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By

Vernon W. Ruttan

In my presentation this morning I would like to comment briefly on:

- o The significance of the Asia Bureau Agricultural Research Review.
- o The activities that have been completed and that are underway as part of the review.
- o Some impressions of the development and productivity of several agricultural research systems in Asia.
- o Some concern about the development of agricultural research systems in Asia.

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The Significance of the Asia Bureau Agricultural Research Review derives from the exceptionally rapid growth in both the economic demand and the nutritional requirements for food in Asia.

With population growth running in the 2-3 percent range even modest income growth implies a growth in domestic demand in the 3-5 percent range. Interventions to overcome nutritional deficiencies could add a few additional percentage points to demand growth. There are few countries in the region in which an annual growth rate of agricultural output in the 4-5 percent range would not pay high dividends in terms of both agricultural and industrial development.

The need for growth rates of agricultural production in this range, and the implications of failure to achieve the necessary growth rates, have been adequately documented in a number of recent reports by the IFPRI study of Food Needs of Developing Countries; the FAO report on Agriculture: Toward 2000; the report of the Presidential Commission on World Hunger on Overcoming World Hunger; and The Global 2000 Report. The implications of these studies for AID policy have been admirably reviewed in the AID "Technical Program Committee for Agriculture (TPCA)" response to the report of the Presidential Commission on World Hunger. I would only like to remind you that the growth rates in agricultural output now deemed essential are more than double the long term rates achieved by the presently developed countries. Between 1880 and 1980 agricultural output in Japan and the United States, two highly successful countries, grew at approximately 1.6 percent per year.

The achievement of growth in output consistent with the growth rates of demand running in the 4-5 percent per year will impose heavy demand on more intensive resource use -- more intensive use of labor, of land,

of water, of machinery and equipment, and of fertilizer, herbicides and pesticides. It will also require rapid advances in the efficiency of resource use -- as measured by the partial productivity ratios such as output per worker, output per hectare and output per unit of total input. It is the advances in productivity that have the potential for lowering the costs of production and creating the incentives for more intensive resource use. Incentives can of course, come from higher product prices as well as lower production costs. But the incentives that come from higher product prices are a burden on development while those that come from lower costs are a source of development!

The major source of improvements in efficiency in agricultural production, in improvements in output per unit of total input -- in total productivity, must be technical change. And technical change in agriculture derives primarily from research leading to new technology -- that can be embodied in new plants, new equipment, new chemicals and in the productive capacity of farm land and rural people.

There is ample evidence that investment in agricultural research and the extension of new technology to farmers has, in a number of developed and developing country, been highly productive when compared to almost any other investment available to either the public or the private sector. An inventory of the results of the large body of studies that have been conducted since the mid-1950's was assembled in an article that Bob Evenson, Paul Waggoner, and I published in Science a little over a year ago (September 11, 1979). These results have been updated and reproduced in the paper on "The Role of Research in Agricultural Development" that was distributed prior to the conference. You will note, if you have the paper with you, that several of these more recent studies report on

research conducted in Asia (in Japan, Mayalsia, Pakistan, India, the Philippines, and in the case of rice, for all Asia). Carl Pray has also recently estimated that investment in research on rice and wheat in Bangladesh has generated, on the basis of very conservative estimates, returns in the 30-35 percent range.

Stating the effects of agricultural research in terms of rates of return is only one way of characterizing the results. High rates of return and rapid productivity growth are two sides of the same coin. Once one can identify the share of productivity growth "accounted for" by research (or extension) it is fairly straightforward to translate the productivity effects into benefit -- cost ratios or rates of return. This is useful in attempting to compare the benefits of investment in agricultural research with investments in other project areas.

But it is also useful to characterize the significance of research leading to technical change, in somewhat broader terms:

- It permits the substitution of knowledge for resources.

- It facilitates the substitution of less expensive and more abundant resources for more expensive or increasingly scarce resources.

- It releases the constraints on growth imposed by inelastic resource supplies.

Let me now turn to the origins of the review and the activities that are underway as part of the review.

