Population Growth and Agriculture in Poor Countries: A Review of Theoretical Issues and Empirical Evidence

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Summary. — The paper contributes a critical survey of the very extensive literature dealing with various aspects of the economic and institutional responses of agriculture to population growth in poor countries, encompassing a discussion of the main underlying theoretical issues. Such responses are evaluated in the framework of the general population-development debate.

The main conclusion is that, although population growth induces adjustments in agriculture, in terms of technical progress, intensification, and definition of property rights, optimism may not be justified in the context of very fast population growth and/or already high densities, especially when the environmental resource base is taken into account. © 1997 Elsevier Science Ltd

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1. POPULATION GROWTH AND ECONOMIC DEVELOPMENT: THE FRAMEWORK

The debate concerning the linkages between population growth and economic development has seen a variety of positions over time and from it several specialized fields have developed. There is, however, a unifying feature among most of the studies: a common reference to the neoclassical growth model and its conclusion that rapid population growth, by lowering capital/labor ratios (an effect often referred to as “resource shallowing” or “capital widening”) reduces the level (but not the growth rate) of per capita income. Such deep influence is not surprising, since the Solow model has dominated economists’ thinking about growth for a long time.1 Optimists, pessimists and “revisionists” — as the literature on the subject often labels more recent, less clear-cut positions (Birdsall, 1988; Kelly, 1988) — basically differ in the extent of their belief in population-induced adjustment mechanisms, both in the economic and the institutional sphere.

It is therefore worthwhile to recall those conclusions of the Solow model (Solow, 1956 and Solow, 1987) which are relevant to the population and economic development debate: (a) an increase in the population growth rate has a negative, resource shallowing effect that depresses the level of per capita income (although we should see no correlation between the long-term growth rates in per capita income and those of population2); (b) since the propensity to save also has a positive impact on the level of per capita income, it becomes important to determine the influence of the population growth rate on the fraction of income saved; (c) even if the later introduction of exogenous technical progress into the neoclassical model makes it possible to explain the growth of capital/output ratios and labor productivity, it does not modify conclusion (a); this conclusion would instead be modified if there were a link between population growth and technical progress, that is to say by endogenous, population-driven, technical progress.3

While earlier studies tended to associate the capital shallowing effect with what was called the “burden of dependency” on savings and drew very pessimistic conclusions about the impact of high population growth on economic development (Coale and Hoover, 1958), more recent discussions have led to less clear-cut positions.4

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The relationship between savings, technical progress and population growth has been extensively discussed. Although a review of such discussion at the general level is outside the scope of this paper, it should be noted that, as will be shown in the next paragraph, the presence of population-driven technological progress has been most convincingly proved in the agricultural sector. As for savings, the literature has evolved from the simple recognition of a negative effect of high dependency rates on household savings to life-cycle type of evaluations, where the net effect of population growth on savings depends on the balance between the positive effect of a high proportion of young workers (savers) to retirees (dissavers) and the negative effect of high dependency rates. Evidence does not provide clear support for the view that high population growth rates have a negative effect on savings in developing countries, although the World Bank suggests that such an effect does exist, even if it is not revealed by national accounts (Kelley, 1988; Mason, 1989; World Bank, 1984).

"Revisionism," however, rests not just on specific issues but on a general confidence that in the long run (with properly functioning markets) demographic shifts will be reflected in relative price changes and will trigger market and institutional adjustments. In this sense, there is a strong affinity with the neoclassical economic historians' idea that institutional change in history is guided mainly by relative price changes, as property rights tend to become better defined for the more expensive factor. Both population-induced technical progress and the response of institutions to population growth will be discussed here, in the context of poor countries' agriculture.

2. POPULATION GROWTH AND AGRICULTURE IN POOR COUNTRIES: MALTHUS, BOSERUP AND THE INDUCED INNOVATION MODEL

Do the population-agricultural development links in poor countries offer good grounds for population optimism? There are many issues to be considered in order to be able to examine this question, but certainly four are essential: the relationship between demographic growth and population pressure on land, the impact of population growth on food production and on agricultural incomes, and the evolution of property rights on land.

If population growth is associated with decreasing land to labor ratios, a possible pessimistic scenario entails not just lower agricultural incomes, but also landlessness. The resulting wage-labor supply increase and the increased factor share of land then translate into lower real wages. Population growth may not imply the lowering of land to labor ratios if the land frontier can be expanded or if labor absorption in the non agricultural sector is fast (or substantial migration outlets exist, as was the case for modern European growth). Neither the first option nor the last, however, are available to most of today's developing countries. Labor absorption has been fast in the newly industrializing countries (NICs), but most developing countries have seen increasing population pressure on land. Indeed, as the World Bank (1984) points out, the high growth rates of population (and of the labor force) in today's developing countries imply growth of the absolute dimension of the agricultural labor force in spite of structural transformation, in contrast with the experience of developed countries.

