

SUSTAINABLE AGRICULTURAL DEVELOPMENT: THE ROLE OF INTERNATIONAL COOPERATION

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INTRODUCTION

Although we do not intend to deal with the economic role of government in detail some preliminary points are worth mentioning. The tradition stemming from Adam Smith considers intervention as unwise: it causes distortions and is not Pareto enhancing. Furthermore, the government does not always contribute to economic stabilization, improve resource allocation or favour income distribution. Concessions are made in the case of public goods including education, defence, research and law and order, and in the management of macro-economic policy, though intervention should be conducted within clearly established rules limiting the discretionary power of the fiscal and monetary authorities. A similar position is held in respect of strategic policies influencing international trade. Free trade should not be restricted, since that would contribute to loss of global and national welfare. All of these issues, however, are still the subject of intense debate which is far from being settled.

The literature on market failure covers such issues as market imperfection, incomplete markets and information, externalities, public goods and returns to scale. It can be cast in the rigorous tradition of Arrow and Debreu, and include propositions suggesting that policy can be Pareto enhancing. It has also been argued that instances of market failure are the rule rather than the exception (Stiglitz, 1989). So far as public goods are concerned, analysis can be much more complicated. Recent theoretical discussion (Hurwicz and Walter, 1990) has suggested that conditions can exist in which it is impossible to reach Pareto optimality in the provision of public goods. To do so requires that participants in an economic system can be separated into groups across which there are no potentially conflicting interests. In trade analysis there is debate about market imperfections and economies of scale which is often based on game theory (Brander, 1986; Helpman and Krugman, 1986). It has been suggested that strategic policies exist in which the income of a country can be improved and maintained without generating major retaliation.

Given the complexity of debate it is far from easy to be confident that simple rules apply in any situation. It can be suggested, however, that in the developing world there are important externalities which have not been internalized by the private sector. These include information processing, research and development, and education. There are also important issues relating to

*Alves and Contini, Embrapa; de Faro, Vargas Foundation; Brazil.

bias against agriculture, and to trade, in which a government role can be considered. It is stressed that we believe that any intervention should not involve the use of parastatal organizations, which have generally been ineffective.

Furthermore, it must be borne in mind that government action is not costless, and that it can become more expensive as it increases in size and scope. That is one of the implications of the theories of rent seeking through interest group collective action, and of bureaucratic behaviour (Krueger, 1990; Olson, 1971; Tullock, 1965). These stress that potentially Parento-enhancing intervention may have a perverse side, which can be the rule rather than the exception. Government can be more subject than the private sector to problems of imperfect information and incomplete markets; the redistributive and allocative roles of the government give rise to inequities, even when the primary goal is to improve income distribution; corruption and rent-seeking activities are wasteful and weaken people's faith in democracy; and bureaucracy, which sprouts the larger the share of government in the income of the country, contributes to waste of resources. Moreover, there is lack of continuity between current and future governments, and government is slow in adjusting to a changing world; the tendency is to maintain old programmes that are supported by powerful rent-seeking groups. Finally, incentives do not work well within the government, because of lack of competition (Stiglitz, 1989a).

In addition to the above, the services provided by government tend to be provided to most, if not all. Its activities generate rent seeking and, since it is heterogeneous and represents different groups of society, there is great temptation to extend the range of benefits (Krueger 1990). The pressures of insiders and outsiders lead to an increase in expenditures, which is usually financed by inflationary means. (Fishlow, 1990).

The debate on government intervention has focused on polar points: intervention or free competition. But intervention has history. In general, it is a major crisis which brings about conditions favourable to the cause of interest groups. It may be a long period of stagnation or a very skewed income distribution, a major recession or a war, or it may be compensating measures in retaliation to policies of other countries. Such examples are frequently well documented, but there is much less literature dealing with the conditions favouring the elimination or reduction of governmental intervention.

The recent events in East Europe, the results of theoretical and empirical literature, and the postwar experience of policy making have raised strong waves in favour of the free-market model. The developing countries are on the verge of reforming their macro-economic policies, and particularly their agricultural policies. The reforms cannot succeed without symmetric reforms in the policies of the advanced countries that are detrimental to the interests of the developing ones, because of the great and ever-increasing interdependence of the world economy. Without dwelling any further on this theme, we would like to stress that agricultural policies have been used by the developed countries as a weapon in their strategic trade policies. This is a well-known difficulty that has hindered negotiations in favour of free trade (Alston *et al.*, 1990).

