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K. William Easter

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BACKGROUND PAPERS FOR DISCUSSION

AT

THE INTERNATIONAL SEMINAR

ON

"COMPARATIVE EXPERIENCE OF AGRICULTURAL DEVELOPMENT IN DEVELOPING COUNTRIES SINCE WORLD WAR II"

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U.S. MALINVESTMENTS IN FOOD FOR THE WORLD

Theodore W. Schultz*

Appropriately we gather in Iowa,[@] the personification of agricultural abundance with progress in science and technology so essential to the modernization of agriculture. Here there is food enough and more. It is being produced by a sparse farm population, highly skilled and world renowned for its gains in productivity. Surely this achievement in agricultural productivity is not for us alone.

The theme of this conference has a familiar ring. My first conference chore at the University of Chicago, now over two decades ago, the Twentieth Institute of the Harris Foundation, was held in September, 1944, and out of it came the book, Food for the World.[1] Judged by demand, this book has the distinction of being the most successful venture ever sponsored by the Harris Institute in over four decades: three printings and many reprints of the better papers! As here, there were two papers on population, Notestein's and Lorimer's, one a classic; on nutrition you have one, whereas we had five authored by the distinguished Elvehjem, Maynard, Cannon, Keys and Roberts. In 1944 we had six papers on food supplies and another six on international trade. But we had none by scientists on the agricultural role of science and technology.

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* Extract. Agricultural Economics Paper No. 6610; Oct.28, 1966, Department of Economics, The University of Chicago.

@ Ames Conference on Balancing Future World Food Production and Needs, Iowa State University, November 8-10, 1966.

1 University of Chicago Press, 1945.

Both conferences, so it seems to me now, underplayed population, i.e. the factors determining changes in the number, composition and quality of the different populations of the world. Why? Both conferences were organized by economists during an intellectual period when economists have had virtually nothing to contribute to an understanding of the population problems. The Chicago conference overrated the possibilities of using the advance in knowledge in nutrition in organizing the production and distribution of food. It should not be blamed, however, for the empty World Food Nutritional Budgets, empty when it comes to making public and private decisions with respect to agricultural production. But it is odd, with economists setting the agenda, that this conference should have omitted international trade. To its credit, however, is the attention given to the organization of science and technology.

But I have the uneasy feeling that we are still confused by the disparate views of our specialities, by the lack of relevance of many of our ideas when it comes to public and private decisions, and by fringe issues. In economic analysis, for example, in clarifying the world food and population problems we ought to be considering a number of unsettled questions that go far beyond the realm of agriculture, nutrition and demography. Let me list five key questions.

1. Why are so many poor countries placing a low economic value on their farm products?
2. Why are most of the less developed countries foregoing many of the gains to be had from international specialization and trade?
3. Why are efficiency prices so low on the policy agenda of many less developed countries?

4. Why is the record of U.S. investment for increasing the agricultural capacity of poor countries so unsatisfactory?

5. Why are economists shy on population analysis?

But these questions are not part of the subject assigned to me. My assignment would commit me to that "modest" task of showing how to use U.S. investments in balancing future world food supplies and populations. Thus, I could bypass the core issues implicit in the questions I have raised. But to do so runs contrary to my professional taste. Yet as I broaden my approach, it becomes an heroic assignment which even a rational Paul Bunyan would find awesome.

Four Malinvestments in a Nutshell

Let me, however, bow to my assignment by taking a look at the pattern of U.S. investments in this area. There are four clear classes of malinvestment, as follows :

1. We are still committed to publicly induced over-investment in material forms of capital contributing to agricultural production. The current food grain shortages in parts of the world could start us off on another binge of federal irrigation programs and the like to increase the capacity of U.S. agriculture. It might also postpone once again bringing U.S. farm product prices in line with their economic values here and abroad.

2. We persist throughout the agricultural establishment to under-invest in the human forms of capital. Fortunately other parts of the federal government are beginning to correct this long standing under-investment in farm

people. But meanwhile the six and more billions of dollars appropriated annually for agriculture become ever more narrowly, simply subsidies to U.S. commercial agriculture.

3. We still have not developed a set of successful public programs for "investing" in agricultural research and technology in poor countries. The Rockefeller Foundation has done well on this score, and in recent years the Ford Foundation has joined in this successful approach. A few of the agricultural colleges, despite the uncertainties of AID financial assistance, have begun to forge a successful pattern. But in general, in terms of U.S. public expenditures to this end, the "investment" is woefully inadequate both in the manner in which it is being accomplished and inthe amounts spent for this purpose.

