PN-ABE-785

Agricultural Growth, Technological Progress, and Rural Poverty

Nurul Islam

Reprinted from *Strengthening the Poor: What Have We Learned?*, ed. by John P. Lewis (New Brunswick, N.J.: Transaction Books in cooperation with the Overseas Development Council, 1988)

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036 U.S.A.

Reprint No. 138

Chapter 6

Agricultural Growth, Technological Progress, and Rural Poverty

Nurul Islam

How do the pace and the pattern of agricultural growth affect poverty? Are there ways in which an agricultural growth strategy can be designed to have a positive impact on poverty?

Theoretical and empirical analysis has led to divergent answers to these questions. Much depends on the nature of technological progress and its diffusion among different groups of farmers, on its impact on the growth of income and productivity, as well as on the initial conditions under which the growth process is initiated—particularly the distribution of assets, especially land. Frequently, access to land as well as to fixed and working capital for financing modern inputs is unequal, as is access to education, training, and research. For growth to reduce poverty and promote equity, the access to all of these factors must be widely diffused. In many countries, experience with the direct redistribution of assets, particularly land, and with public measures directing inputs or resources to poor farmers, has not been very promising. The political and administrative obstacles in the way of direct assaults on poverty are very substantial. This enhances the importance of the poverty-alleviating effects of the growth process itself. To the extent that the latter are positive, the need for a more direct redistribution of assets for poverty-alleviating measures may be less urgent.

In fact, it is advisable to pursue efforts on both fronts—that is, to a) maximize the so-called "trickle-down" effect of growth on poverty while b) undertaking direct poverty-alleviating measures. An appropriate balance between the two is needed so that, in the long run, direct

poverty-alleviating measures do not adversely affect the savings, investment, and technological progress that contribute to growth.

Direct Effects of Growth on Poverty

Technology

The biological and chemical innovations that have generated most of the rapid growth in Third World agriculture have been scale-neutral in terms of cost per unit. Technologically speaking, therefore, big farmers do not enjoy a differential advantage because of economies of scale. Mechanical innovations, however, have tended to be capital-using and labor-displacing, especially when incentive structures and macroeconomic policies lower the relative cost of capital below its opportunity costs—either because of a subsidized interest rate policy, or because of overvalued exchange rates (where capital equipment comes from abroad). This affects the poor adversely, since most of the poor are either wage-labor or sharecroppers.

Yet not *all* mechanization has a net adverse effect on employment. In some instances, mechanization reduces the time required for land preparation and harvesting, and it increases cropping intensity and hence labor requirements and employment. Even if labor input per unit of output declines, larger output increases the net volume of employment. This is apart from the indirect employment generation in the manufacture, maintenance, and repair of equipment.

The direct poverty-alleviating impact of technological progress depends on a) how far it spreads to the small farmers, sharecroppers, or tenants and b) how much it increases the employment of the rural poor. Empirical evidence to date confirms that technology *has* spread, though with a time lag, to the small farmers and sharecroppers, who are usually more risk-averse and hence wait until after the income-augmenting effects of new technology are well demonstrated. However, for the spread to occur, two obvious requirements are that high-yielding modern inputs be plentifully available and that infrastructure (i.e., a road and transportation system for the marketing and distribution of improved inputs as well as training, education, and extension facilities) likewise be widely available. Another matter of high priority is the development—through adaptive and region-specific research—of new technologies suitable for diverse agro-ecological conditions, (e.g., differing water, soil, and climatic conditions). In the past, technological progress has often been confined to principal cereals—for example, wheat, rice, maize—and to regions well endowed with irrigation potential and good quality soil, bypassing poor or rain fed soils and so-called "inferior" crops such as sorghum, millet, and roots and tubers, etc. Yet

the agro-ecologically disadvantaged regions are often very poor; poor farmers are also often found to be producing traditional crops that have scarcely benefited from yield-increasing technological innovations. In addition, in contrast to the high-yielding varieties of wheat and rice, those improved crop varieties that reduce dependence on purchased inputs generally facilitate easier access to new technology, and its faster adoption, by resource-poor small farmers with limited access to credit. Examples are drought-tolerant or pest- and disease-resistant crop varieties, short-maturing varieties that increase cropping intensity, and the biological fixation of nitrogen. These and similar technological innovations enable a rapid increase in the productivity and income of small farmers and thus tend to reduce the conflict between growth and equity and poverty alleviation.