Does this mean that there is no role for government intervention, specifically, in our context, in the case of agriculture? We believe that there is a role, although it is important to draw the boundaries with care. The areas most commonly agreed upon are research and development; policies that create a fertile environment for innovation and change of attitudes; sound macro-economic policies; education and health; and infrastructure investments. There is also a place for some strategic policies to foster the development of agriculture (these include policies dealing with prices, exports, and credit), but they should identify the beneficiaries, they should be based upon non-inflationary financing and clearly indicate the cost-return to society, and they should have a well defined time-span. In short, they should pass the test of transparency in every respect.

THE CYCLES OF STRATEGIC POLICIES

To understand the cycles of strategic policies which have affected farming we have to distinguish between modern and traditional agriculture. Traditional agriculture itself supplies most of its inputs, and decision making occurs in the countryside. Modern agriculture buys most of its inputs from industry and the decision-making centres are urban. Traditional agriculture is labour- and land-based. Modern agriculture is science- and industry-based. The two types share a common name – agriculture – but they have markedly different characteristics.

At the time of the repeal of the Corn Laws in Britain, industry was fighting a senile agriculture which was protected from trade competition. The common interests in free trade of both consumers and industry were obvious. They joined forces and the Corn Laws were repealed. Agriculture lost the battle of the Corn Laws because its political rents became much smaller than the industrial ones, and because the many farmers and landowners were less organized. In the postwar period, modern agriculture has flourished in the advanced countries, and more recently in some countries of the developing world. It holds strong links with agribusiness. Protection to agribusiness and to modern agriculture is essentially the same. Modern agriculture, in itself, is an activity with low barriers to entry, because every farmer is free to modernize and the investments required are not especially large. Protection encourages large-scale entry, and consequently the dissipation of the political rents is very intensive. Agribusiness, however, has higher barriers to entry and therefore enjoys the necessary power to maintain trade barriers for a very long period. Its oligopsonic organization facilitates the ‘collection’ from farmers of the money needed to finance lobby activities or to enhance the political rents, whenever necessary.

In the 1930s, many developed countries were large importers of agricultural products. It was modern agriculture, even though it was less developed than it is now, which was able to organize a strong lobby and secure protection. This also occurred in the United States. It was against that background that strategic policies were put to work to advance modern technology at a very fast pace. The infant-industry argument can also be used to explain why modern

agriculture was protected in the early 1950s. The European countries, in particular, were protecting farming from the competition of land-rich countries, at that time mainly the United States, Canada, Australia and Argentina. It is clear that some measures were introduced to compensate for what others were doing.

It is not difficult to explain why traditional agriculture remains so characteristic of the under-developed world. All activities pass through a life cycle of development from the traditional to the modern. In the case of Third World agriculture this is occurring only with difficulty. In the past there was often assistance for specialized export crops, but as the fashion for industrialization spread it was more common to find that agriculture was discriminated against. The aim was to transfer resources to the urban sectors. Modern agriculture could only develop, if at all, against the background of that discrimination. This does not mean that the development intention was absent; there have been numerous programmes aimed at disseminating new techniques. The problem has been that farmers are numerous, and they do not all have the potential to modernize. However, it is particularly difficult to pursue policies which are selective and which exclude backward farmers and backward regions. There can be beneficiaries among larger farmers who are better placed to take advantage of programme allocations. This accounts for some countries having made progress in creating a modern sector. However, it is expensive especially when attempts are made to spread benefits thinly to many potential participants. The effort can fail for lack of finance. Often the emphasis has had to be shifted from modernization to poverty alleviation, which, though obviously commendable in itself, does not foster progress.

In the past, the rural aristocracy established some forms of protection for agriculture of the developing countries, mainly in the export sector. That was the first phase. The second phase came when industrialization policies became more important, and it was then that agriculture was severely discriminated against. Within this phase, the need was felt initially to increase the supply of agricultural products, and the modern sector did receive some encouragement, though it often proved to be short-lived and gave way to less favourable policies. The final phase, whatever it may be, has often yet to be reached. It may be one in which adverse discrimination is eliminated, or it could witness some movement towards protectionism.

With the advent of industrial policies in developing countries it was basically traditional agriculture which was discriminated against, and analysts, by not making a clear distinction between old and modern forms, failed to understand the strategic policies that were introduced to advance up-to-date technology. Such policies would have had to achieve two goals. One was to maintain the discrimination against agriculture in order to transfer resources to the industrial sector; the other was to stimulate modern agriculture.

