

**Private Sector Research
and Technology Transfer
in Bangladesh**

by

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Executive Summary

This survey is part of a University of Minnesota/Rutgers University study financed by AID/Washington on private sector Research in the Third World. The purpose of this survey was is to (1) find out how much and what kind of research is being conducted by the private sector, (2) identify the policy constraints and incentives to private research and technology transfer, and (3) identify major impacts of private research and technology transfer on farmers.

The Bangladesh survey was conducted in February 1986. Representatives of eight agribusiness companies were interviewed. This included all the private sector agricultural research programs in Bangladesh and representatives of both Bangladeshi and multinational companies that were doing research. In addition, we interviewed officials of the Bangladesh government, AID, FAO and IFDC. We also drew on several recent studies on agribusiness in Bangladesh.

There is very little private sector research in Bangladesh. The most effective program has been the Bangladesh Tobacco Company's applied research program on Virginia and Burley tobacco. Several pesticide companies have small R&D programs and the largest pump manufacturer has done some work redesigning pumps. Finally, one company is conducting some trials on different varieties of vegetables.

Private companies have been more active in transferring and diffusing technology that was developed elsewhere. Tea plantations, pesticide companies, poultry producers and others are importing everything from vegetable seeds to plant growth regulators.

The major impact of private sector research and technology has been in the tobacco industry. The research and technology transfer activities of the Bangladesh Tobacco Company have allowed the country to shift from importing all Virginia and Burley tobacco in 1972 to exporting some Virginia tobacco in 1985.

The primary limitations on private sector research in Bangladesh are the small size of the modern agricultural input and processing sector and the government policies. Bangladesh is a small market for pesticides and commercial seeds. The fertilizer market is large and the jute and tea industries are also quite large, but government intervention in with these industries has also been great. The government owns a large share of the production capacity in all of these industries and regulates the rest. Specific policies on technology imports and incentives for private research may also present constraints. The binding constraints, however, are underdeveloped agriculture and government intervention in the industries.

The policy implications for the government and AID are that they must concentrate their efforts on key public sector investments like government agricultural research and other forms of infrastructure. This will speed agricultural modernization. At the same time, the government and AID must continue to push for more privatization of the input and processing industries. Eventually, if other regulations become a binding constraint, they should be studied and, if necessary, changed.

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1 Introduction

This survey is part of a University of Minnesota/Rutgers University study financed by AID/Washington on private sector research in the Third World. This paper is part of the second phase of this study which consists of a survey of private agricultural research and technology transfer in six countries in South and South East Asia – the Philippines, Indonesia, Thailand, India, Pakistan and Bangladesh. The purpose of these surveys is to (1) find out how much and what kind of research is being conducted by the private sector, (2) identify the policy constraints and incentives to private research and technology transfer, and (3) identify major impacts of private research and technology transfer on farmers. In addition, we have made some preliminary recommendations of programs and policies that AID might support. In a third phase of this project, we plan to quantify the impacts identified in this phase and measure how policies influence these impacts.

The Bangladesh survey was conducted in February 1986. Representatives of eight agribusiness companies were interviewed. This included all the private sector agricultural research programs in Bangladesh and representatives of both Bangladeshi and multinational companies that were doing research. In addition, we interviewed officials of the Bangladesh government, AID, FAO and IFDC. We also drew on several recent studies on agribusiness in Bangladesh.

2 Growth and Structure of Bangladesh Agriculture

The major changes in agricultural production in Bangladesh since independence from Pakistan have come in the production of the major grain crops - rice and especially wheat (Table 1). The growth in grain production has been due to a combination of (1) modern varieties developed in collaboration between government research and international centers like IRRI and CIMMYT; (2) the availability and use of fertilizers; and (3) the spread of better water control - particularly irrigation in the winter season.

2.1 Input Industries

Private seed industry is nonexistent except vegetables. The Bangladesh Agricultural Development Corporation (BADC) provides modern rice and wheat seeds and seed potatoes. Then villagers do their own multiplication of seeds. Most villages have one or two farmers who specialize in seed production and storage. There are few seed firms who produce the seeds of field crops for sale beyond their village.

Ten companies import vegetable seeds. BADC imports an amount of vegetable seeds equal to the private companies. All of the potatoes and other field crop seeds that are imported by BADC. Several small companies are starting to clean seeds and pack them in tins like the imported seeds. Another company opened a small experimental farm and radish seed production operation three years ago. The seed importers and distributors are organized into the Seed Merchants Association.

Table 1: Selected Output and Input Statistics

	1970	1975	1984
Rice (1000mt)	11,815	11,109	14,279
Wheat (1000mt)	103	115	1,192
Tea Production (million lbs.)	67	71	93
Yield/acre (lbs.)	760	636	845
Virginia Tobacco (million lbs.)	0	40	47
Yield/acre		789	826
Fertilizer (1000s long tons)	277	280	1,050
Pesticides (mt)		2,025	3,245
STW (nos.)	0	2,610	67,803
DTW (mos.)	980	2,699	15,519
Area Irrigated by DTW and STW (1000 acres)	81	234	1,648

Source: Bangladesh Bureau of Statistics and The World Bank.

