Staff Paper Series

STAFF PAPER P71-30 DECEMBER 1971

PERSPECTIVE ON THE "GREEN REVOLUTION" IN ASIA

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Perspective on the "Green Revolution" in Asia

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-- Rice Policies in the 1970's: A Perspective on the IRRI Conference
(Summary of the Rice Policy Conference, International Rice Research Institute, Los Banos, Philippines, May 9-14, 1971)

-- Implications of the Green Revolution for Agricultural Development
(Summary remarks at Conference on Agricultural and Economic Development, Japan Economic Research Center, Tokyo and Hakone, Sept. 6-10, 1971)

Staff Papers are published without formal review within the Department of Agricultural and Applied Economics. The research on which these comments are based was supported by grants to the University of Minnesota Economic Development Center and Agricultural Experiment Station by the Rockefeller Foundation and the U.S. Agency for International Development.
RICE POLICIES IN THE 1970's: A PERSPECTIVE ON
THE IRRI CONFERENCE*

Vernon W. Ruttan**

Introduction

What rice policies are currently being pursued by the rice producing
countries of Asia? What are the policy implications of the rice problems
these countries are facing, or will be facing in the near future? What
policy options are open to governments in the region? What research
related to rice policy issues is now being done, and what are the priority
areas for policy or policy related research? These were the questions
which provided a focus for a conference on rice policies held at the
International Rice Research Institute (IRRI) in May 1971.

The conference was attended primarily by economists who are engaged
in research related to rice policy or who are directly associated with
government agencies involved in the determination of rice policies.
There was also participation from members of other social science fields,
particularly sociology and communications. A number of IRRI staff members
from agricultural science disciplines related to rice production also
participated in one or more of the conference sessions.

During the first day of the conference, IRRI staff members reviewed
their approach to research on rice problems, particularly those of rice

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* Summary of the discussion that took place at the Rice Policy Conference
  held at the International Rice Research Institute, Los Banos,
  Philippines, May 9-14, 1971.

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of Minnesota.
production, and outlined the current status and potential developments in rice production technology in Asia. On the second day, the participants discussed policy issues related to farm resource utilization and the distribution of the benefits of new technology. The third day focused on the modernization of rice processing for domestic consumption and for export. The last day of the conference dealt with issues related to price and fiscal incentives for agricultural production and economic development. On the afternoon of the third day, participants visited rice milling facilities, irrigation systems, and rice farms near IRRI in the province of Laguna.

The format of the conference represented a departure from the usual system of formal papers and discussions. On arrival at Los Banos each participant received a set of papers on rice policy in various countries, papers related to rice technology, and reports of research on the economics of rice production, marketing, and policy. Each conference session then operated as an open forum under the direction of a discussion leader. Professor M. L. Dantwala, Director of the Department of Economics, Bombay University (India) served as the conference chairman.

Within this broader perspective, this summary attempts to provide insight into the major areas of agreement and disagreement rather than a precise record of the conference discussions.
Rice Technology in the 1970's

Diffusion of the new rice (and wheat) technology in Asia has been extremely rapid during the last 5 years (Table 1). The initial diffusion of rice technology involved a limited number of new high yielding fertilizer-responsive varieties developed by IRRI and national research agencies. These varieties are now being succeeded by others which incorporate further advances in grain quality, resistance to pests and diseases, and adaptation to varying conditions of water control and weather (rainfall, temperature) uncertainty. Rice research in the 1970's, at IRRI and in many national programs, will place somewhat less emphasis on creating a new high yield potential. Rather somewhat greater priority will be given to realizing the yield capacity that has already been identified under a broader range of environmental and economic conditions.

Throughout the conference, a good deal of discussion related to the environmental, institutional, and economic conditions associated with performance of the new varieties relative to older varieties.

Considerable research has already been completed, particularly in the Philippines, Indonesia, and India on the performance of the "first generation" of new varieties under field conditions. Some discussants emphasized the extremely rapid diffusion of the new varieties in response to their substantial yield advantage in areas in which they are well adapted. Other discussants emphasized the limitations of the new varieties -- lack of adaptation to extreme variations in water (under deep flooding, rainfed, and upland conditions), problems associated with
disease and pest control, problems associated with market quality in domestic and export trade, and others.

