study is a survey of private agricultural research and technology transfer in six countries in South and Southeast Asia. The purpose of these surveys is to (1) find out how much and what kind of research is being conducted by the private sector, (2) identify the policy constraints and incentives to private research and technology transfer, and (3) identify major impacts of private research and technology transfer on farmers.

The Indonesia survey consisted of interviewing officials of eleven companies in Jakarta and Medan in December, 1986. The companies were selected to include all companies that were reputed to have research progrms and several others that were known to be involved in technology transfer. Eight of the companies were multinationals and all of them had some contact with foreign firms. These interviews were supplemented by discussions with officials in the Indonesian government, USAID, USDA and The World Bank.

Hybrid corn, hybrid rice, poultry, pesticide and plantation technologies are being transferred into Indonesia by the private sector. There are about five formal agricultural R & D programs of private companies. Their research budgets total between US $1.5 and 2.0 million annually. The major research programs are in the plantation sector where there is research on oilpalms and rubber. There is one regional pesticide research station of a Swiss multinational, and several other companies conduct research when they need to. Finally, there is a large research program on livestock feed by a Thai multinational.

The major impact of private technology transfer and research has been in the plantation sector. Many of the rubber and oilpalm varieties were developed by private companies in Indonesia, Malaysia, or Papua, New Guinea. Local research by plantation companies has reduced their fertilizer and pesticide costs and increased yields. Pesticides have had a major positive impact on crop production, although some argue that there have also been important negative impacts. Pesticide research has identified several chemicals that are now in use in Southeast Asia. Poultry technology is probably the third largest area of impact. Production has increased rapidly since 1970 and pushed down prices for consumers.

The major constraint on private sector research and technology transfer has been the large role of government enterprises in both the input supply industry and the plantation industry. Until the early 1970's, all large plantations were government owned and most still are. BIMAS supplies most inputs for rice and corn production. There has been a slow trend toward privatization since the late 1960's. In some industries like pesticides, however, the government is increasing its involvement in production.

Government research has not contributed much to the private research programs as yet although private researchers have been in close communication with government researchers. Two constraints on private research mentioned in this survey were difficulties recruiting local scientists and the difficulty of one chemical company of getting permission to expand its research program.

AID's contribution to private research and technology transfer has primarily been through IRRI and CIMMYT. IRRI research has made some pesticides more effective, eliminated the need for others, initiated a

thresher industry in Sumatra, and provided the basis for a hybrid rice seed business. CIMMYT helped develop the Thai corn genetic material that is the basis of the hybrid corn industry.

Continued AID support for government agricultural education programs and agricultural research programs are important for the future development of private research which needs scientists and technical inputs like inbred lines. AID support for privatization of input supply, plantations and processing and AID financing for research on science and technology policy could encourage private research and technology transfer.

INTRODUCTION

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General Agricultural Development

The quantity and area of the different agricultural commodities are shown in Tables 1 and 2. Rice is by far the most important crop. Corn is next most important in terms of area covered, but several of the estate and industrial crops - rubber, oilpalm and perhaps sugarcane - are more valuable crops. Table 3 shows the contribution of various commodities to total agricultural GDP. Crops make up about 75 percent of agricultural GDP, while livestock contributes less than 10 percent.

Table 1. Indonesia: Production of Selected Agricultural Commodities, Values and Indices of Production, Average 1969-71, 1975-79, Annual 1980-85.

COMMODITY	PRICE WEIGHT	AVERAGE 1969-71	AVERAGE 1975-79	1980	1981	1982	1983	1984[1]	1985[2]
	Dollars	1,000 mt							
Rice, Paddy	48	19,173	24,207	29,652	32,774	33,584	35,237	37,500	38,250
Corn	52	2,575	3,251	3,991	4,509	3,235	5,095	5,412	5,500
Cassava	25	10,725	12,776	13,726	13,301	12,988	11,651	14,700	15,000
Sweet Potatoes	30	2,215	2,310	2,079	2,094	1,676	2,044	2,250	2,300
Sugarcane	15	9,758	14,563	13,743	14,254	17,846	19,546	22,950	23,100
Tobacco[3]	482	73	97	73	93	95	111	101	105
Soybeans	126	468	786	653	704	521	580	625	660
Peanuts, in shell	176	463	667	783	791	728	795	830	880
Coffee	385	182	214	322	347	273	308	318	328
Tea	412	67	87	106	110	93	113	116	120
Rubber	310	838	870	898	1,020	963	899	1,230	1,100
Kapok	356	28	32	41	49	51	54	53	55
Palm oil	257	217	503	702	752	807	907	921	1,054
Copra	151	1,100	1,529	1,630	1,765	1,711	1,607	1,731	1,740
Palm kernals	155	49	94	121	133	144	161	162	163
AGGREGATES OF PRODUCTION:		$ million at constant prices							
- TOTAL CROPS		2,307.7	2,949.9	3,403.8	3,682.4	3,610.6	3,832.4	4,227.9	4,296.4
- TOTAL FOOD		1,904.9	2,504.1	2,907.9	3,125.1	3,104.7	3,315.8	3,608.8	3,709.5
INDICES OF PRODUCTION:		(1969-71 = 100)							
- TOTAL CROPS		100	128	147	160	156	166	183	186
- TOTAL FOOD		100	131	153	164	163	174	189	195
- PER CAPITA CROPS		100	110	119	127	121	127	137	136
- PER CAPITA FOOD		100	113	124	130	127	133	141	143
INDEX OF POPULATION:		(1969-71 avg. population = 122,770,000)							
		100	115.9	123.1	125.7	128.4	131.1	133.9	136.7