The review began with a small all day seminar organized by the Asia Bureau in Washington and attended by Tom Arndt, Al Hankins, Ed Schuh, Bob Evenson and Vernon Ruttan and several other AID staff. The question posed by the AID group was whether it would be possible to obtain objective measures of the return to AID investment in the development of agricultural research systems in Asia? The response was "probably not" -- but with qualifications. We pointed out that it would, in most cases, be difficult to separate the AID contribution from the support by national governments and the assistance from other donors. We did agree, that it should be possible to characterize the outputs of national research systems to agricultural productivity. But we cautioned that AID might not always be pleased with our answers -- while there is clearly substantial under-investment in agricultural research in most countries in Asia low or negative rates of return are also possible. Poor quality of research personnel and weaknesses in research management is, in many situations, a source of low or even negative rates of return to research.

After reflecting on the results of the Washington seminar the Asia Bureau suggested that the University of Minnesota, as the lead institution in the development of the project, prepare a project proposal that would involve an evaluation of the contribution of agricultural research to production in four countries. The project would be carried out in three stages: (a) an initial country visit to explore the interest of the national research director and the AID mission in cooperating with the proposed study; (b) a 2-3 week review of the national research system to obtain a qualitative judgement about the effectiveness of the system and

to explore the possibilities for more in depth studies; (c) an in depth quantitative study of the contribution of research. The quantitative study would also, to the extent possible, attempt to assess distributional impacts (by region, by size of farm) of agricultural research. It was initially suggested that the study include four countries (Philippines, Indonesia, Bangladesh, Korea).

When the costs were totaled up the Asia Bureau suggested that the study be limited to two countries -- the Philippines and Indonesia. It now appears, as a result of collaborative efforts with work underway at other institutions (Yale, Cornell, East-West Center) that we may be able to have access to work underway in Korea and India. The addition of Carl Pray, former ADC Associate in Bangladesh, to the Minnesota project staff will also permit us to incorporate Bangladesh into the analysis.

In July and August a Yale graduate student, Jim Boyce spent four weeks in Washington working with Al Hankins to develop and collect the materials on Asian agricultural research systems that were available at USAID and the World Bank. The results have been assembled as Agricultural Research in Indonesia, the Philippines, Bangladesh, South Korea and India: A Documentary History.

In late August and early September qualitative reviews were conducted in the Philippines (by Evenson, Bloom and Waggoner) and in Indonesia (by Evenson, Moomaw and Cardwell). In December a workshop was held at the University of Minnesota to firm up plans for the in-depth quantitative studies.

Before turning to the next section let me attempt to respond to one additional question. What good are the rate of return or cost benefit measures? My response is that as the size of a national research system

gets larger research directors must resort to more formal monitoring and planning instruments. In a small system the director and associate director can personally and informally evaluate the performance of individual commodity, programs, stations and staff. As the system grows larger, quantitative measures can make an important contribution to the refinement of qualitative judgements. Ex-post measures of research productivity may help to confirm or to call into question qualitative judgements. Ex-ante calculations of expected pay-offs can, if not willfully biased, force research planners to respond to the economic question -- what research is worth doing -- as well as the scientific and technical question -- what can be done?

What are some of our initial impressions of the development and productivity of the several agricultural research systems that we have begun to look at?

India, of course, has developed one of the worlds larger and more sophisticated agricultural research systems. At the time of independence, India inherited the elements of a research system that had already made important contributions to agricultural production. This system was strengthened, during the 1950's and 1960 with support from the USAID and the Rockefeller and Ford Foundations. In terms of both the number and quality of professional resources the Indian agricultural research system ranks among the leading half dozen research systems in the world.

There is no question that the investments in agricultural research by the government of India, by the USAID and by other donors have paid off handsomely. Studies by Evenson and Jha and by Kahlon Bal, Saxena and Jha indicate rates of return in the 40-60 percent range for the system as a whole.

This is not to suggest that there are not serious weaknesses in the system. The mixed federal-state system performs better in some states and for some commodities than in others. A great deal of concern has been expressed as to the effect of excessive bureaucratization on research entrepreneurship and productivity.

The studies that are underway at Yale, under Evenson's direction and funded primarily from other sources, should provide greater insight into the regional and commodity diversions of research productivity in India.

In the case of Korea and the Philippines we have two systems that have, in the last decade, emerged with substantial capacity to contribute to agricultural production.