Fertilizer manufacturing and importing is still a government monopoly. However, the distribution of fertilizer has been gradually turned over to the private sector starting in 1978.

Really rapid growth has taken place in the supply of deep tubewells (DTW) and shallow tubewells (STW) since 1979. The World Bank and other donors financed massive imports of STWs and DTWs. The importing and distribution of tubewells was done by BADC or the Bangladesh Krishi Bank until 1983 when the private sector played an important role in fielding STWs for the first time. Tubewell production is done locally except for the engines which were imported until recently. At the end of 1985, a ban was placed on the import of engines for irrigation.

Pesticide importation and distribution was in the hands of the government until 1979. Pesticide prices were subsidized by 50 percent by the government and spraying was carried out by the government. In 1979, importation and distribution was turned over to the private sector. The government's involvement is mainly regulatory now although it does own Burmah-Eastern and has shares in Ciba-Geigy and ICI's formulation facilities. After 1979, there were several years of slow growth while farmers got used to unsubsidized prices and the companies established their distribution networks. Since 1981-82, there has been rapid growth in sales. Ciba-Geigy has about 50 percent of total sales but six other companies have 5 percent or more and a number of other companies are actively seeking a larger share. The total market is about US\$10 million.

No company produces active ingredients of pesticides in Bangladesh. There is a plant for the production of DDT which is not used at present. Several companies are formulating their products locally and several other

companies have applied to start formulation plants.

2.2 Processing and Plantations

The Virginia tobacco industry was started in the early 1970's and is still dominated by Bangladesh Tobacco Company. This company has about 60 percent of the cigarette market and the rest is divided by 16 small companies. BTC is 60 percent owned by BAT Industries, 30 percent by the Bangladesh government and 10 percent by the general public. In recent years, the country has started to export tobacco. Both output and productivity of Virginia tobacco production has risen since 1975.

The tea plantations of Bangladesh are divided into four categories - Sterling estates which are owned by foreign companies; the Bangladesh Tea Industry Management Committee (BTIMC) estates which are owned by the government; the National Tea Company Ltd., a private company set up by the government of former BTIMC estates are 51 percent government owned and 49 percent publicly held; and the Proprietary estates which are owned by Bangladeshi citizens. The most progressive sector of the industry has been the Sterling estates although they have not grown very rapidly since Liberation. They suffered an important set back in the early 1970's when the government forced all expatriate plantation managers to leave. Inexperienced Bangladeshis took over. In addition, there was a long period when there was no replanting because of the uncertainties of the war of Liberation, the threat of nationalization and the lack of markets after Liberation.

2.3 Livestock and Shrimp

Livestock production makes up less than 10 percent of the total value added in the agricultural sector. The official statistics indicate that livestock production is growing faster than crop production since 1971-73. Some of this is due to replenishment of stock that was destroyed or moved out of Bangladesh during the War of Liberation. The rest of this growth may well be a statistical artifact as the livestock statistics are extremely unreliable. Little or no new technology has been introduced either by the government or the private sector in livestock.

Bangladesh has the smallest commercial poultry sector of the six South and Southeast Asian countries in this study. Industry spokesmen estimate that commercial operations produce total daily output of 25,000 eggs and 10 tons of meat. Three companies with links to foreign poultry breeding companies are active in the country. In addition, government poultry farms provide chicks. The main commercial operations make their own feed. There is a government feed mill at Savar which supplies some poultry feed. Only one commercial layer operation appears to be expanding and will go into broiler production fairly soon. If this operation is allowed to make profits, other companies may follow its example. If it does not, the poultry industry will remain a slow growing sector.

The shrimp industry has grown extremely rapidly in the past few years in response to foreign demand. Exports have increased four times between 1977 and 1984. It is now the second largest foreign exchange earner after jute products. At first, exporters simply bought the shrimp from fishermen or farmers, processed them and then shipped them off. Now many of them

are going into production also. It is a very competitive industry with many firms competing. The role of government has primarily been regulatory.

3 Research by Private Sector

3.1 Amount and Type of Research

The amount of private resources being invested in agricultural research in Bangladesh is very limited. I identified only five companies that claimed to do some research, but it is unlikely that their programs are very large. The largest agricultural research programs are probably conducted by Bangladesh Tobacco Company (BTC) and Milnars, the pump producer. BTC spends about \$50,000 annually on research. Milnars has an R&D department which contains 12 engineers which is more scientific personnel than BTC has. Milnar's research budget was not available. The total expenditures on private agricultural research programs is somewhere between \$100,000 and \$200,000 annually depending on how much Milnars is spending. In contrast, the public sector spent over \$27 million in 1980. About 30 scientists and engineers are doing R&D in the private sector while hundreds do research in the public sector.

