ASEAN COOPERATION: TRANSFER OF AGRICULTURAL TECHNOLOGY[1]

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ABSTRACT

Permasalahan alih teknologi, khususnya di hidang pertanian, tetap menarik untuk dikaji. Sejarah pembangunan pertanian mencatat kisah sukses alih teknologi melalui Revolusi Hijau. Hanya nampaknya disepakati bahwa alih teknologi di bidang pertanian tidak berjalan dengan "mulus" begitu saja.

Tulisan ini mencoba menelaah alih teknologi di bidang pertanian dalam lingkungan negara-negara ASEAN. Selanjutnya, juga dikaji faktor-faktor apa yang nampaknya menjadi kendala dalam proses alih teknologi. Di masa mendatang, implikasinya, dituntut upaya-upaya kerjasama antar negara-negara ASEAN yang lebih erat dalam bidang teknologi pertanian, baik melalui COFAF (Komite ASEAN bidang Pangan, Pertanian, dan Kehutanan), 1RRI, maupun SCOFH (Sub komite ASEAN dalam Penanganan Pangan).

Introduction

A contradicting argument regarding agricultural development seems prevalent. Some people believe existing technology will provide the basis for dramatic increases in agricultural output in many developing countries in five or ten or even less. While others feel just as strongly that the necessary prerequisites cannot be put in place in such a short period of time even under favorable conditions. This school of thought argues appropriate technology is not available and ready for immediate application. These prerequisites can be linked to capital investments (Martin, 1966). Few would argue with the proposition that technological innovation lies at the heart of successful agricultural development. Yet the transformation of traditional agriculture remains largerly incomplete, as more than half of the world's agricultural producers operate under technological constraints that have changed little during the twentieth century. This situation is not a concequence of lack of effort to find new technology. But more important, market and subsistence oriented fanners

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alike have shunned new technologies because they offer lower "profits" or productivity than the traditional technology. Thus the problem of technological change lies primarily with the 'appropriateness' of the new technology for the economic and biological environments of the technology-seeking country (Hillman and Monke, 1982). The failure of local institutions to develop new technologies has forced a reliance on outside or international sources, particularly the developed countries, both the private and public type. A number of historical examples suggest that imported technologies can provide benefits to the importing country. Many Europeans practices were directly transferered to the United States in the nineteenth and twentieth centuries. Early Japanese international collaboration with Germany and the Indian-British colonial relationship also proved condusive to the building of national research and extension systems and the spread of technologies (Hanrahan, 1981).

This paper reviews the technology transfer in the field of agriculture in ASEAN. An effort is made to describe the nature of the technology transfer among ASEAN countries. What factors thought to be the constraints for the transfer? ASEAN as a regional cooperation has taken many important steps toward the transfer of agricultural technology.

The Flows and Use of Knowledge

Hazel (1982) provides a useful definition of new technologies:

> If a production function Y=f(Xl.....Xn) relates the maximum crop yield per acre (Y) attainable with different but permissible combinations of inputs (Xi), such as seed, fertilizer and weeding labor, then I shall take the function f( ) to define a technology. Changes in the combinations of inputs represent movements along the production function, e.g. using more or less fertilizer, and are better described as alternative 'techniques'. However, a change in the quality of seed which leads to a structural shift in the production function, and increases the per acre yield with the same level of inputs, is clearly a 'new technology'.

The distinction by Hazel between techniques and technologies is useful because the barriers to the adoption of each are likely to be different. For example,

the availability of credit and fertilizer supplies are likely to have a much greater impact on the level of nitrogen applications per hectare than on the variety of seed chosen by the farmer. The introduction of a new technology by local innovation or transfer from outside requires advances in knowledge and changed availability of inputs. Schultz (1964) points out that the two elements are inextricably linked. Increased agricultural productivity results from sequential advances in knowledge, changes in the supply of new material inputs, and advances in producers' knowhow. Advances in knowledge are differentiated into two categories. One set consists of material things which have come from basic discoveries in the science and engineering. The advance in knowledge in this case becomes inextracably associated with the material substance. For example, knowledge with respect to genetic engineering becomes part of the genes. The other set consists of changes in farm practices. Indeed, the former set is of principal interest in this paper.

Scholars agree that agricultural technology does not transfer readily from one culture to another, and may not always be transferable from one subculture to another within the same society. There is rather widespread agreement that modern agricultural technology must be "adapted" before it can be incorporated in agricultural production in developing countries. But there is little agreement on the nature or the difficulties of this "adaptive" research, on its qualitative requirements, on the time it will require, or on the volume of "adaptive" research that will be needed. Investment that will increase the supply of land available for cultivation are ruled out of this discussion though they should not be ruled out of consideration. The problem under discussion is how to increase output-input ratios for the most common inputs - land, man-hours of labor, water, fertilizer, productive livestock, and so on. Investments with an opportunity cost and those aimed at improving the decisionmaking environment have one thing in common. Both involve information.

