XD-ABA-874-A
ISN 66091

Agricultural Techonology Transfer Project Evaluation

FINAL REPORT

Prepared by

PacMar, Inc.

Pacific Management Resources

September 1989

BASIC PROJECT IDENTIFICATION DATA

1. Country: Thailand

2. Project Title: Agriculture Technology Transfer

3. Project Number: 493-0337 (Grant and Loan)

4. Project Dates:
   a. First Project Agreement: Sept. 20, 1984
   b. Final Obligation: FY93 (planned)
   c. Project Assistance Complete Date (PACD): 12-31-92

5. Project Funding
   a. AID Bilateral Funding (Grant $6,787,092 and Loan $8,000,000)
   b. Other Major Donors: None
   c. Host Country Counterpart Funds: more than 25%

   TOTAL: USAID $14,487,092

6. Mode of Implementation: Host Country

7. Project Design: involved USAID/BKK, MOAC/PS OFFICE, DTEC, MOF/FISC POLICY, NESDB, BOB

8. Responsible Mission Officers (for full life the project)
   a: Mission Directors: Bob Halligan, John Eriksson
   b. Project Officers: John Foti, Dave Delgado, Thongkorn

9. Previous Evaluation: Dr. Sopin, 1987 (admin only)

10. Cost of Present Evaluation: $43,000

		Person Days	Dollar Cost
a.	Direct Hire: USAID		
	(1) AID/W TDY	0	0
	(2) USAID staff	10	in kind
b.	Contract		37,000
c.	Other	RTG 30	in kind

LIST OF ACRONYMS

ATT	Agricultural Technology Transfer
BOB	Bureau of the Budget
BRU	Biopolymer Research Unit
BWFD	Brackish Water Fisheries Division
CIMMYT	Centro Internacional de Mejoramiento de Maize y Trigo
CMU	Chiengmai University
CRSPs	Collaborative Research Support Projects
DOA	Department of Agricultural Technology
DOAE	Department of Agricultural Extension
DOF	Department of Fisheries
DOLD	Department of Livestock Development
DTEC	Department of Technical and Economic Cooperation
FAO	UN Food and Agriculture Organization
FMD	food and mouth disease
FTDD	Fishery Technological Developmet Division
GMP	Good Manufacturing Practices
GTZ	German Agency for Technical Cooperation Ltd.
HS	haemorrhagic septicemia
IDRC	International Development Research Center
JICA	Japanese International Cooperation Agency
KU	Kasetsart University
LNO	Lam Nam Ooon irrigation project
MOAC	Ministry of Agriculture and Cooperatives
MOF	Ministry of Finance
NADC	Northern Agricultural Development Center
NESDB	National Economic and Social Development Board
NICA	National Institute of Coastal Aquaculture
NIFI	National Inland Fisheries Institute
PASA	Participating Agency Service Agreement
RID	Royal Irrigation Department
SEAFDEC	Southeast Asian Fishery Development Center
STDB	Science and Technology Development Board
SU	Srinakharinwirote University
TMZ	Thai Milking Zebu
TARC	Tropical Agriculture Research Center
UNDP	United Nations Development Programme
USAID	US Agency for International Development
USDA	United States Department of Agriculture
VOCA	Volunteers for Overseas Cooperative Assistance

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Executive Summary

EXECUTIVE SUMMARY

1. USAID Thailand. Evaluation of the Agricultural Technology Transfer (ATT) Project, 15 September 1989

2. ATT Project Purpose.

The project purpose stated in the USAID Project Paper is to accelerate the RTG and private sector capacity to identify, introduce, and manage the modern agricultural technology needed to increase yields, production, and farm income. The goal is to increase the level of technology used by Thai farmers, traders and processors, as well as scientists and subject matter specialists, so as to maintain agricultural growth and exports at levels planned by the NESDB and MOAC."

Thailand's recent economic growth, which averaged 9% from 1987-89, results from a rapid increase of manufacturing, mostly for export. However, farming and agricultural processing still account for 40% of GDP and provide the principal livelihood for 65% of the population. Thus, maintaining competitiveness in this sector is important not only to the Thai economy but to the welfare of the less privileged majority. The means of doing this is to introduce new technology, principally from the United States and through Thailand's agricultural ministry and universities, to Thai farmers and businessmen.

3. Purpose and Methodology of the Evaluation. The ATT project, originally planned for 1985-89, was scheduled to cease giving new loans and grants as of September 30, 1989. Several amendments have since increased the funding from the original $4.5 million in loan and $500,000 in grant to $8 million in loan and $4.4 million in grant. A draft amendment has been prepared, which would increase total funding by $2.06 million, all of which would be grant. The evaluation was originally to have taken place in December 1988, before the draft amendment was prepared, to indicate whether project impact justified an extension of the project and to recommend improvements in the way the project is carried out. As the project amendment has already been signed, the evaluation has focused on ways to improve the operation of the project and how to structure any similar project in the future.

In order to evaluate ATT, one American team leader and four Thai consultants interviewed 110 people, studied numerous reports on ATT and its sub-projects, and carried out site visits and individual evaluations of 16 of the 41 sub-projects which have been completed or are currently in progress. The emphasis throughout was to determine the extent to which farmers and the private sector have actually

beneftited or could reasonably be expected to benefit, from the various sub-projects. Thus, 30% of those interviewed were farmers and businessmen identified by ATT as actual or potential beneficiaries.

Top Stuff

4. Findings and Conclusions.

4.1 Impact of ATT Sub-Projects. The most successful of the sub-projects have had a substantial impact on the Thai agricultural economy. Based on the data collected and their professional judgement, the evaluation team divided the sub-projects studied into the following four categories.

BENEFITS TO FARMERS AND PRIVATE SECTOR

Category	No. Sub-projects
A. Clear, measurable benefits already	
A1. attributable to ATT	2
A2. partially attributable to ATT	3
B. Research results likely to produce benefits to end-users	4
C. Results potentially useful in the long term	4
D. Little likelihood of benefits	3

Economic impact of sub-projects in category A came in several forms. Clear evidence was found of increased farmer incomes, increased business profits, increased exports, and reduced loss from disease. ""Likely" or "potential" benefits (categories B and C) included reduction in loss from disease expected to result from projects focusing on major economic animal and plant diseases and research which accelerated development of new agricultural export products or production for import substitution. Projects were assigned to category D because (1) there was no follow-up on successful research results; (2) research was not completed; and (3) production was not sustainable due to cost, quality, and market problems.

In most instances, it is difficult to attribute the impact wholly to ATT. Seven of the sub-projects studied were built on foundations laid by previous projects or private sector activities. In other instances, the private sector would probably have responded to market opportunities without the ATT sub-project. However, it is the opinion of the evaluation team, based on statements by private end-users, that the sub-projects accelerated the use and increased the economic impact of new technologies. The following outstanding examples, already cited in several documents prepared by ATT itself, were confirmed by the evaluation team and are among the projects included in category A above.

Fish products. Export of surimi, a composite fish product made from low value varieties, has grown from 3,000 to 30,000 tons in five years, partly as a result of the sub-project's technical research and assistance to private firms

Lam Nam Oon. The sub-project established the conditions to enable private companies to promote contract farming of specialty vegetable crops worth 50 million baht by 1988/89 and still increasing.

Dairy cattle. New milk cow breed and feeding programs enabled farmers toincrease milk yields by 25%.

4.2 Progress Toward Project Purpose. The purpose in the Project Paper is stated in terms of institution-building, that is, to increase the capacity of the Thai Government and private sector to identify and utilize technology. In the judgement of the evaluation team, the project operations did not focus on this objective but rather on launching and supporting activities in support of the "goal" stated above. Thus, at the overall project level, the team discovered few specific measures taken or results achieved in building the capacity of the project secretariat. Without the ATT project, and particularly the long-term advisor, it is unlikely that the designated Government agency could or would carry on this type of activity. The advisor, however, has identified certain promising mechanisms whereby the process of technology transfer may be carried on after the project is terminated. These mechanisms involve basically strenghtening and adapting existing programs of scientific collaboration between Thailand and the US, such as USDA/PASA, VOCA long-term relationships with US universities, and USAID/CRSPs.

At the sub-project level, however, evaluators felt that in almost all cases sub-project leaders had increased their understanding of how to import needed technology and in many cases how to transfer on to end-users.

4.3 Administrative Problems and Solutions. The major implementation problem cited almost unanimously by principal investigators of the sub-projects as well as ATT administrators was that of slow and out-of-sync disbursement of the funds and resources, which come from at least three different sources, to carry out sub-projects. Researchers were further burdened by the need to report on progress and/or finances to five different agencies in five different formats. Lastly, the evaluation team found poor communication and considerable ill will between sub-project personnel and central ATT administrators.

These problems are inherent in the cumbersome regulations and procedures of the central agencies involved and are difficult to solve. If the Government and/or USAID plan a similar action-oriented research funding activity in

the future, they should avoid loan funds and look for an imlementing agency less bound by bureaucratic requirements. A private foundation, of the type which gives research grants in developed nations, would be much more suitable.

Several possible means of amelioration are proposed for the administrative problems described above. First of all, the decision to transform all additional funds into grant would eliminate one source of additional paperwork and delay. Second, it is suggested that other Departments follow the example of the Department of Fisheries in assigning administrative tasks of sub-projects to their respective Finance and Planning Divisions. Third, the role of the project secretariat should be re-defined as facilitating, rather than controlling, the implementation of sub-projects. Improved sub-project design and selection criteria (see below) should reduce the need for control.

Several constraints were found to reduce the impact of ATT and its sub-projects on private end-users. Five proposals were found to contain no specific provisions for extension of research results to the target users. Six research projects were designed by technical experts without realistic perception of the practical problems facing farmers and businessmen or the cost/benefit ratio of the technology developed. To improve the impact of the sub-projects, ATT should more thorough preparation of sub-project proposals. Potential benefit to end-users must be clearly indicated and the means of extending research results to end-users must be articulated in the proposal. A further conclusion is inescapable that for practical, results-oriented research like that sponsored by ATT, a multi-disciplinary approach is essential. A common element of effective sub-projects was either a multi-discplinary perspective on the part of the project leader or a multi-disciplinary team of researchers. In particular, more emphasis on economic analysis is needed in the design and implementation stages.

4.4 Role of the Private Sector. If ATT resources could be allocated in direct response to demand from the private sector, activities would have a more immediate and stronger impact on agricultural growth and exports. The involvement of the private sector could be increased by involving agri-businessmen from the beginning, that is, at the sub-project identificaion stage. There are numerous means through which this could be brought about. At the very least, no proposal should be accepted before the proposer and the Secretariat have discussed it with a sample of prospective end-users, be they businessmen or targetted farmers. In addition, a sub-committee is needed in which agri-businesmen are in the majority with the task of generating sub-project concepts. Government officials should sit on the sub-committee to apprise the businessmen of the availability of relevant research resources. As a further measure, the Federation of

Thai Industries would be happy to assist in publicizing the ATT resource.

4.5 Fields of research. ATT has funded research on a wide range of agricultural products - from artificial crab to baby corn - and a similar range of innovations, including new techniques of farm production, processing, post-harvest care, and marketing as well as control of diseases which seriously reduce agricultural income. This openness and flexibility is seen as one of the project's strengths, and the evaluators would discourage any measures to narrow its range. The choice of sub-projects should not be confined by the "policy framework" of Government agencies or USAID policies. These policies emerged from planning exercises which took place one or more years ago, when many of today's problems, opportunities, and technological solutions were not foreseeable.

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Brief Background on the ATT Project

MAIN REPORT

1. BRIEF BACKGROUND OF THE ATT PROJECT

The Agricultural Technology Transfer Project (ATT) was designed to identify, adapt and disseminate technology which will benefit farmers and agri-businesses and, therefore, the growth of the agricultural economy of Thailand. The project provides loan and grant funding to the Thai Government to finance applied research activities carried out by highly qualified technical professionals in the Ministry of Agriculture and Cooperatives (MOAC) and in Thai unversities. The project is administered by the Permanent Secretary of MOAC, and the Projects Division in the Permanent Secretary's office serves as the ATT secretariat.

The original project agreement, signed in July 1984, provided US $4.5 million in loan and $500,000 in grant to finance research projects during the period FY1985 through FY1989. Several amendments have since increased the funding to $8 million in loan and $4.5 million in grant, and an amendment signed in August 1989 increased funding by another $2.06 million, all grant. To date, 41 projects have been approved and financed. (See Appendix for complete list of sub-projects.) Loan funds have been used for laboratory and other equipment, materials and operating expenses, and the hiring of non-official staff for the research projects. Grant funds have been used for training, including study tours, and short-term technical assistance, mostly from the United States. Researchers, including university staff, are all Government officials, and their salaries and other expenses are paid out of the regular Government budget.

Sub-Project Impact and Achievement of ATT Goals

2. SUB-PROJECT IMPACT AND ACHIEVEMENT OF ATT GOALS

2.1 Overall Impact

Despite the complexity of ATT and the serious administrative problems encountered (see chapter 4 below), the project and some of the research it sponsored seem to have had a substantial impact. The following table is an attempt to categorize the sub-projects studied in terms of how well they fulfilled the stated goal of ATT "to increase the level of technology used by farmers, traders, and processors." It shows a reasonable distribution of sub-projects from those with clear measurable impact on agricultural growth to those with little likelihood of producing benefits. Although it remains difficult to quanity the benfits and compare them with the costs of the various sub-projects, the distribution shows that a large number of sub-projects will indeed generate benefits in the private agricultural sector.

BENEFITS TO FARMERS AND PRIVATE SECTOR

Category	No. Sub-projects
A. Clear, measurable benefits already	
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The extent to which each sub-project realized the ATT goal is briefly described in section 2.2 below. If we include the factory to be built to produce hoof and mouth vaccine using the oil adjuvant base recommended in sub-project 012 (HS Vaccine), ATT may be said to have encouraged investments of over 1 billion baht. The total number of individual farmers reached in training and extension probably reached 10,000, and some of the technologies introduced will presumably spread by themselves. The incomes of affected farmers increased by 7,000 baht per year (about 30%) in Lam Nam Oon and 15-20% in the Chiengmai dairy sub-project, and gross incomes doubled for mangosteen farmers in Chantaburi. Increases in Thai agricultural exports may be traced to the Lam Nam Oon, fruit and vegetable, and fish products sub-projects.

At the same time, 11 of the 16 sub-projects have as yet had no measurable economic impact. Of these, four were projects seeking long-term solutions to widespread, costly

plant and animal diseases which may be of significant benefit in the future. Only three of the 16 sub-projects studied were, in the view of the evaluation team, unlikely to have any impact. This can be variously explained by impractical technologies and weak project design.

2.2 Impact by Sub-Project

The following section describes, to the extent data was available, the impact of each sub-project in terms of

(a) extent of adoption by end-users; and

(b) benefits or expected benefits to the end-users and the agricultural economy.

Background and further detail on these sub-projects are presented in the Appendix containing Sub-Project Evaluations.

02. Soybean Seed

There has been no adoption of the technology because it has yet to be successfully demonstrated. The germination rate of seed dried by the closed circuit dryer was unacceptable. The technique has not yet been able to produce marketable seed at any cost.

At the same time, several major private seed companies have started to produce soybean seed commercially, using traditional dryng methods. One company indicated it would use the closed circuit system if it proved to reduce cost of production. If the system could be perfected there would be a savings on the estimated 80 million baht presently spent on soybean seed annually. The sub-project rationale implies a second type of benefit, that is that a reduction in seed cost and/or increase in availability would stimulate considerable expansion in the current annual bean production of 300,000 - 400,000 tons worth 2-3 billion baht. This assumption could be questioned.

003. Aflatoxin

When world demand for corn is low, importing countries tend to use claims of aflatoxin to lower the price of Thai maize or ban imports entirely. The ATT sub-project joined in efforts to organize maize exporters, traders, and farmers to attack the problem. Because of th active involvement of several parties, in particular the Thai Maize Traders Association, it is difficult to measure the impact of ATT alone.

The sub-project introduced four technologies, three of which were at least partially adopted. The first, which was not successful, was an inexpensive bamboo bin, called the "crib dryer," which was intended to facilitate mmaize-drying on the farm. The second was field-drying by leaving cobs on the plants for three weeks after maturity. This was difficult for farmers who grew a second rainy season crop and needed to plow their fields quickly. Given proper incentives by middlemen, however, some farmers probably adopted the practice when convenient. Chemical control in silos was adopted by several large exporters following successful testing by the sub-project laboratory. And the sub-project was primarily responsible for establishing the only accepted, standard testing facility for aflatoxin contamination in Thailand.

004. Fruit and Vegetable

The project focussed on improving quality and storage life of numerous types of fresh produce destined for export and had particular impact on the export of mangos, mangosteen, and papaya. It is estimated that a total of 700 farmers and 20 exporters were exposed to new technologies through the project, and more than half of each group adopted the project's recommendations. Mango and mangosteen farmers learned how to harvest, handle, and pack the fruits to maintain export quality. Methods of chemical treatment extended the life of the fruit, and the project taught exporters to use styrofoam trays and to shrink-wrap fruits individually to meet the exacting requirements of specialty produce departments in foreign super-markets.

The project recently made a test shipment of "egg" bananas to Europe, opening the way for considerable increase of fruit exports in the future.

006. Fish Products

The sub-project developed processing technology for surimi, a composite fish product made up of low value fish varieties which are processed into higher value products, especially imitation crab meat, for which there is a very strong demand in Japan. These technologies were disseminated through organized training programs and through frequent consultations with private companies. The number of surimi processors increased from two to twelve during the original sub-project period, 1985-87, partially as a result of the promotion and assistance of the sub-project, which is recognized by the industry as the center for techical information on this subject in Thailand. Exports increased from 3,000 tons in 1985 to 30,000 tons in 1989. Value added is estimated at 20 bt/kg or a total of 600 million baht in 1989.

The sub-project also worked on improved tecniques of frozen shrimp for export. Four companies adopted improved practices recommended by the sub-project for post-harvest care and processing of shrimp to reduce contamination and loss from rejection by importing countries. Another component focused on traditional fermented fish products (pla ra; pla som). This component seems to have had less impact because farmers were not interested in changing their traditional production techniques.

007. Fish Disease

Following an epidemic in the early 1980s which decimated freshwater fish yields from fishponds and natural streams, there was a strong need to disseminate improved pond management techniques to control or prevent future epidemics as well as more common yield-reducing diseases. The sub-project helped finance the establishment of local Fish Disease Control Centers in the two central provinces of Suphanburi and Samut Prakarn. During the 3-year period of the sub-project, an estimated 3,500 farmers received training or consultation. Since many were new entrants in the fishpond business, they learned and adopted new practices which reduced losses and increased yields. Production and culture areas increased by more than two times in the impact area of the sub-project, leading to an increase of at least 150 million baht in the value of fish production.

008. Cockle Seed

Cockle, popular as an appetizer taken with whiskey, is among the shellfish in highest demand in Thailand. The country imports about 200 million baht worth of cockle seed from Malaysia annually. The sub-project attempted to develop domestic capacity to produce cockle seed (small cockle for raising)in two different ways - (1) raising the seed in tanks and (2) raising seed in natural seed beds. The sub-project hatcheries were never able to produce cockle seed economically in tanks, due to high costs of production and a high mortality rate. The seeding of natural beds in Surattani was more successful and resulted in an output of 450 tons of cockle parent stock, worth 3.8 million baht. Consdering that only 20% of the ATT budget of US$207,000 was spent on natural seed bed development, this was an impressive return. There was, however, no extension of results or impact on farmers or the private sector.

009. Seaweed

Under the sub-project, the Department of Fisheries worked towards increasing production of a type of seaweed used to manufacture agar, a product which Thailand imports in large quantities to manufacture medical and food products. In addition, Srinakarinwiroj University established a laboratory and later pilot plant to develop the technology to produce high-grade agar domestically. The Department of Fisheries has not succeeded in promoting production of the seaweed, but by the time of the evalution an estimated ten farmers were growing seaweed in Songkhla and Pattani due to the efforts of the agar pilot plant to meet its own need for raw materials. Interviewed farmers increased their incomes by 3,000 to 4,000 baht per year. The pilot plant is recognized by the private sector as an important center of technology on agar. Several firms are contemplating investment in agar production, though no investment has taken place yet.