In an environment characterized by a large number of farmers, only a minority of whom would have the potential to modernize, strategic policies would need to be selective. Furthermore, they would have to compensate for the discrimination against the sector. Obviously the compensation would need to be directed to those able to modernize their farming practices, and would require built-in rules which would not allow the unfit to apply for the benefits

of programmes for modern agriculture. In other words, the policies would have to exclude backward farmers (and maybe regions), but to do so in such a way that it would not convey the idea of outright discrimination. As a rule, the medium and larger farmers would become the main beneficiaries. They have a higher level of literacy, better titles to land from the legal point of view, and are normally located in regions with more infrastructure.

The main tools of policy include rural credit, investment in infrastructure in progressive regions, irrigation programmes, research for some groups of crops and regions, promotion of special export policies for processed agricultural products which are mainly cultivated in advanced regions or by advanced farmers, and tax advantages such as income tax exemptions or land tax abatement on account of increased productivity. In some countries policies of this type have succeeded in creating a powerful modern sector within agriculture, while agriculture was simultaneously transferring substantial amounts of resources to industry. Often, however, such a set of policy measures could not be maintained for a long period. Some countries abandoned them half way, before a sufficiently large segment of agriculture was modernized, and before the transformed sector was able to supply most of the needs of agricultural products. In other cases, strategic policies were extended to almost everybody, at great cost, and sometimes with larger farmers being excluded. The basic goals of programmes shifted towards poverty alleviation.

SOME POLICY SUGGESTIONS

The following discussion of the policy suggestions will not be exhaustive and will pinpoint only some aspects. There is no pretension to design a complete programme of policy reform. Emphasis is given to long-run sources of growth. The issue is not whether government should intervene, but what it should undertake and what it should avoid.

The secular decline of agriculture as per capita income grows has been known for a long time. Its share in the national income and employment declines, and the value added outside the farm gate increases continuously because of activities such as transport, processing, storage and modern input production. The decision-making centre shifts gradually to the cities. Either the position of the rich countries, which try to avoid the secular decline of agriculture, is mistaken, or that may apply to the developing countries which are accelerating relative decline (Knudsen *et al.*, 1990).

Education and technology

It is common in democratic societies for the equity principle to lead the state to generate policies that are compatible with the interest of the majority. If a large part of the population is illiterate, technology may appear to need to be simple, and there is a temptation to follow this route, selecting agriculture as a sector in which traditional technology is to be used. It may be an apparently logical choice, since farmers tend to be the group having the weakest levels of

education. In our view, however, this is an 'nth' best solution, where 'n' is very large. Interest groups which advocate such a stance, although they may have majority support, may nevertheless themselves be backward.

Lack of modernization in agriculture is known to have sad implications for the growth of the economy. The sectoral differential of income grows with the lack of farm modernization, worsening the sector's income situation, and eventually provoking a flood of rural migrants into the cities. Slums and urban violence are the most visible effects.

A more theoretical argument may be mentioned. The literature on human capital has stressed the spillover effect of investment in education, and the appearance of strong positive externalities (Schultz, 1987). Suppose that we have a production function, applicable to industry, with two inputs, labour and capital. Investments in education make the hypothesis of diminishing returns implausible (Lucas, 1988). The marginal product of capital may well be an increasing function within some range of the production function. The implication is that the rate of profit will not decrease in the industrial sector with the increase of the amount of capital, because of investment in education among those living in the cities. While the rural sector is kept backward and discriminated against in human capital investment, the only avenue left open for the convergence of incomes is the labour market, operating through the migration process. Since the illiteracy rate of rural labour is very high, the migrants are cast into the informal sector, or into the sectors that pay lower wages. This is a mechanism which creates slum conditions and generates urban violence. Income distribution in the cities grows worse.

Thus the basic 'solution' worsens income distribution in general, favours discrimination against agriculture (it is much easier to discriminate against a backward sector), and postpones investments in elementary education to a much later date. Initially, the modern sector requires higher-educated people, and so the universities are privileged. Only at a much later period, when the mass of illiterates flowing to the cities becomes a burden to society, is elementary education seen as a priority. Lack of investment in education, as a consequence of the power of backward interest groups over the government, retards the development of democracy, jeopardizes birth control programmes and is a major impediment to a favourable atmosphere for modernization. Programmes such as rural extension, agrarian reform and irrigation become unproductive. It is utopian to believe that illiterate farmers can modernize their enterprises; the scarce factor in modern agriculture is human capital.