1 Preliminary
2 Forecast
3 Farm weight

Source: Department of Agriculture; Central Bureau of Statistics; National Sugar Council; Office of Agricultural Affairs.

NOTE: Format prices and population data obtained from ERS, USDA Statistical Bulletin No. 710 (July 1984), "World Indices of Agricultural and Food Production, 1974-83"

Table 2. Indonesia: Harvested Area, By Crop, 1981-84.

	1981	1982[1]	1983[2]	1984
		(1,000 hectares)		
Rice	9,382	8,988	9,102	9,400
Corn	2,955	2,061	3,013	3,200
Cassava	1,388	1,324	1,185	1,400
Sweet Potatoes	275	220	261	280
Soybeans	810	608	633	702
Mung Beans	231	204	267	300
Peanuts	508	461	483	507
Coconuts	1,914	1,885	1,904	1,933
Oil Palm	230	245	256	275
Sugar Cane	193	255	275	299
Tobacco	204	210	215	194
Coffee	527	504	533	548
Tea	85	86	89	93
Cocoa	21	23	28	33
Pepper	52	55	58	59
Cloves	173	191	213	230
Cotton	17	13	14	20
Rubber	1,564	1,570	1,607	1,474
Kapok	159	168	159	170

[1]Revised
[2]Preliminary
[3]Estimated

Source: Department of Agriculture (D.G. for Estate Crops and D.G. for Food Crops); Central Bureau of Statistics; Indonesian Sugar Council; Office of Agricultural Affairs.

Table 3. Relative Importance of Different Agricultural Commodities (1981).

	Value of Output Billion Rp	% Agricultural GNP	'000 Ha of Land
Wet land Rice			7,191
Dry land Rice			1,191
Rice	4.600	33.7	9,382
Corn	630	4.6	2,955
Cassava	460	3.4	1,388
Sweet Potato	100	0.7	275
Ground 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
Nonfood Crops	2.230	16.3	6,000
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.

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

Table 1 also indicates where the most rapid growth in output has taken place. Rice and corn production has nearly doubled since 1970. Sugarcane production doubled, and palm oil production quadrupled.

Growth in yield per acre accounted for almost all of the growth in rice production since 1970. From 1968/71 to 1977/80, corn production increased by 39 percent while acreage declined. Since 1980, both acreage and yield per acre have increased. The increase in palm oil production was primarily due to yield increases - output increased by 173 percent, acreage by 53 percent. The increase in sugarcane production was entirely due to increased planted area (ROI, 1983).

New technology embodied in modern seed varieties, fertilizer, plant protection techniques, and better water control were responsible for the growth of rice yields. Corn yields increased primarily because of greater fertilizer application (Boonsue, 1985). The reasons for increases in oilpalm and rubber production were increased yields on large estates (about 25 percent).

Growth in livestock production is shown in Table 4. Total meat production doubled, led by poultry production which increased by a factor of five. Commercial egg production increased from 4,000 tons in 1969 to 164,900 tons in 1982. Milk production quadrupled.

The increase in commercial egg and broiler production led to rapid growth in the animal feed industry. About 90 percent of commercial feed is sold to poultry producers. Feed sales grew 20 to 40 percent annually during the 1970's but decelerated to about 10 percent during the early 1980's (World Bank, p. 15). Interviews with companies indicated slow or declining production at present.

Table 4. Production and Consumption of Meat, Eggs and Milk in Indonesia, 1969-82.

