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PRIVATE SECTOR INNOVATION AND TECHNOLOGY TRANSFER
IN THE AGRICULTURAL SECTOR IN DEVELOPING COUNTRIES

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Carl E. Pray

The International Rice Research Institute
P.O. Box 933, Manila, Philippines

Carl E. Pray

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Agricultural Sector in Developing Countries

I have three purposes in today's presentation. The first is to inform you about the preliminary results of research that we are doing at Minnesota on the role of private sector agricultural research in transferring technology and/or developing new technology. The second is find out from you what is happening in your countries. The third is to inform you about our future plans and how they might involve some of you.

This project is called "private sector innovation and technology transfer in the agricultural sector in developing countries". Dr. Vernon Ruttan and I are the principle investigators and it is being funded by AID/PFC and the S and T Bureau in Washington. The first two phases of this project have been funded with the presumption that a third phase will be funded when we have identified places to do in depth case studies. We are concentrating on the Philippines, Indonesia, Thailand, Malaysia, India, Bangladesh, and Pakistan

The purpose of this project is to better understand the role of the private sector in developing and transferring new agricultural technology to developing countries with special

emphasis on Asia. It will attempt to do three things: (1) assess the present and future importance of the private sector research in developing and transferring new agricultural technology; (2) measure the impact of private sector research, development and technology transfer activities on agricultural productivity and income distribution in Asia; and (3) determine the effect of government policies on private sector research and technology transfer. By better understanding the role that the private sector has played in the past and can play in the future, we hope to be able to suggest ways in which the governments of developing countries and the United States Agency for International Development can promote a more effective role for the private sector in the future.

The first phase of this project has three major goals:

(1) to review the literature on the determinants of innovative behavior and the transfer of technology; (2) to talk to firms in the US about their decisions to do research in or transfer technology to Asia; (3) to identify the main activities of the donors in supporting private sector research and development in developing countries or assisting the transfer of agricultural technology by the private sector.

This talk deals with three issues. I will first review the general trends in private agricultural research in Asia, second present some hypotheses about the impact of the private sector on agricultural production based on earlier research and our literature review, and third present some concerns that we

have about the policies of Asian governments and activities of AID.

1. Trends and levels of private sector agricultural research in Asia

There are two types of companies that are doing research on agricultural production in Asia. The input supply industries are the first type. They can increase their profits by increasing sales through the development of new technologies which will decrease farmers' cost of production or in a few cases increase demand for a farmers' output i.e. high protein corn. They can also increase profits by reducing their costs of production. The second type of industry includes the processing or marketing industries. These industries frequently have their own large plantations and/or buy from contract growers. They do research on agricultural production in order to cut the cost of their inputs or if they grow the commodity to reduce their cost of production. They also do research to improve product quality.

We are still at an early stage in this project, but it is possible to identify many of the industries which are doing research in Asia and to provide some impressions of the trends in their investment in agricultural research. These impressions are based on interviews with companies in the US and a few Asian companies plus our review of the literature and previous research. We will try to confirm these impressions in Phase II of this project.

The input supply industries are the fastest growing area of private research. Hybrid corn is attracting the most private sector research investment of field crops. At least four companies are developing corn hybrids in the Philippines. Six to eight companies are developing hybrids for Thailand. The goal of research in both of these countries is to develop high yielding hybrids that are resistant to downy mildew. There is research on hybrid corn, sorghum and millets in India, hybrid corn and sunflower in Pakistan, and hybrid rice in the Philippines.

Agricultural research by chemical companies in South and Southeast Asia has grown from almost nothing in 1970 to small programs of applied research at present. In company terminology all of the research in developing countries is considered "development" rather than research. In 1970 a number of companies ran field trials in Asia but there were only a few experiment stations. Research on rice was frequently carried out at stations in Japan. By the early 1980s most of the major multinational agricultural chemical companies had stations in tropical Asia. Those that did not have stations also increased their research using rented land from farmers or estates. Examples of this expansion include ICI which had no field stations in Asia before 1970 but by 1978 they had developed field stations in India, Malaysia and the Philippines. Ciba-Geigy shifted their plant protection research on tropical rice from Japan to Indonesia and opened another plant protection station in Malaysia. American Cyanamid established research programs in India and the

Philippines.