010. Lam Nam Oon

Lam Nam Oon is the only large irrigation project in Thailand known to the evaluators to have successfully promoted production of specialty crops on a significant scale, as demonstrated by the followng figures.

	Cultivated Area (rai)	No.Farms	Value (Bt) of Production
1985/6	216	171	763,000
1988/9	4,411	3,238	50,000,000

Net income per farm averaged 7,000 baht for the 3,000 farmers now growing crops under contract to the private companies which have established offices in the area. A number of intensive crops are grown, including vegetable seeds for export, vegetables for canning factories, and high value fresh produce for the farang and khunnai markets in Bangkok.

The foundations for this innovation were laid under an earlier USAID-funded project which showed the irrigation area staff how to provide a welcome environment in which private companies could introduce new production technologies to farmers. However, the greatest expansion came during the ATT sub-project period.

011. HS Immune Status

There is no evidence of impact from this study, which revealed that actual immunity to haemorrhagic septicemia (HS) was lower than assumed by the Department of Livestock Development (DOLD). Results were publicized at a meeting of

responsible veterinary officials, but there was no follow-up to see if these officials, who are responsible for semi-annual vaccination of all cattle and buffalo in the country, had acted on the results.

The annual cost of animal mortality due to HS is estimated at 300 million baht (.5% incidence x 12 million cattle and buffalo x 5,000 baht/animal). Therefore every 10% increase in immunity from the present 50% rate will be worth 30 million baht to small farmers, who hold a significant portion of their productive assets in the form of cattle/buffalo.

012. Oil Adjuvant HS Vaccine

The sub-project research proved that the oil adjuvant vaccine protects cattle and buffalo for at least 12 months in comparison to the vaccine presently used by the DOLD which protects for no more than six. Based on these results, DOLD will build a pilot plant to produce the new type, but benefit will not reach farmers in the near future. In addition, DOLD will build an 800 million baht plant at Pak Chong to produce an oil adjuvant foot and mouth disease (FMD) vaccine.

Annual vaccination costs 70 baht per animal. The new vaccine will considerably reduce total cost by cutting in half or less the frequency of vaccination. More significant will be the reduction in animal loss due to improved coverage. USAID's technical evaluator estimates that the new oil adjuvant FMD vaccine will eventually reduce animal losses by several hundred million baht per year. However, all these projected benefits will be reduced if a solution is not found to the bottleneck of insufficient manpower and efficiency in the district livestock offices responsible for disease control.

013. Liver Fluke

Research came up with the potentially useful result that raising ducks and fish in shallow ponds interrupts the life cycle of the snail which is the host of the liver fluke. But so far there has been no extension or adoption of this technique to farmers.

Incidence of liver fluke is estimated at 10% for buffalos and 7% for cattle. Economic costs include reduced food conversion ability and increased susceptability to fatal disease. The cost due to these losses is difficult to quantify, but over 100 million baht is spent annually on chemical treatment, which could be reduced by the bio-control technique suggested by the research results.

014. Hog Cholera

There has been no adoption of technology by end-users to date. This long-term effort has, in the ATT-supported sub-project, verified that piglets born of infected sows area a major source of hog cholera infection. Further research is required before results can be applied to controlling hog cholera.

Roughly 75% of hogs in Thailand are raised by commercial farmers who would readily adopt new techniques if they were economicaly viable. Annual losses due to this disease are estimated t 1.25% of the hog population valued at 200 million baht.

015. Macadamia

Trees of ten different varieties were planted at 15 different sites around the country. Now in their fourth year, trees are just beginning to bear nuts. Therefore, there has not yet been any direct benefit to end-users from the ATT-funded activity. Seedlings from a 15-year old stand have been distributed to smallholders and to the royal project at Doi Tung.

It is expected that when the present varietal trials yield results, seedlings will be distributed widely to smallholders, who may be able to sell their produce if (1) factories are established and (2) there is sufficient volume in a given location to justify assembly and shipments to factories. No data was found on the projected cost/return of macadamia vis a vis alternative tree crops. It is expected to provide a high return, but only after a long period of negative cash flow.

016. Wheat

Under the sub-project's auspices, wheat has now been grown by 61 farmers in several locations in the North. Due to problems of market, price, and wheat quality, it is questionable whether farmers would continue to grow the crop when the Government ceases its extension activities and subsidies.

Farmers planted an average of two rai of wheat, which requres realtively low moisture, on otherwise seasonally idle land. The following data show actual and potential income per rai from the crop in 1988/89, in baht.

	Yield	Price	Gross Income	Cost of Production	Net Income
average	160	6	960	500	460
highest	421	6	2526	500	2026

017. Papaya Virus

The project has tested two types of virus control measures - injecting a so-called "mild strain" of the virus into the trees and breeding for resistant varieties - at 18 villages near the sub-project center at Khon Kaen. On average, each farmer owns five papaya trees planted randomly around the house.

To date no clear benefit has emerged. The disease is still virulent in all plot villages because farmers refuse to destroy all diseased trees. In Mahasarakam province, however, the Governor's campaign succeeded in destroying diseased trees in many villages and virus losses were considerably reduced for one year. Annual losses from the virus in the Northeast alone are conservatively estimated at 300 million baht per year. Therefore even a modest reduction in loss would yield significant benefits to the bulk of the populaton in Thailand's poorest region. Once the technology is found, adoption would be worth 500 baht annually per household. Commercial farmers, mostly in Rajaburi, earned net return per rai of 7,000 - 10,000 baht before the virus struck.

022. Dairy

Since the sub-project began, farmers have included an additional 2,000 head of high milk yielding Thai Milking Zebu (TMZ) in their herds. Numerous dairy farmers in the provinces around Chiengmai incorported improved pasture and urea-treated rice straw recommendations into their feeding programs.

TMZ has already been shown to increase milk yield from the Thai average of 8 kg to 10 kg per cow. Annual increased value of production is thus 2,000 cows x 2 kg x 6.5 bt/kg x 250 days = 6.5 million baht. The project claims that urea-treated straw sustains yields during four months of dry season when they would otherwise drop 2 kg per cow per day. The increased value of production per cow would thus be 1,560 baht per year.

In addition, the sub-project assisted in the planning of a milk-processing plant to be built by the Chiengmai Dairy Farmers Cooperative.

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2.3 Factors Leading to Sub-Project Success

The five projects placed in category A by the evaluators were:

004	fruit and vegetable
006	fish products
007	fishpond disease
010	high value crops at LNO irrigation project
022	dairy farming

There are no obvious similariaties between these projects in terms of management and organization, objectives, leadership, budget, or other factors which might explain their success. They span a range of agricultural products (from livestock to fruit to fish to vgetable seed) and economic activities (from cooperative-led marketing to smallholder production to contract farming by mid-size agri-business firms.)

It is noted that the five do include sub-projects in which the private sector was involved either in the planning stage or very early in implementation. In the dariy project, the Chiengmai Dairy Farmers Cooperative was represented on the drafting group. The Lam Nam Oon sub-project was drafted by the consultant who had successfully induced private investment in the area under a previous AID-funded project. From their very beginnings, the fish quality and fruit and vegetable sub-projects worked to meet needs identified by exporters.

A further common element was that all five were in the main steam of already vigorous economic activities. Milk, fresh fruit for export, fishponds, vegetable seed for export, and surimi were all products experiencing exceptional growth rates in production and demand when the sub-projects started. An ATT research sub-project is an investment, and like any investment should be neither too safe and conservative nor too untried and risky. Given a product with vigorous demand and a practical (and not too esoteric) technology with a high chance of success under Thai conditions, ATT investments demonstrated high returns.

Strong commitment of the principal investigator and genuine support from the implementing agency could also be identified as pre-conditions for sub-project success.

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Problems and Constraints

3. PROBLEMS AND CONSTRAINTS

The evaluators asked all sub-project leaders to identify the problems and constraints they had encountered The following section describes and analyzes the major constraints cited and suggests some solutions.

3.1 Administration

Almost unanimously, the sub-project leaders complained that they were frustrated in their work by delayed disbursements of funds and approvals of promised resources such as technical consultants, study tours, and equipment. Numerous projects had to be extended because, due to delay in the promised resources, they were unable to launch their research in the first year. Once launched, they complained that too much of their time was taken up by excessive, duplicative paperwork, with reports required by five agencies in five different formats. The design of ATT, itself constrained by the regulations and policies of the donor and the Government, made such problems inevitable when it was decided to fund research activiies with a combination of grant, loan, and counterpart funding, each with its own detailed procedures.

3.2 Selection process

Ideally, competitive research grants are administerd by a committee of experts who have no interest in the awards being granted. When the committee considers a proposal in which a member may have an interest, that member is excused from the meeting. The decision is made by vote. Because the ATT Executive Committee is comprised of representatives of the very agencies which are applying for loans and grants, there is bound to be bias - or at lesat a suspicion of bias - in the selection process.

<u>Time-consuming process.</u> The Project Paper outlined an efficient system whereby the Secretariat and the long-term consultant are available to assist in proposal preparation and, when proposals are officially submitted, take one week to review them for correctness before sending them on to the Technical Sub-Committee. This Sub-committee takes another three weeks to review the proposals before forwarding to the Executive Committee. This Committee meets every two months to approve/disapprove the proposed activities. In practice, another sub-committee and a working group have been added to the chain, the system has been changed to require two cycles - one for "approval in principle" and a second for approval of funding - and the process has taken up to six months.

Selection criteria. From the various evaluation interviews and a review of the origial sub-project proposals, it would appear that there is a need for more detailed criteria and a more complete format for proposals. Committee members complained that much time was wasted at meetings because selection criteria were unclear. Those submitting proposals complained they did not know what the scope and objectives should be.

It is recommended that the sub-projects be considered more as investments in Thailand's agricultural growth. Thus the following are among the relevant criteria which might be established: (1) the magnitude of the problem or opportunity, eg, the cost of annual losses to disease or the value and growth rate of export of the product with which the project deals; (2) potential return to the country on sub-project investment; (3) potentail number of farmers and firms to be affected.

As a result of the administrative problems described above, communication between the Secretariat and the sub-projects was poor from the outset. Several of the people interviewed said they would not apply for ATT grant extension because of the many delays, the attitude encountered in the Secretariat, and the bias in the system. They cited Japanese and foundation sources as much less troublesome.

3.3 Sub-project Design

Several weaknesses in sub-project design were found to reduce sub-project effectiveness. The proposals ranged from three to 30 pages and varied greatly in the amount of detail presented to support the project rationale, implementation plan, and budget.

First, there were several sub-projects with no plans for extension of results to end-users, and implementation plans tended to be sketchy. All sub-project plans should include the following major components: laboratory and/or field-testing, extension, and follow-up with end-users. The exception would be sub-projects with long-range goals, such as disease control and prevention. Even these should indicate how the results can and will eventually reach the end-users, even if the follow-up activities are not specifically included in the sub-project.

Second, in the opinion of the evaluators, there was sometimes insufficient justification, especially economic background, for projects representing investments of many millions of baht. Perhaps the most serious drawback has been that most sub-projects were planned with little consultation with the prospective end-users. The papaya virus project suffered from a mistaken assumption that

villagers would destroy diseased trees. This could have been avoided if a simple socio-economic survey had been conducted during project design. The seed drying project should have sought the blessing of private seed companies in advance. In the seaweed project, a survey of present seaweed production areas may have revealed problems in seaweed cultivation at the start.

It is recommended that no sub-project be approved until both proposers and admnistrators have consulted the private companies, farmer cooperatives, or individual farmers who are expected to benefit. If necessry, a small fund should be available for quick socio-economic surveys of farmers or "rapid rural appraisal." This would not only improve the sub-project plans but stimulate increased interest and involvement on the part of the end-users throughout the sub-project life.

Third, budgets were incomplete and specific cost estimates were inaccurate, such as the low estimate for the closed circuit seed-drying system required by the Lampang seed center.

3.4 Personnel

An absolute shortage of technical personnel was sometimes encountered. The fish disease center at Samut Prakan, for example, had difficulty hiring biologists. The evaluation team noted a lack of proper standards and discipline in some sub-project laboratories, indicating the need for more bio-chemists to run these labs.

Furthermore, ATT like many foreign aid projects create a need for personnel which exceed the allocations made by the Civil Service Commission. The common solution is to hire so-called "temporary employees," who are usually recent university graduates. These employees are continually looking for permanent positions elsewhere, creating both staffing and morale problems. The rapid economic growth in the private economy in Thailand today is creating severe shortages of skilled technical personnel throughout. Thus, ATT's personnel problem is likely to become more severe, particularly if the gap widens between public and private sector wages. This is a Government-wide problem and requires a change in regulations governing the terms of temporary employment. The Government shold seriously consider providing greater incentives to temporary employees, for example, annual salary increases.

3.5 Coordination with Other Agencies

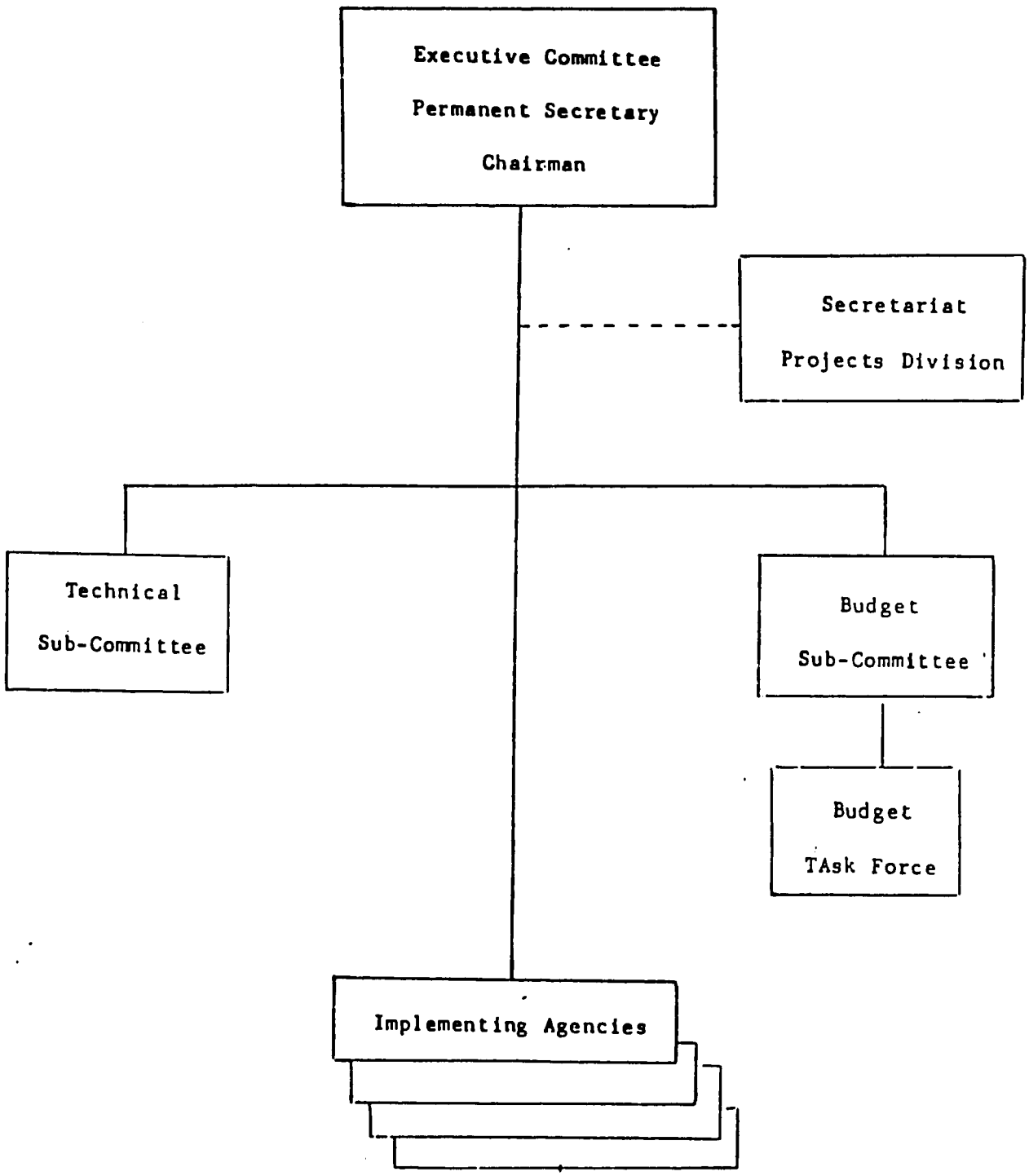
Many of the sub-projects receive some support from sources other than ATT and the Government budget. GTZ provided an expert and some laboratory equpment during the early stages of the cockle project. The wheat sub-project began with the encouagement of CIMMYT, which continues to support varietal research at the sub-project sites. At the same time, for various of the funded activities, there were other agencies working on the same or related topics. TARC, JICA, and UNDP were all involved in finding solutions to the aflatoxin problem, with the Maize Growers Association taking the most active role. Five different units were discovered to be working on post-harvest handling of fruit and vegetable. The papaya virus research at NADC is using traditional methods to produce resistant breeds while researchers at Kasetsart University are using genetic engineering to attack the same problem.

This involvement of several agencies in the same activity leads to confusion on the part of donors as to what their contribution is being used for and to questions about lack of coordination and possible duplication. To really evaluate these questions would require a detailed audit of sub-project accounts and a thorough inventory of all activities with similar objectives, both of which were beyond the scope of this evaluation. In general, the evaluation team did not feel that the lack of coordination between ATT sub-projects and related agencies/programs with common objectives was a serious constraint, but it is possible that greater progress could have been made had there been more networking among these activities. The team would further recommend that problems of coordination should be dealt with clearly in the sub-project design, which should include a careful inventory of related activities and plan for useful inter-relationships.

Project Administration

Chart I

Project Organization



4.1.2 Project Operations

Solicitation of Proposals

Previously there were no regular announcements to solicit proposals, which could be submitted at any time during the year. Starting this year, the Executive Committee will solicit proposals for project funding twice a year, January and June. The selection criteria, format, operating procedures and cost limits for proposals are also announced in each solicitation. From the evaluation interviews, it was found that the information about sub-project application has not been widely distributed. Many researchers do not know about the application time, and some are not aware of the purpose and objectives of ATT. Selection criteria announced are rather broad, leaving too much room for individual interpretation of ATT requirements. For example, one criterion listed is that "activities undertaken should have a high expectation of success and promise to make a lasting contribution to agricultural growth and development." This lack of clear criteria has made some prospective ATT researchers reluctant to develop proposals and in other cases, led to protracted series of questions and answers between drafters and staff of the Secretariat. Furthermore, there is no structured application form to facilitate drafters's expression of their research concept.

Approval of Proposals

Procedures for screening and approving proposals are set down in considerable detail. The approximate duration of each step is also specified. The procedures are as follows:

Step 1 The Secretariat examines proposals for correctness and completeness.

Step 2 The Secretariat submits all proposals to the Project Director for approval in principle.

Step 3 Proposals are presented at a session of the Executive Committee for approval in principle.

Step 4 The Technical Sub-Committee screens each proposal to determine whether it meets the selection criteria outlined in the project paper.

Step 5. Proposals which are technically feasible will be screened by the Budget Sub-Committee for cost effectiveness.

Step 6 Upon positive recommendation of the Budget Sub-Committee, the proposals will be sent to the Executive

Committee through the Secretariat for final approval.

Step 7 The Secretariat notifies implementing agencies of the action of the Executive Committee.

Step 8 An implementation plan of all project activities and a corresponding financial plan are prepared by the Secretariat for each fiscal year and submitted to the Executive Committee. The Executive Committee forwards the financial plan to the Ministry of Finance and to DTEC. MoF subsequently requests USAID to approve loan funds, while DTEC requests USAID to approve grant funds.