Credit

How effectively do the poor participate in the market mechanism so that they can gain fully from the benefits of technological progress? Especially relevant in this context is the access of the poor farmers to the markets for credit, labor, inputs, and outputs.

Rural credit markets are inadequately developed, fragmented, and fraught with imperfections. Nor are there adequate institutions for the mobilization of rural savings, or profitable investment opportunities for such savings—due partly to lack of information or knowledge as well as of transport and communications infrastructure, and partly to the discriminatory pricing and exchange rate policies that depress returns to agricultural investment.

The risks and uncertainties of providing small farmers access to the credit market are frequently overestimated by private lenders; tenants, sharecroppers, and small farmers either lack secure title to land or do not own sufficient land to serve as collateral for loans. Furthermore, the transaction costs of dispensing and supervising small loans are very high, thus limiting the access of small cultivators to institutional sources of credit.

Delinking credit from the ownership of land as collateral has been tried in a very limited way; the uncertainties of crop failure on the one hand, and of price fluctuations on the other, increase the risk of default and constrain the supply of crop-based loans. Public measures designed to reduce, insure against, or compensate for the price fluctuations can lower the risks for credit institutions—but they involve budgetary costs. Similarly, public subsidy of credit agencies can offset the high costs of small loans—but likewise cost budget money. On the other hand, innovative credit schemes based on group lending or group guarantee by borrowers have contributed to the reduction of both the risks and administrative costs.

Experience to date indicates, however, that what is important is not a low or a subsidized rate of interest but access to an elastic supply of loanable funds. Small farmers have demonstrated their ability not only to pay high rates of interest but also to repay on time. What is needed is vigorous competition in the provision of credit through a multiplicity of lenders, both public and private. The credit market is often interlinked with the markets for land and for output; landowners and traders are frequently moneylenders. Different credit institutions developed through public initiative, growth of marketing intermediaries, and possible institutional change in the land structure—all of these will help increase competition in the credit market, delink the different factor markets, and widen opportunities for small farmers. No less important are legal procedures and institutions for the enforcement of contracts; their weaknesses have adversely affected the viability of credit institutions.

Markets for Outputs and Inputs

In the markets in which they sell and buy commodities, small farmers suffer from a relative disadvantage vis-à-vis big farmers. Often, small farmers with limited resources to hold stocks must sell immediately after harvest at a price lower than the annual average price or the price that prevails later in the year; they buy later in the year, when prices are higher, to meet their own consumption needs. In remote or distant regions, they either receive lower output prices, or pay higher prices for inputs because of high costs of transportation, marketing, and distribution. Furthermore, when inputs are in short supply and there are few suppliers—often public distribution agencies—small farmers are likely to lose out, since big farmers with higher status in the power structure have greater access to the public distribution system.[1] Hence what is necessary in a crucial sense is an abundant supply of inputs and credit, as well as a strengthened marketing system to expand and stabilize supplies over time, especially to meet the seasonal variations in requirements of inputs and credit.

Innovation, Employment, and Poverty

The impact of accelerated agricultural growth on rural labor through increased employment and/or an upward pressure on real wages depends on the pattern of growth, including the composition of output and the choice of techniques, as briefly mentioned earlier. In many developing countries, a high rate of growth in population, and therefore in the rural labor force, tends to exceed growth in employment opportunities. The labor market is frequently fragmented or imperfect, with the result that few employers, sometimes acting as both traders and/or

creditors, can choose from among a large number of workers seeking employment. Frequently, wages are determined by convention, old habits, or family links. Big landowners often prefer to employ workers known personally to them, and about whose availability, especially at times of peak seasonal demand, they feel sure. Personal contacts and family links influence employment and wages, promote preferential treatment for those within rather than outside a village, and constrain inter-village mobility and employment opportunities, both short and long run. Two factors can help strengthen workers' participation in the market. First, education can improve the perception of alternative opportunities and encourage mobility of labor; it can also enhance awareness of workers' rights and help farmers to organize and build bargaining strength. Second, employment opportunities in the non-farm sector, including urban employment, improve the relative wages of rural labor.