The companies that do research are quite diverse. Four of them are in the input industry providing pesticides, pumps and vegetable seeds. The other company - BTC - uses agricultural products as an input into its manufacturing activities. A majority of the shares of BTC and the pesticide companies are foreign owned. Milnars is owned by a Bangladeshi company.

The research these companies do is very applied. Most of their activities consist of comparative trials to find which imported varieties or chemicals work best in Bangladesh conditions. BTC tests varieties of Flue Cured Virginia, Burley and Dark Virginia for yield and quality. They do experiments

on fertilizer applications, irrigation and plant growth regulators. They also did a lot of work to develop alternative fuels for flue curing. In the end, they decided that wood will continue to be the main source of fuel. National Agro-seeds is screening local radish varieties to identify the best yielding varieties. It is also conducting trials on tomatoes, cauliflower and ladies finger.

Ciba-Geigy has done research to improve application techniques and to design inexpensive hand sprayers for small farmers. In addition, they conduct bioefficacy trials on chemicals that are new to Bangladesh or try commercial chemicals on new crops. Finally, they do some research on new chemicals which is funded by central research in Basle. ICI's research is similar to Ciba-Geigy's except that the sprayers they are studying are electrodyne sprayers which were not designed or produced locally.

Research by the agricultural equipment manufacturers is of two types. Larger firms like Milnars work primarily to improve the process for efficiently producing pumps based on designs from Germany or redesigning pumps to fit BADC's specifications. Smaller firms have no formal R&D. In a separate study, Jabbar (1985) has identified five firms that "have made significant improvement in equipment design and development". Table 2 shows his findings on the manpower engaged in private and public research on farm equipment. The firms in the table are Comilla Cooperative Karkhana (CCK), New Light Inventory (NLI) in Chittagong, Ittafaq Industrial Corporation (IIC) in Dhaka, North Bengal Agricultural Workshop (NBAW) in Rangpur and Beauty Engineering Works (BEW) in Kushtia. He did not count the research of Milnars and other large firms perhaps because he did not consider their improvements to be significant. The research

of the five firms he discusses have been primarily to design new plows, seed drills, irrigation equipment and post harvest equipment.

Table 2: Manpower Engaged in Farm Equipment Research, 1985.

<u>Institution/ Firm</u>	<u>Engineer</u>	<u>Technician</u>	<u>Service Staff</u>	<u>Total</u>
<u>Research Organisation</u>				
BARI	17	12	28	57
BRI	27	20	5	52
BJRI	5	5	2	12
BAU	12	30	10	52
BARC	8	-	-	8
IAT	1	-	3	4
Total	70	67	48	185
<u>Manufacturing Firms</u>				
CCK	3	5	130	138
NLI	3	18	26	47
IIC	1	39	14	54
NBEW	1	2	7	10
BEW	1	6	12	19
Total	9	70	189	268
Grand Total	79	137	237	453

Source: Jabbar, 1985.

3.2 Impact

Local private research has had a substantial impact only on tobacco farmers. No Virginia tobacco was grown in the area that is now Bangladesh before Liberation from Pakistan. BTC tested varieties and developed the cultural practices for growing Virginia tobacco in the late 1960's. Then it spread the cultivation of tobacco in the early 1970's into Kushtia and Rangpur districts. Through experimentation, experience of farmers and increased inputs, the yield per acre of tobacco of BTC contract growers increased from about 500 lbs. per acre in the early 1970's to 1000 lbs./acre in 1980.

The research and development activities of the pesticide companies have accomplished two things: they have helped get chemicals through the registration process (although the tests that they run are not accepted by the registration authorities), and they may have made some adaptations to the application process so that they are more effective and safer under Bangladeshi conditions. ICI has worked with the Tea Plantations to improve the effectiveness of Paraquat and Ciba-Geigy has developed sprayers for the small farmer so that he does not use brooms and other ineffective and unsafe application methods when sprayers are not available.

National Agroseed has been selling small quantities of radish seeds for the past two years. This year is the first in which they will have large quantities for sale. They are selling for the same price as local seed in order to increase farmer acceptance. The farmers can produce more per acre with this variety. As the farmers recognize this, the company will be able to increase prices and start making profits in the next year or so they

hope.

