Links Between Technology, Agricultural Development, Economic Growth and Trade Creation

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John W. Mellor*

Abstract

This paper presents the argument that, for the most part, the recent successes in development in the Third World are a consequence of growth in the agricultural sector and that, to build on those successes, it is necessary to further promote growth through increased investment in agricultural technology. It is argued that technological change, and the agricultural research systems that lie behind it, increases the income of farmers and, consequently, their demand for labour-intensive, nonagricultural commodities. The poor, who spend a large part of incremental income on food, respond to the resulting increase in their employment and purchasing power by increasing their demand for food. The link between employment and food demand is shown to cause a significant increase in the demand for food imports in developing countries. This increase in imports from greater employment of the poor highlights the mutual benefits of agricultural growth in the Third World to both developing countries and developed countries which export basic food staples.

Introduction

THE dramatic turnaround in many countries from food deficits in the 1970s to food surpluses in the 1980s is evidence of the tremendous success in world agriculture in recent years. Global cereal stocks in the mid-1980s are now almost twice as large as in the mid-1970s. In 1985, real world cereal prices were down 30% from 1981, compared to an almost twofold increase between 1972 and 1974. At no time have the prospects for feeding the world's poor been so encouraging.

In recent years, there have been many successes in agriculture in developing countries as well. During the period 1961 to 1983, developing country production of major food crops grew at an average annual rate of 2.7% and consumption at an even faster rate of 3%, compared to a population growth rate of 2.5%.

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Yet, in spite of those successes, in spite of the abundance of food in the world, many countries in Africa, Asia and Latin America still face food deficits, not surpluses. More to the point, hunger and malnutrition continue to affect the lives of from one-half to one billion people in the Third World.

Given the abundance of food in some areas, particularly the developed countries, it might be tempting to suggest food trade alone as an answer to the world's continuing food problems. Shipping food from more developed surplus countries to still developing, deficit countries might seem to represent the easiest solution to the world's food problem.

However, the world food problem is not merely a physical distribution problem. More importantly, it is a problem of the distinct lack of purchasing power among the poor in many Third World countries. The poor in Africa, Asia and Latin America now lack the means to buy more food at any price. Redistribution of global food supplies through trade is, thus, an incomplete solution to the world food problem. Food trade between the developed and developing countries must be coupled with ef-

forts to raise the purchasing power of low-income people throughout the Third World.

This paper explores the links between poverty, agricultural development and commercial trade between developing and developed countries. Two interrelated themes will be discussed. The first is that in low-income countries, development, agriculture and research are inextricably intertwined. The second is that it is in the best interests of developed countries that are major exporters of agricultural commodities to form a partnership with low-income countries to promote the latter's agricultural development.

Toward a Successful Development Strategy

Any successful development strategy in the Third World should seek to increase the purchasing power of the poor. Necessary to this task is to create employment opportunities for the poor. In the past, two basic strategies have been put forward: (1) a capital-intensive strategy promoting rapid industrialisation as the source of overall growth; and (2) an agricultural-oriented strategy which stresses growth in rural, labour-intensive sectors as the primary engine of overall economic growth.

In general, capital-intensive strategies of development, exemplified by India's Second Five-Year Plan, do not lead to significant increases in employment. Instead, these strategies concentrate resources in large-scale industries, such as steel and heavy machinery, that are intended, but in practice fail, to maximise capital formation and economic growth. Capital-intensive strategies try to minimise employment in the short run to prevent increased consumption of wage (consumer) goods and the consequent diversion of resources away from high-growth capital goods production. Increases in employment are seen only as long-run consequences of the massive growth in capital. Because the supply of capital goods is believed to be the principal constraint to development, little need is seen for increasing agricultural production.

However, as employment grows and the purchasing power of the poor increases, they tend to spend a substantial part of that increased income on food. Elasticities of expenditure on food run as high as 0.62 to 1.06 for the poor in developing countries (Table 1). This increased demand from growth in employment of the poor requires greater supplies of food. If the role of food is neglected in the development process, increased prices will effectively reduce the real incomes of the poor and increase the real cost of labour. The supply of food is, therefore, a critical constraint to sustained growth in employment.