Technological progress requires a careful husbanding and application of modern inputs and increases the use of labor in such operations as land preparation, transplanting, weeding and harvesting, etc. In many instances, small farmers, sharecroppers, or tenants make more intensive use of modern inputs, i.e., higher inputs of fertilizer, modern seeds, and water per acre than do large farmers, at least in the long run, and produce a greater output per acre—even though they frequently pay higher prices for inputs and high interest rates for credit. They maximize net returns (net of purchased inputs) per unit of land by driving down the marginal product of labor to a level at which the average income of the family (total product divided by numbers of family members) is adequate to provide an acceptable subsistence wage. Moreover, with tenants or sharecroppers competing for very scarce land, tenancy arrangements with landlords are likely to involve very intensive use of inputs, especially when the owners share a part of costs and sometimes also provide credit. Higher output per acre can compensate for higher per acre application of purchased inputs and still leave net income per acre at a level higher than that obtained on large farms.[2]

Technological progress in agriculture can have different employment effects, depending on the size of the farms involved. From the point of view of very poor or landless laborers, employment opportunities tend to be positively related to the share of middle or large farmers in the expansion of output; with increased income, these better-off farmers tend to reduce their own rate of participation in the labor force and to hire additional labor. Conversely, small farmers meet increased requirements for labor by working more hours themselves. Therefore the interests of small farmers and those of landless laborers without access to non-farm employment opportunities do not coincide.

The concentration of technological progress on small farms alone may not expand the wage-employment opportunities of the landless as much as if landowners, especially the middle farmers, also participate in technological progress. This may imply, however, that income distribution in fact worsens as the rich gain proportionally more than the poor, while the absolute condition of the poor improves.

Indirect Effects of Growth on Poverty

Technological change in agriculture has indirect effects of two kinds on the alleviation of poverty. The first is the impact of technological change on the supply of food and on its relative price and, consequently, on real wages and employment in both the agricultural and non-agricultural sectors. The second is the multiplier effect on income and employment in the non-agricultural sectors set in motion by the increase in agricultural production and income. Both of these indirect effects are greater if the gainers in the first instance include many not-so-poor middle farmers. But the direct effect on poverty is greater if the beneficiaries in the first instance are exclusively the poor, especially the smallest farmers and landless laborers.

Growth Patterns, Food Supplies, and Prices

The effect of increased agricultural production on domestic food prices depends on how closed or open the economy is to international trade. In an open economy, domestic prices will be equal to world prices, whereas in a closed economy, variations in domestic production will affect the domestic price. In reality, the economies in developing countries are in an intermediate position; they are neither completely closed nor totally open to international trade. Domestic prices diverge from world prices due to tariffs and quantitative restrictions on exports and imports. For a commodity that is domestically produced and partly imported under tariffs, the domestic price is higher than the world price by the amount of the tariff. The domestic price falls when the shift in supply function or increase in productivity is large enough to cause domestic supply at the prevailing price to exceed domestic demand. The new domestic price, however, may remain at a level higher than the world price. There will still be no imports at that price; tariffs remain prohibitive. But with a further increase in productivity and a shift in the supply function, the domestic price may fall to the level of the world price, and the country may change from importer to exporter status.

The domestic price can be lower than the world price either because there is an export tax, the incidence of which falls fully or

partially on the exporter, or because consumers pay subsidized prices that are implemented either through public procurement of domestic output at less than world prices or through subsidies on imports. With an export tax, an increase in productivity and a shift in the supply function would not affect the domestic price. In the second case, what happens to the domestic price depends on the government price policy: It can let prices fall below the previously fixed prices to match the reduction in cost while subsidies are maintained, or it can abolish subsidies, keeping prices unchanged. If the cost reduction is large enough, it can reduce both price and subsidies.

The higher the rate of growth in marketable surplus in relation to demand, the greater the decline in the relative price of food—insulated partially or fully from the world market. The magnitude of the marketable surplus depends not only on the rate of growth in food production, but also on how the increase in production is distributed among different categories of farmers. Medium and large farms have a higher ratio of marketable surplus to output than do small farms. If the increase in food output is generated largely by small farms, this will result in a small marketable surplus. Small farmers have high income elasticity of food demand: they may frequently have a larger family size and a greater dependency ratio. Accordingly, an increase in output on the small farms tends to be consumed by the farmers themselves. If, on the other hand, a substantial increase in food production is provided by a very few large producers, then the fall in price is likely to be so large as to discourage production and detract from the favorable effects on employment and income flowing from increased production by large farmers. This is because the market demand for food will be constrained in the absence of an adequate increase in income of the small farmers, who are far more numerous. There has, therefore, to be an appropriate balance in the distribution of increased output among the different categories of farmers so that a fall in price resulting from an increase in output is not so severe as to discourage production.