The IRRI director, R. F. Chandler, Jr., emphasized the importance, for purposes of planning and policy, of assessing adequately the potential impact of the varieties that are currently being released or will be released over the next few years. He stressed the usefulness of feedback from micro-level studies in guiding further research. He also pointed out the danger, in a situation characterized by rapid technological change, of drawing policy implications from limited observations based on the performance of the "first generation" of new varieties.

Augustine Tan (Singapore) and others emphasized the difficulty of drawing inference for macro-economic behavior and policy from either experimental data or micro-economic observations during the initial stages of technological innovation and diffusion. This is clearly an issue to which statisticians and economists have not yet given sufficient attention. As a result, the macro-economic implications of current or potential technical change are not treated with the same level of analytical and quantitative precision as other variables for which more reliable aggregate data are generated by national statistical systems.

The net effect of the discussion of technical change in rice production and processing, both during the first day and throughout the conference, was to reject any simplistic view regarding the characteristics and potential of the new rice technology. There was general agreement, however, that if the momentum of the present research effort in Asia can
be maintained, rice producers will have access to new sets of varieties and production practices adapted to a much wider spectrum of environmental and economic conditions.

An important area of policy research emphasized by a number of conference participants is the quantification of several technical constraints on growth.

**Self-Sufficiency as a Policy Goal**

Several governments in Asia have identified self-sufficiency as a major policy goal. The goal reflects both political and economic considerations. For most countries of the region, foreign exchange earnings represent a major constraint on the capacity to import either consumption or investment goods. Even where imports of rice, or other food grains are available on concessional terms, dependence on another country for rice may be political suicide for many government leaders. The new rice technology has, in some countries, sharply reduced the cost of achieving self-sufficiency, but has at the same time reduced the cost of imports.

There are also several seeming inconsistencies in the self-sufficiency policies being pursued. In the Philippines, self-sufficiency in rice apparently has great political significance although the growing imports of wheat cause little apparent concern. In Malaysia, the high prices designed to encourage self-sufficiency in rice production impose higher labor costs on the nation's major export commodities. In India and Indonesia and in some other countries, the goal of self-sufficiency has
in the past been pursued at the regional level at the expense, in the view of some participants, of national economic integration. These apparent contradictions led some participants to view self-sufficiency primarily in a political rather than in an economic context.

Hayami (Japan) said, however, that the concern with self-sufficiency has a rational, though perhaps implicit, foundation in the long term decline in the terms of trade between wheat and rice. Before World War II the prices of wheat and of rice were quite similar. By the early 1960's, the price of rice relative to the price of wheat had increased in both international and domestic markets. This sharply worsened the terms on which consumers in the rice producing countries of the tropics had access to food grains. It also weakened the competitive position of the rice producing countries of tropical Asia, in which rice is a wage good that entered directly into the cost of producing other (non-rice) agricultural products, industrial products, and other goods and services for domestic use or for export. He argued that the long run significance of the "green revolution" in rice production for Asia is that, if its momentum can be maintained, food grains may again become available to the underdeveloped countries of tropical Asia on terms that are as favorable as in the developed countries of the temperate region. The national basis of the quest for self-sufficiency becomes more apparent when it is put in the context of removing the food production constraint on economic growth rather than when it is cast in terms of self-sufficiency at any cost.
Discussion of the self-sufficiency issue carried over into the discussion of two closely related issues -- trade and diversification.

**International Trade in Rice**

For nearly 3 years the price of rice has been declining in international markets (Figure 1). Rice trade patterns have changed rapidly. The United States has replaced Thailand as the largest rice exporter. Japan has accumulated substantial surplus stocks. The Philippines has shifted from a deficit to a self sufficient and back to a deficit position. Pakistan, India, and Indonesia have sharply reduced their imports. These changes lent considerable intensity to the discussion of trade policy.