An agricultural strategy of development, on the other hand, promotes employment and increases the purchasing power of the poor through an emphasis on the production of labour-intensive wage goods, particularly food. Such a development strategy emphasises the widespread dissemination of yield-increasing technological change in agriculture. The sheer size of the agricultural sector in most developing countries, accounting for 40–80% of employment, ensures that technical change in that sector will have important macroeconomic implications. Increased agricultural production boosts domestic food supplies at the same time that it stimulates further rounds of employment growth in the service and urban sectors of the economy. Because of its output and employment linkage effects with the rest of the economy, agricultural growth helps raise access to food supplies for both the urban and rural poor.

Table 1 Food expenditure elasticities for low-income* families (source, Alderman 1986).

Country/Region	Urban	Rural
Sri Lanka	0.72	0.86
Thailand	0.62	0.65
Egypt	0.71	0.68
Sudan	0.74	0.84
Indonesia	0.88	0.98
Nigeria		
Funtua	n.a.	0.89
Gusau	n.a.	1.04
Malaysia		
Muda	n.a.	0.88
Brazil	0.83	0.83
Bangladesh	1.06	1.06

* Low income is defined as the average income of families that consume 1750–2000 calories per capita per day.

Impact of Technological Change

To grossly oversimplify a complex issue, the proper stimulus to increased agricultural production is improved agricultural technology which results in increasing factor productivity. These productivity gains provide a combination of increased profits to landowners, increased demand for labour and consumer benefits from lower prices. Growth of this kind produces a net increase in national income that serves as an important engine for driving the rest of the economy.

Higher prices, on the other hand, produce growth with decreasing factor productivity (due to classic diminishing returns), resulting in less and less output for additional levels of inputs. Of course, prices must be at profitable levels for the technology to be applied, and if governments have dictated prices downward they may well need to

reconsider such practices if technological change is to be fully effective.

In fact, in the past two decades higher crop yields from improved technology have become the main source of food production growth in the developing world. Between 1961 and 1980 output per hectare of major food crops in the developing world rose by 1.9% annually and accounted for more than 70% of total food production growth. Increases in harvested area, which averaged only 0.7% a year, contributed the other 30% of total production growth in the Third World (Paulino 1986).

The direct effect of technological change in agriculture is an increase in the incomes of landowning farmers. These farmers typically spend a large proportion of their new incomes on locally produced, nonagricultural goods and services such as textile products, transportation and health services, and housing. Production of these goods tends to be far more labour-intensive than in large-scale industry. As a result of the increased incomes of landowning farmers, the rural poor are provided with a wide range of new, nonagricultural employment opportunities.

The more far-reaching implications of increased agricultural production are the results of increased employment of the poor. Greater employment provides greater income, and effectively increases the poor's purchasing power, providing access to more food. The resulting increased demand for food and other nonagricultural goods provides strong, indirect multiplier effects which stimulate new rounds of growth in the economy as a whole. Inexpensive food from increased production helps keep labour costs down and, thus, encourages employment growth in the urban sectors of the economy. The result is a general increase in domestic demand for labour-intensive consumer goods.

Another favourable result of agricultural growth is the increase in foreign exchange earnings obtained both through increased production of exportable agricultural commodities and the growth in those labour-intensive industries in which developing countries possess a comparative advantage. Taiwan is a good example of a country which used an agricultural-oriented strategy of development to create small-scale manufacturing and industrial enterprises that could compete on the world market.

Of course, necessary to this process of agricultural development is the concurrent development of rural infrastructure. In many developing countries new rural roads, drainage systems and delivery systems are sorely needed. It is essential to provide farmers with access to irrigation and other inputs necessary for use with new technology and to provide them with access to markets for their increased output.

Food Imports and Stages of Development

The initial stages of development are marked by extreme poverty, high death rates and, therefore, low rates of population growth. The effective demand for food at these levels of income and population grows slowly, at a rate that can be met with more effort on a slightly expanded land base.

Later, as development occurs, the population growth rate increases and, more importantly, income begins to grow rapidly. These two forces, combined with the poor's high elasticity of expenditure on food, can produce a rate of increase in effective demand for food that far exceeds all but the most rapid rates of food production growth.