The actual research carried out in Asia is very applied. The US companies thought that no basic research was being conducted in Asia outside of Japan. The applied research on new chemicals included tests of the most effective rates of application and different systems of application. The companies do the trials that are required by the governments to get certification or pay universities or individual scientists to do these tests. There is also research attempting to find pesticides that can be mixed with a company's main product to solve new problems.

In agricultural machinery there is little formal research but quite a lot of innovative activity. In the Philippines 23 of 55 farm machinery firms surveyed in 1981 were able to estimate their R&D expenditures even though only a few of these firms had formally designated R&D personnel with a separate R&D budget (Mikkelson 1984:44). When asked how many personnel participated in inventing new products, improving products and improving production methods; all 55 of 56 firms reported people doing at least one of these activities. In India four large scale agricultural machinery firms reported annual research expenditure of almost a million US \$ each in 1978-79 (India). There has also been continuous innovation by small scale manufacturers of farm equipment for cultivation and seeding, irrigation equipment, threshers and other machinery in India and Thailand.

We have no quantitative evidence on the trend in

innovative activity in farm machinery. It seems to have followed the growth in sales of the industry. Thus as the industry grew in the 1960s and 1970s innovative activity grew along with it.

Private companies in developing countries do not seem to do much poultry breeding whether they are local companies or subsidiaries. This is due to the fact that US poultry technology is easily adopted in a wide range of environmental conditions. It is also due to the fact that the US breeders can replicate the conditions that bird will face in developing countries. Although there is not much breeding, there is some private R and D on feed mixes both in Thailand and in the Philippines. In addition there have been improvements in management techniques and construction of buildings which were done locally but not reported as R and D.

Research by the processing and marketing industries has been going on for a longer period of time and has not grown as rapidly as input research in recent years. Tobacco companies invest in applied research and extension in Bangladesh, Pakistan, India, the Philippines and Thailand. The research has primarily consisted of testing different varieties and production practices for yield and leaf quality but there has also been some research on inexpensive substitutes for wood as fuel in the flue curing. The trend in investment is not clear. Sugarmills invest in research the Philippines, Pakistan, and India. Like tobacco the research consists primarily of testing varieties bred elsewhere and developing better management practices. As yet there is no quantitative evidence, but the trend in research appears to be

downward.

Research on rubber, oilpalms and coconuts is being carried out by private companies in Malaysia and to a lesser extent in Thailand and the Philippines. In Malaysia at least three of the major plantation companies are working to develop superior oilpalm varieties using tissue culture. Some of the new varieties are already bearing fruit. Rubber research was also conducted by companies in Indonesia, but the last ones gave up there in 1965.

Major banana and pineapple operations have grown very rapidly in the Phillipines and Thailand over the last 20 years. Much of this expansion has been due to acreage expansion but we hypothesize that there has been some applied research to find out what varieties and cultural practices work best in these countries.

In some cases the commercial feedmills or corn processors are large companies who have contract growers who produce the corn. These large companies provide the technology to farmers by breeding corn or buying improved varieties from overseas. San Miguel in the Philippines and Rafhan Maize in Pakistan are examples of millers and processors that do corn research.

2 Impact of private research on agricultural production in Asia

The most dramatic increases in agricultural output in

almost all countries of Asia since 1960 have been in three commodities - the wheat and rice crops and the poultry industry. Other crops have grown very rapidly in specific countries but not throughout Asia: cassava and corn in Thailand and to a lesser extent Indonesia; rubber and oilpalm in Malaysia; sorghum, pearl millet and soybeans in India; and tobacco in Bangladesh.

What has local innovative activity accomplished? So far its impact has been limited. The most important impact may have been on farm machinery. Innovations in that industry have reduced the financial cost of mechanization, have saved foreign exchange by increasing local content and saved labor and animal power. The second most important impact may have been on tobacco production. It has identified the best Virginia tobacco varieties and developed cultural practices which reduced the cost of producing tobacco in Pakistan, Bangladesh, Thailand and India. Research by private companies has reduced the cost of production in some plantation crops by fine tuning the results of research from collective research programs like the Rubber Research Institute of Malaysia. It has recently increased the yield of corn in the Philippines and corn, sorghum and millet in India. Local research sped up the adoption of agricultural chemicals, developed some new combinations of chemicals and increased the safety of these chemicals. In sum, with the possible exception of machinery, private sector research has increased the rate of adoption and widened the geographic spread of new technology developed elsewhere.