The issue of whether a set of regional trade policies can be evolved that are consistent with comparative advantage received vigorous discussion. Ruttan (U.S.) argued that agriculture is now a technology-based industry rather than a resource-based industry. Shifts in the production function are being achieved at a relatively low cost. In this dynamic environment the policy implications of traditional comparative advantage are somewhat less clear than in a world in which resource endowments represent the major source of output growth.

Sura (Thailand) pointed out that in spite of the rapid technical changes in rice production elsewhere in Southeast Asia, there can be little doubt that Thailand, where farmers have received less than $50 a metric ton during the last crop, remains a low cost producer. Noting the high prices of rice in Japan and the U.S., he claimed that
the major source of distortion in price and trade relationships, at least up to 1970, has been the domestic price and trade policies in Japan and the U.S. The issue of whether Japan and the U.S. will be content to act as residual suppliers or will be major competitors in the international rice trade was regarded as a serious handicap for Asian countries as they try to plan national rice trade policies during the next decade.

Again the question was debated of whether rice trade policy is amenable to economic analysis or is subject primarily to political considerations. In spite of considerable skepticism, a view was expressed that present policies do reflect, to a considerable degree, the economic circumstances in which countries find themselves. The options available to small countries are clearly different from those available to larger countries. Thailand and Nepal are price takers in the export markets; they remain concerned with maintaining the volume of their exports in spite of adverse price movements. Malaysia and Korea continue to talk about self-sufficiency but have not yet been willing to impose the full costs of achieving self-sufficiency on their consumers. The Philippines, Indonesia, Pakistan, and India -- where the proportion of the rice crop imported has now declined -- indicate a major concern with stabilization policy. In the U.S. and Japan, the relatively high support prices for rice are viewed as part of the political cost of other policies which have greater national priority than efficiency in rice production. The conference reluctantly, and with considerable criticism, accepted the
conclusion that neither Japan nor the U.S. is likely to bring production capacity in line with domestic consumption in the near future.

It was also generally conceded that the rice export market would remain depressed in the immediate future. There is a general tendency for wheat prices to move more in line with feed grain (corn and sorghum) prices than in the past, and it is possible that the gap between rice prices and wheat prices will continue to narrow in international markets. But in view of current rates of growth in population and per capita income, there was concern that pressure on food supplies might again emerge as a serious issue by the end of the decade.

Agricultural Diversification

The emerging potential in some Asian countries to expand rice-producing capacity more rapidly than the growth in demand raises important problems of resource adjustment at least for the immediate future. If significant growth in rice exports is unlikely, the growth dividends from higher rice productivity must be taken through some combination of lower rice prices in domestic markets and a shift of resources to the production of other commodities.

It was pointed out, however, that there are serious obstacles to diversification. Much of the rice production in Asia is in the great river valleys and deltas where water control and climate preclude the production of alternative crops. It was also suggested that a shift of resources from rice to other crops implies a type of resource adjustment
that rich countries, such as the U.S. and Japan, have been unwilling to make. Can we assume that resource use is less rigid in the developing than in the developed countries?

There was rather general agreement that resources could be substantially readjusted through diversification, particularly in some upland rice areas and in some highly developed irrigated areas. Most countries have already experienced some diversification though not under as intensive systems of management as in the crop diversification studies now under way at IRRI.

The pace of diversification will reflect not only the rate of growth of productivity in rice but other constraints operating on both demand and supply. On the demand side, the growth of per capita income limits the ability of the market to absorb other crop and animal products. Economic policies which distort price incentives in favor of rice (Japan) or against rice (Thailand) also have important implications for diversification. It does appear, however, that at present income levels consumers will be ready to use a large part of their higher incomes to improve the quality of their diet. If both rice and alternative crop and livestock products can be made available at lower real prices, this tendency will be reinforced by the relatively high price elasticities.

On the supply side, the potential for diversification is limited by the development of improved technology for alternative crop and animal production, by lack of environmental control, and by the fact that rice in many areas is a subsistence not a commercial crop. If productivity
of rice (and other food grains) continues to advance satisfactorily, some research resources should be reallocated to make the production of vegetable proteins, green vegetables and fruits, feed grains, and livestock more efficient.