4. While we have succeeded in putting family planning and birth control on the U.S. foreign aid agenda, we are still a long way from having developed meaningful public programs in this area. U.S. private groups, notably the Population Council and the Ford Foundation, are far ahead of the U.S. public sector.

Before turning to the harder and more important underlying issues, there are two preliminary matters which call for comments. One pertains to the poor performance of agriculture in so many of the poor countries and the other to the changes underway for the better. In both of my comments I shall follow closely what I said to Paul Hoffman's United Nations development planners at their recent meeting in Italy.

Reasons for Agriculture's Poor Performance

It has been convenient to conceal the mistakes in economic policy that account for the failures in modernizing agriculture by blaming the poor performance of the agricultural sector in poor countries on the adversity of Nature, or the perversity of farmers, or the fecundity of man.

A sequence of bad monsoons or droughts, a spell of bad weather--thus Nature is to blame. As one who was reared in the Dakotas with its volatile weather, I look upon this aspect of Nature as perfectly natural. It should be an integral part of any normal expectations with respect to agricultural production. The bad monsoon of South Asia will return from time to time, but there will be good crop years too. The droughts that have burdened the Soviet Union will pass and in good years there will be wheat enough, even some for export once again. These adversities of Nature do not account for the poor performance of agriculture.

In the minds of many who shape economic policy--some "economists," public leaders, and urban-oriented intellectuals--farmers are ever so perverse. When a national economic plan calls for more agricultural production, farmers fail to respond; when instructions are issued to shift from wheat to corn they fail to produce enough of either crop; when given the command to make a big leap forward, they step backward; and when they are heavily subsidized to reduce the acreage of particular crops, they proceed to increase the yield to more than offset the reduction in acreage. It has been ever so convenient to believe that farmers, especially in poor countries, are loafers who prefer leisure to doing the extra work to increase production, are squanderers when it comes to savings for investment to increase agricultural production, and are ever so inefficient in using the resources at their disposal. Thus these poor, lowly farmers are to blame. But

farmers are not perverse in their economic behaviour.[2] If there has been perversity it will be found in the minds of those already mentioned in what they behold in agriculture and in national economic plans that fail to provide economic incentives for farmers.

It is now fashionable to jump on the fecundity of man as the culprit, as if it were to blame for the poor performance of agriculture. I hasten to say that the excessive growth in population is a serious matter; for surely it has major adverse social and welfare effects in what can be done to improve health facilities, to enlarge cultural opportunities, and to provide schooling, and it can be a heavy drag on economic development. It, of course, also increases the demand for food; nevertheless, the rapid growth of the population is not responsible per se for the poor performance of agriculture. As a matter of fact, no small part of the increases in agricultural production in many a poor country has come in response to the increase in the farm labor force. I shall return to the population problem. As of now, I simply want to make it clear that population growth by itself is not to blame for the poor performance of agriculture.

In my judgment the real culprit causing the poor performance of agriculture in the less developed countries is the lack of economic opportunities in agriculture, opportunities that are rewarding to farmers. It is this lack of viable opportunities that is the crux of the matter.

Some Changes for the Better

Despite past economic policy mistakes and the many unresolved problems in transforming traditional agriculture,

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2 See my, Economic Crises in World Agriculture (Ann Arbor: University of Michigan Press, 1965), 1-40.

the world food supply prospects are not as bleak as the exponential population growth curves would have us believe.[3] These naive projections treat human beings as if they were mechanical robots without preference and choice when it comes to reproduction, which is patently wrong. There is underway throughout the world a fundamental change with respect to human reproduction because clearly parents prefer smaller families and because of wholly new possibilities of achieving effective family planning. To satisfy these preferences for smaller families much can, should and will be done in improving the opportunities of parents to this end.

But to return to agriculture, the long, wasteful swing towards imbalance on the part of economic policy in the less developed countries underemphasizing agriculture has fortunately reached its trough. There are signs that it is on the way to being corrected. In general terms the corrective process, as I see it, consists of the following parts :

1. The less developed countries are beginning to correct their underpricing of farm products, and also their overpricing of agricultural inputs and of the consumer goods and services that farm people buy.