Let us, then, take a look at how does information flow by repeating the work of Martin (1966). Figure 1 illustrates the flow of knowledge believed to be most relevant to agriculture. The rectangles represent *major social processes*; the circles represent stocks. The stocks are outputs of process and are also inputs to other processes. Solid lines designate important directions of information flows; broken lines indicate other flows that may become quite important in some instances.

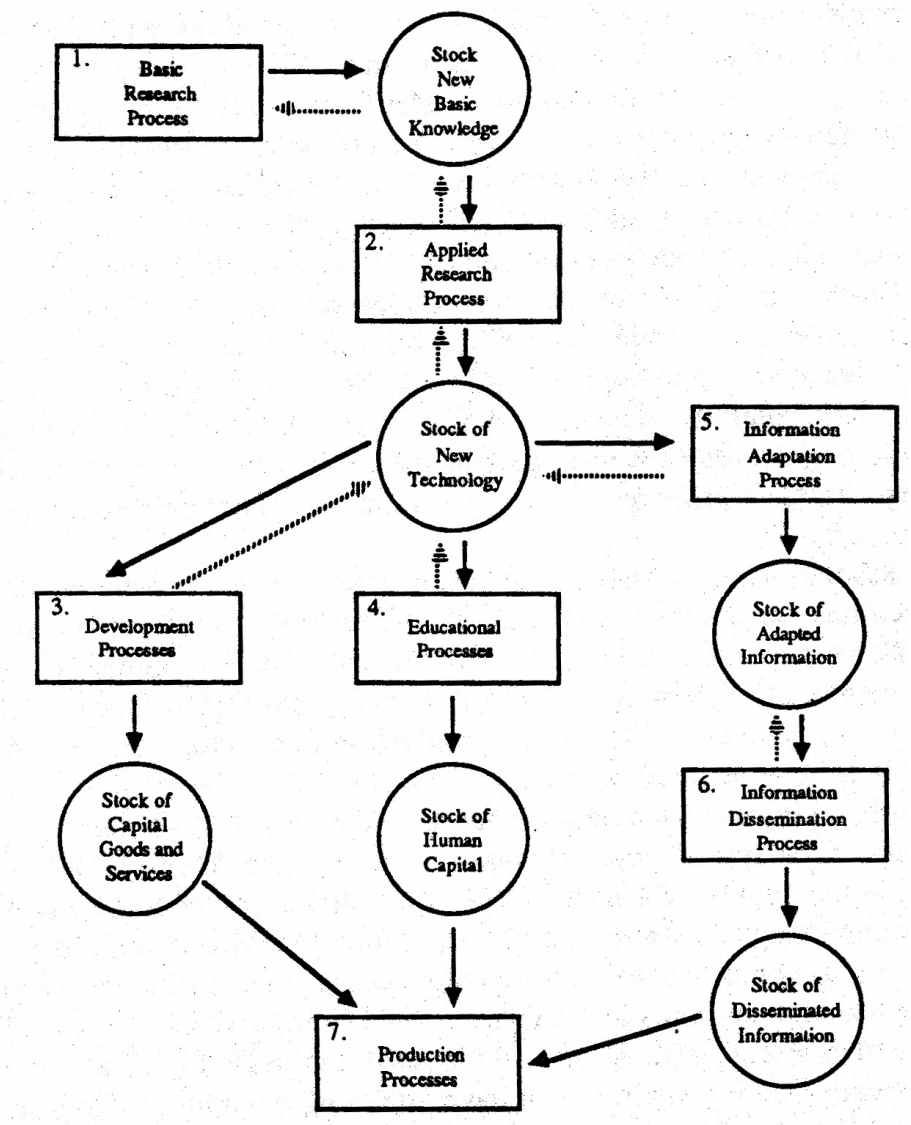

Figure 1. Hypothetical Information Processes and Flows

New knowledge is created by basic research in all fields of knowledge. It is almost always an indispensable input to applied research. Applied research produces what we have chosen to call "new technology", which becomes incorporated in the social production process through at least three paths:

1. By means of development processes that that are carried out largerly by private enterprise, new technology is embodied in capital goods and services that will be used in private and public economic activities.

2. A second path arises because the application of these more productive goods and services often requires the services of more skilled human resources, although the total human effort required per unit of output is likely to be diminished.
3. Another class of new technology consists of new knowledge that must be adapted to particular production situations before it can be incorporated directly in a production process.