Innovations in the agricultural machinery industry have helped to cut costs and to ease labor and power shortages. (Jabbar, 1985)

4 Technology Transfer by the Private Sector

4.1 Transferring Technology Between Countries

All of the companies that were doing research were also transferring some technology directly into the country. In addition, a much larger number of companies were playing a role in transferring technology into Bangladesh. In addition to Ciba-Geigy and ICI, a number of local companies represent American, European and Japanese pesticide manufacturers. About 10 locally owned companies import vegetable seeds. A large number of companies import foreign irrigation equipment. Three firms import foreign breeds of poultry. There are still a number of tea estates which are owned by foreign, primarily British, companies. They are able to bring in some technology and information from India and Africa where they or their consultants operate. Lever Brothers and HICO are bringing in their plant growth regulators from India. Several shrimp exporters and processors are starting to bring in improved technology by hiring experts from abroad to help improve shrimp production technology.

In the mid to late 1970's, most of the tea plantations began to invest in replanting and import new technology to improve the quality and reduce costs of production of tea so that it could compete on the international market. Technology was first brought in by the Sterling companies with some assistance from the government Tea Research Institute. They use consultants from their plantations in other companies or from consulting companies to bring in improved management, clones and machinery. Another source of improved technology in recent years is the OTA/EEC Tea

Rehabilitation project which has been working to improve the Tea Research Institute and the tea industry as a whole in Bangladesh.

BTC brought in the initial technology used to produce Virginia tobacco in Bangladesh from India and Pakistan. BTC has sister companies in those countries - BAT Industries owns a share of Indian Tobacco Company and Pakistan Tobacco Company as well as BTC. BTC continues to bring in most of the varieties that it tests from abroad. BTC does not have its own breeding program. It is also bringing in succorides and PGR's from India. BAT's affiliates in many countries have worked to develop more efficient methods of curing tobacco and alternatives to wood. In the end, they have apparently decided the best method is to promote reforestation with Ipol-Ipol in Bangladesh. They have been providing 500,000 seedlings annually to farmers and government institutions in Kushtia district. These are widely planted along canal banks, roads and in some farmers' fields for commercial forestry. These trees have not yet matured and so it is hard to say how successful this program will be.

Nine companies import or assemble engines for tubewells locally. Four of them are assembling the engines locally with plans for progressive manufacturing. The basic technology is either Japanese, Indian or German. Three companies produce pumps for deep tubewells locally. Milners is the main producer. Their design is German with slight modifications. There are many local manufacturers of shallow tubewells. I was not able to interview them about the source of their technology.

The commercial poultry industry is still in its infancy in Bangladesh. Two firms have hatcheries where they produce commercial chicks for sale. The parent stock they use is imported from Canada or the U.S. The one

apparently successful large scale layer operation imports its commercial layers and management technology from India. At present, a technician from the Indian company which provides the layer chicks is also managing the layer operation and training Bangladesh managers.

The major seed imports by the private sector are vegetable seeds. They are mainly radish, watermelon and cabbage. The seeds come from Japan, Holland, the United Kingdom and recently some have come from Korea.

Transfer of technology between private individuals undoubtedly takes place along the Indian border. It seems clear that the spread of HYV wheat varieties was in part the spread of varieties from India into Bangladesh by farmers and merchants.

4.2 Diffusion of Technology within Bangladesh

The role of the private sector in the diffusion of improved technology to farmers may be more important than their role developing and importing technology. Most of the pesticide companies give their dealers some technical training. Ciba-Geigy by itself has trained over 2000 dealers in the effective and safe use of pesticides. Most pesticide companies also have technical staff to provide back up assistance when the problem is too complicated for the dealer. BTC has a large force of agricultural graduates who provide technical advice to their contract farmers, make sure that inputs arrive on time and buy the tobacco at the end of the season. The Sterling tea estates have technical people in managerial positions and sometimes manage other estates. KSB, which produces irrigation equipment, has technicians on their staff who provide assistance on the installation of wells and

who have carried out a number of well installation projects on contract for BADC.

An additional important group of private entrepreneurs who provide technology to farmers are the fertilizer dealers. They differ from the people in the previous paragraph in that they are selling a product which their firm did not produce or import, and they do not have a contract to buy the farmers' output. They are selling a product that the government produces or imports. They have, however, received a significant amount of training by BADC/IFDC. They provide the farmers with a significant amount of information about what fertilizers should be used and how they can be used most effectively. Even before they had received much training, fertilizer dealers were the farmers' major sources of information on new technology (Gill, 1983).

4.3 Impact of Technology Transfer and Diffusion

The impact of the technology that was transferred by the private sector has been greater than the impact of local research, but it is still dwarfed by the role of the government in recent years. The combination of research and technology transfer turned Bangladesh from an importer to an exporter of Virginia tobacco in just over a decade. The transfer of tea technology has improved the quality and reduced the cost of production leading to an increase in tea production and exports. Pesticides have increased rice, vegetable and cotton production and reduced the cost of tea production. Local manufacture of pumps and engines has probably saved foreign exchange and perhaps increased rice production. Imported vegetable seeds

have increased vegetable production. Modern poultry production is making a start based on technology imported from India and the West. None of these technologies, however, have had the impact that the modern varieties of rice and wheat have had.