In his discussion of diversification, Mosher (ADC) placed particular emphasis on the development and management of water resources to achieve greater environmental control. He argued that an appropriate development strategy would aim for neutral policies with respect to the commodity composition of agricultural output. Future investments in water control -- irrigation and drainage -- should provide potential flexibility in cropping pattern to take advantage of future shifts in demand and technological opportunities.

**Modernization of Product and Input Markets**

The session on modernization of processing and distribution systems focused primarily on two issues: economies of scale in processing, and the appropriate role of the public sector in marketing and distribution.

The initial discussion was characterized by considerable confusion with respect to the dichotomies -- large vs. small and modern vs. traditional -- as applied to the milling industry. The issue, as it finally emerged, centered on the question of the gain in milling efficiency and product quality in a large modern facility (25-30 tons/hour) as compared to either the existing (huller and sheller) small mills (2-4 tons/hour) or the modern small scale mills now in the development stage. Rawnsley (UNDP-Philippines) stated that the
existing small scale mills, when properly operated and maintained, are relatively efficient. Khan (IRRI) indicated that development work now under way suggests that the efficiency of small scale drying and milling operations can be improved. Lele (India) underscored the loss in efficiency in large scale facilities resulting from higher assembly costs and deplored the social inefficiency of substituting capital-intensive milling and warehousing facilities for more labor-intensive systems in economies where labor is relatively cheap.

The view emerged, both among the economists and engineers, that there is a role for large modern drying, milling, and storage facilities to handle the export trade. But with this exception a small scale decentralized system is likely to be more efficient both economically and socially.

It was also observed by Ruttan (U.S.) that the growth dividends from improvements in the product marketing system would under any circumstances be relatively small except where substantial export opportunities existed. Available evidence suggests that in most countries of the region the private sector has performed much more effectively than is frequently assumed. It was suggested that there is an important role for the public sector in the establishment and enforcement of grades and standards, in the provisions of market news, and in the stabilization of producer and consumer expectations.
Discussion about the modernization of factor markets (seed, fertilizer, pesticides, credit) emphasized the relative under-development of factor markets, compared with product markets. Golden (IRRI-Ceylon), in particular, emphasized the constraints on producer response to the new varieties which are imposed by the lack of development of factor markets capable of making inputs available in rural areas.

In addition to the issues involved in the modernization of the marketing system, the issue of price supports and subsidies in factor and product markets was examined closely in several of the conference sessions. There was general agreement that in most countries, particularly those in transition from deficits to self-sufficiency or to surplus status, buffer stocks could play an important role in stabilizing prices and price expectations in producer and consumer markets. Serious reservations were expressed about the financial and administrative capacity of governments to manage stabilization schemes in which the differential between floor prices and ceiling prices is so narrow that a substantial share of total product is either acquired by or moved through public channels. Representatives of two exporting countries, Thailand and Nepal, said that their countries were so dependent on prices in external markets that any attempt to stabilize prices between "good" and "bad" years would be very expensive both financially and in terms of real resources.

Desai (India) indicated that he has concluded from his research, that price supports represent an effective device for speeding the rate of diffusion of new varieties and associated technology.
There was also considerable discussion on the effectiveness of input market subsidies vs. product market price supports in facilitating the adoption of new technology. Park (Korea) argued that it is useful to distinguish between (a) production practices that depend only on better knowledge; (b) production practices that are embodied in inputs purchased from the industrial sector; and (c) production practices that are dependent on public infrastructure development (such as irrigation development). He contended that subsidies on inputs are less expensive than price supports when the constraints on production can be overcome through the purchase of inputs from the private sector. However, if such subsidies are continued for more than a few years, their effects on the marketing system and on public administration will become costly.

Desai (India) challenged the view that fertilizer should be subsidized at all. He argued that his own studies showed that when fertilizer is introduced it flows first to the crops that are of highest value and only later to lower value crops (such as rice). He stated that for such crops, technical changes leading to a steeper fertilizer response curve are much more significant than modest changes in the factor-product price ratio. There was a consensus that generalizations with respect to factor-product price ratios had not given sufficient attention to the technical response of varieties or crops to fertilization. There was general agreement that in both factor and product markets the farmer would be better served by efforts to create a viable marketing system
than by attempts to use factor and product markets to achieve equity objectives. Park (Korea) observed that this good advice is more difficult to follow under democratic than under more authoritarian regimes.

