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The Role of Natural Resources in Regional Agricultural Growth

INTRODUCTION

World food production increased 1.96 per cent per year during 1974–83 (Economic Research Service 1984). Population increased more slowly, 1.75 per cent per year. This resulted in an increase in food consumption per caput of 0.21 per cent per year. During the 1970s, the amount of cropland in the world increased 0.27 per cent per year (Urban and Vollrath 1984). If we use the measure of cropland as an indicator of natural resources used, this implies that the productivity of resources increased 1.69 per cent per year.

Some look at these trends with a sense that food production per caput is not rising fast enough and seek ways to accelerate it. And some look with a fear that food production per caput may decline; that the population may outrun the food supply. Beneath the trends is the relationship that the supply of food per caput increases with increasing resource availability and with increasing technology but decreases with increasing population. This relationship suggests three strategies for ensuring that food supplies per caput continue to increase and for averting a food crisis: reduce demand by slowing the rate of population growth, increase supply by increasing the rate of technological advance, and develop the natural resources.

These three strategies are supported by economic theory and by successful applications of the theory to regional and world food problems. This paper takes the position that the three strategies, while both empirically and theoretically correct, are inadequate because they oversimplify a many-sided problem. They do this in two ways. First, even when demand, resource availability/and technical advance are explicit in the analyses, other bases for growth are often omitted, such as regional variations and institutional arrangements. Second, the level of analysis is often too aggregative and thereby fails to consider resource or commodity substitution within any one of the heterogeneous categories, to consider changes in the structure of agriculture.

All too often, a single strategy is proposed to deal with a regional or world food crisis. One group may recommend: reduce the birth rate and limit population growth. Another says: develop the natural resources,

and conserve what we now have. And yet another proposes: introduce new technology. But economics tells us that a multidimensional problem requires a multidimensional solution, because one strategy may attain the goal defined in one of the dimensions, but it will probably widen the gap with respect to goals in other dimensions. Each basis for growth when taken alone as a basis for policy is found to bestow mixed blessings, but policies which bring into balance the several facets of agricultural growth can avert unintended side effects when dealing with future food crises. At the other extreme, the principle that everything is related to everything else can lead to multidimensional strategies so complicated that no-one can understand them, much less implement them. That will not do, either. In this paper, I emphasise two bases for agricultural growth in addition to the conventional demand, resource and technology bases. These are also found in the literature but do not receive as much attention as they deserve. The additional bases for growth are geographic and institutional. I also explore the benefits of further disaggregation within the heterogeneous categories. The objective of this paper is not to arrive at a new and more comprehensive growth theory, but rather to emphasise the multidimensional complexity of agricultural growth and to suggest some things one needs to think about as one tries to focus on the problem.

RESOURCE AVAILABILITY

The quantity of resources is considered the basis of growth by a number of economists; the idea is firmly embedded in the classical and neoclassical economic literature. Additions of land, labour and capital are what Kindleberger called 'the ingredients' of economic development.

Natural resources that are not reproducible are sometimes considered more important for growth than other resources. One can trace several threads in the literature on the role of natural resources in economic growth. One is the pessimistic view based on Malthus's concern that population is limited by the capacity to produce food, and that food is limited by diminishing returns to the fixed supply of land. Another is the optimistic view that the spectre of diminishing returns can continue to be sidestepped through science and innovation. A third view is one of silence and neglect: the role of natural resources has received little or no mention in several books, articles and models that purport to cover the field of economic growth.

The importance of natural resources relative to other farm inputs varies among regions and over time. Let me recount the experience in the United States during the past half century. The area of US cropland is about the same as it was 50 years ago, yet output has doubled. The potential to convert other lands to cropland has always been there, but during the past half century there was insufficient economic incentive to do so because there were other, more efficient ways to increase output. Production became more intensive on the same land area. Much of the expansion depended on irrigation of arid areas, but that is no longer a

major source of growth; the United States could double exports and feed its growing population during the next three decades without additional irrigation of arid areas but assisted instead by higher yielding varieties, supplemental irrigation in humid areas, double cropping, changes in management and ownership patterns, regional shifts in location of production, resource substitution, and institutional change. This is not to say there will be no resource problems; there will. But the emphasis appears to be on maintaining the resources now in use, conserving them, and replacing them as we can so that we are sure to have at least as much in several decades as now. The country is large, and losses in capacity in some regions probably can be offset by gains in others. The natural resource base is an important determinant of regional growth but a considerable amount of growth and change can be derived from a fixed resource base.

US farmers are using more purchased farm inputs and less labour than they were on about the same amount of land, although there has been a high degree of labour retention during the past decade. Output increases are associated not with more land and labour but with more purchased farm inputs. These purchases, in turn, are associated with new technology, and their supply is relatively elastic. As the added cost of using a scarce resource rises, other, less scarce resources are substituted for it. This principle of substitution is well understood in economic theory, but it is not well represented in most of the models economists use to describe and analyse prospective growth in food production because the models are too aggregated or because they assume fixed proportions. Lutton (1984) illustrates how important the principle of substitution can be in avoiding a food crisis.