2. It has been fashionable since the mid-forties for less developed countries to embark on import substitution virtually regardless of cost. But on this policy too there are now many second thoughts. I would expect some freeing of international trade which will reduce the monolithic push for import substitution; as this occurs agricultural input prices

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3 The height of absurdity is revealed in a full two-page advertisement in The Atlantic, July 1966 issue, by Olin with its half-page heading. "Of the billion people who may starve in 1976," followed by a paragraph saying, "The statisticians say that in ten years over a billion--not a million, but a billion--people may be dying of hunger. "

will decline and the prices of consumer goods farm people buy will also decline in some of these countries.

3. Foreign aid from the more well-to-do countries will be tied less than it has been to the export of surpluses of farm products of the P.L. 480 vintage, and there will be more aid in the form of fertilizer, insecticides, farm tools, machinery, and personnel who have the skills required to modernize agriculture.

4. The valuable stock of scientific and technical knowledge, a critical and major resource for increasing agricultural production, now located predominantly in Western countries, will become increasingly available to farmers in the less developed countries.

5. The endowment of natural resources in most countries will not prove to be a limitational factor to large increases in agricultural production.

6. The subsistence squeeze of the Malthusian-Ricardian pincers will be much reduced, for the excessive increases in population will gradually be brought under control and food supplies will begin to increase enough to raise standards of living generally.

In more specific terms, I call your attention to the following developments :

1. There is a radical change in the economic plans of the Soviet Union providing a much better deal for agriculture. The large 1966 crop may already be in part a payoff.

2. Eastern European countries are adopting the approach of Western European countries in their efforts to modernize agriculture.

3. The new U.S. legislation replacing Public Law 480 is likely to help agricultural development in countries receiving U.S. foreign aid.

4. Mexico's success in maintaining a balanced increase on the part of industry and agriculture is an approach that some of the other Latin countries are likely to adopt.

5. In South Asia we have the improved performance of agriculture in Pakistan, induced by the availability of relatively cheap nitrogen, tube wells, better roads in East Pakistan, and above all a more efficient system of prices.

6. New, productive varieties of wheat coming out of Mexico as a result of the work of the Rockefeller Foundation and the Mexican government are being adapted rapidly to the climatic requirements and soils of other less developed wheat-growing countries. Similar progress is under way with respect to corn, grain sorghums and millets.

7. The picture with respect to improved varieties of rice is not as clear as that for wheat, but it is quite plausible that the research under way at the International Rice Institute in the Philippines will during the next decade begin to achieve for rice what has been accomplished for wheat.

8. The Tropical Food Research Institute which is in the process of being established in Nigeria, pending the political stability of that country, should also be mentioned although it will take a decade and longer before it can discover and develop new and better varieties of food crops for this part of the tropics.

9. The cost of producing fertilizer in the advanced countries has declined by about one-half relative to the price of major farm products. Most of the less developed countries have so far failed to take advantage of this important decline in the real price of fertilizer. But I would expect a marked change for

the better on this score during the next ten years; for example, it is hard to believe that India will not have by then proceeded to take advantage of this cheapness of fertilizer.

10. A specific deterrent is the lack of organised agricultural research to develop new and better sources of plant proteins. Protein food and feed from plants are already in short supply relative to the supply of carbohydrates and fats. The price of soybeans is a sign.

I shall now turn to my list of questions.[4]

1. Why are so many poor countries placing a low economic value on their farm products?

I assume that it reveals a policy preference and that it is an economic possibility. I assume, also, that when countries such as Nigeria, Chile or India want to and can keep their farm product prices low, the investment incentive for increasing the capacity of agriculture is thereby reduced.

The policy preference is for industrialization, and agriculture's contribution to the attainment of it is cheap food, a source of cheap labour, and public revenue. This policy preference implies a low regard for agriculture as a source of economic growth. It means that low farm product prices and cheap food are an integral part of this type of economic policy.