5 Government Policy

There are four types of government policies that have had an important impact on the private sector's research and technology transfer activities. The first is government ownership or monopolies in certain businesses or sectors. The second set of policies is the attempt to encourage import substitution by a combination of tax incentives and tariff and nontariff barriers on imports. Third, there are regulations and policies that do not aim at import substitution or influencing local technology but inadvertently affect companies' decisions to import new technology or to do research. These would include regulations to control environmental pollution. The fourth set of policies is government research activities which are supposed to develop technology appropriate for the country's needs.

5.1 Government Ownership and Competition With the Private Sector

The extent of government ownership limits the areas in which private firms have the opportunity to do research or transfer technology. Competition from public enterprises which are frequently subsidized also reduced the private company's expected profits and, hence, its incentive to innovate. The trend in the Bangladesh economy since 1975 has been towards more active involvement of the private sector. The government corporations have fought this trend every step of the way but, thanks in part to pressure from the World Bank and AID, there has been a substantial privatization of the economy.

During my visit, there were signs that this trend is continuing. Some of the donors expressed cautious optimism that the climate for the private sector was improving. They cited three recent changes:

1. The government has devalued the Taka to make the exchange rate more realistic.
2. The government is denationalizing parts of the banking system.
3. Import regulations have been changed from a listing of what can be imported to a list of what cannot be imported. It used to be very difficult to get new things on the list which slowed the import of new goods.

Despite these trends, there is still substantial government intervention in the agricultural input industry, agricultural production and processing. Government produces and imports all fertilizer. It produces and distributes all improved seeds except some vegetables. It imports, procures and distributes DTWs. It is a minority share holder in BTC. Ciba-Geigy and ICI's manufacturing facilities. It owns 100 percent of the second largest pesticide company - Burmah-Eastern - which distributes Shell pesticides. It owns BTIMC tea estates and 51 percent of the NTC estates.

5.2 Regulations, Taxes and Import Controls

In many industries, there are regulatory requirements and taxes which affect companies' incentive to innovate.

The government has tried to encourage the development of the pesticide industry in a number of ways. It does not charge any import duty on

formulated products or on the active ingredients. It also makes foreign exchange available to the industry at the official exchange rate. If this is not enough (and it usually is not), the industry can buy the rest of the needed dollars through the Wage Earners' Scheme of something like the real exchange rate.

The pesticide industry has had problems getting new products registered in Bangladesh. The previous law that regulated pesticide seem to have worked relatively well. However, government attempts to improve this law combined with the loss of several key individuals in the Ministry of Agriculture through death and retirement has brought the procedure to a complete halt. No new chemicals have been registered in the last two years. Recently, a new law was published in the official Gazette, but it has some conditions that are unworkable. It is now being revised again, and the industry is optimistic that there will be a new law fairly soon. It remains to be seen how the new board will run the registration procedure.

The companies said that a major constraint is the ban on import of spraying equipment. Its purpose was to encourage the local manufacture of equipment, but its affect has been to severely limit the availability of sprayers to farmers. Some people speculated that it was more profitable for people who imported brass for sprayer nozzles to sell the brass for other uses. The ban is forcing some of the large pesticide companies to design and produce their own sprayers. Thus, this shortage may be only temporary. The impact of the shortage is important only for the portion (about one quarter) of the market which is not formulated as granules. It may be particularly important for the control of hispa, the main rice pest, which may be controlled most effectively by a spray formulation. The local

industry has not yet produced sufficient, efficient sprayers and so farmers are using very unsafe and ineffective means to apply the chemicals that are not granules.

There are several constraints on local formulation of chemicals. First, the government is insisting that foreign companies who wish to build new formulation facilities or expand their old ones take a minority ownership position. None of the major companies will agree to give up control on formulation - particularly after Bhopal. Thus, several proposed projects are at a standstill because of this requirement. A second constraint is that while there is no duty on the importation of formulated products or the active ingredient, the other chemicals which are used in the formulation process have duties of 20 to 50 percent. This, in fact, is an improvement over the 100 percent duty that these products faced some years back, but it still is a disincentive to investment in formulation.

The government does still provide free aerial spraying for serious pest outbreaks, but its resources are limited and pilots and planes are insufficient to handle a large outbreak. The existence of this program has an unfortunate negative effect on the farmers who wait to spray until it is too late in hopes that there will be enough of a problem that the government will provide the spraying free of charge.

The pricing system of Virginia leaf tobacco is set up so that BTC has an incentive to increase productivity. The price paid to farmers by all cigarette companies is fixed at a meeting of the Bangladesh Tobacco Board where the government, farmers and industry are represented. Each side brings its estimates of the cost of producing leaf tobacco. An agreement is reached about the costs, a profit margin is added and the price for 8 to 10

varieties and grades of Virginia tobacco are fixed. If the companies can show that the cost of production has been going down due to new technology, the procurement price will also go down. This gives BTC, which buys 60 percent of the tobacco, considerable incentive to reduce the farmers' cost of production which, in turn, reduces their cost for producing cigarettes. They might have more incentive to innovate if about 75 percent of the market price of BTC's cigarettes did not go to the government as taxes.