(000' TONS)

Production	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Meat														
Cattle	164.9	167.3	177.2	196.1	202.6	212.8	224.5	225.3	224.5	225.4	213.7	220.3	227.8	235.5
Buffalo	48.5	49.2	52.1	57.1	69.6	62.3	65.2	64.6	65.5	64.2	64.4	65.4	67.8	70.2
Goat	12.0	12.2	12.9	13.9	14.9	15.4	17.4	19.4	23.5	26.3	35.2	36.3	38.5	40.2
Sheep	9.7	9.8	10.4	11.0	11.7	12.0	13.0	8.4	14.1	14.3	17.1	17.6	18.2	18.8
Pork	34.2	34.6	36.7	38.6	41.2	44.5	47.8	51.2	46.7	47.7	54.2	57.3	59.0	60.8
Horse	0.8	0.8	0.8	0.7	0.9	0.9	0.9	1.5	1.4	1.4	1.4	1.6	1.7	1.7
Poultry	39.2	39.7	42.1	48.8	48.5	55.2	66.2	78.3	92.0	95.3	100.3	172.3	183.0	201.3
Total	309.3	313.6	332.2	336.2	379.4	403.1	435.0	448.7	467.7	474.6	486.5	570.8	596.0	628.6
Eggs														
Village chickens	30.9	31.3	33.2	33.4	35.4	36.1	41.2	40.5	43.4	45.7	48.0	50.4	53.0	55.8
Layer chicken	4.2	4.3	10.9	18.2	15.6	24.8	28.0	31.9	39.4	43.7	50.3	141.6	151.7	164.9
Ducks	22.6	23.0	24.3	25.9	30.4	37.2	43.0	43.2	48.6	61.6	65.6	67.4	70.5	76.3
Total	57.7	58.6	68.4	77.5	81.4	98.1	112.2	115.6	131.4	151.0	163.9	259.4	275.2	297.0
Milk														
Total	28.9	29.3	35.8	37.7	35.0	56.9	51.1	58.0	60.7	62.3	72.2	78.4	85.8	116.7
Per capita cons. (kg)														
Meat	2.74	2.70	2.80	3.02	3.06	3.18	3.34	3.37	3.42	3.41	3.46	3.92	4.00	4.12
Eggs	0.23	0.23	0.29	0.35	0.35	0.45	0.50	0.52	0.80	0.88	0.94	1.44	1.50	1.58
Milk	1.46	1.82	1.70	1.73	1.64	1.96	1.95	2.82	3.06	3.53	3.72	4.36	3.98	4.17

Source: Informal data Peternakan (1983). Directorate - General of Livestock Services, Jakarta.

Growth and Structure of Specific Agribusinesses

The seed industry in general is dominated by the government and small scale local producers of seed. There are two government owned companies - Perem Sang Hyang Seri and PT Pertani Patra Tani. The former company produces all of the rice seed for BIMAS (the government input distribution system for the main foodgrains). They also produce some of the open pollinated corn varieties developed by government research. The latter company is just getting into the seed business working on hybrid corn.

Three foreign based companies now have government approved corn hybrids - P. T. Bright, Cargill and Pioneer. P. T. Bright is also selling the open pollinated variety, Arjuna, which was developed from Thai material from the Kasetsart University/Rockefeller/CIMMYT corn program.

The commercial poultry industry started about 1970 with Charoen Pokphand (CP), which had the Arbor Acres franchise leading the way. The breeding industry has four large grandparent operations with CP and Cipendawa, which has the Indian River franchise, being the two largest breeders. Commercial production appears not to be very integrated. By the early 1980's, two large commercial operations had a very large share of the market and so there was a presidential decree limiting the size of commercial flocks to 5,000 layers and 750 broilers. It is not clear whether this law had the intended effect because the two large producers apparently are still very influential in the poultry market.

The modern animal feed business began in the early 1970's to supply the poultry industry. It was founded by CP and Cargill. They were followed by companies owned by Swiss, German and Dutch companies and then by a number

of Indonesian companies. There are now 20 to 25 feedmills. CP has the largest market share followed by several Indonesian and a Swiss owned company. The market seems to be quite competitive. The government is not in the feed production business.

Until recently, the active ingredients of all pesticides were manufactured outside Indonesia. The last few years, the government has started to produce the active ingredients of some of the most popular rice insecticides. Dow Chemicals also produces the active ingredient for its most important insecticide. There are a number of factories for formulating pesticides using imported or locally produced active ingredients.

Most of the pesticides are distributed through BIMAS. Private companies have their own distribution systems only for nonfood grains which primarily means plantation crops.

Total rubber area is divided roughly equally between large privately owned plantations, government owned plantations and small holders. Oilpalm is all grown by large plantations, some of which are owned by the governments while others are privately held. Several large plantations have been returned to foreign owners since 1970.

TECHNOLOGY TRANSFER BY PRIVATE SECTOR

Importing Technology

Commercial poultry production began in about 1970 in Indonesia. Several companies set up breeding operations at about that time. They started by importing parent stock from North American or Europe, crossing them once and then selling the chicks to commercial poultry operations. In the early 1980's, several companies set up grandparent operations where they imported the grandparents and crossed them to produce parent stock. Recently, a law was passed which prohibits the import of parent stock.

There is at least one large scale importation of dairy cattle planned for 1986. P. T. Mantrust has established a joint venture with Land O' Lakes and a local farmers' cooperative to establish a dairy in central Java. They will be importing 10,000 dairy cattle from the United States to start this operation.