In the Philippines, approximately 850 scientists, trained at the M.S. and Ph.D. levels were, in the late 1970's employed by research and training institutions. Even after discounting for teaching, consulting and administrative commitments there are probably over 300 scientist years available for agricultural research at the M.S. and Ph.D. levels in Korea is (about 200 at ORD) considerably smaller than in the Philippines but a larger share of available scientist years is probably devoted to research.

The two systems present a striking contrast in terms of research organization and management. In Korea, a "concentrated" management style is employed. Both agricultural research and extension are organized under the semi-autonomous office of Rural Development. Administration of research is highly centralized. The universities, except for Seoul National University, play a relatively modest role in agricultural research. Strong links are maintained with the relevant international agricultural research institutes in order to facilitate technology transfer (borrowing, screening, adaptation) as well as technology development. Major attention has been focused on rice. Rice yields have risen rapidly and are now the highest in Asia, with the possible exception of Japan.

The Philippines has employed a more defuse pattern of administration. Research is conducted by a diverse group of Ministry research bureaus, colleges and universities, research centers and institutes, commodity authorities and regional commissions. In 1972, the Philippine Council of Agricultural Research was established to attempt to achieve some coordination of these deverse elements. The system is characterized by a number of centers of very substantial strength and productivity and by a large number of exceptionally weak institutions and locations. In contrast to Korea, research on rice by national institutions in the Philippines is

probably weaker than a decade ago -- due in part to a decision that with the IRRI located in the Philippines there is a higher pay-off to Philippine research resources in other commodity or resource areas.

The agricultural research systems in both the Philippines and Korea have developed substantial capacity for technology generation as well as for technology transfer, screening and adaptation. In both countries this capacity is limited to a few commodity and resource categories. There are other commodity and resource categories where capacity is still rudimentary.

The agricultural research systems in Bangladesh and Indonesia have made great progress in the last decade.

The Indonesian system seems to be evolving more along the lines of the Korean system with primary support for research being channelled through the Agency for Agricultural Research and Development (AARD). It should be noted, however, that this concentrated style of management, which is replacing the extremely diffuse pattern that existed a decade ago, continues to be under continuous challenge from the universities, from the National Science Development Board (LIPI) and the Science Ministry.

Although Bangladesh has established an Agricultural Research Council the Bangladesh agricultural research system remains relatively more diffuse -- with the Bangladesh Rice Research Institute (BRRI), the Agricultural Research Institute (BARI), the Jute Research Institute (BJRI), the Tea Research Institute (BIRI), the Sugar Research (BSRI), the Fisheries Research Institute (FRI), the Forestry Research Institute (FRI), the Veterinary Research Institute (VRI), the Livestock Research Institute (LRI), and the Bangladesh Agricultural University operating as relatively autonomous institutions. Each of these institutes has its own system of branch status, often located in the same agro-climatic region but with no coordination in the use of scientific or individual staff or facilities.

Both the Indonesia and the Bangladesh agricultural research systems are approaching a level of manpower development (200-300 scientists at the M.S. and Ph.D. levels) that should enable the systems to begin to become effective sources of new technology. In both countries this capacity is less effective than it might be because substantial numbers of the scientists with the best training are located at universities which receive limited research support, are not effectively linked with the national research institutions, and lack incentives for technology oriented research.

In spite of these limitations, both systems have evolved significant capacity to transfer, screen, and adapt technology and to serve the information needs of the extension agencies. And both systems have achieved a limited capacity as a source of new rice technology.

Let me now turn to some of the challenges and concerns that have emerged during the initial stages of our review of national research systems in Asia.

1) I am concerned about what appears to be excessive investment in research facilities development relative to development of scientific staff. There are too many facilities without programs. Premature facilities investment represents a burden on the research system rather than a source of productivity.

Example: It will be at least a decade before there will be staff capacity in place at the Sukamandi rice station (Indonesia) to make effective use of the very substantial investment in station development. Lack of effective consultation with scientific and administrative staff during the initial design stage has resulted in the necessity for substantial redesign and reconstruction of facilities even before completion of facilities.

Example: At Bicol University College of Agriculture (Guinobatan, Albay, Philippines) two new laboratory buildings and screenhouses have been constructed for abaca research. But they have not been equipped, there is no staff, and no research leadership. Meanwhile, the BPI research station in the same province (Buong, Albay) has discontinued abaca research. At the University of Southern Mindanao (Kabacan) the animal Science unit has new buildings that are unoccupied. The crop research units have begun to occupy new buildings but the laboratories are not being used. The laboratory equipment that has been delivered remains in shipping crates.