BADC's size is the chief constraint to the private sector playing a larger role in the vegetable seed industry. If BADC reduces its role, there appear to be a number of local companies and their foreign partners that are ready to expand. The government has tried to encourage the local seed industry. There is no import duty on seeds and sometimes the seed industry receives an allocation of foreign exchange at the government exchange rate.

In the recent past, the most important policies that restricted the development of local irrigation pump and engine industry and, hence, the opportunity for innovation within that industry were BADC purchasing policies and import duties on raw materials. For DTW pumps, BADC was supposed to take the lowest price bidders in an international competition, but Bangladesh companies had to pay an 80 percent duty on raw materials so that usually they could not compete. Recently, local producers were able to have a ban placed on imports of DTW pumps and engines. At the moment, there is little demand for DTW's, STW's and their engines from the private sector because of low grain prices, a decrease in government supplied credit and, in some areas, problems with groundwater availability. In addition, BADC has caused problems by selling off its excess large stock of excess equipment.

Regarding engines, the government is requiring progressive manufacture of a higher percentage of parts as part of the agreement for selling in Bangladesh.

STW pumps are primarily made here but at the moment there is little demand and most of the companies are not producing them.

5.3 Relationship to Government Research

The relationship between public research and companies which do research or import technology varies considerably. Only the tobacco industry has a research program that duplicates the work of public research. They are both working to improve Virginia tobacco. BARI has developed high yielding varieties, but because it has no facilities to test the quality of the leaf, the improved varieties are low quality and the industry cannot use them. There appears to be very little communication or cooperation between the public and private sector tobacco researchers.

In contrast, there is communication and cooperation between the tea estates and the Bangladesh Tea Research Institute (BTRI). When there are disease problems, the estates will send transport to get experts from the institute for assistance. The sterling estates get more assistance on management and genetic technology from their home companies than BTRI, but they would like BTRI to do more.

The relationship between the vegetable seed companies, the chemical companies and research is that research has to approve the seeds or chemicals that the companies wish to import. The companies had few complaints about this process.

There seems to be little contact between the private sector and the companies that produce irrigation equipment or other farm machinery. Most government research institutions and the agricultural university have engineering cells which are supposed to be developing improved technology. Jabbar (1985) was not able to find any examples of machines developed by the public sector that were now in commercial production.

There are some recent examples of private support for public research activities. This is one of the benefits that the public sector can derive from a more active private agribusiness sector. Phenix poultry has provided some support for scientific conferences on maize and poultry which were held at BARC. Some fertilizer dealers supported BADC research by conducting trials using their own land and capital. Shilpi food products supported soybean research.

5.4 Future Policies of the Bangladesh Government

Demands for majority ownership of new pesticide formulation facilities should be dropped. They will not be accepted by most companies, and there is no reason to think that government owned factories will be more efficient or safer than privately own companies.

More privatization of ownership of oilseed processing and jute and cotton manufacturing coupled with different pricing policies and some institutional changes might induce the processing industries to contribute some of their resources to improving the production of oilseeds, jute and cotton. BTC does its own research because it finds it profitable. Some of the shrimp exporting companies are reportedly bringing in foreign expertise and exper-

imenting with ways of improving shrimp cultivation. In India, a number of oilseed processors are expanding into the seed business to produce oilseeds. At least one of these companies, Hindustan Lever, Ltd., has a sister company here, Lever Brothers, which is testing the possibilities of moving into agriculture here with a plant growth regulator. Thus, it is quite possible that the right set of incentives would get the processing industries to play a larger role at least in the extension of new technology if not actual research to develop new technology.

BADC could reduce its activities in the vegetable seed industry or get out of the vegetable seed business entirely. In Pakistan, a private company is starting to produce seed potatoes. It is too early to tell whether this will be profitable or not, but it is something that might be possible in Bangladesh as well.

Privatization of the rice and wheat seed business is more problematic. Worldwide, there seem to be three sets of conditions which lead to private seed industries in self-pollinated crops like rice and wheat: (1) the existence and enforcement of property rights on crop varieties like plant breeders' rights - the German wheat seed industry is a good example of this; (2) very large farms which produce their own seed varieties and then sell to others - like Argentina; (3) very close cooperation between the government research institutions and the small scale private companies or cooperatives as there have been in the United States and some places in India. The government provides foundation seed to organizations of seed companies or cooperatives who multiply and keep it pure through a combination of self enforcement and government inspections. These companies or coops then sell the seed to the farmers.