The Project Paper describes a snappy process in which the Secretariat has one week and the Tehnical Sub-Committee three weeks to consider proposals. In practice the approval process has taken as much as six months. Meetings of the Executive Committee and sub-committees have been infrequent and not regularly scheduled.

The weakest point of the approval procedures lies in the inadequate quality control of the proposals approved. Thus far, technical appraisal has not been rigorously or systematically undertaken. The Technical Sub-Committee recently compiled a list of local consultants to be employed in appraisal of proposals, and is expected to begin using these consultants. Up to now, there have been no guidelines to assist the Sub-Committee in sub-project appraisal. A potentially useful draft of a form for evaluation of proposals has recently been prepared by USAID, but has not yet been considered by the Sub-Committee.

Monitoring of Sub-projects' Operations

The implementing agencies are required to submit progress reports in a standard format through the Secretariat to the Executive Committee twice a year in April and October. The Secretariat screens these reports and presents an executive summary to the Project Director for acknowledgement. The Executive Committee will then be informed of all sub-projects' performance.

Interviews indicated the following shortcomings in the monitoring of sub-project performance.

(1) Some implementing agencies failed to submit progress reports to the Secretariat on schedule.

(2) The information presented in the progress reports of some sub-projects was rather vague and brief.

(3) Although the Secretariat had made field observation to some research sites, this activity was not carried out regularly and systematically enough to assist researchers appropriately.

(4) Persistent implementation problems of sub-projects, such as the delay in procurement of equipment and experts, have not been effectively dealt with by the Executive Committee.. Many sub-project personnel complained of the excessive time they spent solving administrative problems when they should have been doing their research.

4.1.3 Sub-Project Implementation

Although the implementation plan and financial plan of each sub-project was set up and approved by the Executive Committee, almost no sub-project directors have been able to perform research activities as planned. Some sub-projects had to adjust research strategies and some had to extend the sub-project period. These resulted mainly form the delay in the procurement of off-shore equipment, contracting foreign experts, and arrangement of short-term training and observation tours abroad. These are three main causes of this problem.

(1) The ATT project is supported by three sources of funds, loan, grant, and RTG counterpart. Each source has its own set of procedures and conditions which impose a heavy administrative burden on project directors. DTEC also provides counterpart funds governed by yet another set of regulations. To manage research activities, each sub-project director has to spend too much time and effort trying to synchronize required inputs from these several sources.

(2) In performing those administrative tasks, researchers of all participating departments, except those of the Department of Fisheries, have received inadequate support and facilitation from their respective departments. Researchers in the Department of Fisheries have been assisted by the staff of the Planning and Finance Divisions while all others had to do paperwork and communication with the Project Division and DTEC by themselves.

(3) The staff of the Secretariat has not been equipped with proper understanding, attitudes and skills in coordinating research activities. They have tended to perceive their role as to controlling rather than facilitating the implementation of sub-projects.

4.1.4 Institutional Support

Like other development activities, the ATT Project, as an action research project of MOAC, needs strong support from, the senior officials of MOAC and participating departments in order to have an impact upon agricultural development. This requires that the Permanent Secretary make it known as a high priority of the Ministry. Sub-project researchers and the Secretariat need sufficient motivation, assistance, and even reward for their

motivation, assistance, and even reward for their participation. the study found that the ATT Project has received inadequate institutional support from these senior officials. The previous Chairman of the Executive 'Committee and Project Director paid close personal attention to the implementation of the ATT project. The present Chairman and Director seem to give it a lower priority.

The support of participating departments to the ATT Project has been inadequate. Some department executives perceive the ATT Project as just another research project initiated by the Ministry. This attitude is reflected in the fact that some Director-Generals have never personally attended the meetings of the Executive Committee, choosing to send lower ranking representatives instead. They have assigned Departmental Representatives to sit on the Technical and Budget Sub-Committees, and these representaties varied widely in rank from Deputy D-G to middle-level personnel analyst.

Further evidence of inadequate support from departments is that some sub-projects received fewer counterpart funds than were approved by the Executive Committee. Sub-project 011, for example, received from the Budget Bureau only 25% of the amount approved by the Executive Committee and therefore could not carry out the research project until the following year. Sub-project 013 received no disbursements from the BOB during its second and third years of operation.

4.1.5 Management Responsibility of USAID

In principle, USAID's role in the ATT Project should be limited to facilitating and advising on contract technical assistance and locating training facilities. In practice, however, USAID program officers have to spend much time following up on paperwork connected with these as well as other tasks. USAID staff limitations will make it increasingly difficult for USAID to carry out these functions as presently organized.

4.2 Recommendations

Recommendations for the improvement of the ATT Project management will be presented in accordance with the findings outlined above.

4.2.1 Solicitation and Approval of Proposals

1. In order to utilize ATT research funds effectively and to solicit good proposals according to the ATT Project's goal and purpose, the Executive Committee should consider identifying priority research issues which have a high impact on agricultural growth and exports, such as, for example, horticulture development and irrigated farming

systems in the Northeast. The Executive Committee should also formulate a set of specific selection criteria, both economic and technical, in each field.

2. The Secretariat should improve the distribution of information about the ATT Project to prospective researchers, holding meetings in each participating department at least three months before each application deadline. A brochure containing brief information about the ATT Project's objectives and selection guidelines should be made available to concerned public agencies and private firms as well.

3. A manual setting out a standard application format, more detailed than the present format, should be prepared by the Secretariat. Such a manual might eliminate much of the time-consuming process whereby the Secretariat returns proposals for alteration. The services of project planning experts should be made available to assist technical researchers in developing their proposals.

4. The Executive Committee should meet at least three times a year to approve proposals, monitor on-going sub-projects, and facilitate transfer of successful research results to targeted end-users.

5. The Technical Sub-Committee and the Budget Sub-Committee should meet bi-monthly to screen proposals and facilitate technical and financial adjustments of sub-projects.

6. The screening and approval procedures should consist of the following steps:

Step 1. The staff of the Secretariat performs the pre-screening (non-technical) of proposals.

Step 2. The Secretariat submits all proposals to the Technical Sub-Committee for technical screening.

Step 3. The Technical Sub-Committee screens proposals, employing local technical and economic consultants.

Step 4. The Budget Sub-Committee considers financial feasibility of proposals which are technically feasible.

Step 5 The ATT Project Director submits all recommended proposals along with an implementation plan of all project activities and a corresponding financial plan to the Executive Committee for final approval and subsequent transmittal to USAID for approval.

7. The Technical Sub-Committee should formulate a set of olear procedures concerning the employment of local consultants in the appraisal of proposals. Detailed

technical and administrative assistance. Under the new arrangement, the ATT project management unit of MOAC will contact the USDA/PASA directly in acquisition of technical assistance for sub-projects.

4.2.6 Alternative Models for ATT

The review of the administration of this project has revealed that its achievements have been made in the face of serious administrative obstacles. The major obstacles observed were (1) the lack of strong administrative support from the Ministry and Departments of MOAC and (2) the complex procedures resulting from the several sources of funds and numerous agencies which are therefore involved in all approvals.

The present project is too far along to consider major changes in administrative structure. If, however, USAID or any other agency wishes to sponsor similar technical research in the future it should find an alternative mechanism in order to reduce bureaucratic constraints on the selection and implementation of quality research projects.

The evaluators interviewed several senior individuals with lengthy experience in research grant administration. These individuals suggested that the mechanism chosen should meet some of the following specifications. First the possibility of bias in the selection process should be minimized by choosing members of the selection committee from agencies which have no interest in the grants. Thus a committee considering research on agricultual technology for economic impact could be drawn from such agencies as the Ministry of Commerce, the Bank of Thailand, TDRI, and NESDB. Second, the Secretariat should have a high level of efficiency, and its staff must be neutral and well paid. Lump sum payments should be made directly to the Principal Investigator, and the Secretariat can audit the expenses. A system of professional peer review should be established to achieve quality control of proposals and results. Grants should be large enough to justify the time spent by high-level committee members in evaluating them. Lastly, it should be lodged in a Thai or joint Thai-donor institution.

A suggested alternative would be to contract an independent institution, such as a university or foundation to manage the research funds. Several existing programs were mentioned as having fewer administrative problems than ATT and could be studied for clues as to how to better organize such a project. These include Japanese and German aid programs, IDRC, ADC/Winrock, and research institutes of Thai universities.

Role of the Private Sector

5. ROLE OF THE PRIVATE SECTOR

For several decades, aid donors and governments have devised rural development programs to help poor farmers to raise their incomes and social welfare. After many failures, it became clear that the only way for projects to be successful was for farmers to have participation in the planning of, and as much as possible some form of investment in, activities which were intended for their benefit. The ATT project presumes to aid private agri-businessmen and farmers with new technology. The same guidelines apply. The projects will be relevant and valued by the beneficiaries to the extent that they are involved, from the very beginning, in project identification and planning and to the extent that they contribute their own resources. Their committment will be proportional not only to their potential gain but also to their potential loss.

The evaluation found that at the overall project level, there did not seem to be a strong commitment to involving the private sector in making the important decisions about ATT. At the sub-project level, on the other hand, there was a relatively high level of involvement of the private sector and farmers in many ATT sub-projects. It was also observed that, true to the expectations of the designers of ATT, the level of private sector involvement was clearly correllated to sub-project success.

The present practice of appointing three representatives of the private sector to the Executive Committee has not helped much in increasing participation. The committee itself does not function so much as a deliberative body as a consultative group for the Chairman, who tends to make the decisions. Private sector members were often unable to attend because meetings were not regular and notification of meetings came very shortly before the meetings were held. Proposals did not reach them in time to study the proposals before the meeting. They were never assigned a role in new project identification.

One private sector member of the committee explained that he and his colleagues have several motives for participating in the ATT committee. First, they felt some of the subject matter might be of interest or use to them. On the other hand, big companies have their own international sources of highly relevant technical expertise and are unlikely to use ATT-type resources to meet their pressing research needs. They acknowledge, however, that in terms of technical resources available locally, the Government and universities are still the main source.

Second, they must deal regularly with Government as a regulator of their businesses and the economy and sometimes as a customer. Therefore it is in their interest to cultivate good personal relations.

Third, sucessful companies and their executives are genuinely interested in performing public service. In this case, ATT did not motivate them because, due to the conditions described above, it did not provide a meaningful role for them.

The following table reflects the involvement of the private sector in several stages of sub-project activity.

INVOLVEMENT OF PRIVATE SECTOR IN 16 ATT SUB-PROJECTS

	Yes	No	Premature
in sub-project planning	3	13	
in implementation	7	9	
in providing resources*	6	10	
in using research results	8	6	2

* includes farmers providing labor and some inputs

Involvement in Sub-project Planning. In only three of the projects studied was the private sector involved at this critical stage. As stated above, the best opportunity for improving the quality of sub-projects is to improve sub-project identification and design, and the best way to do this is to involve the private sector from the beginning. This can happen in several ways. At the very least, no proposal should be accepted before the proposer and the Secretariat have discussed it with a sample of prospective end-users, be they businessmen or targetted farmers.

A stronger measure would be to establish a sub-committee in which agri-businesmen are in the majority with the task of generating sub-project concepts. Government officials should sit on the sub-committee to apprise the businessmen of the availability of relevant research resources. To start such a process, the Secretariat could compile a list of private agri-business firms by field. Such information is probably readily available from the BOI. They could advise these companies of the availability of ATT resources and convene a meeting of perhaps 10 selected participants representing a range of agri-businesses. The Federation of Thai Industries is active and respected in the business community, has a sub-committee on agricultural industry, and sends regular circulars to their members. The Federation would be a suitable channel through which to organize such a meeting and sub-committee.

Involvement in Project Implementation. Of 16 sub-projects, at least seven showed evidence of direct participation of private companies. Traders donated processing equipment to the Srinakarin seaweed laboratory. Fruit exporters worked with the fruit/vegetable project in arranging test shipments of produce overseas. Company managers meet regularly with the officials of the Lam Nam

Oon irrigation area to coordinate activities for the upcoming production season. As concluded above (section 2.3) with regard to common elements of successful ATT projects, the Thai private sector is very dynamic and will participate enthusiastically when products with demonstrated market potential are involved.

For some ongoing projects, more could be done to involve the private sector. Some of the results of livestock disease research could be tested on the farm. Rather than waiting to release the results through the Government's system of veterinary care, the sub-projects could invite veterinarians from private chemical companies to discuss the useulness of the research results and how to accelerate their utilization. In general, however, there seems to be active involvement in many projects by either companies, farmers, or both.

Involvement as End-users. It is axiomatic that the private sector, always seeking to maximize profit, will respond quickly to any opportunity for increased profit. In Thailand, where the Government's laissez-faire business policies have created a free competitive environment, the response is particularly active. Hence, those ATT projects with practical results proabably would have reached the end-users without any active extension. Several of the projects have reached a near-ideal model of what ATT should and can do. In these cases, the sub-projects are acknowledged by their respective industries as the center of technology in Thailand and are regularly consulted by private firms. In one case (surimi), the project director received three phone calls from private businessmen while the evaluator was interviewing her. The seaweed and fruit and vegetable projects exhibit much the same characteristic.

To sum up, there is little need for improved means of reaching end-users. If the technology is relevant and practical, the private sector will seek it out. The problem is rather how to identify and carry out projects which are relevant and practical. This problem can be solved by improving the mechanism for project identification, design, and selection.

Summary of Major Recommendations

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6. SUMMARY OF MAJOR RECOMMENDATIONS

The main report contains recommendations in some detail, particularly on ways to improve the administration of the project. The following is a summary of major recommendations.

6.1 Sub-project Design

A more rigorous and thorough process of designing the sub-projects could improve the projects and eliminate some of the problems encountered. ATT should prepare a small handbook with a detailed format and sample proposal enclosed. Several elements should be required in all proposals. First, there should be evidence that the proposers had consulted the private sector or done at least a brief survey of end-user farmers.

Second, there should be a more serious economic analysis demonstrating the potential benefits. Third, there should be a clear plan of how the results will be extended to the end-users. If it is a long-term effort like the livestock disease research or the macadamia project, the extension might not be part of the project itself but it should be indicated what follow-up will be required for the sub-project to produce the expected economic impact. Lastly, there should be an inventory of all important related activities being carried out by other agencies in Thailand and how they may relate to the proposed activity.

ATT has provided some funds to hire consultants for review of proposals. This money could also be spent on hiring consultants to assist in preparing the proposals, in particular the economic analysis and plan for extension.

6.2 Involvement of the Private Sector

Active participation of several private firms from the same industry in a project proposal can substitute for the economic analysis called for above. This type of participation almost ensures the impact of the sub-project, especially if the private firms contribute resources to the activity, and it obviates the need for formal economic analysis.

As much as possible, the private sector should be involved in ATT from the start. At the overall project level, this means at the sub-project identification stage. At the sub-project level, it means at the design stage. One way of doing this is to establish a sub-committee to identify projects comprised of perhaps ten representatives of different agri-business fields and a few officials to

apprise them of the technical resources available in the public sector. Such a group could be organized, with the assistance of the Federation of Thai Industries, which has its own sub-committee on agri-industry.

6.3 Administration

A third set of recommendations deals with the administrative problems described above. These are serious problems, but due to the legitimate financial regulations of the various agencies involved, they are not easily solved. It is suggested that if the central agencies administering ATT acted more like facilitators and less like controllers of the sub-projects, administrative problems could be considerably reduced.

One specific measure which might be attempted is to follow the example of DOF in appointing a planning or finance officer to handle the paperwork for sub-projects in each Department.

In the long term, it is the evaluation team's opinion that the mechanism chosen is not appropriate for a research grant-giving activity. There are too many bureaucratic stumbling blocks, and Government regulatons cannot be changed for one project. We would suggest that for any future activity of this nature, a private foundation, of the type which gives research grants in developed countries, would be more suitable. In the short term, the solution of having USDA assist in project planning and administering training, technical assistance, and other components of ATT is an excellent one.

NOT suppose to be research at all

6.4 Future Directions

Tech Trans

ATT has funded ~~research~~ on a wide range of agricultural products - from artificial crab to baby corn - and a similar range of innovations, including new techniques of farm production, processing, post-harvest care, and marketing as well as control of diseases which seriously reduce agricultural income. This openness and flexibility is seen as one of the project's strengths, and the evaluators would discourage any measures to narrow its range. The choice of sub-projects should not be confined by the "policy framework" of Government agencies or USAID policies. These policies emerged from planning exercises which took place one or more years ago, when many of today's problems, opportunities, and technological solutions were not foreseeable.

The project's long-term advisor estimates that with the funds remaining after the recent amendment, there may be sufficient funds to extend promising existing projects and

finance perhaps five or six additional ones. Given the high administrative costs of ATT, it is recommended that ATT focus on larger projects of about five million baht and up. Rather than selecting fields of research which reflect the policies or constraints of the agencies involved, the project should adopt an investment approach, where projects are appraised in terms of their expected return to agricultural growth and distribution of benefits.

The analysis of success factors in section 2.3 above gives some clues as to what types of projects are likely to have the highest return for the country. These are projects dealing with newly dynamic agricultural products with strong growth rates. The scale of the ag-industry should also not be too big. For billion baht industries like shrimp, the private sector has the access and resources to transfer technology without Government assistance. Coffee has benefitted from several substantial aid projects for at least a decade. Smaller emerging industries like seaweed, surimi, mushrooms, and fresh fruit and vegetable export would seem much more appropriate candidates for R&D interventions by the public sector. As mentioned above, the fresh fruit and vegetable industry and new areas of fruit and vegetable processing merit consideration as the foci of large, single aid projects.

(do not agree ATT transferred surimi product to Pvt. Sector

SUB-PROJECT EVALUATION

SUB-PROJECT EVALUATIONS

002. Low-moisture Packaging to Prevent Deterioration of Seed
003. Control of Aflatoxin in Agriculture Products
004. Quality Improvement of Fresh Fruit/Vegetable
006. Using Technology to Improve Fish Quality and Develop Fishery Products
007. Improve Fish Disease Control Project for Aquatic Organisms
008. Hatchery Research and Culture of Cockle
009. Seaweed Production and Processing
010. An Integrated Agro-Production and Marketing Program
011. Determine the Immune Status of Cattle and Buffalo to HS
012. Introduction/Testing Effectiveness in Thailand of New HS Vaccine
013. Control of Cattle and Buffalo Liver Fluke Through Control of an Intermediate Host
014. Persistent Infection of Swine with Hog Cholera
015. Accelerated Technology Transfer of Macadamia as the New Industrial Crop
016. Wheat Technology Transfer for Local Utilization
017. Control of Papaya Ringspot Virus
022. Dairy Herd Management Improvement

SUB-PROJECT EVALUATION
Low-Moisture Packaging to Prevent Deterioration of Seed (002)

1. Summary description

The objective of the sub-project is to develop improved drying technology in seed production using a desiccant process.

The project was carried out by the Seed Division, DOAE with an initial the duration of 2 years, beginning in October 1984. Due to the delay in design and installation of the equipment, an extension of the project was granted for 15 months, up to 31 December, 1987.

Seed Center #3, Lampang Province, was chosen to carry out the project with the total budget amounting to US $146,918. Most of the loan has been used for providing equipment, material and to cover installation cost and the grant was used mainly to hire Thai expert as the project consultant who was responsible for designing the system and advising on fabrication and installation.

2. Findings and conclusions

2.1 Research results

The results of the project were inconclusive. Testing of the drying system was done on 9 December, 1987. Germination of seed after 43 hours of drying was reduced to only 62%. Following improvements made to the system, a further test was carried shortly before the evaluation team visited the site. The staff felt it would take two more years to verify which combination of moisture percentage and packing material would produce viable seed at the lowest cost.

The cost of soybean seed is currently 15-18% of the total production cost. And both the DOAE and private sectors currently produce soybean seed with the hot air drying/cold storage system. Private firms hesitate to use the new technology due to uncertainty regarding production cost. If the new system is able to produce soybean seed with high quality and low cost, it will be of interest to the private sector.