Several aspects of the diagram should be emphasized. The flows are largerly intangible, in the form of information. Each of the process shown would require other sources. High level human capital would be a quite indispensible input for each of the six processes shown.

As the gravest and most lasting needs of developing societies are human capital and capital funds, closely followed by adapted technology, then developing countries can "import" some but not all of the needed basic knowledge from developed countries. What can seldom be borrowed is knowledge of the society itself-information in its social, administrative, political, and economic structures, and on its natural and human resources. The potential results from imported technology may not be reached until this information is available and in the right hands. New technology-the output of successful applied research-can seldom be applied directly in developing society.

Transfer of Agricultural Technology in ASEAN:

The ASEAN Agricultural Economies

Crop Production. Agricultural crop production within the region is basically composed of two distinct subsectors - the subsistence subsector primarily food (rice) and feed (maize) grains and the commercial subsector producing cash crops mostly for exports.

Commercial agriculture will have significant contribution to export earnings. Likewise, since majority of the agricultural population will continue to depend on rice and to a lesser extent, corn, for subsistence, these crops will continue to be important in the ASEAN agricultural economy Table 1 shows the distribution of paddy and corn production in the ASEAN. Growth in the region's crop output have come primarily from increases in area rather than yield. In contrast to the relatively more successful

technical improvements in commercial crops production, technical innovation in the subsistence crops subsector is very slow resulting in a chronically low farm yield. For examples, despite the introduction of the high yielding varieties of rice in the early sixties, yield per hectare has remained low - well below the average yields of Korea and Japan. The yield story on corn is just as bad if not even worse than rice (Table 2).

Table 1. Distribution of paddy and corn production in the ASEAN

	1970		1975		1980		1985		1988	
	Level (000 mt)	% of ASEAN	Level (000 mt)	% of ASEAN	Level (000 mt)	% of ASEAN	Level (000 mt)	% of ASEAN	Level (000 mt)	% of ASEAN
Paddy (Rough Rice)										
Indonesia	19324	48.83	22340	49.78	29652	52.44	38660	55.54	43566	57.0
Malaysia	1080	2.73	1997	4.36	1798	3.18	1895	2.77	1697	2.0
Philippines	5322	13.45	6159	23.45	7723	13.66	8300	12.14	9459	13.0
Thailand	13580	35.00	15300	33.41	17368	30.72	19521	28.55	21300	28.0
ASEAN	39850		45796		56541		68376		76022	
Corn										
Indonesia	2825	39.40	2903	34.77	3991	39.48	5300	39.11	6324	31.0
Malaysia	7	0.10	14	0.17	8	0.08	24	0.18	34	
Philippines	2400	33.47	2568	30.76	3110	30.76	3542	26.14	4522	30.0
Thailand	1938	27.03	2863	34.30	3000	29.68	4686	34.58	4456	29.0
ASEAN	7170		8348		10109		13552		15336	

Note: Brunei's paddy and corn production if negligible.
Source of Data: FAO, Production Yearbook.

Table 2. Productivity in rice and corn (kg/ha)

	1970	1975	1980	1985	1989
A. Rice					
Indonesia	2040	2575	3293	4052	4228
Malaysia	2380	2937	2883	2807	2668
Philippines	1780	1737	2155	2250	2705
Thailand	1870	1825	1909	2037	2077
Brunei	2220	1538	2355	1500	1250
Japan	5640	6186	5128	6225	6168
Korea	4600	5324	4308	6350	6749
B. Corn					
Indonesia	920	1079	1459	1893	2130
Malaysia	1710		1143	1600	1838
Philippines	980	1294	957	1037	1296
Thailand	2390	2562	2245	2462	2485
USA	4500	5413	5711	7406	7023

Source: FAO, Production Yearbook.

In view of the closed land frontiers in some of the member countries, the yield constraint problems must be removed if the region hopes to produce enough food for its growing population. Similarly, socio-economic constraints must be dismantled. Since one of the reasons for low yiled is the low levels of fertilizer application due to unfavorable fertilizer-price ratio, some adjustments in farm price incentives must be done.

Substantial post harvest losses reaching as much as 20-30 per cent compound the problem of low levels of productivity in the ASEAN grains subsector. This phenomenon is due to mainly to the lack of post harvest facilities such as storage, transportation, drying and processing. In the rural areas for example, drying is done mostly in concrete pavements, something that is not possible during the wet season.

The Livestock Subsector. The livestock subsector serves as an important link between the crops subsector (feeds source) and the agro-processing subsectors (meat processing and feed milling). Although it is not as yet as important as the crops subsector in terms of value added, its significance is expected to grow as demand for meat increases resulting from the increase in per capita incomes in the member countries.