TECHNOLOGY

Technology and innovation are often seen as the source of growth. Kaldor and Mirrlees (1962) captured the view of many, both in and out of economics, when they said 'technical progress ... is the main engine of economic growth'.

Among the benefits of technical advance are: increased income to the first farmers in a country to adopt successfully new ways of doing things; comparative advantage in international trade to the agricultural exporting country that develops and adopts new farming ideas; and the possibility of feeding more people from the same natural resources. But technology is not an unmixed blessing.' Cochrane said 'technological advances puts farmers on a treadmill' (1965, page 66).

Once enough farmers have adopted an output increasing practice and the produce is sold into inelastic markets, the increase in profits envisioned before the technology was adopted can be more than offset by falling prices received (Van Chantfort 1985). The long-run advantage is to the consumer who buys more food at a lower price, or to the natural resource owner who realises capital gains from rising resource values.

Technical advance can widen the gap between rich and poor regions by working to the disadvantage of those who continue to use traditional practices. It puts agriculture in a cost/price squeeze that hurts most those who do not adopt the new and more efficient techniques – even subsistence farmers eventually face higher opportunity costs for the resources they use. The widening gap has been observed both among nations and among regions within a nation (Todd and Simpson 1983).

Capital intensive technology is appropriate for some regions, including parts of the United States, but does not necessarily serve the needs of others (Fern and Cooke 1982). When high technology is inappropriate it is likely to inhibit economic development in the long run. It will be inappropriate, for example, if it is geared to large-scale production and the local region is suited to a smaller scale. It may fail to use indigenous resources. The multiplier benefits of inappropriately high technology are likely to ripple through economic space to other regions, not through geographic space within the region. It thereby induces leakages for imports of both production and consumption goods with the result of fewer domestic jobs and worsened balance of payments. It tends to skew the income distribution by helping some but not others. The products of 'high-tech' agriculture sometimes do not meet local needs, they are consumed by the local wealthy or are for export. There are social consequences to technical change – social disruption and institutional breakdown – that disenfranchise people both from production and from consumption. At the other extreme, appropriate technology is not necessarily 'low-tech'. For example low technologies are inappropriate which merely take advantage of low-wage labour and make the local region dependent on a distant place (Ndongko and Anyang 1981). The difficulties which accompany the loss of local control over natural resources are considered below in the section on regions.

While adoption of appropriate technology – whether high or low-tech – is an important determinant of agricultural growth, considerable growth and change can be generated in a region even when technology is held constant.

DEMAND

Expansion in the markets for the products of a region was an important aspect of the classical economic model, but it was never really understood as a basis for growth until Keynes set aside Say's Law and considered demand-side economics. Now, from a mixture of macro, micro, and regional economics we get several ideas about demand as a basis for economic growth; regions grow through mutual exchange based on comparative advantage; regions grow through income associated with export multipliers; regions grow through local inducements to autonomous demand as a result of, for example, expansionary monetary and fiscal policies; and regions grow through demand originating in a single, driving sector (or growth pole), which may or may not be agricultural.

A substantial portion of total growth in world food demand in coming decades will be associated with population growth in the rural sectors of the less developed countries (Schutjer, Stokes and Poindexter 1983). However, effective demand depends not only on population but also on purchasing power per caput. Regions with faster growing, lower-income populations tend to have food deficits while those with slower growing, higher-income populations tend to produce agricultural surpluses.

The development of natural resources has been found to affect not only the supply of but also the demand for food. Schutjer and others found that population fertility increases: with more access to land because larger families can lease and work larger farms; with less ownership of land because children substitute for land as a source of security; with less adoption of labour-saving technology because, again, larger families are needed to work larger farms; with more dependence on urban labour markets because some members of the family can bring in off-farm income while others care for the farm; and, with lower family income because another child is not looked upon as another mouth to feed in the short run, but as another source of family income in the long run. In this way, natural resource development can affect the demand for farm products by contributing to increased income per caput and to reduced population growth.

REGIONS

Siebert (1969) said, 'growth occurs in space; it is influenced by the spatial structure and it has a feedback upon the economic landscape'. There are severe food shortages in some regions while surpluses are produced in others. How a region and its agriculture grow depends on what kind of region it is and where it is relative to other regions.