The first condition will not hold in Bangladesh unless hybrid rice and wheat are successful or hybrid corn spreads rapidly in Bangladesh. None of these things seem likely in the near future. There are no really large farmers in Bangladesh and so we are left with the third possibility. The early spread of Green Revolution wheat and rice varieties in India depended to a large degree on private sector seed companies who bought foundation seed from the National Seed Corporation, multiplied it a generation or two, and sold it to farmers. Many farmers have now been trained by BADC in seed production. BADC has seed processing facilities that could be rented or sold to companies or coops. Finally, ex BADC staff are already active in the vegetable seed industry. Current staff with expertise and initiative could either provide leadership or expertise to the private sector. If BADC's seed operations were cut substantially, this would provide extra incentive for BADC staff to seek jobs in the private sector.

The commercial poultry industry would like to have more assistance from the government to increase corn production, to have veterinary services available around the clock, and for better laboratories to analyze feeds. Many of these needs are general needs for government services in the livestock sector which at present is very weak.

5.5 Government R&D

Government R&D needs to work more closely with companies that are doing research, importing technology or spreading new technology locally. If BARI is going to work on cigarette tobacco, it should work with BTC to have its leaf quality tested. There appears to be little reason for BARI to

do research on cigarette tobacco when BTC is doing a good job and nobody is working on local tobaccos which are used for snuff, biris and hookahs.

In the late 1970's, it was suggested that the Bangladesh Tea Research Institute be handed back to the tea industry. This suggestion apparently was not taken. It should, however, continue to be explored. If a governing board which represented all parts of the tea industry could be set up and the institute were financed from a government endowment and a cell, it could be quite successful. It would make the Institute more receptive to the industry's research priorities which frequently are not the same as the government's.

Jabbar's paper on agricultural machinery research by government organizations indicates that this has been a very bad investment by the government. He was not able to find any products produced by government research which had been commercialized. In contrast, five small companies have produced a number of improvements that have been commercialized. This suggests that public research in this area should be cut back drastically and the private sector be encouraged to play a larger role. Jabbar also implies that the Appropriate Technology Cell in Bangladesh Agricultural Council (BARC) or Bangladesh University of Engineering and Technology (BUET) might play a useful role in encouraging the private sector if bureaucratic infighting could be stopped and resources provided.

More research needs be done on integrated pest management in rice and other crops. The best way to get effective control of pests with the minimum impact on the environment is to understand the pests and develop an effective program that uses resistant plant varieties, natural predators, cultural practices and pesticides as necessary to control the pest. I did

not have time to visit BRRI this trip, but my impression from talking to others in Dhaka is that little is known about the causes of the recent outbreaks of hispa which is currently the most serious rice pest. Until more is known, it will be difficult to develop a strategy to deal effectively with it. Bangladesh is still at an early stage in pesticide use. The farmers are using some very dangerous chemicals and are not using them very effectively at present. This appears to be an area which needs more work in research and extension and which AID could and should push through its agricultural research projects.

The government has had no success in spreading high yielding open-pollinated corn varieties. It might be useful for BARI to test some hybrids which are being used commercially in South and Southeast Asia and then make the inbreds available to private companies who are interested. This might include some of the commercial poultry producers, some of the small vegetable seed companies and even some of the BADC contract seed growers. It is possible that a small company which had some proprietary right to a hybrid which it had developed using inbreds provided by BARI might push corn harder than BADC and the extension service. It is also possible that if the hybrids give higher yields than the open pollinated varieties that poultry companies might be interested in growing their own or setting up a contract system to produce maize.

6 AID Policies and Projects: History and Prospects

6.1 Past Policies and Impacts

AID and the World Bank have played a very important role in setting up a major precondition for research and technology transfer by the private sector - a private sector input industry. Their general policy of supporting policy changes which encourage the private sector in the processing industry could also lead to a more active role of the processing industry in the future.

AID played an important role in the privatization of fertilizer distribution. AID financed studies that recommended these changes and then offered grants of fertilizer to the government as the carrot to get acceptance of these policies. The Bank seems to have played a similar role in the pesticide and tubewell distribution business. The Bank led a group of donors that pushed the government to privatize the pesticide industry. In the tubewell case, the Bank offered import credits in return for policies which would allow the private sector to distribute pumps and produce them locally.

AID has also attempted to assist small scale innovators and appropriate technology development through grants to BARC for its appropriate technology cell and small grants to some voluntary agencies to help design and/or produce small scale irrigation equipment.

AID-financed agricultural research projects at BARI and BRRI have not placed any particular emphasis on assisting the private sector. These institutions do, however, play an important role in determining which pes-

ticides will be registered and the recommendations for their use which are given to farmers. BARI also has the role of determining which vegetable seeds can be imported. To the extent that AID projects have improved their ability to identify the best vegetable varieties, pesticides and pest management techniques, AID projects have helped the private sector.