Proposing the use of 'intermediate technology' is also an excuse for not investing in education, and a wasteful excuse at that. It is part of the process which generates jobs for city people with a diploma in agrarian sciences. A cursory examination of the size of the extension, irrigation, and rural-credit bureaucracy that is directed at working with small farmers suffices for proof. The term 'intermediate' technology, seems to imply that in an environment where land is scarce relative to labour (the price of land is increasing relative to that of labour), any new production function should have a higher level of marginal product of land than that of labour for every point of the function, in comparison with the older one. Furthermore, the land-saving inputs are divided into two groups. Group 1 refers to simple technologies, while group 2

refers to complex technologies with respect to the cultural background of the population, so that the same relationship between the marginal products of the two production functions must hold globally.

The global properties of the new production function (in comparison with the older one), or more specifically the bias in favour of technologies that are appropriate to the farmers who are illiterate or have a low level of instruction, gives too much scope to bureaucracy and politicians. The priority setting becomes too bureaucratic and dominated by ideology. The chances for individual freedom and creativity shrink. The fundamental need to create new technology is neglected. The market and the intuition of scientists are underrated. Scientists of high calibre tend to be discriminated against if they disagree with the dominant group. It also seems to imply that society is not going to invest in education.

The egalitarian ideology which claims that the sons of the well-to-do must go to the same schools as the sons of the poor, suggestive as it may be, has resulted in the poor staying without schools and public money supporting the education of the rich. The adverse-selection mechanisms of the public school, as regards location and student selection, should be eliminated. The private sector should be stimulated to invest in elementary education too.

To conclude, we consider it wrong to deny modern technology to those working in the rural sector because farmers are illiterate. What should be done is to eliminate illiteracy. This means that education, and most of all elementary education, should be treated as the number-one strategic policy. We also consider it wrong to deprive the rural sector of modern agriculture only because a small proportion can adopt it. It would be better to select a group for modernization and raise a tax on the surplus generated to invest in education. Health policy is also very important, but its effectiveness is low if illiteracy rates are high.

Research

No one questions the fact that research should be a priority in agricultural policy. But lack of (or inadequate) patent laws have kept the private sector out of agricultural research. In an environment without competition, public research has no basis on which to measure its efficiency. Private research saves the public budget for areas that are riskier. Competition improves the efficiency of the public system, and cooperation with private research enhances productivity on both sides.

Public research is now subjected to ideological pressures to give priority to research in intermediate and no-modern-input technologies, and also very pressed by environmental questions. This severely limits the creativity of the researchers. There is nothing wrong with pressures on researchers. The trouble is caused by ideological and political demands that are derived from them. In general they address short-run problems that may not be relevant, but if they are not introduced in the research agenda the odds are higher for a budget cut. It would then be advisable for public research to separate the programme into two areas: one for intermediate technology and environmental research to

attend political demands and help the transition to modern agriculture, and the other to support advanced agriculture.

Research is intensive in the use of talented and well-trained manpower. There is a very competitive international market in which it is very difficult for the public institutions of low-income countries to compete. The state is subjected to equity rules which limit wages in the public sector (Stiglitz, 1989). Even if it were possible to establish an exception for research, the odds would be for an increase in the number of politically protected scientists in the ranks of the institutions. There are ways out of this problem. Farmer associations may be allowed to collect tax on some products to do research on them, and the public sector may contract the associations for some projects. Private enterprises, including foreign companies, may also be given special conditions to carry out research. The donor community may be of temporary help, and the international centres have a great contribution to offer.

Infrastructure

Another important area for government intervention is the road network to link farm people to the rest of the economy. This helps to eliminate the barriers separating farm people from city life, brings down the cost of food, and makes farm resources more productive. Also important are investments in means of communication such as radio, telephone and mail delivery. Low-cost transportation and communication increase the chances for a better life for both city and rural people.

Credit

The modernization of agriculture requires investment in areas such as farm machinery, irrigation, infrastructure, soil recuperation and conservation, and pasture. Most of the resources comes through the loan market, be it private or government, formal or informal.