Most of the feedmill technology has been imported from outside Indonesia. Some of it comes in embodied in imported feed processing machinery, but much of it comes in through trained manpower in a company or through consultants. CP brought their skills and knowledge from Thailand and Taiwan and imported machinery from the United States and elsewhere. Cargill brought in engineers and designed smaller mills which did not require as much imported equipment. Both of these companies are in regular contact with other feedmills in other branches of their company in the tropics and elsewhere. They pick up many cost saving ideas from other managers in other countries. Other sources of new feed technology are the companies that produce feed

processing machinery, pharmaceuticals and other additives and poultry breeders.

Some early attempts to import hybrid corn were made by Japanese companies in Sumatra that were trying to grow corn for export. These attempts ended in failure. The hybrids were wiped out by downy mildew in the early 1970's.

In 1983, the first corn hybrid with downy mildew resistance was officially released. This hybrid was developed by Cargill in Thailand. The Cargill corn breeder in Thailand was Brazilian. He used SEAsian genetic material developed by the Kasetsart University/Rockefeller/CIMMYT program that had downy mildew resistance, Brazilian tropical material and other Cargill elite lines. This hybrid is being sold in Philippines and in Thailand.

Pioneer has had two hybrids approved. They were developed in Pioneer's research program in Mindinao in the Philippines and are being sold commercially in the Philippines and Thailand. P. T. Bright is marketing a variety that was developed in Thailand in a joint venture between their parent company, Charoen Pokphand, and DeKalb. This hybrid is in use in Thailand.

Several companies said that they are trying to get improved soybean varieties for testing. At least one company is planning to test some of its Brazilian soybean varieties in 1986. Government breeders said that Cargill will be testing three or four rice hybrids in 1986.

There are a number of activities in the horticulture area in which foreign companies provide production technology and the market the produce abroad. A Dutch seed company is producing flower seeds in Sumatra for export. One company has a joint venture with a Dutch company to produce mushrooms for export and another joint venture with Green Giant to produce asparagus.

The major foreign owned plantation companies and some of the government owned plantations import technology from Malaysia and elsewhere. Malaysia has been a particularly important source of technology for rubber and oilpalm. For example, most of the older rubber clones in Indonesia were bred at the Rubber Research Institute in Malaysia, and the most recent ones were developed by the Harrison-Crossfield research program just outside of Kuala Lumpur. This source of technology has been restricted somewhat by Malaysia's ban on the export of planting material.

There are a variety of mechanisms by which technology is transferred. The foreign owned plantations are able to get ideas, technicians, planting material and mechanical technology from other plantations owned by the same company in other countries. Both private and government owned plantations hire experienced Malaysian planters to assist in planning and supervising the planting of new plantations. Most of the large Malaysian plantations also have advisory services that are consulting companies which can be hired to provide a variety of services - many of which transfer technology. There are also consulting firms in the United Kingdom that provided such services.

New Biotechnology

The new biological technology is reaching Indonesia in several forms and there is more to come. Local firms are looking for new biotechnology products and United States, Japanese and European firms are looking for markets. The definition of new biotechnology is very imprecise. I have included plant growth regulators, insect growth regulators and the use of tissue culture. There are also some feed additives which might be called animal growth regulators that probably should be included.

The first new biotechnology product being sold commercially in Indonesia is a plant growth regulator or nutrient that was first marketed several years ago by P. T. Yunavati. This product was developed by Cytozyme Laboratories in the United States. It is supposed to stimulate the growth of naturally occurring bacteria in the soil so that the plant gets more nutrition from the same amount of basic elements in the soil. This product has been very successful in Indonesia, particularly with the government owned plantations. BIMAS is trying it out this year and may start to purchase and distribute it. At least one other plant growth hormone or regulator has received government clearance and is being test marketed at present. This product, called mixtalol, was developed by Hindustan Lever in India.

A second new product that is being purchased by the Indonesian government is what was described to me as a hormonal pesticide. This is very safe for people, very selective and very expensive. The government is buying it from the Japanese company that developed it with Japanese aid money and holding it in case of a pest outbreak. It is for use against rice pests.

The third use of new biotechnology is tissue culture to develop oilpalm clones. Oilpalms developed using tissue culture by Unifield[1] in England are now planted in 80 has. of London-Sumatra estates and will produce their first crop next year. Individual plants produced from tissue culture have already given superior yields, but this will be the first commercial trial anywhere. They feel fairly confident of a 20 to 30 percent increase in yields.

Finally, some new feed additives to improve milk yields and poultry

[1]Unifield is 60 percent owned by Unilever, which established the company, and 40 percent owned by Harrison-Crossfield.

production are being tested in Indonesia at present. It is not clear whether any of these are being used commercially at present.

It is clear that an increase in products of this sort will continue in the future. It was reported that several biotechnology companies are looking for joint venture partners in Indonesia, and several of the Indonesian firms said that they were looking for biotechnology products.