Technical Changes and Income Distribution

The implications of the new rice technology for income distribution in rural areas were discussed during the second conference session and emerged as a major item of concern throughout the conference.

On the basis of the questionnaires filled out by the participants before the conference, Mubyarto (Indonesia) suggested four generalizations with respect to the income distribution effects of the new cereals technology for which he found fairly widespread acceptance:

(a) That the new technology has resulted in cheaper rice production, but that it does not necessarily mean higher real income or greater benefits to all concerned, especially the rice producers.

(b) That the landowner and the larger farmers receive a large share and greater benefits than the tenant or the smaller farmers, which means an increase in the disparity in income distribution.

(c) That the new technology does not alleviate but even aggravates the problem of un- and under-employment in the rural areas because it encourages more mechanization in agriculture.
(d) That the general smallness of landholding makes it impossible to measure the farm viability by rice production alone.

There was, however, substantial disagreement with all four hypotheses. Chandler (IRRI) said that all four could be rejected for the Philippines. Ruttan (U.S.) said he would accept only the first part of hypothesis (a) regarding cheaper rice production. He criticized hypothesis (b), asserting that the new technology is neutral with respect to scale but not with respect to such institutions as land tenure, credit sources, village power structure, and others. He noted that political problems may have been increased because of the new technology as the several social classes and economic interests try to gain access to or control over the new income streams resulting from application of the new technology.

Hypothesis (c) was questioned by Rao (India) and Barker (IRRI). Rao cited Indian data for 1964-1969 showing rising employment and real wages in areas that had adopted the new technology. He foresaw an increased demand for draft power, and felt that although the structure of employment might change, the total man-hours employed would not. Barker cited the stable demand for labor in Central Luzon in spite of new technology.

On the general effect of technology on equity, Ladejinsky (IBRD-India) cited the experience with wheat in the Punjab. With new technology, land values and land rents rose. Tenants found it difficult to remain as operators and began to be displaced and converted to agricultural
laborers. Even in relatively developed areas where agricultural labor has gained from the new technology, there may be increasing mechanization and consequent problems in the future. Finally, access to credit was difficult for tenants and owners without ownership certificates. However, Dantwala (India) and Desai (India) argued that attention should be placed on the **absolute gain** to the small farm from new technology. Rao (India) disagreed, saying that standards of equity are offended when the relative share of large farms in total income is increased even though small farms also gain in absolute terms.

Mangahas (Philippines) observed that the major income distribution problems occur within the rural sector and within the urban sector rather than between sectors. Dantwala said that with respect to the incomes of laborers, whether rural or urban, the most effective way to improve the income distribution is through a sufficiently rapid rate of productivity growth to permit the output of agricultural products to expand more rapidly than growth of demand. The effect would be a decline in the real prices of food to laborers in both urban and rural areas. Falcon (USA) argued that in view of current population growth rates, large works programs are imperative in rural areas to absorb the unemployed and dampen rural-urban migration.

Perhaps the only level of agreement that was reached in this discussion centers around Mosher's (ADC) assertion that growth involves a continuous disequilibrium. Technical changes lead to new income streams that are distributed differently than earlier sources of growth. A
society that achieves viable economic, social, and political development must institutionalize transfer mechanisms and redistribute the income streams in a manner that will reduce the social and political stress resulting from development.

**Implications for Research**

In assessing the implications of the rice price policy conference for further research, it seems reasonable to assume that:

(a) During the 1970's, it will become feasible to shift away from a primary policy objective of simply meeting food needs to one which evaluates national investments in agricultural development in terms of contribution to national economic growth, the welfare of agricultural producers, and the generation of employment.

(b) The material and human resources available for organizing programs and projects will continue to be a major limitation in achieving agricultural development objectives, though clearly this is less serious than in the 1960's.

(c) The substitution of formal quantitative information and analysis for less formal qualitative judgments in economic policy and planning has a relatively high pay-off in achieving development objectives.