Since Malthus, food availability has been a core argument of the population scare. In Malthus' model, population is endogenous (the birth and death rates vary in response to changes in the standard of living), and there are decreasing returns to labor with fixed land endowment. When population grows, since food production growth is less than proportional, real wages decrease and, as a consequence, the birth rate declines and the death rate increases, until the original equilibrium is restored: food production therefore establishes the limits to population growth (Malthus, 1989; Weir, 1988).

Boserup (1965), however, has provided rich evidence to support a model of endogenous technical progress in agriculture that predicts intensification in response to increased population pressure. In the model, growing pressure on land implies increased use of labor with associated diminishing returns until, eventually, a new, superior technique is introduced. Yields per acre increase, but output per hour worked may decline or stagnate. The process occurs in response to increasing food needs within communities and allows for the satisfaction of such needs. Boserup's horizon is very broad, describing a typical sequence of agricultural development from prehistoric times to the recent past in which land use systems and techniques evolve in response to increasing population pressure. Her focus is on transmission, rather than invention, of technologies in low industrial-input agricultures. Optimism, as we have seen, is actually confined to food production, since labor productivity may decline or stagnate in the process (Boserup, 1965; Robinson and Schutjer, 1984).

It is necessary to underline the fact that, since the model refers to an egalitarian subsistence economy, the maintenance of per capita food production is equivalent to the maintenance of per capita consumption levels, a feature that is obviously very simplistic and can be misleading. In the context of more complex economies — with a non-agricultural sector, differing resource bases, unequal distribution
of income and assets, and international trade — such equivalence does not apply. In such a context, for instance, food can be imported; also, as Sen (1981) has illustrated, adequate per capita food production growth does not guarantee that each individual or social group can avoid starvation. Nevertheless, before discussing more extensively the limitations of the model, one must recall the critical links between the satisfaction of individual food needs and food production: global food production is relevant, because of the price of food; countries' own per capita agricultural production is relevant, especially when their capability to import through non-agricultural exports is limited and when agriculture's share in the economy is high, and therefore its growth performance crucially affects income and effective demand (Sen, 1981 and Sen, 1994; Alexandratos, 1995).

A general idea of the relevance of Boserup's analysis for contemporary developing countries can be conveyed by data on labor/land ratios and on land and labor productivity. The figures show, for 1962–92, on the x-axis the percentage changes in the labor/land ratio, on the y-axis the percentage changes in land productivity (Figure 1) and in labor productivity (Figure 2).11

Since the majority of countries in Figure 1 fall in the upper right quadrant, it appears that population pressure on land has increased in most cases12 and a Boserupian, land-augmenting response has also occurred with few exceptions.13 Labor productivity growth (Figure 2), however, has in general been far less substantial, and in many cases productivity has hardly improved in 30 years, or has declined. The majority of such cases are African countries where the yield increases have been on a par or below the variations of the land/labor ratios (countries lying around or below the 45 degree line).

The general conclusion that can be derived from this highly aggregate data is that, as Boserup postulated, although land intensification tends to take place in association with population growth, optimism does not extend to labor productivity since increases here have been generally lower than for yields and many countries have experienced a decline.

Several country studies (Pingali et al., 1987; Pingali andBinswanger, 1987; Turner et al., 1993; Tiffen, 1995) have confirmed Boserup's main arguments14 and it is difficult to disagree with Lipton's (1990, p. 223) observation that the Boserup model, unlike that of Malthus, may offer an explanation for the difference in vital statistics and agricultural growth performance between land-abundant Africa and South and East Asia.

Nevertheless, several theoretical shortcomings limit the validity of the model. First, the egalitarian structure of the model, whereby increasing food needs induce technological responses and increased food production caters to the needs of the community, overlooks questions of distribution and entitlement. Addressing the link between necessity and invention, Lipton (1990) has argued that necessity must not be hunger alone, but rather hunger backed by effective demand, and that in some very poor, intensive-agriculture areas of Asia with severe income inequity, this is not the case. In addition, as Sen (1981) has extensively argued, adequate food production growth does not guarantee that each individual or social group has enough access to food to avoid starvation. Command over food depends on what a person owns (land, labor power, other resources) and on how this endowment enables him or her to obtain food.15 Thus, if population growth is associated with increasing landlessness, technical change must not only make it possible to increase land productivity; it must also be labor-using, or an increasing number of unemployed wage workers may be exposed to starvation. Second, the model focuses on technology transmission.16 Therefore it must be assumed that at some point in space and time necessity has motored invention, and that such invention can be adopted elsewhere. One should, however, provide an economic explanation of invention; in addition, agricultural technologies, especially land augmenting ones, are often location-specific and transmission is therefore not simple. A third, related problem, is that of institutions: do institutions (in this case the research system and property rights on land) adapt, and, if so, how and at what pace? Fourth, the model focuses on low-input agriculture, and therefore neglects the fact that limited availability of capital to acquire inputs may be a constraint to technology adoption. Furthermore, certainly realism and insight could be gained by considering intensification not just in terms of yield increases as in Boserup, but also in terms of shifts from low- to high-value crops on any given land and of geographical shifts in crop production from areas of low potential to those of higher potential, as suggested by Lele and Stone (1989). Finally, as we shall discuss more extensively, the model is based on historical data and slow processes of adaptation and neglects some possible critical implications of the rapidity of changes and/or the already high densities in contemporary poor countries.