What makes this type of policy possible? Politically it is clear enough: where the rank and file of farm people

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4 The economic logic and analysis for answering these questions are in large part from my Transforming Traditional Agriculture (New Haven, Yale Univ. Press, 1964) and my Economic Crises in World Agriculture (Ann Arbor, Univ. of Michigan Press, 1965).

have little or no voice in shaping policy, other interest groups presumably would dominate. But from whence the economic possibilities? Where there is an export surplus of these products, it is possible by reducing the export surplus by an amount that is sufficient to increase the domestic supply of food and thereby depress the internal price. There have been many countries making this "shift" during the post war period, especially so throughout Latin America with Mexico a noticeable exception. Where the losses in foreign exchange earnings caused by such a reduction in exports are offset by foreign aid, it is easier still. It is also possible whenever there is enough foreign aid in the form of farm products. It then becomes necessary to reduce farm product prices below what they would be without such aid in order to utilize such concessional farm products, unless the country is prepared to and capable of administering a two price system.

As I have argued repeatedly, U.S. concessional exports of the P.L. 480 vintage have made this policy of cheap food and low farm product prices possible.[5] Not in Nigeria where the heritage of the marketing boards is predominantly to blame. But surely our aid in the form of farm products to Chile and especially so to India and to many other countries has had the effect of reducing farm product prices below what they would have been without such forms of aid. During the period when we had large CCC surpluses, it was ever so convenient to be blind on this issue. Now that we are less blind, the remedy frequently advanced is a two price system, i.e. cheap food for the poor in the cities and higher farm

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5 T.W. Schultz, "Value of U.S. Farm Surpluses to Underdeveloped Countries," Journal of Farm Economics, 42 (December, 1960); also, Franklin M. Fisher, "Agricultural Production in Recipient Countries," Journal of Farm Economics, 45 (November, 1963).

product prices for farmers, as if it were possible for these countries with their public personnel already burdened to the limit to administer such a two price system. It is sheer folly, so it seems to me, to urge these countries to undertake such a difficult administrative task and assume they could do it successfully.

There is still another part to the question here under consideration. We who are from rich countries are inclined to the belief that policy makers and people in poor countries should rate good nutrition much higher than they appear to do. But better diets entail costs, and for them it is very much a matter of what they can afford. Closely related, as one takes the long view, is our belief that the people in poor countries will in the near future want diets in which the proteins will come mainly from animal sources. Our belief on this point will undoubtedly prove to be wrong. Dairy cows for milk and other animals for food, except where there are forage crops which cannot be utilized otherwise, will not become during the relevant future the major source of food proteins for all populations as people improve their economic lot and thus can afford better diets.

2. <u>Why are most of the less developed countries foregoing many of the gains to be had from international specialization and trade</u>?

National defense considerations aside, such foregone gains are commonly viewed as temporary "losses", the price of achieving rapid industrialization. Thus, here too, the policy objective is industrialization, the development of new industries. Such infant industries require all manner of protection for which there is a ready-made economic doctrine and policies to imitate in what some of the developed industrial countries have done.

Furthermore, under the stress of foreign exchange disequilibrium, import substitution has become popular with policy makers as a way of "saving" on foreign exchange while further protecting domestic industries from foreign competition.

But with few exceptions this rash of import substitution and the accompanying protection has not favored the agricultural sector. On the contrary, in countries which have had viable markets abroad for some of their farm products, these markets have been thereby impaired. In addition, and not to be overlooked, is the fact that if agriculture is to be modernized, farmers must have access to modern inputs--machinery, insecticides, fertilizer and others--at prices which will make it profitable for them to proceed to use them. Where such modern agricultural inputs are produced by highly protected infant industries, the prices of such inputs are far too high to bring about a rapid modernization of agriculture. The gains that could be realized by many of these new forms of agricultural inputs are large indeed.

Still another development reducing the gains to be had from international specialization and trade is the use of an export tax on farm products as an easy source of public revenue, especially so in a number of West African countries where before or during the war marketing boards were established. These marketing boards take a certain amount of the price as revenue by selling the products at the world price, but by paying farmers much less. For example, in Nigeria, farmers have been receiving for their palm fruits about half of the world price and production has been declining. Moreover, palm oil is being "wasted", for it has become so cheap in Nigeria that it is used in place of kerosene as a fuel; yet if there is a "gold mine" in

Nigeria, in pure economic values, it is palm fruit! One reason for the comparative advantage of palm fruit is the genetic breakthrough on the part of biological research. But the potential economic gain from this advance in useful knowledge is being wasted by the export tax on this product.