ASEAN's capacity to produce more meat, especially the nonruminants, depends on its capacity of producing more feedstuffs notably maize. Table 3 shows the human and livestock population in the ASEAN. While Table 4 shows the trade of selected livestock products in the ASEAN.

Table 3. Human and livestock population, ASEAN, 1980,1985 and 1989 (thousand heads of livestock; million people).

	CATTLE		HOGS		CHICKENS		
	Total	% of Total	Total	% of Total	Total	% of Total	HUMAN
1980							
Indonesia	6480	50.5	3018	17.7	114000	37.5	148.0
Malaysia	529	4.1	1813	10.7		17.6	13.8
Philippines	1883	14.7	7934	46.7	53620	19.1	48.3
Thailand	3938	30.6	3021	17.8	63264	20.8	46.5
Singapore	4	*	1200	7.0	13883	4.6	2.4
Brunei	4	*	14	0.1	1221	0.4	
TOTAL	12838		17000		303989		
1985							
Indonesia	6859	48.5	4050	20.9	144000	41.5	165.2
Malaysia	570	4.0	2100	10.8	55000	15.8	15.7
Philippines	1900	13.4	8007	41.4	57000	16.4	54.7
Thailand	4800	34.0	4300	22.2	79000	22.8	51.3
Singapore	1	*	810	4.2	10000	2.9	2.6
Brunei	4	*	76	0.5	2000	0.6	
TOTAL	14134		19343		347000		
1989							
Indonesia	10050	57.6	6700	30.6	435000	65.7	179.8
Malaysia	639	3.7	2350	10.7	59000	8.9	16.9
Philippines	1482	8.5	7809	35.7	66000	10.0	61.0
Thailand	5285	30.3	4679	21.4	95000	14.3	55.0
Singapore	-	-	321	1.5	4000	3	2.7
Brunei	1	-	23	-	3000	-	0.25
TOTAL	17457		21882		662000		

* less than 0.1 percent.

Source of Data: FAO, Production Yearbook.
Key Indicates of DMC of ADB.

Table 4. ASEAN exports and imports of selected livestock product, 1985,1989

	Chicken Meat		Pork		Bovine Meat		TOTAL	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
							1985 (mt)	
Brunei	_	4000	_	300		300	_	4600
Indonesia	_	100	-	_		1500	-	1600
Malaysia	_	5000	_	140	-	15000	_	20140
Philippines	-	75	94	454		1677	94	2206
Singapore	5583	39979	394	7000	485	10403	6462	57382
Thailand	44010	27	50	-	6	176	44066	203
							1989 (mt)	
Brunei	3000	8500	_	300	-	12000	3000	20800
Indonesia	-	45	10	1	-	22481	10	22527
Malaysia	1600	3000	_	100	560	25000	2160	28100
Philippines	_	'96	212	2462	-	11563	212	4121
Singapore	13095	47734	357	8301		1717	13452	- 57572
Thailand	97952	62	36	1	628	10434	98616	10497

Source: FAO, Trade Yearbook.

Cooperation Among ASEAN Member Countries in Agricultural Technology

Our short observations in the previous section serve to underscore the importance of cooperation among the member countries. Technology development to improve productivity is costly, hence, it will less painful, budgetary-wise if the ASEAN countries solved their technological woes together. In a similar manner, the growing agricultural protectionism among industrial countries could be more effectively counterbalanced if the member countries acted together. As a group, they would have a better leverage in the trade negotiating trade.

Operationally, ASEAN, work through committees in the identification and implementation of cooperative undertaking. For agriculture, food and forestry, the ASEAN Committee on FOOD, Agriculture and Forestry (COFAF) is the workhorse. This committee in turn works through a system of sub-committees and coordinating boards/council (Figure 2).