2.2 Major problems and constraints

Major problem and constraints of the project are summarized in 3 categories; budgeting, operation and reimbursement of expenses. Firstly, the proposed budget for equipment was unrealistic; the project's original estimate of the cost of equipment was 55% of the actual final cost. Secondly, as the consequence of the inadequate budget, the project consultant was delayed in the delivery of his

design. Thirdly, reimbursement of expenses from the coordinating office was extremely late.

2.3 Recommendations for future

To better serve the ATT goals, the sub-project should call for attention of the private companies involved in seed industries to participate in the design and operatin of the project. Consequently, if the technology being tested is successful, it can be readily put into use by the private sector, who would welcome a process which lengthened the life of the seed. As a result, low-cost seeds would be available to farmers.

Further studies should emphasize modification of equipment (bin ladder to reduce damage from jostling of the hard seed) and analysis of the cost of running the proposed system compared to the conventional technique. Additionally, experiments should continue on material for packaging.

3. Brief background of the sub-project

Under the sub-project, an air-tight closed-circuit desiccant-dehumidified dryer was designed by Dr. Pipol Boonchanta, the short term consultant, and was constructed by the Ua Widhya Equipement Co. Ltd. The dryer has 4 main components: 1) drying bin with 10-ton capacity, 2) the dehumidifyer, 3) the belt conveyer and 4) the blowers. The dryer was installed at the Seed Center #3, Lampang Province,

Due to the delay in designing and installing the dryer, a project extension was granted up until the end of 1987. Eight tonnes of soybean seed with approximately 14-15% moisture content were tested. After 43 hours of drying the seed moisture content was 8%. The cost of drying the seed is estimated by the researchers at 0.5 baht per kilogram of seed. The Seed Center is nw carrying out tests to find an economic combination of drying temperature, cold storage, and appropriate packing material.

Currently, private firms have begun to produce soybean commercially. Companies include Charoen Seed Company of the CP Group and Cargill. Seed moisture content is reduced using the conventional hot-air drying/cold storage system. Information from these private firms revealed satisfactory seed quality after storage. Soybean seed produced in the dry season (March) was processed and stored for use in the rainy season (July-August). The storage time period was short and had no significant effect on seed quality.

Appendix to Sub-Project Evaluation : 002

Sub-Project Data Sheet

1. Full name of sub-project

   Low-moisture Packaging to Prevent Deterioration of Seed

2. Implementing agency/agencies :

   Seed Division, DOAE

3. Name of Principal Investigator

   Mr.Panoo Sattayaviboon, Chief of Development Production and Factory Section

4. Name of Project Director

   Mr.Petcharat Wallapee, Seed Division Director

5. Scheduled start : Oct. 1984 Actual Start : 1984

   Scheduled finish : Sep. 1986 Actual finish : Dec. 1987

6. ATT Budget : $136,918 Actual expenditure : $137,368

7. RTG budget : $10,000 Actual expenditure : $1,731

8. Other sources of resources

Source	Item	Value

9. Extension
   1. from Oct. 86 to June 87 ATT budget: none
   2. from July 87 to Dec. 87 ATT budget: $4,500

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION
Control of Aflatoxin in Agriculture Products (003)

1. Summary description

Frequently in the past, aflatoxin contamination in corn grain has been a serious barrier to corn export to the international market. This problem still exists. Therefore, the Department of Plant Pathology, DOA, proposed a sub-project entitled Control of Aflatoxin in Agricultural Products. The project has two objectives: 1) to conduct research on improved storage techniques so as to avoid contamination of aflatoxin in corn, sorghum and peanut, and 2) to transfer the improved technique and knowledge to farmers, extension officers and the private sector. A "crib dryer" first observed in Africa was chosen as one technique to be tested.

The life of the sub-project was five years (1985-1989) and US $ 227,224 was budgeted. Of the total amount, $154,440 was a loan and $72,800 was a grant. The funds were mainly to cover the expansion of DOA laboratory facilities, training project staff, hiring a short-term project consultant from the United States, and construction of the crib dryer.

2. Findings and conclusions

2.1 Research results

The crib dryer was not successful in Thailand due to the high moisture in the air, particularly during the harvest of the rainy season crop which is most susceptible to aflotoxin contamination. The field-drying technique, including toppin, was widely introduced, but faced resistance from farmers who need to plow as soon as possible in order to plant their second crop.

A chemical tested by the sub-project was adopted by two companies for use in its silos, and a contamination test developed by the sub-project has also been useful and economic. The Division was recognized as the official unit for certifying corn grain for export.

2.2 Impact or potential impact on end-users

The Division of Plant Pathology was one of several agencies actively involved in solving the aflatoxin problem. The major results were probably achieved by the campaign of farmer education conducted largely by the Maize Growers Association. The main reason, however, why exports have not been inhibited by aflatoxin recently is that the crop has been in increasing demand in the world, and in a seller's market the buyers quickly lower their standards on contamination. As markets change, however, the knowledge

gained by Government, traders, and farmers will once again be necessary and useful.

2.3 Major problems and constraints

Problems of implementaton occured when events dictated that there should be a change in the project plan. The difficulties encountered in getting approval from the ATT central administration caused conflict and stalled the project activities.

The requirement for frequent reporting to numerous agencies also plagued the sub-project personnel.

2.4 Recommendations

Several international organizations (i.e., TARC, JICA, UK ODA) joined the DOA to solve this aflatoxin contamination problem. Those organizations made contributions to the Thai effort to assess the problem and develop solutions. These joint contributions greatly leveraged the ATT assistance, and cooperation among these agencies should be strengthened in the future.

3. Brief background of the sub-project

Aflatoxin contamination is usually found on grain harvested from corn planted in the early rain season (first crop corn). Grains from this crop have high moisture content and the harvest is done during a period of cloudy sky and high rainfall. The problem may not be serious when corn was planted as the second crop (late rainy season. The sub-project activities and efforts contributed from several agencies resulted in mitigating the problem of aflatoxin contamination.

Several types of dryers were tested in addition to the crib dryer but were unsuccessful because they increased cost of production. Field drying recommendation was to leave the corn in the field for three weeks after maturity. The development of chemical analysis to detect aflatoxin contamination has been very helpful. Samples of corn grain from corn trader have been analyzed chemically at the cost of 300-600 baht per sample.

Appendix to Sub-Project Evaluation : 003

Sub-Project Data Sheet

1. Full name of sub-project

   Control of Aflatoxin in Agriculture Products

2. Implementing agency/agencies :

   Plant Pathology Division, DOA

3. Name of Principal Investigator

   Mr. Prawat Tanboon-Ek, Plant Pathologist 7

4. Name of Project Director

   Mrs. Dara Buangsuwan, Director of Plant Pathology and Microbiology Division, DOA

5. Scheduled start : Oct. 1984 Actual Start : Oct. 1985

   Scheduled finish : Sept. 1989 Actual finish : On going

6. ATT Budget : $154,440 Actual expenditure : Thru FY88 123,936 $

7. RTG budget : $72,800 Actual expenditure :

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p ?
Kasetsart University	Field practices and chemical control	none

SUB-PROJECT EVALUATION

004. Fruit and Vegetable

1. Summary description.

The goal of this project is to identify production and post harvest handling techniques for fresh fruits and vegetables to attain levels of quality necessary for export. The five-year project (1985-89) carried out by the Plant Pathology Division of DOA was supported with an expanded and equipped laboratory, US technical assistance from short-term consultants, overseas training, and temporary technical staff. With this assistance the project was able to test technologies desired by exporters and farmers of products such as mango, banana, papaya, and mangosteen.

2. Findings and conclusions

2.1 Research results

Results were achieved in several areas for several different products. Anthracnose in mangos was found to be controlled by regular spray of two chemicals readily available in the market. Wrapping of mangos on the trees was found to improve quality and size. Shrink-wrapping and spraying with benomyl before cold storage improved quality and increased shelf-life of mango, papaya, and "egg" bananas. The above are only a few important examples of useful research results.

2.2 Impact

The project had particular impact on the export of mangos, mangosteen, and papaya. It is estimated that a total of 700 farmers and 20 exporters were exposed to new technologies through the project, and more than half adopted the project's recommendations. Mango and mangosteen farmers learned how to harvest, handle, and pack the fruits to maintain export quality. Methods of chemical treatment extended the life of the fruit, and the project taught exporters to use styrofoam trays and to shrink-wrap fruits individually to meet the exacting requirements for exotic specialty produce which commands high prices in foreign super-markets.

The project recently made a test shipment of "egg" bananas to Europe, opening the way for considerable increase of fruit exports in the future.

2.3 Problems

The main problem cited by the project director was that of maintaining her staff of temporary employees, who were mostly recent graduates looking for permanent positions elsewhere.

2.4 Recommendations

The evaluation team notes that this project received not only $500,000 from ATT but significant support from the RTG and elsewhere. For a project of this scale, a detailed cost/benefit analysis, over and above the "evaluation of impact" called for in this evaluation, would be justified.

Due to the demonstrated potential for growth of this industry, this activity is well worth continuing, and the evaluation team suggests that a detailed feasibility study of an expanded project would be advisable. Such a study should include cost/benefit analysis of the present project, a careful inventory of the various agencies already doing post-harvest and other related activities, and an economic and technical feasibility study of the specific products which have the highest potential in foreign markets.

3. Background of the sub-project

The recorded value of exports of fresh fruit and vegetable increased from 168 million baht in 1984 to 338 millon in 1987. The potential for export to such countries as Japan, Hong Kong, and European countries is far greater. Thailand has the supply and farmers who readily adapt to meet market demand. The principal need to is to identify the appropriate technologies for quality improvement and demonstrate them to farmers and exporters.

Fresh fruits and vegetables studied by the project included mango, papaya, egg banana, passion fruit, orange, pineapple, rambutan, asparagus, baby corn, mangosteen, straw mushroom, and yard-long bean. Papaya and banana were sprayed with benomyl and kept in cold storage; the technique extended the storage life of these fruits to two and five weeks respectively. As for mangos, the project experimented on production at the division's experiment station in Chiengrai and worked with farmers in several locations. Annual seminars were held for farmers, exporters, and extension personnel, instituting gentler harvesting practices to avoid soiling the fruit with its sap, wrapping of fruits on the trees, and the preserving and packing techniques mentioned above. The are numerous varieties of mango, and variations were required depending on the variety.

For baby corn, the project tested to see if different varieties might have different storage lives; result was negative. They also identified varieties which produced the size cob desired by the market.

The recent shipment of egg banana involved packing in whole hand, half hand, and individual pieces. Packed in cardboard boxes, the bananas were transported from the farm

in a truck cooled to 15 degrees C. After transport of 1,500 km, fruits were examined to compare quality.

Various methods were used to extend the results to the end-users. Field visits to farm groups, such as a mangosteen growers for export group in Chantaburi. Exporters frequently consulted the project with their technical problems. Seminars were held for end-users directly and also for ag extension workers who could disseminate relevant production technology in their tambons.

Appendix to Sub-Project Evaluation : 004

Sub-Project Data Sheet

1. Full name of sub-project

Quality Improvement of Fresh Fruit and Vegetable

2. Implementing agency/agencies :

Plant Pathology Division, DOA

3. Name of Principal Investigator

Mrs. Dara Buangsuwan, Director of Plant Pathology and Microbiology Division, DOA

4. Name of Project Director

Mrs. Dara Buangsuwan

5. Scheduled start : Oct.1984 Actual Start : Sept. 1984

Scheduled finish : Sept. 1989 Actual finish : On-going

6. ATT Budget : $321,617 Actual expenditure : $246,107

7. RTG budget : $184,400 Actual expenditure :

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p
TISTR	Post-harvest technology technology	none

Sub-Project Evaluation

Using Technology to Improve Fish Quality and Develop Fishery Products for Export (Phase I) 006

1. Summary description of sub-project

The goal of the sub-project was to identify appropriate technology for development in fishery exports. Instead of exporting unprocessed frozen products, processing only 10% of these frozen products would increase foreign exchange earnings by at least 25%.

The sub-project was divided into four parts: improving quality of frozen shrimp export; fermented fish processing; lactic acid fermented fish processing; and surimi to process low priced minced fish meat to higher value surimi based products such as imitation crab meat.

The Quality Analysis and Research Section in Fishery Technology Development (FTDD), Department of Fisheries (DOF) was the responsible agency under the management of Khun Pongpen Rattakul. The total budget for the project was $132,320.

Appropriate production and processing techniques were recommended to improve quality of frozen shrimp.

The duration of this sub-project was three years (1985-1987) after which the surimi part was extended for two more years During the extension a 1.7 million baht pilot plant was set up to demonstrate the available processing technology. The equipment provided was also useful for fishery product quality control.

2. Findings and Conclusions

2.1 Research result.

It was found that marine fish could be used for fermented fish as well as freshwater fish. Techniques for better product quality were introduced in order to improve product standard, thus making it suitable for export.

The main focus of this sub-project was surimi for which technology was transferred from abroad, adapted, and transferred to relevant individuals through seminars, training courses, workshops, and published documents.

2.2 Impact on end-users.

Seven training courses and workshops were completed in the first phase for more than 950 participants from the private and public sectors. Processing technology has

been made available on request. The number of surimi processors increased from only two before 1985 to twelve in 1987, with production capacity of 20,000 tons in 1988. Two of these firms succeeded in producing surimi based products such as imitation crab meat for export. Export of surimi increased from 3,000 tons in 1985 30,000 tons in 1989.

Regarding frozen shrimp, the quality of products from four cooperating processing plants has been improved. FTDD was able to identify "Good Manufacturing Practice (GMP)" from post- harvest to processing of frozen shrimp. This GMP has been recommended to processors to improve their product quality in order to to reduce loss from export rejection by importing countries.

2.3 Relative contribution to goal of ATT.

Sub-project 006 successfully attained the goals of ATT, by being able to identify, introduce and manage modern technology to increase income and upgrade the level of technology used.

2.4 Role of private sector.

One surimi firm receiving technical assistance from Japan through a joint venture on surimi processing also worked closely with FTDD on surimi production techniques. FTDD cooperation with this and other firms was useful for obtaining information from the commercial sector to complement laboratory work.

2.5 Major problems and constraints.

Like many sub-projects, 006 also had problems with delayed disbursement of funds, which delayed purchasing and setting up the processing machinery. Difficulty in importing process machinery was also a problem for this sub-project.

2.6 Recommendations.

Inspection and follow-up to give advice on and improve the efficiency of technology transfer is recommended. In addition, a technical information unit to compile and disseminate available technology among end-users should be established. ATT support should be continued to extend the knowledge and success of this sub-project, including the upgrading of existing technology. Although the sub-project has been successful, the transfer of technology to users is not yet complete.

3. Brief background of the sub-project

The sub-project was inititated to reduce the problem of rejection of fishery exports due to low export quality, and at the same time to attempt to increase the value added of fishery exports from low priced fish by processing into surimi and surimi based products. The sub-project achievements were outstanding, especially for surimi.

Before the approval of this sub-project, FTDD had been working with FAO on fermented fish processing and fish sauce mainly for household consumption. Related to this previous project a chemist form FAO was assigned to provide technical assistance for FTDD.

FTDD personnel were also assigned by the Southeast Asian Fishery Development Center (SEAFDEC) Post-harvest Division to be trained in surimi processing for two weeks. This proved to be very useful for the ATT project since the sub-project manager had been equipped with the basic knowledge which allowed her to successfully apply and adapt appropriate technology for use in Thailand.

The sub-project began with experiments on processing techniques. Equipment was provided from the ATT budget. Personnel were trained. In the second year processing research was conducted along with market tests for surimi products. Extension of the final results was scheduled in the last year of the project period, and included an export market test.

Sixty-eight per cent of the ATT budget was spent on purchasing necessary equipment and materials and 23% on operating costs. As an expert was assigned by FAO only around 5% was spent on training and observation costs of importing technology.

Appendix to Sub-Project Evaluation : 006/1

Sub-Project Data Sheet

1. Full name of sub-project

   Using Technology to Improve Fish Quality and Development of Fishery Products for Export (Phase I)

2. Implementing agency/agencies :

   Fishery Technology Development Division, DOF

3. Name of Principal Investigator

   Mrs.Pongpen Rattakul, Chief Analytical Research Sub-Division

4. Name of Project Director

   Mr. Wanich Vareekul, Director-General of DOF

5. Scheduled start : Oct.1984 Actual Start : Nov.1984

   Scheduled finish : Sept. 1987 Actual finish : Sep. 1987

6. ATT Budget : $124,350 Actual expenditure : $123,046

7. RTG budget : $7,970 Actual expenditure : $6,886

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Improved Fish Disease Control for Project Aquatic Organisms (007)

1. Summary description of sub-project

The outbreak of fish disease in 1982-93 led to a loss of not less than US$5,000,000 per annum and discouraged investment in freshwater fish culture.

This sub-project was designed to increase aquatic production and decrease losses incurred through infectious diseases by introducing appropriate management techniques to fish and prawn farmers, instilling self-reliance so that they could recognize and treat disease outbreaks, and strengthening aquatic farming as an occupation in order to increase aquatic production.

The sub-project started in 1985 and ended in 1987. The total budget for the sub-project was $158,170, of which $144,721 was expended . After completion of the sub-project the services have been continued under RTG budget at Fish Disease Control Centers in the two selected sites.

2. Findings and Conclusions

2.1 Research Result

The project began by collecting samples of diseased fish from the most affected areas, Suphanburi and Samut Prakarn, in order to diagnose the diseases and establish their treatment. The responsible agency was the National Inland Fisheries Institute (NIFI). Fishery biologists from NIFI detected causes of nine important fish diseases and disseminated information on prevention and treatment to farmers, giving on-farm advice and conducting training courses. Measures adopted by fish and prawn farmers included water treatment, lime and other appropriate chemical treatments, improved stocking and feeding practices and pond management.

2.2 Impact on end-users.

Technical services were provided for more than 600 fish farmers and 200 prawn farmers in Suphanburi, Samut Prakarn and nearby areas. In Samut Prakarn 235 fish farmers annually received advice, exceeding the target of 180.

Samut Prakarn Fish Disease Control Center also conducted a training course for 60 farmers on "Catfish (Clarius) Culture and Its Disease Prevention and Treatment" at the end of the sub-project. In total, 1,309 farmers received advisory assistance and 860 received training.

During the three years it is estimated that more than 3,500 farmers received assistance or advice from this sub - project. Fish production increased significantly in the areas without any serious disease outbreak. Production and culture areas that more than doubled before and during the project led to an annual increase of at least 150 million baht in the value of fish production in the Central Plain.

2.3 Relative contribution to goal of ATT.

The sub-project has been successful in increasing the level of technology i.e. better pond management and disease control for fish farmers in the sub-project areas, thus leading to higher yields and better incomes.

The Fish Disease Control Center in Suphanburi has been able to render technical services directly to the farmers after the completion of the sub-project. The Fish Disease Control Center in Samut Prakarn is slower in its development due to the lack of qualified staff.

2.4 Role of private sector.

Except for farmers who have received technical services from the sub-project, there has been no involvement of the private sector.

2.5 Major problem and constraints.

Major problems arose from delayed disbursement, especially relating to equipment purchase. This affected implementation of the work plan.

Lack of qualified personnel has been another problem, and one which has been an important reason for not continuing this sub-project. For example, the Fish Disease Control Center at Samut Prakarn, though fully equipped after the sub-project completion, was unable to find a fisheries biologist to be stationed at the Center, with sufficient background in fish diseases.

About 13% of the total budget was for operating costs and 12% for the training of 4 biologists. Expenditures for one expert (Dr. John Fryer) was around 6%. The principal investigator indicated that overseas training for Thai specialists would have been more beneficial than importing a short-term expert from outside. With their understanding of local conditions, technology could have be transferred with less difficulty than having a foreign expert work without equipment (due to delayed imbursement) for a limited period of four weeks.

2.6 Recommendations

Due to delayed disbursement after collecting fish disease samples, the diagnoses had to be carried out NIFI. Biologists had to make site visits to collect samples, observe disease outbreaks, and give advice to farmers. About 60% of the budget was for equipment and material which was partly for the provincial Fish Disease Control Centers. If disbursement had permitted the work plan to be maintained, the short-term fisheries expert could have worked more effectively with Thai fisheries biologists in the provincial centers to develop skills in using modern technologies of disease diagnosis and treatment.