Loans are an exchange of funds by one party with another for a promise of a future return. Loan contracts are heterogeneous, with different probabilities of default. Lending institutions are therefore subjected to restrictions imposed by an environment of incomplete markets and incomplete information. They have to perform the roles of collecting funds, allocating them and monitoring the loan applicants. Thus there are costs of collecting information, screening applicants and monitoring them. The costs tend to be lower for larger loans, higher when the applicants are scattered over an extensive area, and even higher when ignorance about the state of nature is greater. Farmers, especially the small ones, are at a low point on the list. When there is need for credit rationing (and there always is), they are the first to be screened out. In the developing world there are two additional factors: discrimination against agriculture makes it riskier, and the legal weakness of titles to land limits the ability of farmers to offer them as collateral. That is why it is justifiable for government to take action in order to legalize property rights to land.

Banks may prefer to ration credit on a non-price basis rather than increasing the rate of interest (Stiglitz and Weiss, 1981). The selection procedures are based on characteristics associated with relatively low risk. Farmers operate in an environment in which the states of nature are less known or subjected to a larger variation. Thus they may receive less credit from the private sector, and proportionately even less when the aggregate supply of funds declines.

To overcome such problems rural-credit institutions are often established. In the same country one may find public and private institutions lending money according to the rules of the system. One of the means of reducing the risk to the lending institutions is an insurance on outstanding loans, the cost of which is borne by society, at least partially. Sometimes technical assistance is required, which may be paid by the farmers or by government.

Rural credit may be used to provide subsidies to farmers who have great potential to modernize. When a large part of the population is illiterate, located far from bank facilities, and title to land does not exist or is of poor legal status, self-selection or adverse-selection mechanisms tend to appear. Even when the government sets strict rules for both types of banks, they do not always follow them. When they adhere to the small farm segment, it is to benefit farmers who offer less risk. The private bank system offers much more resistance to working with small farmers, because of the cost of searching for information, screening and of monitoring. The laws protect small farmers, and obtaining repayment of a loan can become a complicated legal operation that may create a bad image with public opinion. To induce private banks to finance small farmers is costly to the treasury. The trouble is that the same may happen to public banks. They may induce small farmers into risky operations to be agreeable to them, because they know the treasury will take responsibility for any failure. Generally, however, if it is decided to provide credit to small farmers, there may be no alternative other than the public banks.

If they are likely to lose money on lending to benefit small farmers, one can be sure that adverse selection will be the rule, as is the case of private banks. The wages of bank employees depend on the profitability of the institution, and it is the same with public banks. Why would the institution take the risk of losing money, when it could otherwise gain?

Subsidized credit is a large part of the cost of government programmes to compensate farmers for losses which economic policies impose on agriculture. In this sense, it is a second-best solution. But there is an additional problem, for it induces farmers to cross the line of safe behaviour and take advantage of subsidies since they know that repayment of loans will not be demanded. The experiences of both advanced and developing countries are full of examples in which large numbers of farmers cannot service their debts. The answer to this problem cannot be sought through the credit system; the first-best solution is to remove the underlying distortions which are so characteristic of agricultural policies.

The subsidies incurred are frequently financed by printing money. Rural credit then becomes an important source of inflation. This is a side-effect to add to the distortions of resource allocation and income distribution caused by the subsidization of rural credit. If the monetary authorities push up the

interest rate as a means of fighting inflation, then the difference between the interest rate charged to farmers and the market interest rate becomes very large. The treasury authorities would need to cover the difference by non-inflationary means, which is self-defeating: the larger the difference between the two interest rates, the larger the demand of farmers for loans. Credit rationing, which is the compromise solution, is difficult to implement.

Banks monitor their clients to be sure that they follow the contracts agreed upon. But if government becomes liable to cover losses, the monitoring function weakens or may disappear. If there is an insurance on the loans, and government is liable for losses, the same will be true. Whatever method is employed to reduce the costs of rural credit to a comparable basis with other sectors of the economy, the final result is to weaken the monitoring function and to induce farmers to borrow less than wisely.

The scale of farming

It is common to raise the question of whether small farmers are more efficient than larger operators. Both theoretically and empirically, the answer is ambiguous (Binswanger and Elgin, 1989; Stiglitz, 1974). But if the distribution of literacy is bimodal, with a large number of illiterate small farmers, and the medium and larger farmers have a greater degree of literacy, then the latter group is better prepared for modern technology. If that is more profitable, literate farmers will spring ahead on the road to modernization. Income distribution will worsen in rural areas. Some policy makers believe that one should block the advancement of agriculture, or at least that its speed should be reduced, while others argue that the group with potential should be stimulated, if necessary, with subsidies. Without specifying the conditions of the environment, it is difficult to decide on the relative merits of these opposing views. It is, however, very difficult to accept policy measures which may eventually block modernization. There is nevertheless a correct answer: investment in education.