The investment implications when it comes to increasing the capacity of agriculture in these countries are patently clear. The World Bank turned down Nigeria's request for a large loan to expand the production of palm fruit because of her export tax and its adverse effects on the profitability of that industry. India has been beset with difficulties no end in developing an adequate supply of cheap fertilizer for her farmers; the investment required for this purpose has not been forthcoming. In Chile, too, although Chile is an exporter of nitrogenous materials which she sells at world prices, these materials are anything but cheap to farmers. Strange as it may seem, the facts are that the price is very high in Chile and the obvious reason for this price distortion is that the price is rigged. Chile appears to be playing a monopoly game in producing and selling nitrogenous materials. The government is a partner of private producers in this game of exploiting Chilean farmers. The logic of this game is as follows : The material that is exported must be sold at the world price which is low and thus it is presumed that it is sold at a loss; to offset this presumed loss, the price in Chile is set high, for it is sold in Chile at a price that is far above the world price What a sad perversion of economic logic!

I would be remiss if I were not to comment on the economic policies of the more developed countries that impair the gains to be had from international trade. No one can

doubt that sugar cane produced in the semi-topics has a marked comparative advantage over sugar beets grown in Europe and the United States as a source of sugar. U.S. imports of fresh fruit from Chile, for example, are required to meet higher standards than domestically produced fruits. We too engage in all manner of import substitution by the use of rules and regulations to protect particular farm products. But much more serious in the area of agriculture are the explicity and implicit export subsidies that permeate our federal farm programs.

3. Why are efficiency prices so low on the policy agenda of many less developed countries?

It could be they learned it from us! We were preaching not so long ago that farm prices could only be inefficient in guiding the allocation of resources. Cobweb models, backward sloping supply curves and perverse responses by farmers to price changes, were the order of the day. While there have been second thoughts in light of the contrary behaviour of farmers, our doctrine of depreciating the function of prices has no doubt had some influence in shaping price policies in some of the less developed countries.

But policy makers in these countries have their own special reasons. They want to industrialize rapidly, and this objective, as I have noted above, has among other things expressed itself in a policy preference for cheap food and relatively low farm product prices which for some of them has been in the realm of economic possibilities for reasons that I have set forth. One must add here also the widely held view that rent performs no allocative function. There is, of course, strong economic logic which

shows that Ricardian Rent is "unearned". Moreover, the income from rent is as a rule a relatively large income stream in most poor countries; then, too, landowners are generally obstructionists politically with respect to planning for economic growth, and essentially functionless economically. On top of all this is the cultural and intellectual orientation which looks upon the rank and file of farm people as belonging to an inferior occupation and "deservedly" are subject to all manner of social, political, and economic discrimination.

Economic theory also enters, performing two parts. Income and employment theory (macro economics) plays the role of the villain extolling the quantity of capital and labor using fix-price models; price and allocative theory (micro economics) plays the role of the old virtuous heroine defending efficiency prices. It is noteworthy in this connection that modern economists have greatly clarified the relevance of price theory. The major advance has been in treating different forms of economic organization predominantly with respect to the relevance of price theory. Price theory, originally conceived to determine how resources are allocated and income distributed in a competitive capitalist economy, has now been extended to a planned economy. As Solow has noted, modern work has rediscovered the same price theory "in the guise of shadow prices or efficiency prices," and accordingly we now know "that the theory of perfectly-competitive capitalism is in many respects the theory of a planned or socialist economy."[6]

One of the necessary economic requirements in modernising and increasing the capacity of agriculture

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6 R.M. Solow, Capital Theory and the Rate of Return

in poor countries, so that investments in agriculture will take the forms that will produce the best rates of return--is a system of efficiency prices. But it would take a book to show why this is true and what is happening with respect to only three sets, namely the prices of farm products, prices of agricultural inputs, and also very important, prices of the consumer goods and services that farm people buy for consumption. These prices are indispensable as an organizing device where there are many farmers, whether thousands or millions of them. No alternative system has as yet been devised that can integrate and organize efficiently the activities of many farmers. But it is a fact that these three sets of prices are as a rule badly distorted. Most of the less developed countries have inefficient systems of prices.

In my comments on question No. 1, I have presented a picture of the low economic value being placed on farm products. I did not elaborate on the price distortions among farm products within such countries. There are many such.