Lack of personnel is a problem which cannot be solved in the short run. ATT enabled NIFI to hire temporary workers (including academic technicans and field workers), but since the termination of the project the problem has returned. Cooperation with DOF personnel planning should be sought in order to let the project sustain its results after completion.

3. Brief background of the sub-project

This sub-project was initiated to alleviate problems of disease outbreaks and encourage expansion in freshwater culture. Research on and diagnosis of diseases, including introducing proper pond management successfully reduced the problems. In addition, two Fish Disease Control Center have been located in the culture areas, one of which sucessfully began operations to render services to farmers.

Besides the stated goal, an additional outcome of this sub-project is the provision of services in the culture areas. At present, fish and prawn farmers in and around Suphanburi can obtain technical assistance at the provincial center instead of travelling to NIFI in Bangkok.

Since completion in 1987, the Fish Disease Control Centers in the two provinces have been fully equipped. The Center in Suphanburi renders its services smoothly having one full time biologist at the station. The Center in Samut Prakarn cannot acquire the needed biologist and has been working on hatcheries rather than disease control. Inconvenient location for transportation is a hindrance for development of this Center.

Appendix to Sub-Project Evaluation : 007

Sub-Project Data Sheet

1. Full name of sub-project

   Improved Fish Disease Control for Project Aquatic Organisms

2. Implementing agency/agencies :

   DOF

3. Name of Principal Investigator

   Suphanburee - Khun Sopha Areeratana, Fisheries Specialist
   Samut Prakarn - Dr.Sitdhi Boonyaratpalin, Fisheries Specialist

4. Name of Project Director

   Mr.Wanich Vareekul, Director-General of DOF

5. Scheduled start : Oct. 1984 Actual Start : Jan.1985

   Scheduled finish : Sept. 1987 Actual finish : Sept.1987

6. ATT Budget : $118,170 Actual expenditure : $118,115

7. RTG budget : $40,000 Actual expenditure : $26,606

8. Other sources of resources :

Source	Item	Value

9. Extension From To Att budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Hatchery Research and Culture of Cockle (008)

1. Summary description of the sub-project

The original sub-project goals were i) to promote research and study on cockle hatchery to increase cockle production to meet domestic demand and ii) transfer production technology to farmers. In the completion report, the objectives were identified as i) to develop cockle seed culture in tanks, ii) to develop natural cockle habitats, iii) to develop and transfer production capability to farmers, and iv) to produce an adequate supply of seed for domestic cockle culture.

In this sub-project there were two means of increasing cockle seed supply: development of cockle hatchery technology and development of natural seed beds, including the study of production techniques for higher production. The Brackishwater Fisheries Station in Prajuab Khiri Khan was responsible for the hatchery research. The Brackishwater Fisheries Station in Surat Thani was responsible for development of the natural seedbeds. The selected sites for development of seedbeds are in Surat Thani, Chumporn, Phangnga, and Nakhon Si Thammarat. The sub-project was directed by the Director of the Brackishwater Fisheries Division.

The sub-project period was 1985-1987. The total proposed budget was $222,029 of which $176,501 was actually expended.

2. Findings and Conclusions

2.1 Research Result

Research on cockle hatcheries at Prajuab Khiri Khan was not able to produce cockle seed economically due to high costs of production and the high mortality rate. At the same time, the laboratory at Prajuab Khiri Khan was carrying out research on a bivalve hatchery (e.g. oyster) which later proved to be quite successful and developed into ATT sub-project 026.

Development of a natural seedbed has been successful in Surat Thani under close monitoring by the Station. Development of seedbeds in the other areas was not successful in producing parent stock for sustained yield due to problems of poaching, predators and encroachment by push net operators and trawlers.

2.2 Impact on end-users.

Due to failure to achieve success in cockle hatchery the equipment purchased under this sub-project was used for oyster and other economic bivalves.

The natural seed bed at Surat Thani was able to begin harvesting marketable sized cockle and planned to use revenues for buying more seed to transplant into an extended seedbed, at the same time collecting data for further research in cockle culture. It has been estimated that there were 450 tons of cockle parent stock, valued at 3.84 million baht, at Ban Don Bay project site in Surat Thani. This investment has been highly profitable, since less than 20% of the budget was spent on natural seedbed development.

2.3 Relative contribution to ATT goal.

An expert was assigned to assist in hatchery research, setting up the equipment and providing general background on hatchery techniques. The Prajuab Station was found more suitable for producing other bivalves rather than cockle.

For natural seedbed development the technology has not been clearly transferred from outside the country, though the team members observed cockle culture in Malaysia. Cockle culture technology has not been well defined and it has not been possible to transfer it to Thai farmers. If technology is defined and farmers are provided with enough seed, take proper care of the beds and do not have problems of poaching and predators, cockle culture in appropriate sites is a potentially profitable investment. Many of the farms with high returns are joint ventures with Malaysians, who seem to have better culture techniques.

2.4 Role of private sector.

The private sector was not involved in this sub-project.

2.5 Major problems and constraints.

Delayed disbursement delayed the buying and transplanting of cockle seed into the natural seedbed. An extension of the project at Prajuab Station was therefore necessary. Delayed disbursement also created problems for the payment of sub-project employees.

Close monitoring seemed to be necessary for high yielding cockle culture but the budget was inadequate to allow for this activity. This affected the ability to develop natural seedbeds in some areas.

Provincial stations had difficulties obtaining disbursement from the Central authorities which further delayed sub-project activities.

2.6 Recommendations.

To make this sub-project serve ATT goals better, more background and basic research on cockle is needed for effective development planning. Once provided with adequate background, observation and training in a producing country like Malaysia could make the transfer of technology for domestic production possible. More data are also required to design cockle culture management procedures.

To increase cockle seed supply, development of natural seedbeds only is recommended. Close monitoring is necessary to prevent losses and to maintain parent stock for sustainable production.

Provided there is better coordination among sub-project team members and a clear duty assignment, development of natural cockle seedbeds should be continued. At the earlier stage of compiling necessary information to provide adequate understanding of this shellfish, funding may be possible either from USAID-STDB or GTZ.

3. Brief background of the sub-project

Cockle is an important shellfish in Thailand with a production value of around 45 million baht annually. Domestic production, in some cases as joint ventures with Malaysian interests, has not been able to satisfy the demand. Annual imports cost around 200 million baht and are increasing. One of the constraints in development of cockle culture, in spite of the availability of suitable locations, is the seed which has to be imported from Malaysia. With the banning of seed export by Malaysia, the local production situation has declined further. This sub-project was designed to reduce such problems. However due to a lack of basic data and adequate background on cockle the sub-project was not effectively designed and thus was not able to meet the stated objectives.

Prior to the ATT sub-project the Prajuab Station had been supported by International Center for Living Aquatic Resources Management (ICLARM) scientists working on developing the background for bivalve culture, financed by German Technical Cooperation(GTZ). The ATT sub-project allowed the Station to go beyond laboratory experiments.

Appendix to Sub-Project Evaluation : 008

Sub-Project Data Sheet

1. Full name of sub-project

   Hatchery Research and Culture of Cockle

2. Implementing agency/agencies :

   DOF

3. Name of Principal Investigator

   Mr. Yuth Hunsopa, Director of Research and Development, Sea-side Fisheries Station, Phuket

4. Name of Project Director

   Same as Principal Invstigator

5. Scheduled start : Oct. 1984 Actual Start : 1984

   Scheduled finish : Sept. 1987 Actual finish : 1987

6. ATT Budget : $193,509 Actual expenditure : $169,882

7. RTG budget : $28,520 Actual expenditure : $6,619

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Seaweed Production and Processing (009)

1. Summary description of sub-project

Seaweed culture and agar processing was initiated to find an alternative source of income for coastal villagers while at the same time making possible import substitution for agar and developing processing techniques for higher grade agar products.

Sub-project goals were to identify the condition of important economic value seaweeds and their potential culture areas, to build up two seaweed experimental farms with a yield of around a metric ton per rai, and to conduct seaweed culture training for at least 150 officials and farmers and seaweed processing for at least 50 trainees.

The sub-project was divided into two main parts : seaweed culture was mainly the responsibility of the Brackishwater Fisheries Division (BWFD), working in collaboration with the National Institute of Coastal Aquaculture (NICA), several provincial Fisheries Stations and Kasetsart University (KU); and seaweed processing which was the responsibility of the Sri Nakharinvirot University (SU). A private consulting company, HAII gave technical assistance in both seaweed culture and agar processing.

This sub-project lasted for two years, 1986-1987, after which the culture part was terminated. There has been an extension of the processing part under ATT sub-project 034 which is being implemented by SU. The proposed budget for the project was $275,382 of which $214,031 was expended.

2. Findings and Conclusions

2.1 Research Result

Supported by the research work at Biopolymer Research Unit (BRU) at SU and working closely with the consultants, the seaweed processing unit was able to identify the technology of processing agar from local seaweed.

2.2 Impact on end-users.

At present research on seaweed culture is still going on at the provincial Fisheries Station in Chanthaburi and NICA in Songkhla, with minimal support from RTG. KU Research Center in Chonburi, and SU research unit in Trat are also carrying out research on seaweed. Information from this research will be useful for further development of seaweed culture in Thailand.

SU gave training on household agar processing and was able to set up a pilot agar extraction unit. Forty trainees from the public and private sectors attended these courses. Due to these successes SU was able to get more funding from FAO, USAID STDB, and the Center of Genetic Engineering in Bangkok for further research in this field.

2.3 Relative contribution to ATT goal.

The sub-project was able to transfer technology from outside and adapted it to domestic conditions to enable technology transfer to selected end-users for agar processing. The success was minimal for seaweed culture due to the lack of background on biology and physiology of seaweed in Thailand.

2.4 Role of the private sector.

HAII acted as consulting company. There has also been a private company; Pure Agar, which continuously followed up on results from seaweed processing and cooperated in the development of seaweed farming in the South. Pure Agar is potential end-user for agar processing. So far there has been no actual investment from the private sector in agar processing. However, SU has established a 1.8 million baht pilot plant, paid for by the university and a contribution from a private firm.

2.5 Major problems and constraints.

Lack of coordination on seaweed culture, as there were several units in the East and South working on culture experiments, has been a major problem. Information has not been adequately exchanged among the groups involved. Better exchange of information and results would have been beneficial.

2.6 Recommendations.

The work under DOF would have been better if there had been priority for seaweed in DOF planning . This would have provided more incentive for team members.

Role assignment should be more specific and continous to facilitate work.

Better coordination is needed not only between BWFD and the provincial Fisheries Statuations but also between team members and the consultants. Output from the consultants should have been made available to the field team members to enable them to better understand the results of their experimental work.

Prior to any further ATT sub-project in this field, there should be some attempts to acquire background on

biology and physiology of seaweed. Resources might be made available through support from a source like USAID-STDB in order to gain adequate knowledge before starting work on technology transfer.

3. Brief background of the project

Seaweed culture was proposed as an additional source of income for farmers in coastal areas. Furthermore, cultivated seaweed may be processed domestically to subsitute for present imports of high grade agar. The Seaweed Production and Processing sub-project was proposed to transfer appropriate technology to achieve these goals. Culture techniques were attempted but inadequate knowledge on local conditions constrained success. Processing technology was imported through the consulting company while at the same time it was adapted to suit local conditions. The sub-project was able to identify appropriate technology for processing agar from seaweed in Thailand.

The sub-project started out by giving seaweed orientation for project teams conducting surveys on potential culture areas, building up experimental farmsin the east, mainly in Chanthaburi and in the South in Songkhla. At the same time the research and training on processing was begun by SU. About ten culture methods were tried under the advice of the consulting company. None of these methods were able to achieve the sub-project goal of producing about one metric tone per rai, since they were unable to successfully construct a suitable experimental farm. To support processing SU also tried pilot farms in Songkhla and Pattani and several other potential areas in the South. In 1989 some of these pilot farms seemed to be potential sources of additional income for the farmers in surrounding areas. Farmers at Koh Yor raised seaweed on nylon cords strung up among their mackeral raising nets. They claimed to harvest about 150-200 kg per year for sale at 20 baht per kg. More farmers are expected to join the project.

At BRU, background information and basic science on seaweed processing were acquired. There were several related projects working on biology and physiology of seaweed at BRU supported by USAID-STDB, FAO, and the Center of Genetic Engineering in Bangkok. These projects support each other as they can provide related information on seaweed which has been extended under sub-project 034 - A Technology Transfer and Development Center for Phucodolloids, a further step in seaweed processing technology.

Appendix to Sub-Project Evaluation : 009

Sub-Project Data Sheet

1. Full name of sub-project

   Seaweed Production and Processing

2. Implementing agency/agencies :

   DOF

3. Name of Principal Investigator

   Mr. Bunsong Sirikul, Chief of Provincial Fisheries Station, Chantaburi
   Mr. Siri Tukwinas, Chief of Provincial Fisheries Stations, Satun

4. Name of Project Director

   Dr.Plodprasop Suratsawade, Deputy Director-General of DOF

5. Scheduled start : Oct. 1985 Actual Start : 1986

   Scheduled finish : Sept. 1987 Actual finish : Aug.1987

6. ATT Budget : $236,882 Actual expenditure : $198,144

7. RTG budget : $38,500 Actual expenditure : $15,887

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION
An Integrated Agro-Production and Marketing Program at Lam Nam Oon (010)

1. Summary description

The sub-project was imlemented by the Royal Irrigation Department (RID). It aimed at transferring to Government officials the knowledge and techniques necessary for the extension of production and marketing of industrial crops in a complete-cycle system that leaded by private firms. It also aimed at creating appropriate linkage and cooperation among investors, farmers and government agencies as well as structuring production and marketing of certain crops in a complete-cycle system that entwined the farmer-investor relationship.

The sub-project was carried out at Lam Nam Oon Irrigation Project, Sakol Nakorn Province. The project period was 3 year, during 1986-1988, budget amounting to $100,698. The total cost of the ATT project was about $94,000 to employ a project coordinating specialist and a production and marketing specialist for 18 months.

2. Findings and conclusions

2.1 Impact or potential impact on end-users

Sub-project activities led to fruitful results. Farmers and private firms have been mutually benefited. Farmers learned to use their judgement to assess which crops are in demand by the market. Favorable environmental conditions to produce hybrid vegetable seeds for export and fresh fruit and vegetables for local market and canning lead to greater net income of farmers.

2.2 Relative contribution to goal of ATT

Contributing both to increased exports and the increase of farm income, the sub-project fulfilled quite directly the goals of ATT. Farmers adopted technology to produce new crops for which there is a strong demand. Experience gained during the implementation of the sub-project will give farmers the skill and confidence to deal with private firms.

2.4 Role of private sector

The private sector participated in determining which crops to produce to meet market demand and transferred the technology to grow these crops. The firms purchased the produce, generally at prices agreed upon beforehand. These arrangements were coordinated by the LNO staff and the ATT consultant so as to gain maximum benefit to both parties.

The close cooperation among the three parties convinced the private sectors to confidently invest in agro-industrial crop production to achieve the target goal.

2.5 Major problems and constraints

The sub-project has not been fully supported by all agencies. This may be because the nature of sub-project was quite innovative and put involved RID directly in agricultural management, which some may have considered a proper role for RID.

2.6 Recommendations for future

To better achieve ATT goals, extension of the sub-project should be granted so that crop production in irrigated areas can be expanded. In addition, ATT or RTG should support the RID to implement similar activities in other irrigation projects using LNO as a model.

Confusion, among the sub-project staffs can be avoided if clearer criteria are set and the criteria indicate which department, under MOAC, is responsible for proposing the project and acts as coordinator.

3. Brief background of the sub-project

Previous experienced in producing agro-industrial crops during 1983-1985 at the LNO irrigation project revealed that information on types of crop demanded marketly is inaccessible by farmers. Additionally, cooperation between private sectors and farmers is lack. Moreover, local government officials lack of experience in commercial crop production simultaneously with none of the agencies acts as coordinator. Thus, RID proposed an Integrated Agro-Production and Marketing at Lam Nam Oon.

From 1985 to 1988, in the dry season, an increase in cultivated areas (216 to 1410 rai), number of contract farmers (171 to 1418 farmers) and farm value of production (763,000 to 11,935,00 B) has been noted. This indicated good cooperation among the three parties. The consequence was an increase in farmers' income and investment by the private sector. RTG officials gained experience in promotion of production of high-value export and specialty crops.

Appendix to Sub-Project Evaluation : 010

Sub-Project Data Sheet

1. Full name of sub-project

   An Integrated Agro-Production and Marketing Program

2. Implementing agency/agencies :

   RID

3. Name of Principal Investigator

   Mr. Lek Jindasanuan, Deputy Director-General, RID

4. Name of Project Director

   Mr. Vichai Sguanpaiboon, Civil Engineer 7

5. Scheduled start : Oct. 1985 Actual Start : Nov. 1986

   Scheduled finish : Sept. 1988 Actual finish : Apr.1988

6. ATT Budget : $100,689 Actual expenditure : $94,166

7. RTG budget : - Actual expenditure :

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Determine the Immune Status of Cattle and Buffalo to Haemorrhagic Septicemia (011)

1. Summary description

The sub-project goal was to conduct a sample survey of cattle and buffalo to determine the present immunity to HS in order to evaluate the effectiveness of the DOLD vaccinationprogram and provide baseline data for the Department's planning.

Tests were done of 200 cattle and 200 buffalo in each of the four regions of Thailand. The project was to have taken place during 1986-87 but due to budget and procurement delays was delayed for one year. The project was carried out by the Veterinary Research Division of DOLD at the National Institute of Animal Health and Production.

2. Findings and conclusions

2.1 Impact on end-users

Results from this research were clear and simple, revealing that immunity was lower than assumed by the Department. Results were publicized at a meeting of responsible veterinary officials, but there was no follow-up to see if these officials, who are respnsible for semi-annual vaccination of all cattle and buffalo in the country, had acted on the results.

The potential benefit from this study is also limited as the use of the research results would encounter a bottleneck at the extension level. DOLD maintains 2-3 officers at each district, and these officers have insufficient time and resources to fully carry out their disease prevention responsibilities.

2.2 Problems and constraints

The RTG counterpart budget, which would financ the travel to do the survey, was cut to only 25% of the requested amount approved by the Executive Committee. This made it impossible to start until year 2.

Procurement of tools and equipment was also delayed by the long delay in disbursement of ATT funds. There was also a six month delay in the reimbursement for the short-term expert from the US who had advanced his own funds to pay for the trip. These problems so frustrated the project leader that he will no longer request ATT support but will request from JICA, whose procedures are much less cumbersome.

2.3 Recommendations

To better serve the ATT goal, it is recommended that the private Beef Cattle Association of Thailand or others should be invited to participate in the sub-project planning and operation. If the testing was carried out on private farms, under the eye of the Association, it could have immediate usefulness in increasing awareness and immunity. It would also be helpful if the project would plan for open seminars in HS prone areas with participation of farmers and local DOLD officers. This would facilitate the extension task of the local officials.

3. Brief background of the sub-project

Haemorrhagic Septicemia (HS) is one of the major livestock diseases in Thailand, regularly causing major losses. A bacteria specie is the cause of this disease and almost 100% of those infected die. Predisposing factors such as changes in nutrition, poor herd management and changes in temperature, especially during the rainy season, are thought to encourage the disease. The annual cost of animal mortality due to HS is estimated at 300 million baht (.5% incidence x 12 million animals x 5,000 baht/animal). Therefore a 10% increase in immunity will be worth 30 million baht. These benefits will accrue largely to poor farmers who hold a major share of their productive assets in the form of cattle and buffalo.

The project idea was originally conceived by the Veterinary Research Division with full support from the Director General. The laboratory test to determine the immune status of the cattle and buffalo from many villages were carried out. The results suggested that 51% of the cattle and buffalo surveyed had gained protection from the disease. This result was in contrast to the 70% and above normally assumed by the DOLD in planning its annual disease prevention program.