The idea of regional analysis caught hold in many professions during the 1960s. In the United States, it resulted in several new agencies to implement social programmes. These agencies included the Economic Development Administration (EDA), the Appalachian Region Commission (ARC) and other regional commissions, and the Office of Economic Opportunity (OEO). The US Department of Agriculture applied regional analysis to its rural development programmes and regional ideas were introduced into political programmes: growth centres, growth poles, base multipliers, plant location and job creation in depressed areas, and trickle down progress, to name a few. But because of oversimplification of complex ideas and because of false political hopes, the enthusiasm for regional thinking waned during the 1970s and 1980s, at least among the easy converts. The regional agencies were either closed or scaled down. Fewer questions originating with programme administrators were addressed to regional analysts; fewer books and articles were written on regional economics; and fewer students enrolled in regional economics classes. Analysis of spaceless regions as trading partners continued to be important, but analysis of

geographic regions, with natural resource endowments that affected location and growth, slowed.

Let me give one example of how the oversimplification of valid and complex ideas in regional economics led to the unfortunate de-emphasis on regional analysis as a basis for public policy. The example is taken from Higgins (1983). Consider the idea of a growth pole. Growth poles are defined in economic space and innovation ripples through economic links that need not be spatially contiguous. Contrast this with the idea of a central place. The hierarchy of central places and their hinterlands is defined in geographic space. Economic change in the central place ripples through geographic links to places lower in the hierarchy and to the periphery or hinterland. Programmes based on a confusion of these two ideas can be expected to fail to attain their intended goals; the gains intended for the local hinterlands were received instead by distant central places.

Despite the loss of faith in the regional programmes of the 1960s, regional perspective on natural resource use and food production still makes a difference. Every economic event happens in some place and where it happens affects how it happens. Regional problems abound in agriculture with respect to access to markets, to natural resources, and to regional governments. Regional analysis still has much to say about growth, development, and progress. This applies both to less developed nations relative to more developed ones, and to less developed parts of either kind of nation (Todd and Simpson 1983).

There are two major threads weaving through regional economics: one focuses on the economics of the geographic location of an activity, the other on the influence of regionalisation on economic activity. Location economics, for example, explains the relocation of some corn production in the United States during the seventies. Export markets for corn were burgeoning and the Corn Belt was supplying all it efficiently could. The favourable prices induced increased corn production in the South where yields were lower but the location was closer to shipping ports. This had two effects on aggregate performance indicators: first, more corn was produced and shipped and farm income increased; second, efficiency appeared to lessen because average US yields decreased as output from the faster-growing but lower-yielding South was averaged in with output from the more stable but higher-yielding Corn Belt.

As an economy grows, each of its functional economic areas can be expected to grow (or decline) differently. Regional variations in natural features such as arable land, water, and shipping ports are enough to guarantee that. In addition a number of economic forces differentiate regions even when natural features are equal. Some of these forces are cohesive and lead to formation of central places and to urban-oriented functional economic areas. These cohesive forces include transportation costs, risk avoidance, economies of scale, externalities, and agglomerative efficiencies. Schultz pointed out that agriculture thrives when it is affected by these cohesive forces. Other forces are dispersive and lead to

formation of hinterlands to central places and to rural-oriented functional economic areas. These dispersive forces include access to scattered resources or markets, access to amenities, avoidance of high rent, diminishing returns, and personal preferences. The agriculture in such areas tends to be relatively extensive. The interplay among a diversity of regions helps to determine the growth of economic activities, including the production, distribution, and consumption of the world's food supply.

INSTITUTIONS

Group behaviour for setting regional goals and resolving conflicts creates an institutional framework that affects regional growth. North and Thomas (1973) said, 'efficient organization is the key to growth'. A number of economic situations call for explicit institution building. Among them are: 1 Competitive market forces may result in inequities and society becomes dissatisfied with the *status quo*. 2 The economy may not be converging on an equilibrium but may be observed, in fact, to be diverging. 3 Monopoly power may override competitive forces. 4 Uncertainty, or imperfect knowledge, may interfere with competitive choice. 5 Market failure may arise for public goods that are not distributable by the same institutions that distribute private goods. 6 Conflicts related to disagreements on goals and on distributive justice among individuals may not be resolved by market forces.

Henry George (1929, pp. 126–8) was one of the first to note that recognition of institutional arrangements explained a major difficulty in the Malthusian view. In reviewing Malthus's explanation of the Irish potato famine, George pointed out that in an earlier period there were only half as many people on the same land using the same technology of food production. They therefore had the capacity then to feed twice as many people as there were, yet they had a famine then also. George attributed the famine not to the limitations of land and technology, but to the institutional arrangements for distributing food. The landlords always took as much food from the tenants as they could, leaving the tenants close to subsistence. Under this arrangement, there was no incentive, says George, for a tenant to produce more than the minimum that would keep the landlord from evicting the tenant's family. One or two years of adverse weather would deplete reserves and induce famine regardless of the rate of population growth or of advance in resource productivity.