Most of these products do not appear to be dangerous to humans, although some chemicals which are promoted as animal and insect growth regulators may be dangerous. Therefore, regulatory authorities have to continue to check these products carefully. The main question regarding this is, however, there effectiveness. This is not so much a problem when the market is determining what is used. Farmers will not use these products for long if they are not effective. The danger is that government organizations will purchase products that are not effective. I was not able to find out how good the government is at assessing the effectiveness of these products.

Technology Transfer Within Indonesia

There are several types of private sector technology transfer within Indonesia that are sufficiently important to be singled out.

The first is CP's poultry technology courses. The first one was started in 1978 on a poultry farm near Jakarta. They have three week long practical poultry production courses for farmers. CP pays all the costs,and they can take 30 to 40 farmers a month. In 1983, they started a second course in Surabaya which takes about 30 farmers a month. They have now given diplomas to over 1,000 students. The instructors are the staff of CP's

breeding, feedmill and research operations. In addition, they have a travelling team of a veterinarian, animal husbandry person and government extension person that hold poultry workshops in the countryside.

The second is the advisory services provided by some of the larger private plantations. They manage private estates and provide the technology they develop through their research or that they import from other companies.

The third type of activity, which is also the most common type, is the technology that is spread by the technical and sales staff of pesticide companies, seed companies, poultry breeders, feedmills and similar people.

RESEARCH

Aggregate

There is not much formal research and development activity by the private sector in Indonesia. The total expenditure is between $1.5 and $2 million annually by the private sector. Several large Malaysian plantations have larger annual budgets than this. Research is conducted by only five firms - one agricultural chemical firm, one feed producer and three plantation companies. In addition, there is some product development work by other agricultural chemical firms that could be classified as R and D. They have produced some new technology which is described below. However, this is buried in their budgets on extension and demonstrations and so it is not added to the total research expenditure of the companies. The expenditure for the testing of new corn hybrids has not been included as research. These trials are not extensive enough to require any full-time scientists. Their expense can usually not be identified from sales and extension activities.

Specific Industries

The research activities of the livestock sector concentrate mainly on improving the quality and reducing the cost of poultry feed. They are also doing some trials on feed for swine and dairy cattle. Next year, they plan to start research on shrimp and fish feeds. Their trials include testing the efficiency of various combinations of ingredients, testing different additives, trying to locate new inexpensive ingredients such as cassava or wastes from food processing activities that can be used in animal feed. They

also test different management techniques and medicines to control poultry disease. In addition, they test their own and their competitor's feed three or four times a year.

Livestock feed research just started in 1983 and will continue to expand in the near future as they work on more products like fish and shrimp. It did not appear that the two other foreign firms in the feed market - Gold Coin and Cargill - intended to establish research facilities, but there was some discussion that one of the local mills might start doing some research.

London-Sumatra has the largest research program of the plantation companies. It is working on rubber, oilpalms, cocoa and coconuts. Their program started in 1971 with one scientist and now there ar six staff at the station in the Bah Lias estate just south of Medan. This staff is supplemented by a number of foreign consultants every year who do much of the research planning and design.

Their research is about evenly divided between breeding, agronomy and plant protection. The breeding work is primarily the selection of new varieties of oilpalm, rubber and cocoa from material of other plantations in Indonesia, Malaysia and Papua, New Guinea. Their program is also receiving oilpalm planting material (called ramets) from the Unifield tissue culture research laboratory in England. They are doing extensive tests on this material. The aronomy resesarch concesntrates on the fertilizer requirements of the plantations. The plant protection work attempts to reduce the cost of plant protection while preserving useful insects. They do a lot of biological control research while also testing various chemical control measures.

Socfindo and Goodyear have smaller research programs. Socfindo works

on the same crops as London-Sumatra with less staff. It has a tissue culture laboratory at its research station. Goodyear does research on rubber only. It may have the largest private rubber research program at present. These companies have programs that are quite similar to London-Sumatra's - testing new varieties as they become available, testing fertilizer requirements and reducing the losses from pests and the cost of plant protection.

Plantation research has had an erratic history depending on government policy toward plantations. Research on rubber and oilpalm started early in the Twentieth Century. All research activity stopped at the outbreak of World War II. Some companies re-established research in the 1950's but, in 1958, the Dutch plantations were nationalized in 1958 and the rest in 1965. In the late 1960's, the government started negotiating with companies to return the land that had been nationalized. Four companies re-established their research programs soon after they go their plantations back. Two of the three research programs are growing. I was not able to get any information on Uniroyal. The amount of resources invested in research seems to vary a good deal from year to year depending on whether there are any new opportunities like new varieties or new techniques available.

