The Globalization of Science

The Place of Agricultural Research

New, expanded edition

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Agriculture as an Engine of Economic Development

G. Edward Schuh

Agriculture is in danger of falling off the agenda of the bilateral and multilateral development agencies. It also continues to receive low priority on the part of governments in the developing countries.

This decline in the importance of agriculture on development agendas appears to be due at least in part to a misunderstanding of how agriculture contributes to economic development, and a failure to recognize what a powerful engine of economic development it can be, especially in the early stages of economic development. It also appears to be due to a failure to recognize some of the positive income-distribution features of promoting economic development through the modernization of agriculture.

This paper discusses these issues. It begins with a discussion of what appears to be the conventional view about agriculture in the development process. It then addresses how the modernization of agriculture can contribute in a positive way to broader economic development. This is followed by the role of food as a wage good and how the modernization of that sector can contribute to helping a country be more competitive generally in the international economy. The final section discusses an important opportunity many developing countries have if they take steps to shape their comparative advantage in favor of agriculture. At the end there are some concluding comments.

The Conventional View of the Role of Agriculture in Economic Development

The prevailing view about the role of agriculture in economic development appears to be based on an incorrect interpretation of two important facts about that sector as economic development proceeds. The first fact is that agriculture's share of a nation's gross domestic product (GDP) declines as the economy develops and per capita incomes rise. The second fact is that the share of the total labor force that agriculture accounts for declines under these same circumstances.

Policymakers and developers appear to conclude from these inevitable consequences of economic development that the way to promote economic development is to facilitate such long-term trends. This is to concentrate on the symptoms or consequences of development, in contrast to understanding the underlying economic and technological forces at work.

Agriculture declines both as a share of the GDP and of the labor force as a consequence of some basic features of the food sector. Food tends to have a low income elasticity of demand, which is to say that as per capita incomes rise, the demand for food does not rise as much as the demand for other goods and services. This is rooted in what economists refer to as Engel's Law: the empirical fact that as per capita incomes rise, consumers spend an ever smaller share of their budget on food.

These demand considerations mean that under rather general conditions, food and agriculture as a sector of the economy will decline as the economy grows and develops. This process will be accelerated if new technology that raises productivity in the sector is introduced. This increase in productivity will, in turn, contribute to the release of capital and labor from the sector as output expands against a demand that is rather unresponsive to increases in per capita incomes.

None of the above means that the food and agriculture sector should be neglected as the means of promoting economic development. To the contrary, we will explain in the following sections how the food and agriculture sector can play a significant role in promoting general economic development.

How the Food and Agriculture Sector Contributes to General Economic Development

The food and agriculture sector can contribute to general economic development in very positive ways if the development of the sector is based on the development of a capacity in research and extension to develop and deliver new production technology to the sector, and if economic policies are such as to promote the adoption of that new technology. It is useful to consider two distinct cases: the modernization of the subsistence or staple sector and the modernization of the export or import-competing sectors.

The subsistence or staple sector refers to the bundle of commodities that constitute the main food items for consumers. In most countries this includes such commodities as rice, maize, cassava, potatoes and other tubers, edible beans, and sorghums and millets. These commodities tend to be called *necessities* since they are so essential to providing the caloric intake of the consumer, especially the low-income consumer. An important feature of the conditions of demand for these commodities is that not only is the demand for them relatively unresponsive to increases in per capita income, but the quantity demanded is also relatively unresponsive to changes in their price. That is in part why they

are referred to as necessities. These commodities tend to be relatively important in the budget of low-income people.

Consider what happens when a new, yield-enhancing technology is introduced into the production of these commodities. This technological change will increase the supply of these commodities, a process which will continue as the adoption of the new techniques spreads among an ever-larger number of farmers. Because of the unresponsiveness of price to changes in supply, the price of the commodity will tend to decline. Such commodities tend not to be traded internationally by low-income countries, with the result that the price tends to be determined by conditions of domestic supply and demand.

This decline in price, although it will be disadvantageous to farmers who do not adopt the technology, has a very positive effect in the economy at large. The decline in price of an important staple constitutes an increase in the real income of the consumers who consume the staple. Although the increase in income for each consumer may be relatively modest, when summed over the entire economy, the total increase in income can be substantial. That is one of the reasons the social rate of income to investments in research that lead to new production technology tends to be so high.

There is another important feature of modernizing the production of subsistence or staple commodities. The benefits of the new technology tend to be distributed disproportionately in favor of the poor. That is because poor consumers tend to spend a larger share of their budget on food than do middle- or upper-income consumers.

This distribution of the benefits of economic development in favor of the poor is a very important characteristic of the development of agriculture from the introduction of a new production technology. In fact, one can identify no other sector of the economy that has this characteristic, nor for which the benefits are so widely distributed in the economy. The reader can gain insight into this by considering the distribution of benefits from developing an automobile industry or other goods and services whose demand expands more rapidly as per capita incomes rise. Relatively few people will be benefited, and they will tend to be the middle- and upper-income groups.

The benefits of modernizing the subsistence or staple sector does not stop there, however. The widespread increase in per capita incomes will generate an increase in demand for goods and services, the demand for which will increase in a relative way as those incomes rise. That increase in per capita incomes will induce an expansion of the nonfarm sector. Thus, the benefits of the modernization of agriculture will be spread to the rest of the economy in successive waves.