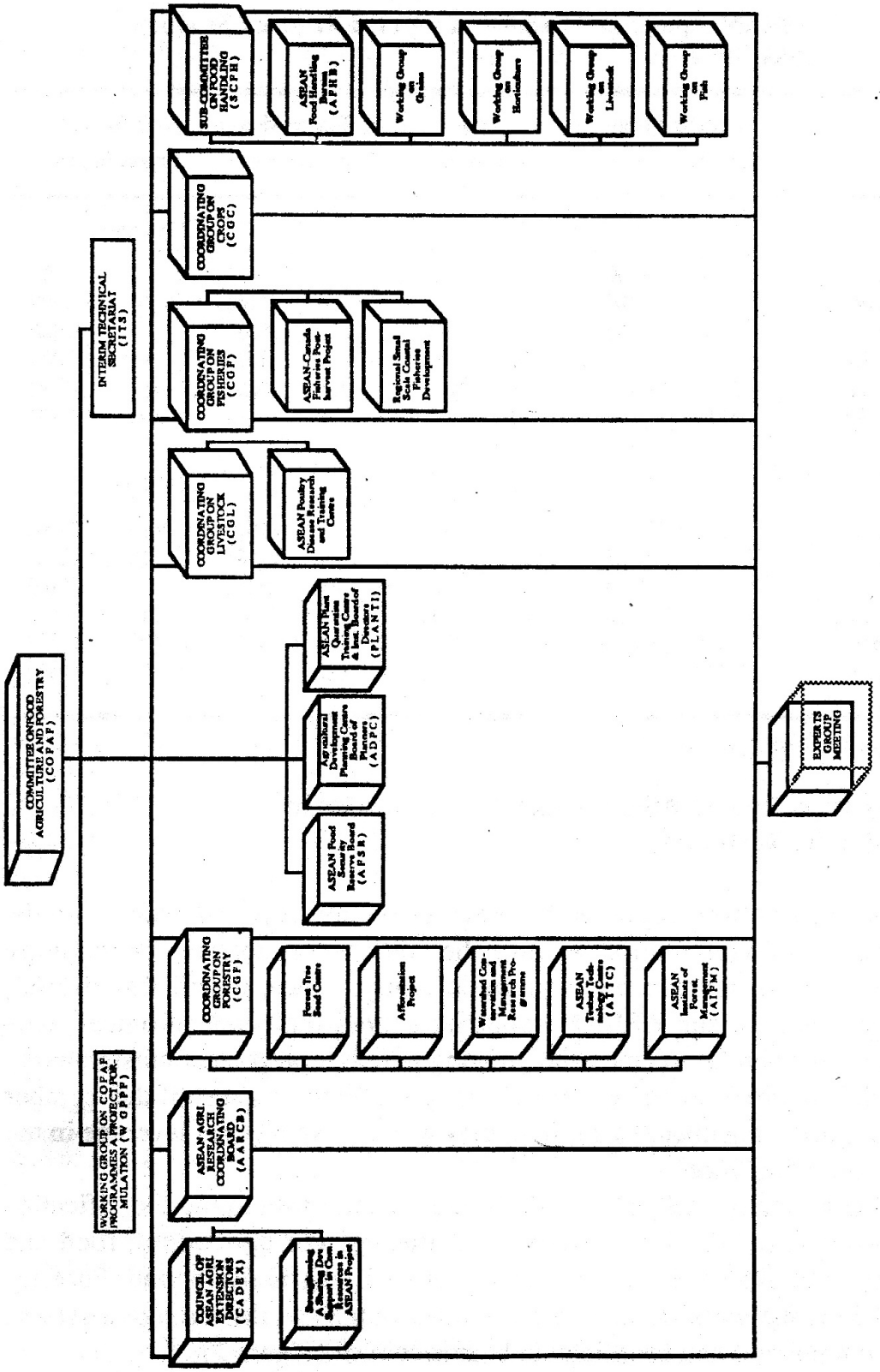

Figure 2. Organizational Chart of COFAF

Based on COFAF classification, in 1988 a total of 44 cooperative projects have been identified - 6 in food, 8 in agriculture, 12 in forestry, 8 in livestock 8 in fisheries and 1 cooperative (Table 5). Most of the projects approved are not short duration in nature. It should be noted also that the bulk of the funds to support the cooperative projects come from donor countries outside the region. Table 6 shows a list of approve COFAF projects, while table 7 and 8 shows the number of COFAF projects by host country and by donor respectively.

Table 5. Number of COFAF projects by type of activity, 1985, 1988

	On-going	Completed	Not yet implemented	Total
1985				
I. Food	3	—	3	. 6
n. Agriculture	4	1	6	11
m. Cooperative	-	-	-	
IV. Forestry	4	2	8	14
V. Livestock	-	1	7	8
VI. Fisheries	-	-	6	6
VII. Extension ,	-	-	-	—
	—	—	—	—
	11	4	30	45
1988				
I Bood	4	-	2	6
II Agriculture	4	1	3	8
III Cooperative	-	-	1	1
IV Forestry,	4	1	7	12
V Livestock	3	-	4	7
VI Fisheries	2	-	6	8
VII Extension	1	-	1	2
	—	—	—	—
	18	2	24	44