The sub-project also adopted a new technique for testing the samples, using serology instead of injecting mice to test their reaction. Techniques used in the study were learned from the short-term expert from the US and a study tour by the research team to the US.

Appendix to Sub-Project Evaluation : 011

Sub-Project Data Sheet

1. Full name of sub-project

   Determine the Immune Status of Cattle & Buffalo to Haemorrhagic Septicemia

2. Implementing agency/agencies :

   DOLD

3. Name of Principal Investigator

   Dr.Prapad Neramitmansuk, Senior Livestock Technician

4. Name of Project Director

   Same as Principal Investigator

5. Scheduled start : Oct. 1985 Actual Start : Mar.1985

   Scheduled finish : Sept. 1987 Actual finish : Sept.1988

6. ATT Budget : $6,136 Actual expenditure : $5,312

7. RTG budget : $23,542 Actual expenditure : $14,514

8. Other sources of resources :

Source	Item	Value

9. Extension from Oct. 1987 to Sept. 1988 ATT budget : 89,000 Bt

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Introduction and Testing Effectiveness in Thailand of New HS Vaccine in an Oil Adjuvant Against Existing Aluminum Hydroxide Gel Vaccine (012)

1. Summary description

The sub-project goal was to find a new formula and method of producing haemorrhagic septicemia (HS) vaccine which could give longer protection than the six months achieved by the present vaccine. The sub-project was carried out by the Veterinary Biologic Center, Packchong, with a two- year duration from 1985 to 1986. Due to the delay in disbursement, it was further extended for another year to finish in 1987.

2. Findings and conclusion

2.1 Impact

The sub-project research proved that the oil adjuvant vaccine protects cattle and buffalo for at least 12 months in comparison to the vaccine presently used by the DOLD which protects for no more than 6 months. Based on these results, DOLD will build a pilot plant to produce the new type, but benefit will not reach farmers in the near future. In addition, DOLD will build an 800 million baht plant at Pak Chong to produce an oil adjuvant food and mouth disease (FMD) vaccine.

Annual vaccination costs 70 baht per animal. The new vaccine will considerably reduce total cost by cutting in half or less the frequency of vaccination. More significant will be the reduction in animal loss due to improved coverage. USAID's technical evaluator estimates that the new oil adjuvant FMD vaccine will eventually reduce animal losses by several hundred million baht per year. However, all these projected benefits will be reduced if a solution is not found to the bottleneck of insufficient manpower and efficiency in the district livestock offices responsible for disease control.

2. Recommendations

In order to serve ATT goals better, it is recommended that further semi-industry scale of this new vaccine production method be developed. The resource should be from STDB as this is a manufacturing problem.

At the same time, it would be useful to publicize the technique through a seminar and workshop for officials and farmers. Given the limited capability of the DOLD to reach 100% of its target for vaccination, means should be

considered whereby the private sector or farmer ,themselves could do some of the vaccinating.

Appendix to Sub-Project Evaluation : 012

Sub-Project Data Sheet

1. Full name of sub-project

   Introduction and Testing Effectiveness in Thailand of New HS Vaccine in an Oil Adjuvant Against Existing Aluminum Hydroxide Gel Vaccine

2. Implementing agency/agencies :

   DOLD

3. Name of Principal Investigator

   Dr.Wuthiporn Roongvejwuthinvithya, Veterinarian 7

4. Name of Project Director

   Same as Principal Investigator

5. Scheduled start : Oct. 1985 Actual Start : Mar.1985

   Scheduled finish : Sept. 1987 Actual finish : Sept. 1988

6. ATT Budget : $36,869 Actual expenditure : $36,256

7. RTG budget : $6,000 Actual expenditure : $6,912

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Control of Cattle and Buffalo Liver Fluke Through Control of an Intermediate Host (Lympnaea Snails) (013)

1. Summary description

The project was designed to investigate the ecology and distribution of the cattle and buffalo liver fluke parasite, including its intermediate host (Lympnaea snail). This includes the examination of the larval stage of the parasite in the snail and their egg in the cattle and buffalo fecal samples. This information could be used in devising control measures for the parasite and finally reducing liver fluke damage to the cattle and buffalo population.

The project was carried ont by the Veterinary Research Division, DOLD with 2 year duration from 1986 to 1987. However, due to the delay in equipment purchasing the project was extended for another year to 1988.

2. Findings and conclusions

2.1 Research results

The sub-project succeeded in identifying important ecological characteristics and the distribution of the liver fluke. In addition, the researchers found that raising ducks on farms where cattle and buffalo are raised can reduce the snail population by 26 percent. This research finding could have good potential impact on farmers but so far there is no indication of the DOLE to adopt this research finding into their routine extension work.

2.2 Sub-project impact

Direct, immediate impact at the farm level was not anticipated in this sub-project. Sub-project results will assist DOLD in planning futher research and suggesting control measures, such as raising ducks in proximity to cattle and buffalo. Since there were no farmers or agri-businessmen involved in the planning or implementation, it is not known whether the suggested result is applicable under farm conditions.

2.3 Problems and Constraints

Researchers complained of the excessive amount of paperwork they had to do, which should be handled by administrators rather than researchers.

2.4 Recommendations

To better serve the ATT goal, the sub-project should seek the involvement of interested caltle-buffalo raiser

groups to contribute to the project design from the beginning and participate in a DOLD seminar to present the results. This way the end-user could be informed and test the recommendations right away, without waiting for the results to pass through the DOLD extension officers.

For continuation of the project, it is suggested that a follow-on activity be organized between DOLD and DOF to develop an integrated system including duck and fish raising to interput the ecological chain or the liver fluke life cycle and thus arrive at a successful bio-control system for farmers living in liver fluke prone area, including a farmer trial and extension component.

3. Brief background of the sub-project

Liver fluke is the most prevalent parasite and one of the most costly livestock diseases, affecting the over 10 million cattle and buffalos in Thailand. It can be absorbed by humans, particularly in the Northeast where the people commonly eat a preparation of raw meat. Incidence of liver fluke is estimated at 7% in cattle and 10% for buffalos. Economic costs include reduced food conversion ability and increased susceptability to fatal disease. The cost due to these losses is difficult to quantify, but over 100 million baht is spent annually on chemical treatment. Thailand has not had a systematic program to control the parasite.

The concept for the sub-project was originally was from the DOLD Director General who felt that research on liver fluke was a high priority need. The project studied the life cycle of the liver fluke, for which the Lympnaea snail acts as intermediate host, in the reservoirs of six provinces in the North, Northeast, and South South. The study involved the examination of the snails for presence of young liver fluke and the examination of various water plant species to see which ones commonly are a home to the liver fluke eggs and the young snails. The fecal matter samples of the cattle and buffalo from these areas were also examined for the liver fluke egg.

After the ecology and distribution of the snails and the liver fluke were identified, the researchers experimenting by raising ducks together with cattle and buffalo in the areas around water reservoirs. This was found to reduce the number of the snails by 26.8% and finally reduce the damage to the cattle and buffalo to some degree.

Laboratory equipment was financed by ATT and field reserach expenses were paid out of the RTG budget.

Appendix to Sub-Project Evaluation : 013

Sub-Project Data Sheet

1. Full name of sub-project

   Control of Cattle and Buffalo Liver Fluke Through Control of an Intermediate Host (Lympnease)

2. Implementing agency/agencies :

   DOLD

3. Name of Principal Investigator

   Dr. Tasanee Chomphuchan, Veterinarian 7

4. Name of Project Director

   Same as the Investigator

5. Scheduled start : Oct. 1985 Actual Start : Nov. 1986

   Scheduled finish : Sep. 1987 Actual finish : Sep.1988

6. ATT Budget : $8,128 Actual expenditure : $7,591

7. RTG budget : $15,350 Actual expenditure : $10,995

8. Other sources of resources :

Source	Item	Value

9. Extension from Oct.1987 to Sep. 1988

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION

Hog Cholera (014)

1. Summary description

The sub-project goal was to determine whether or not female swine which are known carriers of cholera transfer the disease to their young, such that their piglets become major sources of contamination in the herd. The research could pinpoint one of the important cause of the disease and thus lead to more effective measures for the control of the disease in Thailand.

The project was conducted by the Veterinary Research Division at both the National Institute of Animal Health and the Production and the Veterinary Biologic Center at Pakchong. Originally planned for 1987-1988, it was extended a year due to the delay in budget release. Loan funds financed laboratory equipment and operating expenses, while the RTG budget financed travel expenses.

2. Findings and conclusions

2.1 Research result

The sub-project demonstrated a technique to identify hog cholera in persistently infected swine which could be used to develop more effective control measures to be extended to swine farmers by government and private veterinarians.

2.2 Impact

The contribution of this sub-project to the ATT goal is therefore the improvement of the RTG capacity to control the disease. Thailand loses over 67,000 swins a year to hog cholera infection, and this together with other costs associated with the disease amounts to an economic loss of estimated at 318 million baht per year.

2.3 Problems and constraints

These can be summarized as follows: 1) delayed disbursement; 2) a requirement for excessive, duplicative paperwork; 3) lack of a biochemist and, therefore, proper standards in the laboratory; 4) lack of end-user involvement.

2.4 Recommendations.

The evaluator recommends the following measures to solve these problems and improve project implementation. First, DOLD should assign an official to assist the researchers with all paperwork and contact with outside

agencies on administrative matters. A bio-chemist might be found to assist the project through cooperation with a university graduate program. To accelerate dissemination and utilization of the results, seminars should be held up-country for village, DOLD, and private veterinarians.

The project should be continued, possibly with ATT support, to realize the potential benefits. Faster and more comprehensive results could be attained by including university specialists, along with DOLD technicians, in a larger research team.

3. Brief background of the sub-project

Hog cholera is a disease of swine that can spread very rapidly under the conditions in Thailand. The disease causes an estimated loss of 1.25 percent of the total 5.3 million swine, amounting to 67,000 head per year. It is generally fatal.

Under the present sub-project, 20 pregnant sows were used. The hog cholera virus was introduced to the animals. After that, a series of operations was conducted to determine if the animals were disease carriers. The research proved that if fetuses become infected in the uterus of the sow before birth, they then become carriers of the virus after birth with the potential to infect non-immune piglets in the herd. The sub-project also demonstrated that the DOLD has the technology to identify hog cholera in persistently infected swine.

Appendix to Sub-Project Evaluation : 014

Sub-Project Data Sheet

1. Full name of sub-project

   Persistant Infection of Swine with Hog Cholera

2. Implementing agency/agencies :

   DOLD

3. Name of Principal Investigator

   Dr. Kanya Subintarakorn, Veterinarian 7

4. Name of Project Director

   Same as Principal Investigator

5. Scheduled start : Oct. 1985 Actual Start : Apr. 1987

   Scheduled finish : Sept. 1987 Actual finish : Sept.1988

6. ATT Budget : $20,977 Actual expenditure : $14,342

7. RTG budget : $11,800 Actual expenditure : $18,989

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

SUB-PROJECT EVALUATION
Accelerated Technology Transfer on Macadamia as the New Industrial Crop (015)

1. Summary description

Macadamia commands a high price on the world market. Production of macadamia nut in Thailand may be promising because the environment in the Upper and Lower Northern region is comparable to that of macadamia producing areas in Australia, Hawaii and South Africa, the major world producers. Therefore, the Horticulture Division, DOA proposed the sub-project 1) to conduct experimental research on variety, cultural practices and industrial processing; 2) to compile information of Macadamia and distribute it to government agencies and investors; 3) to transfer technology generated from sub-project research results and from off-shore training and study tours to interested agencies; and 4) to construct demonstration of both large and small scale plantations.

The project duration was 3 years (1987-1989) with the total budget of US $270,888. The budget was used to provide equipment, seedlings, seeds and other materials, a short-term project consultant and off-shore training of the sub-project staff in the USA

2. Findings and conclusions

2.1 Impact or potential impact on end-users

Results from the three-year period are potentially useful to end-users in the long-term. Macadamia is a perennial crop which takes 3-4 years to fruit. Therefore, the first three years was used to introduce macadamia for testing, study crop growth and find means to propagate the plant. These are needed for future establishment of the crop. The results cannot pin point to what degree the sub-project contributes to ATT goals. The results from the varieties planted under ATT will only begin to be known next year, at which time it may be suitable to make recommendations and distribute seedlings. Consequently, transfer of technology to end-users will not begin until the end of the present project.

2.2 Role of private sector

The private sector has not been directly involved in the sub-project. The first seminar held by the sub-project was to introduce macadamia as a potential new industrial crop. Two investors have started plantations in Kanchanaburi and Chiengrai, but in both cases they made direct contact with international sources.

2.3 Major problems and constraints

The lack of an established suitable variety affected the study on cultural practices. Additionally, macadamia planted in Thailand abnormally flowered year round. This was undesirable because it puts extra stress on the trees and makes harvesting and assembly more difficult.

Project staff has been considerably discouraged by the slow process for reimbursement of expenses.

2.4 Recommendations

To generate appropriate technology for macadamia production, the evaluation team recommend that studies should be continued to identify suitable variety, optimum cultural practices and on processing plant. This it will take time since macadamia is perennial in nature. If appropriate technology is generated, it should be transferred to the end-users either through seminars or other means. Support from the ATT project should continue through to the stage of technology transfer. The Government should also consider support of a long-term effort to develop macadamia as an export crop for Thailand.

3. Brief background of the sub-project

Macadamia nut is quite a new crop to world marketa, but it is expensive. Large production areas are located in Hawaii, which produces 85% of world macadamia output. However, US demand for macadamia nut is high and it has been met by importing from Australia, Mexico, Costa Rica and Kenya. Thailand has environmental parallels to Hawaii, and macadamia has been introduced and tested. Therefore, commercial production of macadamia for export should be pursued.

As macadamia is generally new to Thailand , emphasis has been placed on finding suitable varieties from introduced germplasm. However Macadamia was first introduced and planted at Fang Horticulture Research Experiment Station 25 years ago. A stand of an improved variety was planted about 15 years ago and has been used for propagation. A seminar has been organized with a macadamia expert from the USA to introduce the crop to the private sector and government agencies. This seminar emphasized macadamia's economic importance, production techniques and utilization.

Appendix to Sub-Project Evaluation : 015

Sub-Project Data Sheet

1. Full name of sub-project

   Accelerated Technology Transfer on Macadamia as the new Industrial Crop

2. Implementing agency/agencies :

   DOA

3. Name of Principal Investigator

   Mr. Damkerng Chaleechan, Chief of Highland Agriculture Division

4. Name of Project Director

   Same as Principal Investigator

5. Scheduled start : Oct. 1986 Actual start : June 1985

   Scheduled finish : Sept.1989 Actual finish : On-going

6. ATT Budget : $203,924 Actual expenditure : $94,505 thru FY88

7. RTG budget : $66,960 Actual expenditure :

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p

SUB-PROJECT EVALUATION
Wheat Technology Transfer for Local Utilization Project (016)

1. Summary description

The sub-project goal is to transfer production and consumption technology to farmers and to expand the utilization of wheat as grain and other products for household consumption. Consequently, it may lead to new job opportunities for farmers.

Six institutions worked on the sub-project; namely, DOA, DOAE, KU, CMU, Lampang Agricultural Research and Training Center and Huay Sithon Farm Demonstration Project, Kalasin Province. Implementation sites were in the Upper Northern and the Northeastern parts of the country. Duration of the sub-project was three years (1987-1989) with a budget of US $ 244,930 (loan). The budget financed the hiring of temporary employees, operating expenses, training and demonstration, and equipment.

2. Findings and conclusions

2.1 Impact or potential impact on end-users

Under the sub-project auspices, wheat has now been grown by 61 farmers in several locations in the North. Farmers grew several rai each and continued to grow the crop, achieving increasing yields, for the second and third years. They made a small profit, although this was partially due to the 50% subsidy provided by extension officers in the form of fertilizer and seed. They were taught how to use wheat for several types of snacks and in some exotic (for the farmer) recipes where it was substituted for rice. The following data show actual and potential income per rai from the 1988/89 crop in baht.

	Yield	Price	Gross Income	Cost of Production	Net Income
average	160	6	960	500	460
highest	421	6	2,526	500	2,026

The crop is attractive to farmers because it requires relatively low moisture and can be planted during the late rainy season when both upland and labor are otherwise idle.

2.2 Relative contribution to goal of ATT

It is the opinion of the evalution team that farmers are unlikely to continue growing wheat except with aggressive promotion and subsidy. In Fang they continue to grow the crop, but in Lampang they have already stopped.

2.3 Major problems and constraints

Quality. The wheat grown is of very inferior and uneven quality for making flour. Thus it is not possible to sell this variety to flour mills.

Price and demand. The wheat can only be used for limited cottage production of snacks (khanom) and whole wheat bread. The only purchasers are the DOA for seed and a few small factories which manufacture a coagulant for sweets (for example, toffee and peanut brittle) called "bae sae." The factory visited used only 40 kg per day, and mixed 4-day wheat sprouts with other substances to produce the bae sae.

Consumption. Rice, especially glutinous rice, is the staple food for farmers at the sub-project sites, and an attempt to change eating habits of farmers is almost impossible.

Administrative problems. Reimbursement of expenses has been very slow. The Lampang center has not yet succeeded in obtaining reimbursement for its final year expenses requested over half a year ago. In addition, communication between institutions involved and ATT coordinating office is quite poor.

2.4 Recommendations

To achieve the ATT goals, production technology, before being transferred to end-users, should be modified and verified. For example, wheat varieties should be improved until grain quality demanded by processing plants is attained. Institutions involved in the sub-project may continue to cooperate with CIMMYT to test and select wheat varieties with high yield and good grain quality.

The objectives of the sub-project should be changed, Instead of transferring production and consumption technology of wheat to farmers it should develop varieties and production technology to reduce the importation of wheat and flour. Annual impots are approachng 1 billion baht and growing very fast due to the growth of the Thai middle class, which has increasingly adopted urban Western eating habits. Changing the habits of rural Thai farmers is much more difficult.

Another temperate cereal that is of interest is barley. The demand of barley as raw material for malt in brewery is high. Currently, there is only one malting plant affiliated with Boonrod Brewery, Ltd. It has a capacity of 30,000 tonnes (grain) per year. ATT may gear it interest to this crop. Boonrod has long attempted to develop local production to reduce its dependence on imported barley.

Appendix to Sub-Project Evaluation : 016

Sub-Project Data Sheet

1. Full name of sub-project

   Wheat Technology Transfer for Local Utilization Project

2. Implementing agency/agencies :

   DOA, DOAE, CMU, KU, HST, ARTC

3. Name of Principal Investigator

   Dr. Wichien Petpisit, Director of Rice Research Institue, Prae

4. Name of Project Director

   Same as Principal Investigator

5. Scheduled start : Oct. 1986 Actual Start : Oct. 1987

   Scheduled finish : Sept. 1989 Actual finish : On-going

6. ATT Budget : $244,930 Actual expenditure : $123,185 thru FY88

7. RTG budget : Actual expenditure :

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p

SUB-PROJECT EVALUATION

Control of Papaya Ringspot Virus Disease (017)

1. Summary description

The Papaya Ringspot Virus (PRV) Disease was first reported in 1975 and has since then destroyed the majority of papaya trees in the Northeast and Central Regions and spread to other regions.

The objectives of the sub-project were as follows: first, to evaluate the potential of using Cross Protection (the use of mild strain to protect plants against damage caused by a severs stain of the same virus, called the challenging strain) to control PRV-disease in the Northesat; second, to develop a Cross Protection control program suitable to Thai conditions; third, to transfer the practical PRV control program to DOAE personnel; and fourth, to select mild strains from Thai-severe PRV isolates.

The project duration was 3 years being from October 1986 and ending is September 1989. The Northeast Regional Office of Agriculture, NEROA, in Khon Kaen was responsible for carrying out the sub-project. The budget was US $115,970 with $62,726 was loan and $ 53,244 grant. The budget was used mainly for improving greenhouses, providing scientific equipment, training, and hiring a short-term consultant from the US.