There seemed to be agreement that two areas of research deserved particularly high priority.
(1) Research designed to identify and evaluate quantitatively the technological, investment and institutional constraints on growth of agricultural output. This research is essential if research resources, capital investment, and planned institutional changes are to be directed into high pay-off areas.

(2) Research related to the resolution of conflicts arising from the distribution of the new income streams resulting from technical and institutional change. The design of economic policies that are consistent with economic viability in factor and product markets and that distribute the gains of progress in a manner consistent with viable social and political development represents an important challenge to economic, social, and political innovation.

There was considerable disagreement about the skills and perspectives which economists must bring to this task. There was general agreement that the traditional pattern of academic organization of professional resources in the West, and in institutions based on Western models, wastes professional manpower. There also was disagreement about the role of the economist, as an economist, in the political process.
Table 1. Estimated area planted in high-yielding varieties (HYV) of rice and wheat in West, South, and Southeast Asia.

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<td>19,250</td>
<td>1,542</td>
<td>10,170</td>
<td>19,654</td>
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Fig. 1. The Thai export price of rice 5% broken, parboiled 10%, long grain, white broken 25% super and white broken A.1 super.  F.O.B. Bangkok.
IMPLICATIONS OF THE GREEN REVOLUTION FOR AGRICULTURAL DEVELOPMENT*

Vernon W. Ruttan**

There are a number of issues that have emerged during the conference, with respect to the development of the agricultural sector, that should be critically examined in this closing session.

First, has there really been a "green revolution"? What has been its impact on the farms of Asia, Latin America and Africa? Or does it exist only in the popular press and in the academic journals?

The evidence indicates that the rate of diffusion of the new wheat and rice varieties has been extremely rapid since 1966/67. In absolute terms, however, the area planted to the new varieties remains low. Two countries, India and Pakistan, account for a very high percentage of the area planted to the new varieties. The impact on output has, however,

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** Professor, Department of Agricultural and Applied Economics and Department of Economics and Director, Economic Development Center, University of Minnesota.
been substantial in those areas where the environmental and institutional conditions have favored adoption of the new varieties.

Yet there is, in my judgement, serious doubt that the conditions necessary to maintain the momentum of the "green revolution" have yet been fully established in Asia. These conditions include:

(a) The development of experiment station and extension capacity capable of producing and diffusing a continuous stream of new technical knowledge and materials.
(b) The establishment of improved environmental control through better design and management of soil and water.
(c) The establishment of organizational capacity, both economic and political, at the local level that is (i) capable of performing the essential factor and product market functions and (ii) has the capacity to interact politically with higher levels of organization to assure that the conditions for viable agricultural development are met.

Second, what is the role of indigenous technology and inputs relative to modern biological and mechanical technology and inputs produced outside the agricultural sector (or on specialized farms such as seed farms or hatcheries)?

Modern biological technology, just as modern mechanical technology, is clearly embodied in more efficient inputs produced by research and development in public and private sector institutions outside the
agricultural sector. Furthermore, to attain access to the new technology the farmer must be able to purchase these inputs from non-farm sources.

But the efficiency with which the new technology is employed is a function of the farmers capacity to employ them with skill and imagination. This includes his task efficiency in the performance of individual farming operations, his allocative skill in decisions regarding the substitution of modern for traditional input, and his innovative capacity in adapting the use of the resources he controls - his land and labor - and the new technology itself to the physical and economic environment in which he operates. The significance of this capacity is illustrated in Barker's paper, by the gap between the actual and potential yields obtained from the new varieties. 1/ In another paper he has illustrated the effect of "learning-by-doing", associated with the adoption of the new varieties, on the upward drift in the yield of the older varieties still being grown.

The effects of education, both schooling and extension, became highly important in expanding the farmers allocative and innovative capacity.

Third, is an efficient small scale agricultural system compatible with modern agricultural technology?

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The answer is, in my judgement, unambiguous and affirmative. There are two kinds of evidence which support this judgement.

(a) Modern biological (or biological-chemical) technology is clearly neutral with respect to scale. Furthermore, it is not yet clear that modern mechanical technology, when designed with the factor endowments and prices that prevail in tropical Asia, can not also be made neutral with respect to scale.