Table 6. List of approved COFAF projects

	PROJECT	STATUS as of 1985	STATUS as of 1988	HOST	DONOR	Funding ASEAN	Funding DONOR	DURATION
I.	POOD							
	ASEAN Food Security Reserve (AFSR)	Ongoing	Ongoing	ASEAN	UNDP		US$345,000	15 months
	ASEAN Food Handling	Ongoing	Ongoing	Malaysia	Australia		A$2,810,000	1979-185
	ASEAN Small-Scale Agro-Engineering Postharvest Technolog y Project (AGROTECH)	Not yet implemented	Withdrawn	Japan	Malaysia		US$5 M	3 years
	ASEAN Food Security Reserve Study Project	Not yet implemented	For FAO funding starting 1991					
	ASEAN Post-Harvest Exchange Regional Information Network Project (APEX)	Not yet implemented	Ongoing	ASEAN			US$1.24 M	3.5 years
	ASEAN Crops Post-Harvest Programme	Ongoing	Completed	Philippines	IDRC, CIDA, USAID, DTH, UNDP		US$838,500 to be equally shared by donors	Oct. 1983-Sept. 1986
	ASEAN-Canada Grains Post-Harvest Project		Not yet implemented					
	ASEAN Aflotoxin Control Program		Not yet implemented	ASEAN	Unfunded		US$6,218,100	US$7,836,900
II.	AGRICULTURE							
	The Study on Supply and Demand for Food and other Strategic Agricultural Products	Completed	Completed	Indonesia	UNDP			May 4, 1979-Dec. 31, 1984
	ASEAN Agricultural Develop ment Planning Centre (ADPC)	Ongoing	Ongoing	Thailand	USAID	US$1 M	1980–1985	
	ASEAN-EEC Collaborative Programme of Grain Post-Harvest Technology	Ongoing	Completed	ASEAN	EEC		EUA4,300,000	3 years
	Centre for Irrigation System Management for ASEAN (CISMA)	Not yet implemented	Reformulation of proposal	Philippines	Australia		US$3,780,000	
	Plant Quarantine Training Centre and Institute (PLANTI)	Ongoing	Ongoing	Malaysia	USAID	US$2.7 M	US$5,440,590	1981-1985
	Pesticide Management Integrated Pest and Control	Were integrated into ASEAN Pesticide Mgt. & Integrated Control	Were integrated into ASEAN Pesticide Mgt. & Integrated Control		Unfunded			
	Rodent Control							

Table 6. List of approved COFAF projects (cont'd)

	PROJECT	STATUS as of 1985	STATUS as of 1988	HOST	DONOR	Funding ASEAN	Funding DONOR	DURATION
	ASEAN Pesticide Management and Integrated Pest Control	Not yet implemented	Withdrawn	Philippines	Japan		US$17.9 M	5 years
	ASEAN Project Formulation, Monitoring and Evaluations (APFME)	Ongoing	Ongoing	Indonesia	UNDP	US$70,000 (in kind)	US$481,420	3 years, 3 months
	ASEAN New Zealand and Regional Seed Technology Centre	Deleted	Deleted					
	Strengthening Development Support Communication Resources in ASEAN	Not yet implemented	Not yet implemented	Indonesia	UNDP	(in kind)	US$240,000	1984–1985
	ASEAN Centre for the Development of Agricultural Cooperation (ACEDAC)	Not yet implemented	Not yet implemented	Indonesia	EEC	(in kind)	US$1,008,000	
	ASEAN Agricultural Development Planning Centre, Phase II	Not yet implemented	Ongoing	Thailand	USAID		US$5,376,000	5 years
III.	COOPERATIVE							
	ASEAN Centre for the Development of Agricultural Cooperatives (ACEDAC)		Not yet implemented	Indonesia	EEC		US$1,008,000	
IV.	FORESTRY							
	ASEAN-Canada Forest Tree Seed Centre	Ongoing	Phase II under negotiation	Thailand	Canada	C$1.4 M	C$1.5 M	5/1/81–9/30/84
	Forest Tree Improvement Centre	Not yet implemented	Completed	Thailand		US$250,000 (in kind)	US$2.47 M	3 years
	ASEAN-New Zealand Afforestation Project (ANZA P)	Ongoing	Completed	Philippines	New Zealand			
	Watershed Conservation and Mgt. Research Programme	Ongoing	Completed	Philippines	USAID		US$3 M	5 years
	Regional Study for Commercialization of Timer Resource in ASEAN	Completed	Completed	Malaysia	EEC		EUA300,000	6 mos start 4/82

Table 6. List of approved COFAF projects (cont'd)