CONCLUSIONS

A summary of the positive roles of government in agrarian reform includes the following points: eliminate the adverse-selection mechanisms within economic policies; improve or reform the law to stimulate sharecropping and land renting; impose a progressive land tax on unproductive land; establish long-term credit to help small farmers to acquire land; and let the farmers' associations manage agrarian reform projects. An extensive discussion of this controversial subject can be found in Binswanger and Elgin (1989).

The view that all government intervention in price mechanisms have negative consequences is well known. For instance, theoretical and empirical literature stresses the high cost for farmers and society of policies such as an over-valued exchange rate, tariffs to protect industry or agriculture, quantitative barriers, voluntary restraints, ceiling prices on wage goods, outright pro-

hibitions on exporting some products or importing requisites, subsidized credit and unsound macro-economic policies. Also well known are the negative effects of the protection which is given by the developed countries to their agriculture, disregarding both their consumers and the farmers of the Third World and distorting world trade (Knudsen *et al.*, 1990).

Nevertheless, governments cannot be denied the role of counterbalancing significant actions of other governments to protect their agriculture or to counterbalance large fluctuations of the world economy. The tit-for-tat type of strategy, however understandable, is a major stumbling-block to free trade and to the reform of the agricultural policies of both developed and developing countries. Every country may not see any advantage in moving towards free trade and a free market economy. These demand good will and cooperation, at least, of the major producers and importers of agricultural products.

The major point in the paper is the need to remove from the economic policies of the Third World the strong bias against investing in rural people, and especially in their education and health. If investments in rural people are not made, either agriculture will not develop or, if it succeeds in advancing, a mass of poor people will be left behind, with sad implications for income distribution, urban unrest and political instability. Investments are highly recommended in research, extension, infrastructure, and in activities that create a general atmosphere which favours innovations. The distortions which act upon agriculture and the adverse-selection mechanisms of economic policies must be eliminated. If for some reason the government intervenes in the price mechanism, the policies must be absolutely transparent, and have a short life span.

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DISCUSSION OPENING – JULIO HERNÁNDEZ-ESTRADA*

Alves, de Faro and Contini argue in their paper that it is necessary to remove bias against investment in rural people from Third World economic policies, especially in education and health. If this kind of investment is neglected, agriculture will not develop, and this could worsen intersectoral and intrasectoral income distribution and might cause urban unrest and political instability.

Although the authors' conclusions are valid, it would also be appropriate to urge that economic and agricultural policy reforms in Third World countries be accompanied by similar changes among industrial countries, in order for the poorer countries to be successful in reaching their social, political and economic goals.

The paper pointed out that the secular decline of agriculture as per capita income grows means that agriculture's share in national income and employment also declines, while value added outside the farm gate increases continuously owing to the growing complexity of the processes involved. The richest countries are trying to avoid secular decline of agriculture and the poorest countries are accelerating the process, because they need to produce more manufactured goods. The authors indicated that both policies are misguided. However, international trade in the last two decades has favoured manufactures. Between 1980 and 1987 alone the prices of 33 commodities (basically raw material exports such as copper, iron ore, timber, sugar, cotton and coffee) fell by 40 per cent on average, catching the Third World between the blades of rising debt and falling earnings.

Prospects for the world economy in the 1990s are very much at risk because of the massive balance of payments problems in the major industrial countries, which could result in trade war, and because of uncertainties about changes in the environment. A crisis in either case could sharply reduce the rate of private investment and therefore economic growth. A financial crisis was responsible for the severe depression of the 1930s and for the economic malaise of many developing countries in the 1980s. It is difficult to measure the impact of environmental changes on long-run growth prospects of the world economy since the issues are complex and the nature of the links are not yet understood. Many types of environmental problems cross national frontiers, so their resolution requires international agreements, without which they could be even more costly than a massive financial crisis.