2) I am concerned about excessive administrative burden that stifles both routine investigations and research entrepreneurship. It appears that a concern for fiscal responsibility has often been carried to the point where it becomes an excessive burden on research productivity.

Example: In the Philippines, the complicated project review or process, which involves both the Philippine Council on Agricultural Research and the Budget Commission, requires a minimum of 18 months, and an incredible amount of staff time, between the time a project is proposed and the time funds become available to initiate the project.

Example: At the Indonesian National Vegetable Research Center at Lembang, it has sometimes taken as long as 18 months to obtain the repairs and servicing of simple equipment (for preparing distilled water, for example) needed for routine analysis.

3) I am concerned that location decisions for major research facilities, often made with the advice of World Bank and USAID consultants, have frequently failed to give adequate weight to the factors that contribute to a productive research location. These factors include (a) location in a community that includes related educational and professional infrastructure; (b) location in an agro-climatic environment that is representative of an important part of the area in which the particular commodity is grown or which is representative of a major resource (soil, water) problem area; (c) selection of a site with appropriate resource (soil, water) and infrastructure (electricity, transport, amenity) characteristics.

Example: In the early 1970's the Indonesian Ministry of Agriculture decided to move its Central Rice Research Station from Bogor to a major rice growing area on the north coast of Java. This was a correct decision. It was followed by two costly errors. The first error was to locate the station in an isolated area completely lacking in either physical or institutional infrastructure. The station has had to build it's own power plant, housing for scientific and technical staff, and the facilities for health, education and cultural amenities. The second major

error was the choice of the specific site. The station was located on a former cassava plantation on the insistence of the Minister of Agriculture and over the strong (verbal) objection of the members of at least one World Bank review team. The site is not representative of major rice soils on the north coast, soils are too acid to permit high rice yields. At a very minimum consideration should have been given to alternative sites near a north coast urban center such as Tjirebon or Semarang. The Sukamandi mistake is in the judgement of amny observers as being repeated at the Rubber Research Station near Medan.

Example: The Philippines have made an opposite error. There are in the PCARR system some 130 cooperating research stations. Some of them are federal ministry research stations that are poorly staffed and inadequately equipped. Others are small agricultural colleges (more appropriately junior colleges) with poorly trained faculty and with no research management experience. I do not want to carry these criticisms too far. The PCARR has made some very good facility investments. Establishment of the La Granja Agricultural Research Center is an example. The Center integrates: (a) the Carlata Stock Farm of BAI; (b) the La Granja Experiment Station of PBI; (c) the La Granja Sugarcane Experiment Station of PHILSUGEN; and (d) the La Granja Research and Training Center of UPLB.

If the objective of investment in agricultural research is to generate growth, it is clear that many of the research facilities investments being made by donor agencies will not measure up. The costs of these errors are measured in terms of the maintenance burdens imposed on national research systems, the delayed flow of technology to producers and the delayed growth of production.

4) I am concerned about the lack of congruence between research budgets and the economic importance of major commodities or commodity groupings. If new knowledge and new technology were equally easy (or difficult) to come by in each commodity area a good rule of thumb would be to allocate research resources roughly in proportion to the value (or value added) by commodity output or resource input. It is easy to think of good reasons for departure from such a rule. In a small research system critical mass (i.e. scale economies) imply the desirability of focusing resources on areas that account for a large share of output (i.e. rice) or on a commodity where very large gains can be made in a short time (i.e. lowland irrigated rice in the 1960's). But extreme lack of congruence may suggest that little careful thought has been given to research resource allocation or that particular interest groups have biased research resource allocation to their own benefit.

Example: In Bangladesh the rice crop accounts for more than half of the value of agricultural output. Yet less than one-fourth of the agricultural research budget is allocated to rice. Is this the correct proportion? Sugarcane research represents an even more extreme example. The Bangladesh Sugarcane Research Institute spends almost all of its efforts on improving sugarcane for use in sugarmills despite the fact that 80 percent of the sugarcane is used to make gur (unrefined brown sugar).

Example: In the Philippines, the principle has been adopted that equal funding should be available for commodities within each of three priority categories. The formula, adopted to implement this principle, implies that coconut research and carabeef research should receive the same level of funding, has even less to recommend it than the congruence approach referred to above.