Past AID assistance to voluntary agencies and the Academy for Rural Development in Comilla has assisted the development of some of the small scale irrigation equipment and hand implements used in Bangladesh.

6.2 Areas for Future AID Intervention

AID should continue its push for a larger role for the private sector in Bangladesh. Government ownership in pesticides is growing rather than declining, and BADC continues to produce and distribute inputs. It is clear that there are or have been a number of anomalies in the tariff structure which act as disincentives to local production of DTW pumps and the formulation of pesticides. These structure are beyond the scope of the current study.

Another area for policy dialogue which may not directly affect innovation and research may be the government's ownership requirements for new factories. At present, this is holding up local formulation of pesticides. Therefore, companies may have less incentive to experiment with more effective formulations. The reality of the situation in Bangladesh is that the market is too small for companies to risk the health problems which might arise from government majority ownership. Thus, companies will simply formulate elsewhere and import into Bangladesh or close down.

Regulation does directly affect the availability of new technology. The regulatory machinery for pesticides is still in confusion and will be at least until some new rules are agreed upon. Even then the regulators do not have some of the equipment required to evaluate the pesticides. In one case, a private company is actually importing the equipment on their own and will let the government use it so that the company's product can be registered. There may be some room for foreign assistance to strengthen and rationalize the registration system.

People in the poultry industry are particularly interested in having US-AID push corn cultivation. They would like to see imports through PL480 to be used to poultry feed and to popularize corn with consumers. They would then like to have assistance in popularizing corn cultivation with farmers.

The vegetable seed industry is at the early stages of its existence. This might be a good time for AID to bring in someone from the U.S. vegetable seed industry with experience in Asia to see if something could be done to assist this industry. The company I met with mentioned the need for small scale seed processing equipment, training and credit. It might also makes sense to look into the possible alternatives to BADC as the only distributor of improved rice, wheat and potato varieties.

AID has considerable influence in the research system through its research projects with BARC, BARI and BRRI. It should encourage more interaction between the private sector and the government research institutions. The private sector can speed the flow of government research results to the farmers. They can contribute information on their needs and farmers' needs which should go into the research priority setting process. They

also can provide financial support to research programs and conferences. Thus, government research needs to start looking upon them as an asset rather a threat.

I also think that AID should push for more government research on IPM, particularly in rice. This is an activity that the pesticide companies would be very interested in and might well support financially.

There may be some opportunity to assist in the development of small scale irrigation equipment. Continued assistance to innovated NGO's is one possibility. A re-evaluation of government research in this area might also reveal ways to assist the private sector. Otherwise research in agricultural machinery should probably be reduced. Finally, there may be things that the Appropriate Technology Cell at BARC or BUET can do to help small scale manufacturers. If so, AID might support that activity.

List of Interviews in Dhaka

Monday, February 10 H. Patrick Peterson, Chief, Office of Food and
Agriculture. U.S. AID Mission to Bangladesh

Alan R. Hurdus, Deputy Chief, Office of Food and
Agriculture, U.S. AID Mission to Bangladesh

Kevin A. Rushing, Agricultural Development Officer
(Agronomy), Office of Food and Agriculture, U.S. AID
Mission to Bangladesh

Gary W. Vanderhoof, Project Development Officer,
U.S. AID Mission to Bangladesh

John R. Westley, Director, U.S. AID Mission to
Bangladesh

Samiul Ahsan, Phoenix Poultry, Ltd.

Hugh Brammer, F.A.O.

Tuesday, February 11 Siraj A. Chowdhury, Sales Manager, ICI Bangladesh

Hafeezuddin Ahmad, Deputy Managing Direction, ICI
Bangladesh

J. P. Krotoszyner, Marketing Manager, Plant Protection
Ciba Geigy

M. H. Khan, Manager, Trials and Registration, Ciba Geigy

Wednesday, February 12 Ken Mootz, IFDC/BARC

M. A. Jaleel, Shetu Corporation and Pesticide
Association

Thursday, February 13 D. M. A. Quasem, Bangladesh Institute of Development
Studies

Md. Maasum, Executive Director, M/s. Rashed Mahmud
and Company, and National Agrosect.

Golam Mainuddin, Leaf Manager, Bangladesh Tobacco
Company

Abdul Munim Chowdhury, Leaf Services Manager,
Bangladesh Tobacco Company

S. Alam Miah, Leaf Blender, Dhaka Laboratory,
Bangladesh Tobacco Company

Gerry Gill, Winrock/BARC

Friday, February 14 Darrell Deppert, Master Planning Organization

Wahiduddin Mahmud, Professor, Economics, Dhaka
University

M. A. Azim, Duncan Brotheres

Saturday, February 15 F. Islam, General Manager, Milnars Pumps

Shafiqur Rahman, Milnars Pumps

Dr. Altaf Ali, Planning Commission

Dr. A. K. Kaul, Winrock International/BARC

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