Volatile exchange rates and interest rates are part of any realistic scenario for the 1990s. For example, a decline in the dollar's role as a major exchange

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vehicle could lead to increased financial volatility. The foreign exchange markets have certainly been subject to fluctuation since the late 1970s. In a world of reduced international credit, it has been difficult for the agricultural sectors of the Third World countries to transfer substantial amounts of resources to industry and at the same time create a powerful modern sector within agriculture. Against such an unfavourable background, the authors also stressed that it is utopian to believe that illiterate farmers can modernize their enterprises, especially when modern agriculture depends so much on investment in human capital. To add to that there are signs that land is also becoming scarce.

As we enter the 1990s, the world has little to celebrate on the food front. Between 1950 and 1984, farmers raised world grain output 2.6 fold, an increase that dwarfed the efforts of all previous generations combined. Since then, little progress has been made and the proportion of hungry and malnourished people has increased. Growth in world food output is being slowed by environmental degradation, a world-wide scarcity of cropland and irrigation water, and a diminishing response to use of additional chemical fertilizer. Soil erosion is slowly undermining the productivity of an estimated one-third of the world's cropland. Deforestation is leading to increased rainfall run-off and crop-destroying floods. Damage to crops from air pollution and acid rain can be seen in industrial and developing countries alike. Each year millions of hectares of cropland are lost, either because the land is so severely eroded that it is no longer worth ploughing, or because new homes, factories and highways are built on it. World-wide, the potential for profitably expanding cultivated area is limited. The global decline in grain area per person from 0.16 hectares in 1980 to an estimated 0.14 hectares in 1990 seems certain to continue. The prospect for expanding the world's gross irrigated area is hardly more promising, since it is now lagging behind population growth.

From the middle of the century, increasing use of chemical fertilizer has been the engine powering the growth in world food output. Between 1950 and 1989, world fertilizer use climbed from a meagre 14 million tons to an estimated 143 million tons. If for some reason fertilizer use was abruptly discontinued, world food output would probably plummet some 40 per cent or more. But rapid growth in fertilizer use has depended on the continued spread of high-yielding seeds as well as irrigated area. Once the new fertilizer-responsive varieties are planted on all suitable land, growth in fertilizer use also slows. Many developing countries are now experiencing diminishing returns in fertilizer use and, given its dependence on water availability, the reduced growth in irrigation is almost certain to affect fertilizer use as well.

Alves, de Faro and Contini argue that it is wrong to deny agriculture access to modern technology on the grounds that farmers are illiterate. I agree with that view, but I also contend that education and research must be major policy priorities. There are other contributors to agricultural growth but those two certainly appear to be crucial. A recent study by Frisvold and Lomax (1989) emphasizes the point. To give some examples, the average annual growth rate (1970–80) of agricultural total factor productivity was 0.31 per cent for Mexico, which was the lowest positive value for the selected countries. The highest rates were for Spain and Netherlands, with 4.01 and 3.22 per cent respec-

tively. In contrast, Peru had the poorest performance, with a negative rate of -2.66 per cent, and Pakistan was the second lowest at -1.43 per cent. The total factor productivity levels for 1980 setting USA equal to 100 were as follows: Israel 113.3, Belgium 106.5, Chile 31.9, Mexico 19.2 and India 15.9. In my view, this provides strong evidence that the ability of a country to develop and encourage adoption of new technologies is directly related to public investment in agricultural research and education. It is worth emphasizing that, in the past century, between 60 and 70 per cent of the improvement in living standards in high-income OECD countries can be explained by growth in labour productivity.

The developing countries do face different risks and opportunities from industrial countries. Most of them import new technologies, so their access to technology depends on the availability of the foreign exchange and external financing needed to import appropriate capital goods. Although the comparative advantage of developing countries remains in producing and exporting relatively labour-intensive products, some of them may have to move gradually towards a more capital-intensive strategy. Whatever their position, however, they must invest more heavily in human capital, to take advantage of the opportunities available to them.

In the 1990s, population (and the labour force) in the developing countries is expected to grow substantially faster (roughly 1.9 per cent a year) than in the industrial countries (roughly 0.5 per cent a year). This means that the developing countries on average must grow significantly faster than the industrial countries just to maintain their relative position in terms of real per capita income. To achieve higher growth, the developing countries must improve the level of efficiency of investment and raise the growth rate of labour productivity. It will not be easy, since the external debt problems which many developing countries face show that they are not well prepared, either financially or politically, to cope with major shocks of the kind which occurred in the 1970s and 1980s, including the sharp rise in energy prices and international interest rates. They now have the additional problem of environmental degradation to add to their problems.

REFERENCES

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