The impact of the direct transfer of technology so far has been greatest in fertilizer and poultry. Fertilizer was one of the main elements of the green revolution in wheat and rice. The private sector played a major role in Pakistan and the Philippines in spreading the package of fertilizer and modern varieties of wheat and rice. The commercial poultry industry is now growing rapidly in India, Pakistan, the Philippines, Thailand and Indonesia. The hybrid birds which are the basis of this growth were all developed in North America or Europe. They are then sold to breeders within the country as grandparent or parent stock.

The industries that will be the major sources of new technology in the future will probably be the major seed, chemical and pharmaceutical multinationals and to a lesser extent through some of the smaller biotechnology firms. There seems to be a good chance that hybrid rice will become an important source of growth in the future. The major source of increased yields and decreased costs in the future in the developed countries is expected to be the new biotechnology. The firms that are making the major investments in this field at the moment are the large chemical and pharmaceutical firms plus a number of new biotechnology firms and some independent seed companies.

The results of the new biotechnology will probably not have a major impact on agriculture in Asia until the 21st century. However, some results of the new biotechnology are about to go into production in Malaysia. Oilpalm varieties developed

using tissue culture are yielding their first harvest on experiment stations. Tissue culture is being used to grow disease free potato seed in Vietnam and elsewhere in Asia. Actual genetic engineering of plants is not expected to affect American crop agriculture until the 21st century and less is known about major Asian crops like rice. Thus, developments can be expected to be slower in Asia.

3. Policy Issues

This section highlights some of the major issues of government intervention which the firms we interviewed thought were important and the general literature views as important. This section is not meant to be a complete analysis of government policies which affect firms' decisions to invest in research or to transfer of technology. We will provide a more complete catalog of those in phase II of this project and a quantitative analysis of their importance in phase III.

Host country policy issues

1. Some countries are giving up considerable growth in the agricultural sector because of restrictions on private sector research and extension activities.

India is the biggest producer of corn in South and Southeast and so most major companies have considered doing

business there. One major US seed company initiated operations there in 1960 but pulled out of India in the late 1960s because of problems finding a suitable Indian partner and government redtape. Another company did extensive surveys but decided that the Indian government would not permit them to make sufficient profits. Pioneer is the only foreign seed company with an active hybrid corn program in India at present. They have had a number of bureaucratic problems such as the inability to get any of its hybrids certified.

Other countries were less subtle about their restrictions on research. Pakistan did not allow private companies to breed and sell new varieties until recently. The Philippines did not allow foreign owned firms to conduct research.

The growth rate of productivity in the Indonesian plantation sector has been reduced because of its general policies toward private plantations which discouraged private invest in research and everything else. Therefore the last private rubber research programs were terminated in 1965.

The absence of an effective patent system is a policy that can reduce research and agricultural growth. In Thailand one company developed a combination of herbicides for rice. One of the ingredients was for grasses and the other for broad. They invested four years of research into developing this product from 1978 to 1982. They did not try to obtain a patent for this combination because they felt that the patent system offered no real protection. They were just going into production when a

local chemical firm started to produce and sell this combination first. The local firm had not done any research on this product and so the US firm felt that it must have been copied from their research. The US company decided not to produce this commodity. In addition it will not do anymore research or sell its new products in Thailand.

2. Some countries do not have access to the safest and most effective pesticides because of their patent and registration system. (They also have the cheapest)

India which has a large market for pesticides was one of the first countries in which companies registered new products. Now the length of time it takes to register a new product, the short patent life, and other restrictions such as the difficulty of importing key materials mean that companies introduce new products into India after most other countries in Asia. The company in the previous example says that it will not introduce new chemicals into Thailand.

The thing that most chemical companies want is not complete deregulation but uniform regulations across countries. This is one of the main goals of GIFAP, the international agricultural chemicals organization. Several of the American firms were in fact hoping that regulations would be made tougher so that local formulators would have to install more safety measures which would raise their prices closer to the prices of the multinationals.