The indirect favorable impact on food prices is most likely to be realized if the increase in production takes place mainly among the middle and small farmers, but not *only* among small farmers. In many countries, governments intervene to stabilize farmers' prices or to support minimum prices through buffer stock operations. The politically vocal or organized large and middle farmers may exercise pressure to support prices at levels that allow farmers—especially big farmers—to reap excess profits from cost-reducing innovations rather than pass them on to the consumers. The optimum policy therefore calls for allowing prices to fall to an extent that maintains producers' incentives while conferring benefits on the net purchasers of food. Given the differential impact of technological progress on different

categories of farmers, or different farm sizes, a steep decline in price may reduce the net income of the small farmers who, at least in the early stages of the diffusion of new technology, do not benefit, or do not benefit adequately, from cost-reducing innovations. Thus the price of progress may be that, initially, the pioneers or the early innovators earn excess profits.

Low food prices resulting from cost-reducing innovations directly improve the real income of the poor, who are the net purchasers of food.[3] By making available a large supply of the principal wage good—food—at a stable and low price, technological progress in food production facilitates the adoption of an employment-based development strategy, especially in the non-farm sector. Otherwise, as employment and income of the poor expand, given their high income elasticity of demand for food, a rapid increase in food demand is likely to put an upward pressure on food prices.

Furthermore, a fall in food prices improves the terms of trade of the non-farm, industrial sector and tends to lower wages in the non-farm sector and to encourage labor-intensive industrialization and the substitution of labor for capital in various processes and products. Thus food price declines also enhance the competitiveness of labor-intensive products in the world market and thus promote exports, which in turn adds further stimulus to the expansion of output and employment in the non-farm sector.

The role of marketing, distribution, and transaction costs in the movement of food from rural producers to urban consumers is crucial. An increase in such costs would offset the cheapening effects of technological progress on the relative price of food.

Intersectoral Linkages

Increased agricultural output and income have a multiplier effect on income and employment. There are certain linkages within the agricultural sector itself: For example, an expansion of income in staple food or cereal production leads to a higher percentage being spent on horticulture and livestock products. When carried out on small farms—as they are in many developing countries—these activities are labor-intensive and help expand employment and income of the poor.

An increase in agricultural production affects the rest of the economy via intersectoral linkages. On the one hand, it leads to increased demand for inputs such as fertilizers, pesticides, irrigation equipment, and other tools and implements; on the other hand, it stimulates demand for processing, marketing, and distribution of agricultural output. Empirical evidence suggests that the forward linkages (i.e., marketing, distribution, and processing, etc.) of agricultural products

provide a much stronger linkage than the backward linkages (i.e., expanded use of production inputs). More important than the production linkages are the consumption linkages—stemming from the expenditure of incremental agricultural income on non-agricultural goods and services—produced in both rural and urban/semi-urban areas.[4] These linkages include the stimulation of not only a wide variety of manufactured consumer goods, but also trade and other services; they are frequently highly labor-intensive. The employment-creating role of small and cottage industries has received much attention. But the role of rural trade and services (which include housing, education, health, transportation, and personal services, etc.) as a source of employment and income for the poor has not been sufficiently recognized.

The growing demand for non-agricultural goods and services (upon which, of course, employment expansion depends) must originate primarily from agricultural growth, especially the expenditures of middle and large farmers who devote larger shares of their income gains to non-farm, labor-intensive goods and services. The expenditure patterns of very small farmers, who spend a higher proportion of incremental income on food than on non-food items, provide a weak intersectoral linkage. Wherever the middle farmers are numerous, their absolute aggregate expenditure on non-food items is often as great, if not greater than, the aggregate expenditures of a larger number of small farmers. Starting from this large base, the fact that middle farmers channel higher percentages of whatever increments on income they get into expenditures on non-food items provides a strong stimulus for the non-farm sector's output and employment. In Malaysia, a study in which the largest farm size covered was 15–20 hectares showed that middle farmers (defined as those from the fourth through the seventh deciles in terms of farm size) spent 63–66 per cent of their incremental income on non-farm goods and services in 1972–73. Of the non-farm goods, about three-fifths were produced locally and two-fifths came from outside the region. In Africa, the shares of incremental income that medium-size farmers spent on non-farm goods and services were lower, i.e., 24 per cent in 1976–77; those on locally produced goods and services were about 11 per cent. But the incremental income shares spent on livestock and horticultural products, which were also highly labor-intensive and locally produced, were higher—as high as 30 per cent. In Bangladesh, the shares spent by middle farmers on non-farm goods and services were about 25–30 per cent.