2. Findings and conclusions

2.1 Impact and potential impact on end-users

The project has tested two types of virus control measures - mild strain and breeding for resistance - at several villages near the sub-project center at Khon Kaen. On average, each farmer owns five papaya trees planted randomly around the house. Farmers allowed use of their trees for the testing and some, but not all, agreed to destroy diseased trees. To date no clear benefit has emerged. The disease is still virulent in all plot villages because farmers refuse to destroy all diseased trees. In Mahasarakam province, however, the Governor's campaign succeeded in destroying diseased trees in many villages and virus losses were cut by sharply, but only for one year.

Annual losses from the virus in the Northeast alone are conservatively estimated at 300 million baht per year. Therefore even a modest reduction, in loss would yield significant benefits to the bulk of the populaton in Thailand's poorest region. Once the technology is found, adoption would be worth 500 baht annualy per household. Commercial farmers, mostly in Rajaburi, earned net return per rai of 7,000 - 10,000 baht before the virus struck.

2.2 Relative contribution to goal of ATT

NEROA is responsible for research and devlopment, especially on agricultural products relevant to the Northeast region. In carrying out the sub-project, staff were trained and assistance was received from the technical consultant. The staff was able to apply problem-solving methodoligies and technologies which may be applied to work on other economic crops in the region.

2.3 Major problems and constraints

1. Injection of mild strain failed at the village level because of the pressure of infection from the numerous diseased trees which villagers refused to destroy. This required a new parallel approach, that of breeding for resistant variety with acceptable quality for consumption in the area. Work on this second approach, which began in the third year of the project, has not received support from the ATT administration.

2. Researchers complained that they had to file progress and financial reports to five different agencies in five different forms, wasting time which they could have used for research.

3. There was evidence that scientific equipment was operated by people with insufficient training and background in its use.

2.4 Recommendations

Greater inter-agency cooperation among people working on the same problem should be encouraged. For example, Kasetsart University is also conducting Cross Protection research using bio-technology. Formal or informal exchange of information could shorten the time it takes for Thai scientists to find a practical cure for this costly disease.

The DOAE should have a role in the sub-project in terms of planning and operation. DOAE personnel at field level could be of important assistance is regards to farmers' understanding and adoption of transferred technology.

Breeding for resistance to PRV and for quality desired by farmers should be carried out simultaneously with research for improving technology. Although breeding programs take some time, the payoff is worth-while.

Given the importance of the crop and the fact that results are still indefinite, the sub-project should be extended for another period of time with financial support either from ATT or STDB.

Appendix to Sub-Project Evaluation : Q17

Sub-Project Data Sheet

1. Full name of sub-project

   Control of Papaya Ringspot Virus Disease

2. Implementing agency/agencies :

   Northeast Regional Office for Agriculture (NEROA), MOAC

3. Name of Principal Investigator

   Mrs. Vilai Prasartsee, Plant Pathologist

4. Name of Project Director

   Dr.Uthai Pisonc, Director of NEROA

5. Scheduled start : Oct. 1986 Actual Start : Oct. 1986

   Scheduled finish : Sept.1989 Actual finish : On-going

6. ATT Budget : $115,970 Actual expenditure :

7. RTG budget : Actual expenditure :

8. Other sources of resources .

Source	Item	Value

9. Extension from to ATT budget :

10. Related Activities :

Agency	Activity	Coordination with sub-p
Kasetsart University	Cross protection by genetic engineering	no formal coordination
Khon Kaen University		

SUB-PROJECT EVALUATION (022)
Dairy Herd Management Improvement

1. Summary description

The goal of the sub-project is to improve the total system of dairy herd management in Thailand. The project was conducted at the Thai National Dairy Training and Applied Research Institute, which is attached to the DOLD's Animal Husbandry Division. The life of the project was two years from 1987 to 1988 and was extended for one year to 1989.

The project includes studies on dairy cattle breeding to establish the Thai Milking Zebu breed (TMZ), nutrition, farm management and milk processing at the Institute's own farm and the end-users' farms in the Chieng Mai area.

2. Findings and conclusions

2.1 Impact

The TMZ breed was shown to increase mild yield from the Thai average of 8 kg to 10 kg per cow per day. Urea-treated straw was found to sustain yields during four months of of dry season when they would otherwise drop 2 kg per cow per day due to feeding stress. Partly as a result of the project's training programs, farmers have added 2,000 TMZ cows to their herds since the sub-project began. Numerous farmers have adopted the nutrition and urea-treated straw recommendations. In financial terms, the increased value of milk production per cow per year is estimated at 3,250 from the TMZ and 1,560 from the improvement of dry season nutrition.

2.2 Problems and constraints

The major problem, as with virtually all ATT sub-projects, has been the delay in disbursement. In the first year, the work was delayed for seven months. Better results wer obtained during the second year.

The other problem, in the opinion of the Institute, is a shortage of permanent researchers. Given the positive results of the project's outreach, an increase in manpower would increase the project's impact.

It is strongly recommended that the sub-project be continued. Researchers at the Institute presently give priority to improving their computer capability for herd improvement with the use of an expert from the US and possible training in the US.

3. Brief background of the sub-project

Current annual milk production in Thailand is about 160 tons per day from a total of 100,000 milking cows. NESDB projects that by 1990, the total number may reach 200,000. Average milk production per cow in Thailand has been about 7-8 kg/day for many years while in developed countries it is 20-30 kg. Productivity must be improved if Thailand is to be self-sufficient in milk production at a cost which does not require the present barriers to import.

In order to improve, the whole system should be elevated, and this includes the cattle breed, farm management, the feeds and milk processing. Regarding cattle breed, the sub-project has focused on using the TMZ (Thai Milking Zebu = 75% Holstein Freisian x25% Brahaman) as the target breed to be established. The number presently raised in Thailand is about 4000 head, scattered mostly in the North and the Central regions. The present average milk yield of the TMZ cows is approximately 10 kg per day, contributing an additional 8 tons to daily production when compared to ordinary breeds. Farm management will be improved by the introduction of the Dairy Herd Improvement (DHI) program to farmers. This program will enable the farmers to accurately assess the performance of their animals. For feed supply, the sub-project emphasized the quality of pasture and urea-treated rice straw studies and extension.

The urea treated rice straw was recommended by this sub-project for use during the four month dry season from January through April. Normally the milk yield will drop from 8 to around 6 kg per day during this period. The total production of Chiengmai Cooperative members, normally 15 tons per day, would drop by 3.75 tons during this period. The introduction of urea-treated rice straw sustained the normal output. The farmer training program by the Institute in Chieng Mai province reaches 200 farmers per year and in addition up-country training accounted for about 100 farmers per year. Therefore during the two year project period, about 600 farmers have undergone training.

In addition, the Institute also assisted the Chieng Mai Dairy Farmers Cooperative to prepare a feasibility study to apply for a long term loan from The Central Bank and the Bangkok Bank worth of 12-15 million baht for a 15 ton milk processing plant to be constructed within 1990.

Regarding dairy products, experiments were conducted on the production of several kinds of cheese and the results included in the appopriate training programs. It was forecast that within six to eight years, these products may become commercially feasible as the domestic supply of raw milk catches up with demand.

Appendix to Sub-Project Evaluation : 022

Sub-Project Data Sheet

1. Full name of sub-project

   Dairy Herd Management Improvement

2. Implementing agency/agencies :

   DOLD

3. Name of Principal Investigator

   Dr. Tawatchai Indratula, Veterinarian 7

4. Name of Project Director

   Mr.Anant Chainwala, Director, Animal Husbandry Division

5. Scheduled start : Oct. 1987 Actual Start : Apr. 1988

   Scheduled finish : Sept. 1989 Actual finish : On-going

6. ATT Budget : $232,654 Actual expenditure :

7. RTG budget : $19,100 Actual expenditure :

8. Other sources of resources :

Source	Item	Value

9. Extension from to ATT budget

10. Related Activities :

Agency	Activity	Coordination with sub-p ?

List of Appendices

I. Scope of work for Evaluation

II. List of 41 ATT Sub-Projects Funded To Date

III. Evaluation Methodology

IV. Logical Framework and Current Status

V. Description of Other Research-funding Institution

VI. List of Interviewees

VII. Bibliography

Appendix I

Scope of Work for Evaluation

SCOPE OF WORK

AGRICULTURAL TECHNOLOGY TRANSFER PROJECT

1. The ATT Evaluation

A. Purpose

The main purpose of the evaluation is to assess the degree to which the ATT project and individual sub-projects have attained the overall goal of technology transfer resulting in increased economic impact in the agriculture and agro-industrial sectors of the Thai economy. The evaluation team will prepare a report assessing the following;

1) What has been the economic/financial impact of the ten sub-projects which have been completed? What are reasonable expectations for the economic impact of the review of the selected sub-projects still underway? (See attachment for list of sub-projects proposed for examination)

Comment: The preferred proxy for standard appraisal techniques is the extent to which technology brought in and developed/adapted under the project has been diffused, e.g. the extent to which Thai end-users have taken up a particular product or process as measured by the volume of sales, numbers of manufactures, or end-users and the financial profitability of the product/process so transferred. The principal question on which evidence is required is the movement of the product or process from the "laboratory environment" into the "field". Attempts to quantify returns on investment using standard appraisal techniques should be undertaken only where data is readily available and reliable and benefit streams attributed to the sub-project activity are distinctly identifiable.

The contractor will select the three most successful sub-projects are prepare a short case study on each one which describes the problem or

opportunity, the intervention and its present and projected impact. For these and other sub-projects examined the evaluation team will make recommendations on how to improve the process of technology transfer.

2) What constraints (technical or administrative) to project implementation remain? What recommendations are made to resolve the problems identified?

3) What has been the project's overall progress toward attainment of it's objectives? What factors have contributed most importantly to the attainment (or failure to attain) the project goals?

4) What is the nature and extent of the private sector's involvement in the ATT sub-projects? What is the extent to which interaction between the public and private sector has increased as a consequence of the project. What recommendations are made for increasing role of the private sector?

5) What new areas seem of best potential for future support either under the ATT or USAID/Thailand programs.

6) What is the relationship of ATT project activities with other USAID funded activities (S&T project and AID/SCI grants) that support technology development and utilization? Are procedural or relationship changes needed to bring about the best possible complementarity of these activities and the ATT project?

Comment: The contractor will present findings on each of the above items. The contractor will also present the conclusions about project strengths and weaknesses based upon these findings. Finally, the contractor will make recommendations for change and future directions of the project.

B. Administrative Evaluation

The evaluation team will be of assistance in answering the following question related to the ATT project administration:

1) Given USAID staff limitations, are there opportunities to transfer greater management responsibility to the HOAC secretariat, or ATT sub-project staff?

2) Are there modifications to the project which can be made to streamline the management function and accelerate project disbursements?

3) Is the established process efficient? How long does it take to get new sub-projects reviewed and approved? What recommendations are made for improvement in the review/approval system for sub-projects?

c. Sub-Project Impact

1) What are the actual or potential economic impacts of the ten completed seclected sub-projects using costs/returns of production and/or value added through processing?

2) Have the individual sub-projects been able to meet their implementation and financial plan schedules? If not, why not.

3) Are the individual sub-projects receiving the required level of support from the RTC budget, from the parent agency and the ATT project? Are adequate resources provided to completed sub-projects to continue their outputs to warrant longer term institutional support after the sub-project is completed?

4) What degree of cooperation exists between sub-project activities and those of related concerned agencies and other USAID supported projects and activities? For example, how is the ATT aflatoxin sub-project related to activities of Kasetsart University, other donors, and the private sector.

The questions above should be asked of sub-project leaders, Project Secretariat staff, the project consultant and the project coordinator.

2. Suggested Evaluation Techniques

A. Interview selected individuals from among the Executive Committee, Technical Sub-committee, Secretariat, long term consultant, project coordinator, sub-project managers and scientists, users of expected results NESDB, DTEC, MOF, MOAC, Ministerial Departments, University, USAID officials, and private sector individuals.

B. Review selected sub-project progress through site visits to compare actual progress with that planned.

3. Suggested sub-projects for evaluation:

A. Completed Projects

1) Low-Moisture Packaging to Prevent Deterioration of Seed (Sub-project 002)

2) Using Technology to Improve Fish Product Quality (Sub-project 006/1)

3) Improve Fish Disease Control in Ponds (Sub-project 007)

4) Hatchery Research and Culture of Cockle (Sub-project 008)

5) Seaweed Production and Processing (Sub-project 009)

6) An Integrated Agro-Production and Marketing Program (Sub-project 010)

7) Determine the Immune Status of Cattle and Buffalo to Haemorrhagic Septicemia (Sub-project 011)

8) Introduction and Testing Effectiveness in Thailand of New H.S. Vaccine in an Oil Adjuvant Against Existing Aluminum Hydroxide, Gel Vaccine (Sub-project 012)

9) Control of Cattle and Buffalo Liver Fluke Through Control of an Intermediate Host (Lympneae) (Sub-project 013)

10) Persistent Infection of Swine with Hog Cholera to Ecaluate new Diagnostics and Treatment to Reduce Losses (Sub-project 014)

B. Sub-projects Not Yet Completed

1) Control of Aflatoxin in Agriculture Products (Sub-project 003)

2) Quality Improvement of Fresh Fruits and Vegetables (Sub-project 004)

3) Accelerated Technology Transfer on Macadamia as in New Industrial Crop (Sub-project 015)

4) Wheat Technology Transfer for Local Utilization (Sub-project 016)

5) Control of Papaya Ringspot Virus Disease by Cross Protection (Sub-project 017)

C. USAID S & T Financed Projects which should be reviewed for complementarity:

1) R&D for a Seaweed Phycocalloids Industry; and

2) Prevention and Control of Aflatoxin in Corn.

4. Reporting and Debriefing Requirements:

Format for Final Report The evaluation team should prepare a written report containing the following sections:

Basic Project Identification Data Sheet

Executive Summary: Three pages, single spaced.

Body of the Report: The report should include a description of the country context in which the project was developed and carried out, and provide information (evidence and analysis) on which the conclusions are based.

The report should end with a full statement of conclusions and recommendations. Conclusions should be short and succinct, with the topic identified by a short sub-heading related to the questions posed in the Scope of Work. Recommendations should correspond to the conclusions; wherever possible, the recommendations should specify who, or what agency, should take the recommended actions.

Appendices At a minimum, these should include the following:

(a) The evaluation Scope of Work;

(b) The project design Logical Framework together with a brief summary of the current status/attainment of original inputs and outputs (if these are not already indicated in the body of the report);

(c) A description of the methodology used in the evaluation (e.g., the research approach or design, the types of indicators used to measure change);

(d) A bibliography of the documents consulted;

(e) A list of the individuals and agencies consulted.

Appendix II

List of 41 ATT Sub-Projects Funded To Date

AGRICULTURAL TECHNOLOGY TRANSFER PROJECT
LIST OF SUB-PROJECT

Sub Proj.	Description	LOP	Approved Loan	Project Grant	Budget(s) Total	Implement Agencies
001	Project Director/Secretariat	85-72	337,400	438,144	775,544	MOAC
002	Low-moisture Packging to prevent Deterioration of Seed	85-87	139,681	10,200	149,881	DOAE
003	Control of Aflatoxin in Agriculture Products	85-87	154,440	72,800	227,240	DOA
004	Quality Improvement of Fresh Fruit/Vegetable	85-89	321,624	184,400	506,024	DOA
005	Black Mungbean Contaminated with MACROPHMINA PHASELONA	85-89	62,456	5,954	68,410	DOA
006	Using Technology to Improve Fish Quality and Develop Fishery Products for Export :PHASE I	85-87	132,548	6,885	139,433	DOF
	:PHASE II	88-89	355,750	91,374	447,124	
007	Improve Fish Disease Control Project for Aguatic Organisms	85-87	118,170	26,605	144,775	DOF
008	Hatchery Research and Culture ofCockle	85-87	193,590	29,661	223,251	DOF
009	Seaweed Production and Proceedsing	86-87	236,882	37,855	274,737	DOF
010	An Integrated Agro-Production and Marketing Program	85-88	100,698		100,698	RID
011	Determine the Immune Status of Cattle & Buffalo to H.S.	86-97	6,137	23,296	29,432	DOLD
012	Interoduction/Testing Effectiveness in Thailand of New H.S. Vaccine in an oil adjuvant against existing aluminum hudroxide GEL vaccine	86-87	36,869	20,800	57,669	DOLD
013	Control of Cattle & Buffalo Liver Fluke Throug Control of an Intermediate Host(Lympnease Snails)	86-87	8,128	19,400	18,528	DOLD

014	Persistent Inflection of Swine with Hog Cholera to Evaluate New Diagnostics & Treatment to Reduce Losses	86-87	20,977	41,600	62,577	DOLD
015	Accelerated Technology Transfer on Macadamia as the new Industrial Crop	87-89	203,928	66,960	270,888	DOA
016	Wheat Technology Transfer for Local Utilization Project	87-89	203-928		244,930	DOA DOAE CMU KU HST ARTC
017	Control of Papaya Ringspot Virus Disease	87-89	62,726	53,244	115,970	NEROA/HOA
018	The Application of Maize Mobile Dryer	87-88	144,362	24,000	168,362	DOAE
019	The Promotion of Copra Production Development Project	87-88	8,240	14,649	22,889	DOAE
020	Arabica Coffee Development in Northern Thailand	88-89	407,099	42,810	449,909	DOA DOAE RFD NADC
021	Control of Passionfruit Woodiness Virus by cross Protection and Resistant Varieties	88-89	60,297	30,373	90,670	DOA

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022	Diry Herd Management Improvement	88-89	232,654	15,600	248,254	DOLD
023	Development of Straw Mushroom, Shiltake & Button Mushroom Cultivation in Thailand	88-89	432,441	61,200	493,641	DOA
024	Artimia Culture and Processing Technology Transfer	88-89	291-897	125,000	416,897	DOF
025	Hatchery and Culture Technology Transfer for Development of Penaeus Monodon Fabricus Production	88-89	225,248	38,300	290,548	DOF CU
026	Technology Transfer to Increase High Value Shellfish Seeds	88-89	103,318	20,000	123,318	DOF
027	Improving Control of Swine Dysentery Thru Use of Rapid Diagnostic Technique(Elisa)	88-89	32,011	15,000	47,011	DOLD
028	Bovine Babesiosis Vaccine Production	88-89	45,000	5,000	5,000	DOLD
029	Development of Serological test for Trypanosmiasis	88-89	13,260	5,000	18,260	DOLD
030	Biological Control of Insert Pest	88-89	247,213	40,000	287,213	DOA DOAE
031	Black Pepper Development for Export	88-89	148,173	20,000	168,173	DOA
032	Applied Atmospheric Resources Research Program	88-92	1,440,000*	2,280,000*	3,720,000	RRDI
033	Transfer of Feeding Buffaloes	88-89	27,487		27,487	KKU
034	Technology Transfer and Development Center for Phycocolloids	89-90	201,117	20,124	221,241	SWU
035	Quality Inspection for Agricultural Products for Export	89-90	159,334	39,984	199,318	DOA

036	Project for Extension and Development of Cocoa as an Intererop of Coconut	89-90	236,596	29,563	266,159	DOA,DOAE
037	Improvement of Aplicuture and Bee Products	89-90	406,583	28,800	435,653	DOA,DOAE RFD,KU,CU KMTL
038	Technology of Egg Production by Seed Area System	89-90	204,499	9,762	214,261	DOA,DOAE,
039	Oil Plam Seed Improvement	89-92	384,464	4,267	388,731	DOA
040	Citrus Disease Control	89-91	415,837	25,000	440,837	DOA,DOAE
041	Low Pressure Drip Irrigation	89-91	14,642	2,208	16,850	CMU
	Total 41 Aproved Sub-Projects		7,191,531	5,553,048	12,744,579	
	ATT's Project Funding		8,000,000	4,425,000	12,425,000	

Appendix III

Evaluation Methodology

EVALUATION METHODOLOGY

The evaluation team was made up the following people:

Mr. Richard Sandler, agricultural economist, team leader
Dr. Ruangrai Tokrisana, fisheries economist
Dr. Chainarcng Kanthapanit, livestock specialist
Dr. Vichan Vichukit, crops specialist
Dr. Chartchai na Chiengmai, administrative systems analyst

This team spent approximately one month on data collection and two weeks on report preparation and revision.