	PROJECT	STATUS as of 1985	STATUS as of 1988	HOST	DONOR	Funding ASEAN	Funding DONOR	DURATION
	ASEAN Timber Technology Centre	Not yet implemented	Ongoing	Malaysia	EEC		6 M	5 years
	ASEAN Packaging Research and Dev't.	Not yet implemented	Not yet implemented	Phillipines			US$224,941	4 years
	End Use Survey of ASEAN Wood Products	Completed	Comleted	Malaysia	New Zealand			
	ASEAN Institute of Forest Mgt.	Not yet implemented	Not yet implemented	Malaysia	Canada		US$3.6 M	
	ASEAN Extraction of Small Dimension Logs	Not yet implemented	Not yet implemented	Malaysia	Canada	M$1.06 M	M$1.94 M	3 years
	Forest Fire Control	Not yet implemented	Deleted from COFAF	Thailand			US$245,500	1978-1982
	Samwilling Research and Trng. Centre Project Scholarship, and Consultante	Incorporated in ASEAN Timber Tech. Centre	Incorporated in ASEAN Timber Tech. Centre	Philippines	Japan	US$42,788	US$123,000	5 years
	ASEAN-UNDP Standardization Grading Rules & Specific-ations for Timber	Ongoing	Ongoing	Malaysia	UNDP		US$428,000	3 years
	Forest for Rural Community Development Centre	Not yet implemented	Not yet implemented	Indonesia	Australia		US$6,062 M	5 years
	ASEAN Timber Bureau	Not yet implemented	Not yet implemented	Malaysia	Japan	US$331,000 + US$1.5 M	US$3,189 M	5 years
	ASEAN Rattan Reneration Center		Not yet implemented	Indonesia	Unfunded	US$1 M	US$4 M	5 years
V.	LIVESTOCK							
	Training of Trainers for Dairy Production in ASEAN	Not yet implemented	Ongoing	Malaysia	New Zealand	US$1,405 M	US$2.11 M	5 years
	Duck Disease Research & Training Centre	Not yet implemented	Not yet implemented	Thailand	Unfunded		US$767,600	5 years
	Veterinary Administration Devt. Programme (VADP)	Completed	Completed	Thailand	New Zealand	(in kind)		1978-1983
	ASEAN Poultry Disease Research and Training Centre	Not yet implemented	Ongoing					

Table 6. List of approved COFAF projects (cont'd)

	PROJECT	STATUS as of 1985	STATUS as of 1988	HOST	DONOR	Funding ASEAN	Funding DONOR	DURATION
	Pig Health and Production Resource Centre (PHPRC)	Not yet implemented	Not yet implemented	Singapore	GTZ		US$6.5 M	5 years
	Upgrading of ASEAN National Quarantine Centre	Not yet implemented	Not yet implemented	ASEAN		US$5 M	US$4.8 M	5 years
	Eradication of Foot and Mouth Disease in ASEAN	Not yet implemented	Ongoing	ASEAN			A$15 M	5 years
	Buffalo Research and Development Centre	Not yet implemented	Not yet implemented	Philippines			US$10 M	5 years
VI.	FISHERIES							
	Regional Project for Fisheries Resource Evaluation	Not yet implemented	Not yet implemented	Thailand	UNDP		US$7.9 M	5 years
	Aquaculture Development and Coordinating Programme	Not yet implemented	Ongoing	Thailand	EEC	ECU2.39 M	ECU8.94	3–6 years
	ASEAN-Canada Fisheries Post Harvest Technology	Not yet implemented	Not yet implemented	ASEAN	Brunei/ Canada	C$9.84 M	C$14.03 M	5 years
	ASEAN Fish Quarantine Project	Not yet implemented	Not yet implemented	Philippines	UNDP	US$1.593 M	US$5.3 M	3–5 years
	Training in Monitoring Control and Surveillance of Fisheries in EEZ	Not yet implemented	Ongoing	Indonesia	Canada		US$2.763 M	1983–1985
	ASEAN Small-Scale Fisheries Project	Not yet implemented	Not yet implemented	Philippines	UNDP		US$669,500	1984–1985
	Marine Resources Assessment in the ASEAN		Not yet implemented	Thailand	EEC	ECU30,000	ECU497,770	2 years
	ASEAN Small-Scale Coastal Fisheries Development Project		Not yet implemented	Philippines	UNDP		US$544,000	2 years
VII.	EXTENSION							
	Strengthening and Sharing of the Dev't Support Communication in ASEAN		Ongoing	ASEAN	UNDP	(in kind)	US$240,000	2 years
	Development and Implementation of Modular Training on Farm Mechanization in ASEAN		Not yet implemented	Thailand	EEC	(in kind)	US$2.29 M	3 months

Table 7. Number of COFAF projects by activity and by host country, 1988

Activity	Host						
	Phil.	Mal.	Thai.	Ind.	Sing.	Bru.	ASEAN*
Food	1	1	–	–	–	–	4
Agriculture	1	1	2	3	–	–	1
Cooperative	–	–	–	1	–	–	–
Forestry	3	5	2	2	–	–	–
Livetock	1	1	1	–	1	–	3
Fisheries	3	–	3	1	–	–	1
Extension	–	–	1	–	–	–	1
Total	9	8	9	7	1	0	10