The expansion of the non-farm sector in the rural areas provides employment and income for the rural poor; this, in turn, creates additional demand for food as well as non-food commodities, thus setting in train successive rounds of income and employment expansion. In Ma-

laysia, an increase of $10 in agricultural income was associated with an increase of $8 in rural non-farm income; in India, a 10-per-cent increase in agricultural employment was estimated to lead to a 10 to 13-per-cent increase in non-farm employment.[5]

However, the consumption expenditure patterns of the richest or largest farmers do not have strong positive interlinkages for income and employment expansion in the non-farm sector. First, the propensity of these farmers to spend on *imported* goods is high—constituting a leakage from the domestic multiplier effect. Second, the saving propensity of these farmers is also high and constitutes a leakage from the consumption expenditure stream. It is true, of course, that if these savings are invested in labor-intensive activities, whether rural or urban, they have positive employment effects. Nevertheless, the net leakages tend to be greater than in the case of the medium farmers, whose consumption patterns are more domestically oriented.

The demand pull provided by agricultural growth needs to be matched by an elastic supply response from the non-farm sector. A few preconditions need to be met if the rural non-farm sector is to respond strongly and positively to the stimulus provided by increased expenditures by the farm sector. Most important among these is the availability of physical infrastructure—a road and transport system, a communications system, rural credit to finance both current and investment costs of non-farm activities, as well as education, extension, and training relating to non-farm activities. The role of government policy in either directly providing—or stimulating the private sector to provide—these prerequisites is crucial.

Conclusion

Targeting rural technologies and public investments on small farms leads to immediate gains in equity and production—although not necessarily to gains for the landless or for marginal farmers, who cannot respond by expanding output. If the focus is exclusively on *small* farms, the indirect impact on growth in income and employment through the expenditure multiplier is not likely to be as high as it would be if the increase in production largely took place in the first instance on middle-size farms. Focus on *middle-size* farms, on the other hand, may have a high multiplier effect on growth, with a favorable impact on absolute poverty—but at the cost of worsening the relative distribution of rural incomes.

Therefore, there is a trade-off between growth and equity or poverty alleviation; a balance needs to be struck by targeting technology and investment on a broader range of farm-size groups, including *both*

small and medium farms. The degree of absolute poverty initially, the relative distribution of farm sizes, and the urgency of immediate action to relieve poverty will all affect the appropriate policy choices.

Notes

[1] Mahabub Hossain, "Fertilizer Consumption, Pricing, and Foodgrain Production in Bangladesh," in Bruce Stone, ed., *Fertilizer Pricing Policy in Bangladesh* (Washington, D.C.: International Food Policy Research Institute and Bangladesh Institute of Development Studies, 1987).

[2] Michael Lipton and Richard Longhurst, "Labor and the MVs," and "Putting Together the MV-Poverty Mystery," in *Modern Varieties, International Agricultural Research, and the Poor*," Consultative Group on International Agricultural Research, Study Paper No. 2 (Washington, D.C.: The World Bank, 1985), pp. 49–64 and 87–100.

[3] John W. Mellor and Gunvant M. Desai, "Agricultural Change and Rural Poverty: A Synthesis," in *Agricultural Change and Rural Poverty: Variations on a Theme by Dharm Narain* (Baltimore, Md.: The Johns Hopkins University Press, 1985), pp. 192–199; and John W. Mellor, "Food Price Policy and Income Distribution in Low-Income Countries," *Economic Development and Cultural Change*, Vol. 27, No. 1, October 1978, pp. 25–26.

[4] Steve Haggblade, Peter Hazell, and James Brown, "Farm/Non-Farm Linkages in Rural Sub-Saharan Africa: Empirical Evidence and Policy Implications" (unpublished discussion paper, Agricultural and Rural Development Department, The World Bank, May 1987), pp. 113–125; and Peter Hazell and Ailsa Roell, *Rural Growth Linkages: Household Expenditure and Patterns in Malaysia and Nigeria*, Research Report No. 41 (Washington, D.C.: International Food Policy Research Institute, September 1983), p. 12.

[5] Hazell and Roell, ibid., p. 12; Steve Haggblade et al., ibid., pp. 113–125.