The evaluation methodology was determined by the scope of work, which required information and opinions on a wide range of project issues at two levels, the overall project level and the sub-project level. Sources of information included available documents (see attached bibliography), interviews, and site visits to 16 sub-project sites spread over the four regions of the country.

The list of interviews (attached) included principal investigators and/or other staff of all 16 sub-projects, end-users of the sub-project research results, and people involved in the administration of ATT and related programs.

The emphasis throughout the evaluation, as required by the scope of work, was to determine the extent to which farmers and the private sector have actually benefitted or could reasonably be expected to benefit from the various sub-projects. Thus approximately 30% of the interviewees were farmers and businessmen identified as actual or potential beneficiaries. The interviews did not constitute a random sample of objective respondants. For the most part, the team had to rely on the sub-project leaders to identify private sector interviewees. Evaluators did, however, contact some beneficiaries and prospective beneficiaries directly.

Three basic formats were used in the study of sub-projects and their impact: a format for semi-structured interviews covering all questions raised in the scope of work; a sub-project evaluation summary; and a sub-project basic data sheet.

The purpose of the evaluation summary was to draw some general conclusions from the individual sub-project evaluations. It contained items such as quantifiable evidence of impact, incidence of problems mentioned, and involvement of private sector at various stages of the sub-project. It also required the evaluators to assign each sub-project to one of four categories which reflect the

degree to which the project has already, demonstrably, attained the goal of ATT. Evaluators made a special effort to confirm the figures claimed by the project as evidence of economic impact.

The evaluation team cannot guarantee the accuracy of the ratings of individual projects. The team had essentially one day to study each of the 16 sub-projects, which differed from each other greatly in terms of subject matter and economic environment; this was not adequate to reach a final judgement about any single project. Furthrmore, there was little concensus among project administrators as to which were the successful and unsuccessful projects. The objective of the ranking was rather to make some generalizations about ATT as a whole, based on the distribution of findings and judgements concerning the 16 sub-projects. In other words, while the individual assessments may not be totally reliable, it is our hope that the sum may tell us something.

Following the ranking of sub-projects, the evaluators returned to collect additional information on three of the five projects in category A. They then met as a group to identify the common elements of projects which had best fulfilled the goal of ATT.

It should be noted that the evaluation has not focussed on research results except to the extent that they affected project impact. From our interviews with the project adviser and reading the reports by Mr. Vocke and Mr. Walker, it appears that some of the research results have been of very high quality and originality and have been of interest to international academic communities.

Appendix IV

Logical Framework and Current Status

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title and Number: Agricultural Technology Transfer (493-0337)

Life of Project: 8 years
From FY 1984 to FY 1992
Total U.S. Funding $15 million
Date Prepared: July , 1989

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Program or Sector Goal: The broader objective to which this project contributes: To sustain agricultural growth and development in Thailand.	Measures of Goal Achievement: Agricultural growth is reattained and maintained at about 5%.	Agricultural statistics collected and analyzed each year by MOAC/OAE.	Assumptions for Achieving Goal Targets: - RTG and MOAC to continue to make agriculture a key growth sector and make decisions supporting this policy - MOAC can and will transfer appropriat technology to farmers through the newly reorganized National Agricultural Research Program which stresses a multidisciplinary approach and the Extension Program which now includes 28,000 village extension agents, subject matter specialists to train the village agents, and a train and visit method of extending technology.
Project Purpose: To accelerate the MOAC's capacity to introduce and manage modern agricultural technology needed to increase yields, production and farm income.	Conditions that will indicate purpose has been achieved: End of Project Status - Introduction to Thailand and diffusion of appropriate modern technologies to increase production on small farms and export growth. - Increased understanding by MOAC scientists and subject matter specialists of latest research and extension techniques adaptable to Thailand's natural resources, climate, and economy. - Improved MOAC professional staff performance in planning, implementing and managing agricultural development policies, programs and projects. - Closer linkage between public and private sector activities.	Subproject annual reports/evaluations Site visits (MOAC and USAID) Economic impact studies Project Technical Services	Assumptions for Achieving Purpose: - Inputs will be sufficient to make a difference in the MOAC. - Other donors continue their major support for research and extension. - Economic impact of subprojects can be measured.

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project: 8 years
From FY 1984 to FY 1992
Total U.S. Funding $15 million
Date Prepared: July , 1989

Project Title and Number: Agricultural Technology Transfer (493-0337)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTION
Outputs: - Technology packages for selected crops and other farm enterprises. - Significant improvement in quantity and quality of overall MOAC research and extension program. - Technology transfer projects which are closely associated with problems of/or opportunities for private sector (U.S. or Thai). - An institutional linkage for the provision of U.S. technical assistance and training.	Magnitude of Outputs: - Minimum of 40 new technologies introduced or developed. - Commercial application and private sector investment in at least 5 technologies. - Increased export of Thai commodities involved in project - at least 10 commodities showing increased export. PP Amendment - 40 ongoing subprojects and approximately 10 new subprojects with technologies capable of attracting at least $10 million in private sector investment (e.g. equipment, materials and joint investment). - 25 workshops with private sector involvement, estimated to be attended by 3,750 private and public sector representatives, or 1,250 companies or business entities. - Technical Assistance: 55 experts - Training and Observation: 100 participants - Counterpart funded: 1,500 participants - Approximately 5,000 new jobs created by 40 ongoing technologies and 10 new technologies funded under the ATT amendment. "AARR" - Strengthened Institutional Capacity at the Royal Rainmaking Institute to demostrate weather modification in the largest watershed in Thailand. - Operational plan developed that will permit Thais to implement weather modification demonstration programs on their own. - L-T Masters degree training in U.S. (5) - Electronics Technology and radar equipment training (2) - Managerial Training at World Tech./DOA Institute (2) - In-service training data management at field operations (20)	- Statistics on imported machines, equipment, MOAC agency reports, special surveys, BOI reports. - MOAC records and training agency reports, monitoring & evaluation reports of research and extension activities. - Records, survey of private sector commodity groups, Board of Trade. " " " " " " " " " "	Assumptions for Achieving Outputs: MOAC to select best qualified staff for skills and managerial training and use technical assistance on problems that when solved will result in yield increases. Technology identified and transferred will reflect best opportunities to promote export and reduce import.

Appendix V

Description of Other Research-Funding Institution

DESCRIPTION OF OTHER RESEARCH-FUNDING INSTITUTIONS

In looking for solutions to administrative constraints and alternative models for ATT-type projects, the following information was gathered on programs of a similar nature.

1. The Office of the Science and Technology Development Board (STDB)

This project is an effort by the US Government to assist the Thai Government and private sector to expand the contribution of science and technology to the country's development. It was funded by a US$26.5 million long-term soft loan and $8.5 million grant in August 1985.

The project is administered by the STDB board which established offices in the Jaran Insurance Building, Rachadapisek Road, Bangkok in September 1986. The project purpose is to enhance the effectiveness and extent of public and private sector application of science and technology to Thailand's development in order for the country to increase its self-reliance in science and technology in the future. The project will try to solve specific technology-related problems in three areas - bioscience/bio-technology, materials technology, and applied electronic and computer technology.

Four main activities of the project are:

(1) strengthening the existing science and technology institutions, such as universities, government research agencies, and private sector facilities;

(2) review of science and technology policy and practice;

(3) promotion of research, development, and engineering;

(4) support of industrial development.

In 1987, there were 23 projects approved, includng 12 in bio-technology, six in materials technology, and five in applied electronics and computer technology.

An interesting feature of the project is that certain projects must include a private end-user as an integral part of the project before they will be approved.

2. Program in Science and Tecnology Cooperation (PSTC)

The PSTC program, initiated by a US Congressional mandate in 1981, seeks to stimulate new and innovative scientific research on problems that confront developing countries. The program is administered by the Office of the Science Advisor (AID/SCI) and provides highly competitive research grants which are subject to external scientific peer review.

PSTC gives highest priority to submissions for scientists in developing countries which receive USAID development assistance. The program seeks new research ideas in the natural sciences and engineering. Innovative ideas that will eventually lead to solutions to serious developing country problems are accorded highest priority.

The program anticipates allocating approximately $1 million in current competition from developing countries, including Thailand. Proposals are screened at the country level and forwarded to compete at the international level.

3. US-Israel Cooperative Development Research Program (CDR)

The CDR Program is a joint effort to provide access by developing countries to Israeli technology which may help solve the problems of the less-developed countries. Roughly $2.5 million is expected to be available in the 1989 progam.

LDC and Israeli scientists and institutions are invited to submit research proposals for up to $200,000 funding for 3-5 year projects. Investigators may be from universities, government, or the private sector. Priority is given to collaborative research projects between Israeli scientists and those from LDCs receiving aid from USAID.

4. International Develolopment Research Center (IDRC)

IDRC is public corporation created by the Parliament of Canada in 1970 to stimulate and support sceintific and technical research by developing countries for their own benefit. It gives financial and profession support for the following fields of investigation: farming, food storage, processing and distrubion, forestry, fisheries, animal sciences, energy, tropical disease, water supplies, health services, education. By 1988, IDRC had awarded a total of $108 million, of which $18 million went to Southeast Asia. Thailand has received support for 6 projects totalling $866,000. IDRC maintains a reginal office for Southeast Asia in Singapore.

5. Japan International Cooperation Agency (JICA)

JICA is an aid agency of the Government of Japan established in 1974. It is supervised by the Japanese Ministry of Foreign Affairs, with involvement of the Ministry of Agriculture and Ministry of International Trade and Industry (MITI). It includes a Training Program, Expert Dispatch Program, Equipment Supply Program, and Project-Type Technical Cooperation under the Agriculture, Forestry and Fisheries Development Cooperation Program. The latter is intended to offer technical guidance, extension, and research and development in the fields of agriculture. JICA has abundant resources and maintains an office at the Japanese Embassy in Thailand.

6. Rockefeller Foundation

The Foundation was founded in 1913 by John D. Rockefeller to "promote the well-being of mankind throughout the world." It operates international programs in agricultural sciences, arts and humanities, equal opportunity, international relations, and populaton science. Projects are carried out primarily through grants to univerisites, research institutes, and other qualified agencies. The agricultural science program supports selected projects to improve food production for the poorest sector of the population in developing countries and is currently focussing on schemes concerning food cereal, rice and babesiosis (a haemo-parasitic disease). In 1984, the Foundations total assets were over one billion dollars and expenditure was $53 million.

Appendix VI

List of Interviewees

List of Interviewees

Mr.	Akhlaporn Fangklai	Extensionist-Hortthai Co., Ltd.
Dr.	Akwut Tasanasongchan	Agronomist, KU
Dr.	Amar Siamwala	TDRI Agricultural Program Director
Mr.	Aphisit Thanasumpun	Pathomfarm Amphur Muang, Nakhonpathom
Mr.	Auichai Wattrapudet	ATT Project Coordinator ,MOAC
Mr.	Bandit Chan-ngam	Head of Wawi-highland Research Station
Mr.	Boontham Phrommanee	Director of Agricultural Economics Research, Office of Agricultural Economics, MOAC
Mr.	Bunrod Malagrong	Economist, ARTC
Mr.	Chareon	Seaweed Farmer, Koh Yor, Songkhla
Mr.	Chareonsak Salakij	Phathom Farm Amphur Muang Nakhonpathom
Mr.	Chew Sae-ngow	Owner Yong Haud Factory
Mr.	Chow Vatcharathai	Cattle Farm Amphur Doumbangnangbuat, Supunburi
Ms.	Chutinat Maliwal	Economist LNO-Project
Mr.	Danai Praditsong	Director of Project Division, Office of Permanent Secretary, MOAC
Mrs.	Dara Buangsuwan	Director of Plant Pathology and Microbiology Director, DOA
Mr.	David Delgado	USAID Program Officer
Mr.	Grival Gosumal	Mechanical Officer 4, Seed Centre 3 Lumpang
Dr.	Jaroon Kamnuanta	USAID, S&T
Ms.	Jessada	Ao Chau Fisheries Station
Mr.	John Coole	Winrock Foundation, Bangkok
Ms.	Jurai	Seaweed Farmer, Koh Yor, Songkhla
Mrs.	Kanittha Juengpirpien	Biologist, Brackish Water Fisheries Division
Mrs.	Kwanruthai Thanomkiat	Biologist, Brackish Water Fisheries Division
Dr.	Kisda Sampantarak	Sorghum Breeder
Mrs.	Kongkaew Pirai	Farmer Banrae, Tambon Rae, Amphur Pangkone, Sakonnakhon
Mr.	Krisda Piempongsan	Chief of U.S.Relations Sub-Division DTEC
Mrs.	Manop Chomphuchan	Officer Phukiew Wildlife Conservation Protectorate, Chaiyaphum Province
Mr.	Nakorn Sangplung	Chief, Rice Sub-division, Crop-Promotion Division, DOAE
Mr.	Niwat Panuampai	Technical Officer, Fang
Mr.	Pakorn Uonprasert	Fisheries Specialist, National Inland Fisheries Institute
Mr.	Panu Sattayaviboon	Seed Division, DOAE
Mrs.	Penswart Suwanasorn	Technical Officer, Seed Centre 3, Lumpang
Dr.	Phavinee Wongsonsunee	Veterinarian, Hog Training and Research Institute, Nakhonpathom
Dr.	Pipol Bunjunta	Mechanical Engineer, KU.
Mr.	Pisit Siriwan	Beef Farmer, Amphur Kampaengsan, Nakhonpathom
Mrs.	Pongpen Rattakul	Chief, Analytical Research Sub-Division, Fishery Technological Development Division
Ms.	Pornthip Kutwanakarn	Technical Officer, Cow Promotion Oganization, Saraburi

Mr.	Pornchai Pornchaleompong	Salesman, Jirakorn Co., Ltd.
Dr.	Pote Chumsri	Director, Office of Planning Improvement and Farmers' Participation, DOAE, MOAC
Dr.	Prapan Kessung	Department of Livestock, KU
Mr.	Prapan Laopiyabut	Beef Farmer, Amphur Takuapa, Pang-nga
Mr.	Prapan Tangcharuwattanchai	Lengkeng Farm, Amphur Muang, Nakhonpathom
Mr.	Prapan Wattanawinin	Executive Director, Asia and Pacific Quality Trade Co., Ltd.
Mr.	Prapas Chirapatsakul	Deputy Agriculture Manager, FE Zuellig (Bangkok) Co., Ltd.
Dr.	Prapas Neramitmansook	Veterinarian 7, Animal Health Care Institute, DOLD
Mr.	Prasert Phaiseta	Farmer Banrae, Tambon Rae, Amphur Pangkone, Sakonnakhon
Mr.	Prasit	Seaweed Farmer, Koh Yor, Songkhla
Mr.	Prasit Piruncharoen	U.S. Relation Sub-Division DTEC
Mr.	Pratya Hemsuji	Factory Manager Nestle Co., Ltd. and Private Sector Member of ATT Executive Committee
Mr.	Prawat Tanbun-Ek	Leader of Sub-project 003
Mr.	Pruchya Kingphupha	Pathom Co., Ltd. Amphur Maung, Nakhonpathom
Mr.	Pullop Popug	Cattle Farmer, Amphur Kowliew, Nakhonsawan
Mrs.	Ratchaneeporn Sirilurgpipat	Manager, Pisitchai International Co., Ltd.
Ms.	Ratri Chuentonglang	Farmer, Mu 8 Bansawang Tumbon Don-hun Amphur Muang, Konkaen
Mr.	Rewat Vatcharathai	Cattle Farmer, Amphur Doumbangnangbuat, Supunburi
Dr.	Robert a. Ralston	ATT Project Advisor, USAID
Mr.	Sakorn Tripetpaisan	Marketing Manager, Cargill Seeds Co., Ltd.
Dr.	Sawalee Chankrachang	Assistant Professor, Srinakharinwirote University
Mr.	Sawit Mejui	Head of Field Crop Division, ARTC
Mr.	Sirivat Salobol	Director of Planning Division, Department of Livestock, MOAC
Mr.	Somchai Jomtong	Food-Service Technologist, ARTC
Dr.	Songchai Sahawatchasin	Chief, Prachuab Kirikhan Fisheries Station
Ms.	Sopha Areewatana	Fisheries Specialist, National Inland Fisheries Institue
Mr.	Srimun Bunyarat	Deputy Head, Fang Horticultural Experiment Station
Mr.	Suchart Nilawat	Exporting Manager, Shell Co., Ltd.
Mr.	Suchart Wongwai	Pure Agar Co.
Dr.	Sujira Pachariyanon	Veterinarian, Animal Healthcare Institute, DOLD
Ms.	Supatra Supamethi	Institute of Horticulture Research, DOA
Dr.	Supot Fuangfupongse	Corn Agronomist
Ms.	Suree Wongwitchakorn	Project Division, MOAC
Mr.	Sutthipong Thirasak	Cow Farmer, Amphur Muaglek, Saraburi
	Caretaker of SU Experimental Plot	Trat
Dr.	Tasanee Chomphuchan	Veterinarian 7, Animal Healthcare Institute, DOLD

Dr.	Tawatchai Intaratul	National Dairy Tranining and Research Development Institute, Amphur Muang, Chiangmai
Dr.	Thalerng Damrongnavaswadi	Former Permanent Secretary of MOAC
Ms.	Thanomnual Leekunpitak	Export Division, C.P. Intertrade Co., Ltd.
Mr.	Thammasak Sommart	Plant Patholgist
Mr.	Thomas Buhler	US Agricultural Attache
Mr.	Tneodure Panayotou	Formerly with Agricultural Development Council
Mrs.	Tongkorn Hirunruk	USAID, ATT
Mr.	Toudsak Chainarong	Beef Farmer, Amphur Dankuntod, Nakhonratsima
Mr.	Udom Sithipuprasert	Associate Professor, KU.
Dr.	Udom Phupipat	Plant Pathologist (Aflatoxin)
Dr.	Udomchai Shivadit	Assistant Professor, Srinakharinwirote University
Mr.	Ura Pancharoen	Ass. Prof.,Chulaongkorn Unversity
Mr.	Utai Pisone	Director of NEROA
Mr.	Utit Panyapong	Extensionist, Known You Co., Ltd.
Mrs.	Vanida Anuman	Chief, Director Sub-Division Brackish Water Fisheries
Mr.	Varin Pattiyakij	Pathiyakij Farm, Amphur Muang, Nakhonpathom
Mr.	Vichal Sngaunpaiboon	Head of Lam Nam Oon-Project
Mr.	Vichien Worasayan	Biologist, Brackish Water Fisheries Division
Mrs.	Vilai Mesricharounkiat	Marketing Service, CP. Co., Ltd.
Mr.	Vinit Yimkoson	Technical Officer, Seed Centre 3, Lumpang
Mr.	Visut Chompradit	Production Manager Asgrow Co., Ltd.
Mr.	Vivat Singhataweesak	Biologist Chantaburi Fisheries Station
Dr.	Waewjuk Kongpolprom	Plant Breeder
Mrs.	Waree Sornsri	Farmer Ban Pong Tueb Tambon Wieng
Dr.	Watsana Pinyochon	Veterinarian, Animal Healthcare Institute, DOLI
Dr.	Watsana Wongyai	Sorghum Leader
Mr.	Weera Suriwongs	Deputy Kaset Amphur 5, Fang
Mrs.	Wilai Prasartsee	Plant Pathologist
Ms.	Wililak Chareonkul	Chief of Project Sub-Division, Project Division, MOAC
Mr.	Will Knowland	USAID, Consultant
Mr.	Winya Srichaimul	Farmer, 7 Mu 7 Tambon Nongjom Amphur Sansai Chiangmai
Mr.	Wisut Himarat	National Dairy Training and Research Development Institute, Amphur Muang, Chiangmai

Appendix VII

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