Many countries in a high-growth, medium-income stage of development, therefore, find it necessary to rely on food imports to meet a portion of their surging food demand. A close look at Figure 1 shows that increasing per capita income is the dynamic factor underlying the surge in food imports in the Third World. Between 1966 and

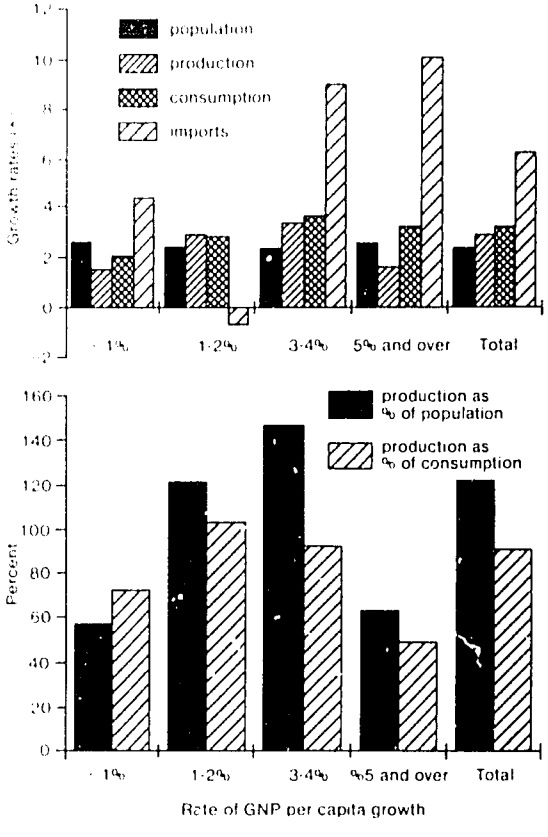

Fig. 1. Growth rates of population, staple food production, consumption and imports in developing countries, 1966-80 (adapted from Mellor and Adams (1986) and Paulino (1986)).

1980, in the fastest-growing countries (over 5% annual increase in GNP per capita), the rate of food consumption growth was over twice the rate of food production growth. Food imports increased at a 10% rate of annual growth for these countries. This is in part due to the inclusion of a number of oil-exporting countries in this fast-growth category. For all developing countries, however, across all levels of GNP growth, food imports still grew at an annual rate of 6.3%, while consumption grew at only 3%.

Even those countries with a high rate of technical progress in agriculture might not be able to meet their rates of growth in food demand. For example, the 24 countries with the fastest growth rates in basic food staples production between the periods 1961-65 and 1979-83 collectively increased their net imports of food staples by 419%, or by 9.6% annually. This level of increase of imports was necessary despite a 4.3% average annual growth rate of production of food staples (Table 2).

Finally, in the later stages of development, population growth rates decline and growth in income begins to have little effect on the demand for food. Meeting food demand becomes more manageable as food production growth rates become institutionalised at high levels. At this stage, food imports become unnecessary and agricultural surpluses begin to accrue.

Impact of Livestock Production on Imports

As income rises in developing countries, the relative character of food demand changes. Rising income causes food demand to shift to the more preferred cereals and to highly income-elastic livestock products. The latter, in particular, become

Table 2 Net imports of food staples in 24 countries with rapid growth in food staple production (source, FAO Production Data, 1961-1983).

	Net food staple imports (000 t)		Annual growth rate (%)	
	1961-65	1979-83	Net imports[a]	Production[b]
Colombia	161 728	681 091	8.3	4.2
Costa Rica	-4 422	-53 892	14.9	4.5
Cuba	947 768	2 079 589	4.5	4.0
El Salvador	92 146	179 499	3.8	4.1
Guatemala	54 837	95 041	3.1	3.3
Indonesia	871 641	1 759 489	4	3.8
Iran	243 639	3 332 452	15.6	4.0
Ivory Coast	54 638	487 363	12.9	3.4
Korea, Dem PR	153 851	215 3[illegible]0	1.9	4.3
Libya	117 219	731 082	10.7	4.2
Mexico	-374 846	5 986 181	—	3.8
Mongolia	-20 195	95 577	—	3.4
Pakistan	750 483	-342 655	—	4.6
Paraguay	69 145	58 366	-0.9	4.7
Philippines	656 305	934 539	2	4.7
Rwanda	-49	20 702	—	4.2
Sri Lanka	787 420	622 612	-1.3	4.6
Sudan	-232 128	-235 756	0.1	3.5
Surinam	-3 621	-60 525	16.9	6.4
Syria	-326 635	559 880	—	3.3
Tanzania	16 408	182 457	14.3	4.7
Thailand	-2 808 116	-10 680 672	7.7	4.3
Venezuela	589 144	2 629 198	8.7	3.3
Zimbabwe	-57 544	-247 743	8.4	3.3
Total	1 738 816	9 029 235	9.6	4.3

[a] Calculations based on mid-points of indicated periods.