Agricultural chemical companies do a substantial amount of applied research in Indonesia. Only one company - Ciba-Geigy - has an experiment station of their own. A second company has a few hectares of land and a permit for an experiment station but, reportedly, has not developed it. Many other companies rent land or contract with farmers to conduct their trials. The research they do is of two types - (1) experiments for the central research program of the company to test biological efficacy and environmental

effects of new chemicals in tropical, Asian conditions, and (2) experiments to meet local registration requirements and improve local application and management practices.

The Ciba-Geigy station is their only operating location for testing new compounds on lowland rice in tropical Asia. They have applied for permission to open an upland crops' experiment station but, so far, have not received permission from the government.

Constraints to Expanded Research

Three types of constraints to expanded research were mentioned by companies that I interviewed. First, the small size of the market and the availability of useful technology from outside Indonesia makes investment in research unprofitable for some companies and industries. The seed industry is not investing in research in Indonesia because corn hybrids developed in Thailand and the Philippines yield well in Indonesia, and the market for hybrid corn is quite small. The seed companies suggested they will set up research programs when the market grows. In broilers and layers, varieties developed in the North America or Europe fit Indonesian conditions quite well. The synthesis and initial screening of agricultural chemicals has economies of scale which keeps companies from doing that type of research outside the large developed economies.

A second constraint to research in Indonesia is government activities. One major agricultural chemical company has applied for permission to establish an experiment station but has not received permission. A major foreign wood products company had built up a large research and replanting

program. The research expenditure was between 0.5 and one million dollars a year during the 1970's. However, the government institution with which they were partner requested increasingly large shares of the income until it became unprofitable for the company to continue to operate, and it pulled out of Indonesia entirely.

A third constraint that several companies mentioned was the difficulty of hiring scientists. Private companies were prepared to pay salaries two or three times higher than the government, but they still could not attract Indonesian scientists. The major difficulty seems to be the perception that jobs private companies are not secure. Given the flip-flops in government policies towards the private sector and, for instance, the experience of private plantations since Independence this perception has some basis in history. At least one company also mentioned the difficulty of getting Javanese, who make up most of the scientists, to move off Java.

IMPACT OF PRIVATE RESEARCH AND TECHNOLOGY TRANSFER

Technology Transfer By Private Companies

The industry in which technology transfer has been exclusively by the private sector is commercial poultry. The genetic stock is from private sector. Feed technology and health products were brought in by the private sector. Poultry management techniques came from the private sector. The impact of this technology is the remarkable growth in egg and broiler production was shown in Table 4. This has led to a decline in the relative price of eggs and poultry meat. "From 1975 to 1981, egg prices increased by 118% compared to corn (135%), soybeans (155%), sweet potatoes (156%), cassava (160%), rice (182%) and buffalo meat (190%)." (World Bank)

Plant protection technology was much more a joint product of private sector technology transfer and local research along with public sector research. The private sector developed all of the major chemicals and their formulations in research and development activities outside Indonesia. They developed some of the application methods in their Indonesian research programs. The integrated pest management techniques that are used were developed by the public sector.

The major pest problem of the 1970's was brown plant hopper in rice. Many scientists argue that the pesticides used in the late 1960's and the 1970's, growing rice year round and susceptible varieties were the main causes of this problem (Oka). Others primarily blame pesticides (Kenmore). Thus, although it is impossible to quantify the impact, there may have been a negative impact of some of the pesticides used in the 1970's.

Since the development of integrated pest management techniques which include resistant rice varieties, leaving a fallow period and limiting pesticide use to major outbreaks, brown plant hopper has been controlled in recent years. The transfer of pesticides that do not cause resurgence may have had an important impact on rice production. Chemicals are also important in controlling other rice pests. They are also used extensively in vegetable and fruit production in response to consumer demand for wormless cabbages. It is not clear how the heavy application of insecticides has affected net profits of vegetable production in the long run, but in the short run, farmers appear to find it profitable.

The transfer of hybrid corn technology and improved varieties like Arjuna has raised yields on at least 30,000 ha and perhaps on as much as 100,000 ha. Estimates by the companies and by government scientists of the yield increase from hybrids centers on about 2 tons per ha. This is supported by field research in East Java on Tepal and where the local variety (Kretek) yielded 2.8 tons per hectare, Arjuna 3.8 tons and hybrid C-1 5.5 tons (Dorash, 1984). This suggests increased output of 60,000 to 200,000 tons due to private hybrids. At the government price of $100 a ton this comes to at least US $6 million worth of corn.

Technology transfer has had a major impact on the plantation industry. The African pollinating weevil for oilpalm was introduced by London-Sumatra in 1982. The research behind this introduction was done in Malaysia and Africa by Unilever and the Commonwealth Institute for Biological Control. This has saved London-Sumatra $400,000 a year on hand pollination. They also believe it has increased the yield of fruit per hectare by about 7 percent and the oil

extraction rate by almost a percent. If either of those increases are accurate, they are worth millions of dollars a year. The weevil and these other techniques have spread far beyond the London-Sumatra estates and so the social rate of return on these investments is very high.