(b) No efficient large scale or multiple family farming system has yet emerged that is capable of achieving efficiency in the use of either labor or modern inputs in an environment where labor is abundant relative to other inputs. The plantation system is, by and large, a pre-modern or pre-capitalist system of agriculture which finds it increasingly difficult to compete successfully with small holder agriculture in an environment characterized by adequate infrastructure development and farmer education. Furthermore, no system of communal, collective, cooperative or joint farming system has yet emerged that is not relatively inefficient in its use of both labor and material inputs.

Fourth, is it possible to implement a modern agricultural technology that is capable of absorbing the residual growth in the labor force, that must remain in rural areas, during the next two to four decades?
Let me be perfectly clear that I do not know the answer to this question! Yet it is also clear that the view that a modern agricultural technology is necessarily embodied in large scale mechanical equipment has lead to factor market policies which encourage the inefficient substitution of capital for labor in agriculture. I only need to refer to the examples provided in the paper by Islam. 1/ Furthermore, urban labor market policies have been adopted which have forced the private cost of labor above the social cost and have dampened the output-employment multiplier.

These distortions have not only resulted in bias in the choice of factors by agricultural producers and industrial entreprenuers. They have also distorted the incentives and the direction of technological effort and innovation along an inefficient path.

A major unresolved question of the conference remains -- if the factor market biases were eliminated what, if any, further policies would be required to achieve consistency between equity and growth objectives? What, if any, would be the trade-offs? It is clear, however, that elimination of the factor market biases which induce inefficient use of capital intensive technology would be consistent with both equity and growth objectives. I would insist, however, that in our concern for labor absorption we should not let ourselves become trapped into a view that labor productivity -- output per man -- should not rise. We should

insist that the rise in output per man should be associated with a rise in total productivity and that the potential growth in total productivity be guided by an efficient set of prices.

Fifth, what are the implications of rapid technical change for social and political stress and for institutional reform?

Clearly the 'green revolution' is occurring in a part of the world in which great economic and political inequalities already exist. I see no possibility that the new income streams associated with technical change and total productivity growth in agriculture will be partitioned equitably given the existing social, political and economic structure in most developing countries.

The new income streams can be expected to generate social and political stress among the separate social and economic classes as they attempt to obtain control over the new income streams. There will be stress on the relationships:

(a) between landless laborers and farm operators,
(b) between landlords and tenants,
(c) between urban and rural areas -- between agricultural producers and consumers,
(d) among regions within countries,
(e) between the private and the public sector, and within the public sector between the "development" and the military bureaucracies,
(f) among nations-among exporting and importing nations.
I also see the struggle over the partitioning of the gains from productivity growth giving rise to institutional changes that will give agricultural producers greater control over national agricultural development and market policies. In some cases the social and political stress will be greater than the fragile political and economic systems in Southeast Asia can bear. I do not expect the 1970's to be an era of stability!

Finally, there is the issue of the degree to which the economic gains from the new technology can be realized through export earnings or whether they must be taken in terms of a shift in the domestic terms of trade in favor of consumers.

Prior to World War II the prices of wheat and rice were quite similar. By the early 1960's, the price of rice relative to the price of wheat had roughly doubled in both international and domestic markets. This sharply reversed the terms on which consumers in the rice producing countries of the tropics had access to food grain. It also weakened the competitive position of the rice producing countries of tropical Asia, in which rice is a wage good that enters directly into the cost of producing other (non-rice) agricultural products, industrial products, and other goods and services for domestic use or for export.

If the momentum of the 'green revolution' can be maintained food grains may again become available to underdeveloped countries of tropical Asia on terms that compare favorably with the developed countries. One
effect of this, judging from Japanese experience, would be a strong inducement for diversification of crop production and intensification of agricultural systems through the development of integrated small scale crop-livestock enterprises. This would also be consistent with the view, expressed by Dantwala at an IRRI conference, that the most effective way to improve the income distribution in Asia is through a sufficiently rapid rate of productivity growth to permit the output of agricultural products to expand more rapidly than growth in demand. The effect would be a decline in the real prices of food to rural laborers and urban workers.