5) I am concerned about the lack of information and analysis that goes into establishment of research priorities and thrusts.

Example: Farming systems (or cropping systems) research has been embraced as a major thrust by a number of aid agencies, national research systems and some international institutes. The attraction of the farming system approach is due in part to the 1970's assistance ideology which emphasized the desirability of direct intervention at the individual farm and village level to expand production and employment in contrast to what was perceived as a more elitist or "top down" approach to technology development and diffusion.

But the enthusiasm for farming systems research has at times obscured both its limitations and its value. Among the limitations of farming systems research is that it is not a source of new technology. Its contribution to production derives from learning how to more effectively exploit the technological components available to it. Thus farming systems investigations designed to exert a direct impact on production is most appropriately carried out in connection with the outreach activities of branch experiment stations or as an extension program activity.

A second major function of cropping systems research is to feed back information on the need or value for improved components into the technology research and development activities of the central experiment station or international institute. The director of a central research station or research institute needs to devote a limited amount of resources to the acquisition of information on the problems and constraints of existing cropping systems as an aid in research resource allocation. The design of a cropping system activity for this purpose will, however, be quite different than a cropping system program designed to feed information into outreach and extension activity.

In my judgement, the big payoff in agricultural research will come from the development of components that can improve the efficiency of existing farming system or that are responsive to the constraints (length of season, weather) that limit the evolution of more efficient farming system.

Example: The Bangladesh Rice Research Institute established as an objective the development of improved varieties of deep water rice the capacity to yield one ton per hectare. The objective prevailed for several years before it was discovered that farmers already were achieving yields of double that amount.

Example: There has been a great deal of rhetoric, about the desirability of allocating research resources to meeting the needs of the poor. But there has been much less clarity about the operational implications of this concern. In my judgement, there are two major implications for research resource allocation.

The most important implication is that research resource allocation should be biased toward the production of poor peoples foods. In Latin America, this means beans instead of beef. In Indonesia this means more emphasis on palawija crops. The second is that research needs to be directed to improving the productivity or improving the quality of the resources that can expand the economic size of small farms (i.e. water supply and use) -- the factors that can increase intensity of labor and land use.

Once a commodity focus is chosen, however, I see little scope for work that will further bias the benefits to the poor. The same is true on the resource side.

One is forced to a conclusion that the allocation of research resources to production research is a weak instrument for improving income distribution. Institutional reform, changes in land tenure arrangements for example, represent a much more powerful instrument than technical change for modifying income distribution. Research that can serve as a back up for institutional innovation and reform is a more powerful instrument for improving equity than production oriented research.

6) I am concerned that discussions of the appropriate role of centralization vs. decentralization (a concentrated vs. a diffuse structure) have often taken place without reference to the structure of political institutions.

Example: In the United States and Japan (and perhaps India) a research system that combines a large degree of decentralization in funding and decision making (in the state and perfectural systems) with a centrally administered national system has been highly effective. This is because of the short feedback loop between the performance and funding of the state or perfectural system. The short feedback loop exists because the local (state or perfectural) institutions have a considerable degree of fiscal and policy autonomy. In the absence of political decentralization administrative decentralization may result in less rather than more responsive behavior.

I do not want to be misinterpreted to suggest that the perspectives and concerns that I have expressed about agricultural research in Asia are the exclusive problems of new and growing research systems.

Example: Don Hadwiger, in a forthcoming book on the Politics of Agricultural Research points out that in the United States the "pork barrel" approach to the location of agricultural research facilities

resulted in 44 percent of all USDA research facility construction between 1958 and 1977 in states represented by members of the Subcommittee on Agriculture of the Senate Appropriations Committee. He noted that this practice has forced "the federal Agricultural Research Service to operate a 'traveling circus' opening up new locations in current Senate constituencies, while closing some locations in states whose Senators are no longer members of the subcommittee."

Nor do I want to suggest that agricultural research lends itself to great precision in planning and programming. During the last century, declining energy prices was the major focusing device for both land saving and labor saving technology. As energy prices have changed, it is highly desirable that the agricultural research system remain open to the dynamic interaction between thought and practice, at the levels of the system closest to practice, if the efficient new directions are to be found.