Research

The major impact of private research has been in the plantation sector. London-Sumatra managers were able to point to innovations that have saved them millions of dollars a year. Through joint research with some of the chemicals companies, they have developed low volume spraying techniques that reduce the cost of herbicide application by 25 percent. Agronomic research showed that they did not need to apply potassium in their Sumatra plantations which saved them $500,000 a year.

The impact of feed research is already starting to pay off for CP. They feel that it has enabled them to reduce the cost of producing high quality feed but were not able to give a quantitative estimate of how much they had saved.

Research by agricultural chemical companies operating in Indonesia played an important part in the commercial development of several products. One was redomil, a fungicide which is used as a seed treatment to prevent downy mildew on corn. Several rice insecticides also went through their early testing here. Research has also helped develop cheaper and more effective application methods for herbicides. Plantations now use low volume or ultra low volume applications of herbicides which reduces costs. Monsanto, over the years, has developed more effective methods of using its chemicals for control of the empirata grass in the transmigration programs.

POLICIES

Government Research

The relationship between government and the few private research and technology transfer programs seems to be quite close. The plantation research programs have joint research with the research programs of the government owned plantations and the government research institutes. The research people from the chemical companies invite the government scientists at least annually to field days and to other special demonstrations. The technical people from the seed companies are also clearly in close contact with the government scientists.

The private companies have a strong incentive to have cordial relations with government scientists who determine what the government will buy or recommend to farmers. The incentive to cooperate with government research is to get government permission or recommendations not because the companies think they can learn much from government research. In most fields, companies feel that they are more advanced than the government and have little to learn from government scientists. In addition, government research does not provide tangible benefits to research programs such as inbred lines of corn which companies can use to produce their own private hybrids. One seed company does sell a government corn variety - Arjuna - and will probably sell the new government varieties as they come out. This may provide some profits which will be used to support research, but it does not directly help private programs.

Government Ownership

The major constraint on private sector research and technology transfer has been the large role of government enterprises in both the input supply industry and the plantation industry. Until the early 1970's, all large plantations were government owned and most still are. Chemicals are distributed through BIMAS or sold to government plantations. One quasigovernment firm has a monopoly on improved rice seed. Foreign companies did not participate in the seed industry until the 1980's. The general trend since Suharto took control in the 1960's has been toward privatization. This movement has been quite slow, however, and in the pesticide industry, the government is building its own manufacturing capacity. The memory of past nationalizations may make the plantations wary about long term investments like research.

Other Policies

Government approval and recommendations were mentioned as important determinants of profits in most of the interviews I conducted. The agricultural chemicals industry is especially dependent on government policy. About 70 to 75 percent of the pesticides in the country are sold through the government input distribution program for the basic food crops called BIMAS. The pesticides in this program are highly subsidized. Farmers pay about 25 percent of the chemicals' market value. Once a product is on the approved list for this program BIMAS does the distribution and marketing of the product. Thus, in theory, companies do not have the expense of setting up their own distribution and technical advisory system. In fact, they still do

have to supplement the BIMAS system. A product that is on the list tends to be approved forever, although the amounts ordered will move up and down, depending on how much the farmers use. Companies try to influence how much farmers buy through their promotion and technical backstopping activities and making sure that their product is moving efficiently through the BIMAS system.

It is not clear how a chemical gets on the BIMAS list. At least one company made an in depth study of this process but were not able to discern any pattern. A chemical has to be registered first and then has to prove that it is effective against pests. Beyond those two basic requirements, the key seems to be a local agent who can effectively lobby to have your chemical added to the list.

The other 25 or 30 percent of pesticides is sold on the free market. This goes to plantations, vegetable producers and transmigration projects. Since a large share of the plantations are government owned PTPs which depend on government research programs for advice, government institutions play a large role in determining the chemicals used in the plantation sector. The transmigration projects are all government projects which use herbicides to clear new land of a particularly difficult weed called empirata. These herbicides are too expensive for farmers to buy and so the government buys and applies them.

Another set of policies that determine what technology companies transfer are the patent and registration policies. Indonesia has had a draft patent law pending since 1954, but the private sector does not expect it to be passed soon. There were few complaints about the pesticide registration system. Companies feel that it is quite fair and honest. They do not worry

that important confidential information will be leaked to their competitors (possibly because the information requirements are not very detailed). They also feel that they get a certain amount of protection from competition because the government does not permit more than two or three companies to sell the same chemical, and it does not allow cheap "me too" registrations. A company that wants to register a chemical has to produce its own testing results not just xerox someone else's results.

The recent entry of the government into production of active ingredients reduces the market of several of the major companies who produce the same product. The expansion of government production of pesticides clearly reduces private companies' market share. However, since the market for pesticides has increased very rapidly recently, the actual sales of the private sector are still probably growing.