[b] Trend growth from regression of the natural logarithm of the annual production values.

Note: Rapid growth countries are defined as those with greater than 3.25% growth in food production from 1961 to 1983. Excluded are China, because of biases in data in the early 1960s, and those countries with an average food production of less than 100 000 t/year from 1979 to 1983. Although there may be questions regarding the quality of national statistics in these countries, especially those in Africa, the trends reflected by their aggregate annual data on production and trade clearly indicate that net food imports of the group have increased much faster than food production.

increasingly important in consumption patterns. Evidence of this fact is the rapidly increasing rate of Third World meat consumption: between 1961–65 and 1973–77 meat consumption in the Third World grew at an average annual rate of 3.4%. As a result, developing countries have been rapidly expanding their imports of livestock products. Between 1961–65 and 1973–79, imports of meat products to developing countries have increased by 79% (Sarma and Yeung 1985).

However, since livestock is a labour-intensive enterprise, it is generally desirable for developing countries to displace these meat imports with domestic production. Accelerated growth of domestic livestock production would, in turn, stimulate the demand for food staples as feed for livestock. In many high-growth, medium-income developing countries, growing demand for livestock feed serves to accelerate the already high demand for cereals.

Projections

Simple trend projections to the year 2000 of basic food staples imports, including livestock feed, show incremental net imports reaching approximately 40 million t. If adjustments are made for increasing feed to livestock ratios from present levels, which are almost certain to occur, these projections could well increase by another 40 million t (Paulino 1986).

The developing countries are not likely to overcome their dependence on food imports for some time. A rough guess would place the necessary level of per capita income near $3000 before demand for imports would fall off. The phase of very rapid growth in import demand from developing countries could last for about 40–50 years. While exports from some developing countries, most notably Argentina and Thailand, have increased in recent years, their share in the overall export market is quite small and will continue to be so. Therefore, the bulk of increased food imports to developing countries will have to come from the developed countries.

Policy Implications

These increased imports mark the unity of interest between food exporters and those developing countries. On the one hand, food exporters are anxious to sell their products on the world market. On the other hand, the developing countries represent the only remaining growth market in the world for basic food staple exports. To ensure continued growth in that market, it is in the interest of the developed countries to nurture agricultural growth in developing countries. To do so, the following steps should be taken:

(1) Increase the purchasing power of the poor through growth in agricultural production brought on by technical change. This can be accomplished only through increased investment in agricultural research and extension in the developing world.

(2) Avoid investment in large-scale capital-intensive enterprises that drain agriculture and employment-intensive, nonagricultural industries of the little capital they need to increase employment. Capital-intensive intermediate goods such as fertilizer and steel and heavy machinery create little domestic employment and can be imported.

(3) Increase investment in rural infrastructure concurrently with increased investment in agricultural research. In many cases, food aid from developed countries will be necessary to undertake these efforts since the employment generated from public works programs on rural infrastructure increases short-term demand for food.

(4) Promote labour-intensive livestock production in developing countries. The potential increase in employment in this sector is extremely high. Again, increased production of livestock in developing countries contributes substantially to those countries' increased imports of basic food staples.

(5) Promote open markets for imports of grain and exports of labour-intensive industries in which developing countries have a comparative advantage.

Conclusion

Continued success in development requires an active partnership between the developing and the developed world. On the part of developing countries, the first priority is to recognise that increased employment and increased demand for food go hand in hand. An agricultural-oriented strategy of development is the best way to confront that fact. On the part of the developed countries, there must be a commitment to make available the technical and financial resources necessary to insure the success of an agricultural strategy of development. The result of such success could guarantee an adequate level of food for all the world's poor.

Acknowledgment

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References

Alderman, Harold. 1986. The Effect of Food Price and Income Changes on the Acquisition of Food by Low-Income Households. Washington, D.C.: International Food Policy Research Institute.

Mellor, J. W., and Adams, R. H. 1986. The New Political Economy of Food and Agricultural Development. Food Policy, 289–97.

Paulino, L. 1986. Food in the Third World: Past Trends and Projections to 2000. Research Report 52. Washington, D.C. International Food Policy Research Institute.