Now consider the introduction of a new production technology into the tradable sectors. There are two components to this sector—the export sectors and the sectors that compete with imports. The contributions of the modernization of each of these sectors are somewhat different, in large part because the demand for these commodities is substantially different than the demand for subsistence commodities. Because these tradable sectors are part of the interna-

tional economy, increases in supply have very little effect on the price of the commodity.

Although the benefits from the introduction of a new production technology into the sector are somewhat different, the modernization of these sectors can also be powerful sources of more general economic development. In the case of exportable commodities, farmers rather than domestic consumers will tend to receive a major share of the benefits of the new technology. The prices they receive will not decline, other things being equal, but they will have an increase in output due to the increase in productivity the new technology makes possible.

Although this will benefit the agricultural sector, it is not the end of the story. The increased productivity will make producers more competitive in international markets, and the increase in supply that the increase in productivity makes possible will, in turn, increase the volume of exports. The net effect will be an increase in foreign-exchange earnings. This increase in foreign-exchange earnings can be used to service foreign debt, or to finance a higher rate of economic growth. If the latter, the benefits will again be distributed rather widely in the economy, although not as widely as in the case of subsistence commodities. However, the new jobs that are created can have more widely felt spillover effects in the economy.

The effects of introducing a new production technology into import-competing commodities is basically the same, although with one important difference on the foreign-exchange side. Rather than increasing foreign-exchange earnings, in this case it saves them since the need for imports will decline. Those savings, however, can be used to service foreign debt or to finance a higher rate of economic growth in the same way as an increase in foreign-exchange earnings from an increase in exports can be used.

In conclusion, we can see that the development of agriculture through the introduction of a new production technology can be a powerful engine of economic growth. Its benefits will be widespread in the economy, generally in favor of low-income groups. Investments in agricultural research and extension to develop and distribute new production for farmers has a high social rate of return. In fact, extensive research has shown that these rates of return range all the way from 35 percent to over 100 percent. Those are handsome rates of return, especially when developing countries can borrow from the World Bank and other development agencies at rates of less than 10 percent. Distributing the benefits of economic development in favor of the poor also tends to be a goal of policymakers.

Food as a Wage Good

The allocation of development resources to the modernization of agriculture, and especially to the subsistence sector, also has more general positive benefits in the economy. Food constitutes an important wage good. Workers tend to spend a large share of their budget on food. Thus, the decline in the price of

food results in an increase in the real wage rate for workers so long as the nominal wage does not change.

It is useful to think about the consequences of this in the context of the need for an economy to remain competitive in the international arena. Two factors tend to play significant roles in shaping international competitiveness: the real exchange rate for the nation's currency and the cost of labor, which is determined by both the wage rate and the productivity of the labor.

Let's for present purposes focus on the cost of labor. One can think about it from two different perspectives. First, with food prices declining, the nominal wage can decline with no reduction in the real wage. This will help the country to be more competitive in the international economy. The effects of this can be widespread in the economy, thus increasing foreign exchange earnings and helping to finance a higher rate of economic growth.

Second, the nominal wage rate can stay the same, with the result that the real wage will increase in the domestic economy. In this case, workers will be benefited with higher real wages instead of through increased employment.

How the benefits from the modernization of agriculture are distributed under these two circumstances will be very different. Which of the two scenarios is realized, or whether it is some combination of the two, will depend on the competitiveness of the economy as a whole and the competitiveness of the labor markets themselves.

In any case, the role of food as a wage good is another important means by which the modernization of agriculture—by the introduction of a new technology into the sector—can contribute to the general development of the economy as a whole.

An Opportunity

The developing countries have an important opportunity to earn increased foreign exchange if they are willing to modernize their agriculture. The current situation is that comparative advantage is shifting in the international economy, with the advantage for agriculture shifting to the developed countries.

The reason for this shift is that the developed countries have the installed capacity for agricultural research and thus can continue to produce a steady stream of technology for that sector. For the most part, however, the developing countries lack such capacity. What they have to their advantage is that the technology for the manufacturing sector can be readily transferred to their economies, in contrast to agricultural technology. In addition, over recent decades the developing countries have been increasing their level of general education, which makes it possible for them to adopt new technologies from abroad for their labor-intensive manufacturing sectors.

The issue that is likely to emerge in the future is that the continued growth in the world's population and the potential for increases in per capita incomes in the developing countries makes it likely that the demand for food will be

strong in the future. The issue of whether the developed countries will be able to meet this increased demand is open. If they cannot, developing countries that begin today to develop their capacity for agriculture will be able to capitalize on the agricultural markets of the future.

Concluding Comments

To conclude this paper, it is useful to return to a point made near the beginning. It is true that a country should want to see its agriculture become an ever-smaller part of the general economy. That is in effect the mark of a developed economy since it indicates that most of the productive capacity of the economy is being used to produce the goods and services associated with higher levels of per capita incomes.

The issue is how to bring that transformation about in an efficient and equitable manner. The implications of the analysis contained herein is that the way to do it is to invest in modernizing the agricultural sector. Agriculture can be the engine or driving force for general economic development, with the social rate of return from investments to this end having a very high payoff, while the benefits of the development are distributed in favor of the poor.

The modernization of agriculture requires, critically, the development of a vital agricultural research and extension system, the education of the rural population, and the access by farmers to modern inputs such as fertilizer and pesticides at reasonable prices. It also requires favorable economic policies that provide the incentives for farmers to adopt new technologies.

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