The policies on agricultural chemicals clearly provides enough incentive for companies to transfer new technology and do some research. More would be done if the government permitted Ciba-Geigy to set up a second station. The effect of reducing or eliminating the pesticide subsidy would be to decrease the amount of insecticides used and, thus, profits. However, there is not much pesticides research and what there is seems to be determined by the number of new products coming out from headquarters, government registration requirements and specific problems that arise. Unless there was a major decrease in pesticide use, the reduction in pesticide research would probably be quite small.

Several government policies affect the supply and demand for hybrid corn seed. Government import barriers and purchases keep corn prices above

the world price which increases the derived demand for corn seed of any type. The government also tried to provide a subsidy on hybrid corn seed. However, they announced the program before the bureaucratic machinery was in place to implement it. As a result, it probably decreased the demand for hybrid seed rather than increasing it as intended. The government is expected to announce the end of this subsidy program in December or January.

The government requires that all seeds be tested and approved by the government before they can be sold commercially. This has not been a problem for any of the companies interviewed.

The feed industry had two major complaints. First, the price of inputs is too high. They either have to buy soy protein and corn from BULOG (the government agency which buys grain) at prices about a third above world prices or import it themselves paying taxes and duties that make the inputs more expensive than from BULOG. Their second complaint is about the 1983 Presidential Order (Kepres 50) that limited the size of commercial poultry operations to 5,000 layers and 750 broilers starting in May 1984. This was aimed at encouraging small scale producers. Instead it seems to have mainly increased inefficiency and increased the cost of production and the market price of poultry products. The feedmills feel that it has reduced the demand for feed, although the World Bank (1984) argues that it may have increased demand for feed.

Poultry breeders have been affected by the law that will soon prohibit the import of parent stock into Indonesia. This is no problem for the larger breeding operations that already were importing only grandparent or great grandparent stock, but it means that several of the smaller operations may drop out of the market.

Historically, private plantations have been periodically nationalized and returned to the private sector. The private companies at present do not seem to be worrying about nationalization but, in the long run, they must consider this possibility in their investment decisions. History would seem to dictate that they work primarily on short term problems. Therefore, there is probably less research to develop new varieties and that research is primarily being done by two foreign companies with large holdings elsewhere.

A recent policy that has caused the plantations some concern is the government's ban on the importation of foreign planting material. This ban was just established a few months back, and it is not clear how strictly it will be implemented. If strictly implemented, it could cut Indonesia off from some of the most productive oilpalm varieties in the world. This could substantially reduce foreign exchange in the future in order to make a very minor savings in foreign exchange today.

AID PROJECTS

Current Impact on Private Technology Transfer and Research

AID has contributed indirectly to the development of several of these industries through its support of the International Agricultural Research Centers. The first is the hybrid corn industry. AID funds helped support CIMMYT and Kasetsart University program in Thailand which developed the downy mildew resistant varieties and hybrids. The AID financed AARD/IRRI rice research project has led to more effective use of rice pesticides for controlling rice pests. Brown plant hopper has been controlled by resistant varieties, coordinated planting and the reduction of pesticide use. Other pests have required increased pesticides. The IRRI-DITPROP small scale agricultural equipment project has been successful in starting a thresher production industry in Sumatra based on the IRRI thresher (Johnson, et. al.). This will probably spur local minor innovation as it has in the Philippines and Thailand.

AID programs which attempt to bring together United States and Indonesian companies to transfer technology have not had much impact so far. They have been in operation for about a year and so it is too early to tell much about their potential impact.

Potential

AID support for agricultural education and research has the potential to be very important. The availability of agricultural researchers was mentioned as an important constraint by several companies. More graduates with higher degree will help this situation. As some of the more experienced scientists start to retire from the government research system and take jobs in the private sector, AID's earlier investment in the education of these men will start to pay off in the private sector.

Support for government research which releases inbred lines of corn or in the future, rice could be a spur to private sector research on these crops by local companies who do not have access to the international germplasm collections of Cargill and Pioneer. Support for government feed research might also assist small, local producers in that industry. This assistance could make these industries more competitive and help farmers get the lowest possible prices for inputs.

There still appears to be room for more assistance to intermediaries in the technology transfer process. Several individuals in Indonesian companies interviewed asked for assistance in finding new biotechnology products. They were directed to the consultants who have the AID contract to provide such information. This consultant, on the other hand, had only been contacted by American firms. It is not clear whether this was an isolated Indonesian company or whether there are opportunities for more activity here.

AID support for research on technology policy may also have the potential to influence the government to adopt policies that are more effective in meeting their goals. There was insufficient time to meet with

many policy makers, and it is not clear how much understanding there is of the impact of certain policies. It appears, however, that some policies like the ban on importing planting material of plantation crops are very short sighted. Research which shows the costs and benefits of such policies might lead to better technology policy in the future. AID may be able to have some impact on policy by supporting science and technology studies by local social scientists followed by a conference on this topic.

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