Sarma, J. S., and Yeung, P. 1985. Livestock Products in the Third World: Past Trends and Projections to 1990 and 2000. Research Report 49. Washington, D.C. International Food Policy Research Institute.

Comment on J. W. Mellor Paper

Heinz W. Arndt*

THIS paper admirably highlights the three propositions that form the core agenda of this seminar:

(1) Agricultural research can make a major contribution to growth of farm output and income in developing countries;

(2) Growth of food output in developing countries does not necessarily reduce food imports because in the earlier stages of development both the share of agriculture in GDP and the income elasticity of demand for food are high; and

(3) Therefore, concern among farmers in food-exporting countries, such as Australia, about agricultural research aid as a potential threat to their overseas markets is misplaced.

One can only applaud Mellor's authoritative and forceful statement of these three propositions. The fears he seeks to allay are one form of protectionist zero-sum-game thinking which it is the job of economists to counter.

There are, however, two aspects of Mellor's argumentation which I do not find entirely convincing.

The first relates to the evidence he advances for the broad proposition that rapid growth of food production in developing countries has in the last two decades increased rather than reduced their food imports. The statistical evidence is summarised in his Table 2. It purports to show relatively high growth rates of food imports for countries which, over the period 1961–83, have recorded the highest rates of growth of food production.

The data appear to confirm the correlation mainly for three categories of countries: (a) oil exporters (Iran, Libya, Mexico, Venezuela) which were able to use petrodollars to stimulate both food production and food imports; (b) 'basic-needs' oriented economies (Cuba, Mongolia, Tanzania) which become less self-sufficient in food while (if the data can be accepted as reliable) achieving relatively high rates of growth of food production; and (c) some small Latin American countries (Colombia, El Salvador, Guatemala).

Against this, there is weighty contrary evidence: (a) some of the largest food-deficit countries of the Third World have, thanks to the Green Revolution, achieved virtual self-sufficiency in food; India (not shown because it does not rank as a fast-growth food producer), Indonesia and the Philippines (which over the years shown appears to have experienced increased food imports but which has in fact become, on balance, self-sufficient), net importers in some years, net exporters in others; (b) the

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USSR and some other Comecon countries (not shown) whose increased dependence on food imports largely reflects poor agricultural performance; and (c) some countries (Thailand, Zimbabwe, Costa Rica) whose apparent high rate of growth of net food imports in fact records rapid growth of net food exports (negative net imports).

It would be foolish to use the table as evidence against John Mellor's broad case. He is clearly right in pointing out that agricultural growth does not necessarily reduce food imports. But neither does it necessarily increase them. Much depends on what is happening to growth in other sectors of the economy, to income distribution and to the commodity structure of agricultural production and trade.

This leads me straight to my second point, the relevance of Mellor's demonstration of probable growth of developing country demand for food to the world market prospects facing Australia's rural industries; for this relevance depends very much on the commodity patterns of Australian production and developing country demand.

Insofar as Mellor's argument refers to monsoon Asia, and increased developing country demand for food imports of rice, it is largely irrelevant to Australia which cannot significantly increase rice production (without causing severe salination problems in irrigation areas). Developing country demand for wheat and sugar could be more beneficial to Australia, but for neither commodity are developing countries the main importers, and for both world markets seem likely to be depressed by surpluses for some time to come.

Mellor emphasises the high income elasticity of demand in middle-income developing countries for protein foods, such as meat and dairy products, and urges them to meet this growing demand by expanding domestic livestock production which has the advantage of being highly labour-intensive, thus shifting import demand from outputs (meat, dairy products) to inputs (feedstuffs, especially cereals). Such a prescription, if it were followed (which does not in fact seem very likely in Southeast Asia where efforts to expand livestock production have not so far been very successful) would be a lot more encouraging to the USA with its huge potential for additional cereals production, than for Australia which has tended to think of growing East Asian demand for protein food as one of the most promising potential growth markets. It is also worth mentioning that the Australian industry in which fears of strengthening potential competition in export markets through export of technology, or aid in research, have been most strongly voiced is the wool industry, rather than any of the food-producing industries. But Mellor's argument, of course, applies as well to wool.

Let me conclude by repeating that these somewhat niggling comments are in no way intended to weaken John Mellor's case, with which I entirely agree.