The picture of agricultural input prices is even more beset with price inefficiencies and they are serious obstacles to the path of modernizing agriculture. Farmers must buy if they are to modernize--fertilizer, insecticides, other chemicals, tools, equipment, machines, fuel and repairs; in general where they are available, they are very expensive. These input prices are not only high but they are also distorted one to another in most poor countries. Competition is weak because of all manner of barriers to trade to protect the domestic producers of these inputs from foreign competition. Internal competition is also weakened by domains of monopoly. In some countries the production of some key

agricultural inputs is restricted to the public sector. Where it is in the private sector, the suppliers of these inputs are as a rule not subject to effective competition.

Fertilizer deserves a special comment because it has become one of the principal inputs in increasing agricultural production. Although the discovery that nitrogen, phosphate and potash can increase yields is not new, the profitability of using vast quantities of commercial fertilizer in farming throughout the world is largely a post-World War II development. The dominant factor underlying this development has been the decline in the supply price of commercially produced fertilizer materials--relative to farm product prices. Farmers, of course, must learn how to use it efficiently, which is not very difficult provided the variety of wheat or rice they grow is responsive to the application of fertilizer and provided there is sufficient rainfall and supplementary water.

Although relatively cheap fertilizer opens the door for large increases in agricultural production, this door still remains closed in most of the less developed countries. As a consequence it has not been profitable for farmers in these countries to buy and use large additional quantities of fertilizer because the advantage of the decline in world prices of materials that provide nitrogen, phosphate and potash has not been extended to them. Despite all good intentions and efforts, this door is still shut in India. On the other hand, Pakistan has opened it for nitrogen; so has Taiwan for all types of commercial fertilizer. But they are among a handful of exceptions.

In some countries there are already many types of complex machines and tractors. With respect to these, it is the lack of organization and the pricing of repair parts

that is appallingly inefficient. Tractors stand idle after a couple of years of use for lack of parts that have broken or have worn out. The cost and the time it takes to obtain repair parts is the explanation.

A brief reference to the prices of the consumer goods and services that farm people buy will suffice. There is all too little recognition of the economic importance of this set of prices. They really matter because they are the key to the purchasing power of the net income that farm people earn. In general, farm people in the less developed countries have fared badly in what they can buy with their earnings. While it is to be expected that the prices of consumer goods and services that are produced in urban areas will be somewhat higher when they reach the countryside, the rub is that they appear to have been rising relative to the prices at which farmers sell their products and, in many instances, the quality of the items they buy has been declining.

4. <u>Why is the record of U.S. investment for increasing the agricultural capacity of poor countries so unsatisfactory</u>?

For want of an investment policy in this area, no meaningful investment programs have been developed. Our policy preference has been very ambiguous. The agricultural committees of Congress for years, with some change for the better this year, have been opposed to such programs because they might develop agricultural capacity abroad that would compete with U.S. farm products. The thrust of Congress has been "surplus disposal" and larger foreign sales subsidized and promoted.

The dogma that the economic growth of poor countries is dependent predominantly upon industrialization and for all practical purposes is independent of the development of the agricultural sector has long been compatible with the biases of agricultural committees of Congress, the instructions given to U.S. aid missions abroad, and the general orientation of the State Department. All had been bitten by the industrialization bug.

While there is now under way a marked policy change in favour of increasing the agricultural capacity in poor countries, it is an exceedingly difficult policy to implement. How can public agencies of the United States make efficient investments in traditional agriculture? Loans to provide additional funds for millions of small farmers to augment the stock of the forms of capital that are used in traditional farming would be very hard to organizeand administer and of little avail because the pay-off on such investment would be low indeed.

But the problem that confronts us in the modernization of agriculture in poor countries is compounded by three basic errors. We must first rid ourselves of the false belief that traditional farmers are in general highly inefficient in allocating the agricultural resources at their disposal and that they will not respond to better economic opportunities. We must secondly face up to the fact that efficient prices for farm products, agricultural inputs, and consumer goods that farm people buy are necessary before it is possible to invest appropriately and efficiently in agriculture abroad. Nor do I exclude rent, for it is the price of the services of land and the price of resident entrepreneurs (farmers) in this connection which in some countries will require land reform.

The third error lurking in the background, especially so in the minds of some economists, is the assumption that efficiency prices are sufficient. It is very much an error in modernizing agriculture because the investment opportunities, the new high pay-off inputs, must be discovered, developed and supplied before farmers can turn to them in making their investment.