*Implemented by the ASEAN Secretariat

Table 8. Number of COFAF projects by type of activity and by donor, 1988

Donor	Food	Ag.	For.	Coop.	Fish.	Lives.	Ext.	Total
Australia	1	1	1	–	–	–	–	3
Canada	–	–	3	–	2	–	–	5
EEC	–	2	2	1	2	–	1	8
IDRC	1	–	–	–	–	–	–	1
Japan	–	1	2	–	–	–	–	3
Germany	–	–	–	–	–	1	–	1
New Zealand	–	–	1	–	–	1	–	2
UNDP	1	2	1	–	4	–	1	9
USA	–	3	1	–	–	–	–	4
	3	9	11	1	8	2	1	36

As a whole, our inventory of ASEAN cooperative on food, agriculture and forestry, however, show that not one among the approved projects is a serious effort to increase levels of productivity (Cabanilla, 1988). Projects on integrated pest management and irrigation system management are underway but it appears that the region as a whole, is bent on depending on International Organization (e.g. IRRI) for the development of superior genetic crop varieties although some member countries are alloting some budget for genetic improvement in food crops. As a long term solution to the low productivity problem, the area of genetic materials must be considered by the ASEAN. It must be borne in mind that while the role of international organizations such as IRRI are geared towards this effort, however their activities are not specifically geared for ASEAN.

Increased food production in ASEAN countries will depend mostly on an increase in the crop yield per hectare and the number of crops produced per year. Emphasis on the generation of agricultural technology that increases annual output per hectare will, therefore, continue. As long as rice production is concerned the role of the International Rice Research Institute (IRRI) in transfering rice technology to ASEAN countries is so extremely important. Hence, the cropping system research methods also developed by IRRI in collaboration with national programs represent a multicommodity, environment-conditioned approach to agricultural research. The Cropping Systems Research Network, with its focus on rice-based cropping systems, is an excellent example of the interaction that can exist between national research and national research programs in the ASEAN.

Field visits by officials and farm leaders to ASEAN member countries are important in understanding the variety of farm technologies available in the member countries; the so-called *surjan* system which was borrowed from Indonesia for example, is introduced. The system provides soil and water environments conducive to high yields of rice and of the rainy season, upland crops grown on raised beds with good drainage and yield remarkably well, while rice grows well in the wet depression. In the dry season, the upland crops are shifted to the depressions and are provided with good soil moisture (Brady, 1982).

The transfer of technology in agriculture can be best illustrated for Indonesian case. Much of the Green Revolution technology was imported, developed at

international centers/ IRRI. Indonesia made admirable strides in organizing systems to adapt and implement this technology for rice and to a lesser extent, a secondary food crops. But, for the other food, feed and industrial estate crops this well is nearly dry although to some extent the transfer of technology exists in the field of holttculture between Thailand and Indonesia and in the area of plantation crops - palm oil and rubber - between Malaysia and Indonesia. Lately, through SCOFH (ASEAN Sub-Committee of Food Handling) the new technology in food handling has been intensively introduced in the ASEAN member countries. Projects to improve grain bulk handling, cold chain for agriculture produce, and fluidized bed drying on paddy, just to name a few, are some current SCOFH project activities. Compared to the technology available for pre-harvest, the post harvest technology is more limited.

Closing Remarks: Challenges Ahead

More than in the immediate past, technology for food and related crops will have to come from domestic research arid development. As well extension systems, which have been responsible for the success with the imported green revolution technology have evolved with a specialized structure. Redirecting the research and extension programs to a more domestically produced technology for agriculture implies fundamental changes in organization and philosopy.

In redirecting the research to a more domestically produced technology we are faced with many problems. Investment in agricultural research and development retained a low priority in the allocation of government expenditure. In addition to lagging investments, a second set of reasons for the absence of local innovation in agricultural technology revolves around t lack of economic incentives for researchers and scientists. And lastly the factor most limiting the expansion of the domestic research processes is lack of weel-trained, dedicated, and creative individuals. And this short supply of trained people is partly also the result of the two limiting factors mentioned earlier.

A related major concern for technology development and adoption involves the impact of die reforms underway in the economy. This implies that some of the technology development and the services to initiate adoption will be supplied by the private sector. There are, however, some perhaps obvious principles that should guide

the organization and regulation of technology development and adoption services by government. First, whether the technology services are provided by private industry or the public sector, the consumers will ultimately pay. Private firms must ultimately recover their investment. Public investments are supported by tax revenues. Of course, these observations abstract from questions of leakage through trade and international sharing. The point is, however, that private sector development of technological services is not a panacea.

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