Institutional arrangements affect the allocation of natural resources among alternative uses. Bromley and Chapagain (1984) examine economic growth which involves moving community control functions from the hinterland to the central place. As a consequence, decisions affecting the hinterland no longer met local needs and objectives. They give the example of the nationalisation of all forest lands in Nepal in 1957. This upset centuries of traditional patterns of resource control and shifted control to the government from the village so that there were different

priorities, objectives, and means taken. Central policies threatened not only people but also natural resources. However, Barker (1984) questions whether the village can effectively control and manage resources. These authors disagree about what institutional arrangement is best, but they agree that an appropriate institutional arrangement is essential for using natural resources in the context of economic growth and change.

Growing regions need to compete successfully in open, interregional or world markets. These markets are expanding and provide a basis for growth for some regions. In general, the market institutions are not free. They incorporate non-price barriers and government intervention. Government intervention can be intermittent and is subject to policy reversals. Consequently, government intervention has become a major source of price volatility in international food markets. Market volatility induces risk-averse farmers to curtail production. This decreases the supply of food, influences the allocation of natural resources, and reduces the use of productive capacity. As a region grows, exposure to markets adds risks not experienced by farmers in a self-sufficient agriculture. These risks are increased when the country becomes an open economy dependent on world markets. Shortrun concerns for productivity and income that overlook longrun concerns for stability and sustainability do not serve the needs of farmers; particularly smaller farmers (Johnson 1984).

Even when farmers' commodity markets function competitively, their factor markets may not. For example, allocation of water among various farm and nonfarm uses in the United States is determined by laws, regulations, and customs affecting water rights, and the resulting institutional allocation of water among alternative uses is different than would obtain under free markets. Institutions need to be developed to share risk and to help regions grow.

STRUCTURE

Global and regional analyses tend to focus on aggregates. We talk about numbers of people without reference to changes in the demographic composition of the population. We talk about food consumption without distinguishing crop products from livestock products. We talk about the level of resource use without distinguishing among land, labour, and capital resources. We talk about area of cropland without reference to changes in soil quality, or to regional location of land development relative to land retirement.

Changes within heterogeneous aggregates can be important in understanding and dealing with food problems. Natural resource limitations can induce substitution of other inputs. Food shortages can induce changes in the mix and location of commodities consumed. Increases in production from a given quantity of cropland are different when farms are increasing in size and concentration, as they were in the United States after the Second World War, than when the size and

distribution are relatively stable, as they have been during the past decade. Changes within the aggregates can be more important than changes of the aggregate levels in explaining changes in performance of the farm sector.

Changes in productivity are usually associated with technology. At the firm level, this is a natural way to think about productivity. However, in aggregate analysis, measures of productivity can change even when technology does not. The measures change when the proportions of farms in alternative technological situations change. For example, changes in the commodity mix toward more livestock and less crop production tends to increase aggregate measures of productivity even though technology does not change in either enterprise because of the higher input requirements per unit of crop output. More high yielding wheat on irrigated land in Arizona increases the national average wheat yield even though technology does not change either in Arizona or Kansas. Corn yields in the United States are higher on larger farms than on smaller ones, and on farms with a higher volume of sales. Tenant and part owner farms have higher yields than full owner farms. Incorporated farms have higher yields than unincorporated ones. Farm operators between the ages of 35 to 44 have higher yields than those who are older or younger. And farms specialising in cash grain production have higher grain yields than farms in other industrial classifications. The flow of output and income for the farm sector is, in part, a function of structure, of the composition of the aggregates. Highly aggregated models fail to describe or explain adequately the interplay of natural resources, technology and demand with other factors affecting regional agricultural growth.

CONCLUSIONS

World and regional food problems are multidimensional. Too often, the proposed solutions are one-dimensional. One group calls for conservation and development of natural resources. Another promotes invention and dissemination of new technology. A third seeks decrease in demand for food through population control. Each view has sound theoretical and empirical support and each has been found workable for specific situations. Yet each oversimplifies. However, even reconciling and co-ordinating the views of all three could still result in oversimplification because there are yet other, less frequently heard dimensions to the problem. Agricultural enterprises can relocate among regions, or induce modifications in the structure and character of the region in which they are located, as limits are approached within existing regional patterns. New institutions, including government policies and trade relations, can change limits to growth. Agriculture is a flexible and resilient industry which, when it approaches a limit to growth, can, through resource and product substitution, or through regional and institutional change, grow in a new direction. It can continue to grow on a fixed natural resource

base by substituting reproducible resources for non-reproducible ones. There is a great diversity of agriculture beneath the aggregate indices we usually examine, a diversity of people, places, resources, and technical and social ways of doing things. Changes beneath the aggregates are recognised in aggregative models as changes in the structure of the farm sector. Food crises continue to occur. Perhaps we can discover better ways to deal with them if we can find ways to incorporate structural changes in regional and institutional patterns into the more usual analyses of markets, technology and natural resources to describe and explain world and regional food problems.

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