In our failure to see the lack of new pay-off opportunities we make the following mistakes :

1. We assume that there are available in these countries usable and profitable new agricultural techniques, varieties of crops, vegetables and fruits and other agricultural inputs;
2. We then start with extension programs before there is anything worthwhile to extend to farmers;
3. We link agricultural colleges to the Ministries of Agriculture abroad to concentrate on improving administration and information instead of a college-to-college arrangement with at least some emphasis on research; and
4. We undertake country-wide community development programs without sufficient attention to the profitability of such programs for farmers.

Although a system of efficiency prices will usually reveal some rewarding opportunities, once these have been exhausted the further progress of agriculture is dependent upon a wide array of modern agricultural inputs, modern in the sense that they are the fruit of organized agricultural research.

At this point it should be said that we live in a period in which there is indeed an Agricultural Revolution. The scientific and technical knowledge in the West is so far ahead, in terms of what is theoretically possible, that what we see in more than half of the world is obsolete by a very wide margin. It is this stock of knowledge that warrants a large measure of optimism. This knowledge is exceedingly valuable, although much of it is still theoretical in the sense that the appropriate varieties of rice, wheat and so on for many countries are not as yet available.[7] It of course calls for applied research, although much of it is more basic than many of us perhaps realize.

Thus, clearly the new inputs to increase world food supplies must come from outside agriculture. To develop these inputs, mainly through organized agricultural research, calls for a transformation of the existing knowledge so that it will be economically useful in the less developed countries and for a further advance in knowledge that will be applicable in agricultural production.

But we have fallen far short in meeting this requirement. Look back two decades and see how little the Point Four Programs accomplished in Latin America. A third of the U.S. expenditures at that time in Latin American countries were for agriculture. Nevertheless, not a single first rate agricultural research center was developed by this program.[8] This

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7 For a highly competent evaluation, see A.H. Moseman, "National Systems of Science and Technology for Agricultural Development," presented at the meeting of University Directors of International Agricultural Programs, University of Minnesota, June 9, 1966.

8 T.W. Schultz, "Economic Growth from Traditional Agriculture," Agricultural Sciences for the Developing Nations, American Assoc. for the Advancement of Science, No. 76, 185-205 (1964).

research was grossly neglected. Why? I have already given the reasons. It was taken for granted that the supply of usable and profitable agricultural knowledge was large. Extension, yes. Crash programs are always given top priority. The organization of viable agricultural research centers, no.[9]

Fortunately there also have been a few successful ventures, models to emulate. The success of the Rockefeller Foundation and the government of Mexico in agricultural research is such a model. So is the International Rice Institute, the new Corn and Wheat International Corporation which has just been put together in Mexico. The fairly recent and still modest agricultural research program in India, in which the Rockefeller Foundation again is joined, rates high.

But a good research enterprise by itself, let me underscore, while an essential, may not lead to increases in agricultural production. To go back to Chile, where the agricultural research program is quite advanced: in forage crops, food crops, vegetables, and fruit, Chile has in general good varieties.[10] But clearly Chile has not been successful in its agricultural production during the last two decades.

In India, despite the breakthroughs that have been made in corn research, grain sorghum, and millet, there has

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9 T.W. Schultz, "Education and Research in Rural Development in Latin America," Conference paper, Cornell University, December 2, 1965, to appear in a book on the Hot-Humid Tropics in Latin America, Cornell University Press.

10 T.W. Schultz, "An Endeavor to Clarify the Economic Components Underlying Chilean Agriculture," University of Chicago, Office of Agricultural Economics Research, Paper no. 6603, March 30, 1966.

been a long delay in getting the new varieties propagated, multiplied, and distributed to farmers.

In the Philippines where Cornell has been for a long time and no doubt has done a fine job, there is as yet nothing to show for it in the agricultural production.

Thus, clearly, price and related economic policy can indeed keep a country from realizing the gains in productivity to be had from successful agricultural research.

Also high on my investment agenda, as I look ahead, is additional capacity to produce and distribute fertilizer and land structures to increase and improve the supply of water as fertilizer and improved varieties become available.

Surely it is obvious in retrospect that our investment record for increasing agricultural capacity in poor countries is a sad affair. I am moderately optimistic that we will begin to do better during the decade ahead as we learn from our errors.

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The last portion, consisting of Section 5, devoted to economists' approach to Population Analysis has been dropped.