3. The prospects for future agricultural growth are also being reduced by the policies of some countries.

With the privatization of research in the United States particularly in the new biotechnology, private sector will be more important as a source of technology in the future. Countries which do not encourage the spread new technology by the private sector may be left behind.

The first two issues provide examples of the constraints to technology transfer in the seed and chemical industry. The oilpalm research in Malaysia offer a positive example of a country which does not discourage research. Researchers for three of the large oilpalm plantation companies in Malaysia have used tissue culture develop improved varieties which are higher yielding. These varieties are starting to bear fruit this year. In contrast the Philippines has still not adopted the short statured hybrid coconut palms nor have they developed improve coconuts using tissue culture as far as I know. Thus, in the near future when high yielding Malaysian oilpalms push vegetable oil prices down, Philippine farmers will not have any varieties which will help them reduce their cost of production.

4. Few government research and extension projects or plans explicitly consider the needs and activities of private agribusiness.

This leads to unnecessary duplication of research. For

example the Bangladesh Agricultural Research Institute conducts the same research on Virginia tobacco as the Bangladesh Tobacco Company only the government scientists do not have sufficient equipment to do some of the research.

It also means that opportunities for spreading research results quickly are lost and information on farmers' problems which the private sector has accumulated is not used to set research priorities.

5. By design or neglect public research institutions are missing an opportunity to mobilize political support from the private sector.

Private sector research is a natural ally of the government research system. Both the private input companies and the farmer can make more money if there is an effective public sector research program. Hybrid seed companies in the US and in Asia depend on local research programs to provide them with genetic material that they can cross with their elite lines so that the hybrid are suited to local conditions. Chemical companies do not find it profitable to test their chemicals on minor crops or in small agroclimatic regions. Public institutions can provide a useful service to farmers by identifying the chemicals that will solve their problems and this will enlarge the market of the chemical company also.

Examples of this type of activity would be the hybrid corn programs in Thailand which use the downy mildew resistance

developed by Kasaetsart U/the Rockefeller Foundation/CIMMYT program. Another example is the work of scientists at the University of the Philippines at Los Banos who discovered that growth regulators could be used to produce mangoes almost all year round. Another scientist at Los Banos discovered that a rice fungicide could be used to treat corn seed for downy mildew.

AID Policy Issues

1. AID should not put too much emphasis on private sector research and extension to the exclusion of public sector investment in research and education.

Investment in the private sector seed industry in Thailand for all companies with the possible exception of Pioneer starts after the release of the Suwan varieties by Thai government, Rockefeller Foundation and CIMMYT. The Suwan varieties are used in the private breeding programs for their downy mildew resistance.

Some IRRI intervention spurs innovative activity in the Philippines. In Thailand the government provided prototypes for the propeller pumps, the private sector started making them and now they are popular throughout Thailand.

A large portion of the scientists and technicians who work in private sector research and extension were trained at agricultural universities that were financed by AID, gained experience in government research systems that were assisted by

AID and/or did graduate degrees in the US with AID money.

2. When AID and the World Bank are planning public agricultural research, education, and extension projects the needs and activities of the private sector are rarely taken into account.

AID has financed the development of research and extension projects which compete directly with the private sector. The one US seed company that operates in Egypt felt that it was being pushed out by government research and sales of corn which was subsidized by AID.

3. AID may not have learned lessons from its past achievements and mistakes nor from other AID bureaus.

At present AID has at least three types of projects which are listed below with some examples. I hope to learn more about them in the next few days and in the next phase of this project.

I. Project support for private research:

- a. An AID project in Honduras project is helping to establish a private research foundation.
- b. The Fund for Technology Development in India supports local r and d through joint ventures.

II. Projects that support private industries which do research

- a. The privatization of pesticide distribution and production in Bangladesh and Pakistan
- b. Assistance in forming the pesticides and fertilizers associations in India

do some research.

c. A joint project of Purdue and DeKalb to establish a private seed industry in Sudan

III. Projects to promote technology transfer

a. Asia Bureau projects and S and T project which assist Asian private firms to link with small firms in the US.

b. OPIC insurance reduces the risk of agribusiness firms that want to invest in Asia.