Optimism over the first three questions left open by Boserup is suggested by the Hayami and Ruttan (1985) induced innovation model (IIM). This model provides an economic theory of invention and adoption of technologies, whereby relative price changes determine responses by economic agents and research institutions, that guide technological progress toward saving the factors that become relatively scarce. Thus, as population grows, land prices increase relative to wages and to the prices of man-made, land-saving inputs (such as fertilizers).
Technological change therefore moves in a land-saving, labor-intensive direction. Moreover, Hayami and Ruttan argue that changes in underlying economic conditions (increasing population pressure on land, increasing product demand because of trade opportunities) also induce the shift.
development of property rights and contractual arrangements that allow a more efficient allocation of resources. The possibility that the induced technological and institutional innovation mechanism may not work is envisioned by Hayami and Ruttan themselves when
they acknowledge that, in the case of agriculture, the public good attributes of biological technology result in a less than optimal level of supply by private firms, and that, in general, obstacles to the inducement mechanisms can stem from the influence of interest groups, religion and ideology. A cautious appraisal of agricultural perspectives is suggested in a recent contribution by Ruttan (1993) in view of a number of scientific, technical and environmental constraints on future agricultural production.18

Lipton (1990) reviews reasons why increasing rent-wage ratios may not be associated with higher labor-land ratios, thus leaving the adjustment process without a mechanism that would ensure wage earners adequate command over food. de Janvry et al. (1989) argue that the IIM is oversimplistic since it does not take into account the distortions that are introduced into the induction process by the unequal distribution of land holdings.19

3. THE RESPONSE OF INSTITUTIONS: THE RESEARCH SYSTEM AND PROPERTY RIGHTS ON LAND

The response of the research system and of property rights on land to changes in the underlying economic conditions is crucial both for the Boser-upian model and for the induced innovation model. In the case of research, it seems that optimism is not entirely justified, since it is widely held that the response of research institutions to rapidly growing population in most of Africa has been inadequate.

The reasons for this inadequate response may lie in three different spheres: research and extension; support services and infrastructure; and the policy environment, determined by both macro and sectoral policies. Severe problems in the latter two areas have hindered agricultural intensification in sub-Saharan Africa (SSA).20 There is also ample evidence, however, of serious difficulties with the induction mechanism, by which research institutions should produce innovations that are consistent with farmers objectives and constraints and are therefore adopted.

The exploration of the causes of such difficulties must start with the recognition that the physical environment for agriculture in SSA is extremely diversified and generally very difficult, especially in semiarid areas. Matlon (1987), in trying to explain the lack of success in introducing more productive varieties of millet and sorghum in the West African Semiarid Tropics, cites the difficulty of adapting Asian varieties to African conditions (due to the location-specific nature of agricultural technologies) and the lack of congruence between research priorities (traditionally biased toward high-yielding varieties under high-input management) and the physical and economic constraints faced by farmers. Other sources point at several other difficulties, that inhibit the effectiveness of research in coping with SSA agricultural problems: lack of a strong tradition of research and education and of an effective political commitment to research; insufficient and unreliable financing, coupled with inadequate management of research programs; and an historical bias in favor of export crops (Valleys et al., 1987; Pickering, 1987).

There is, however, an underlying factor that may partly explain many of the problems mentioned. SSA has experienced an extremely rapid process of transition from land abundance to increased population pressure on land, in the context of difficult natural environments. Presumably, the society’s response in terms of research could not be fast enough. The starting point, in terms of the general scientific and educational foundation, was very low, and national research structures are recent in most of Africa. In West Africa, for example, until the 1970s agricultural research was carried out mainly by foreign research institutes. Even if adaptation does occur when underlying economic conditions change, the pace at which such changes occur is critical.

Recent studies on the relationship between population growth and evolution of land rights in developing countries have mostly used the theoretical framework of the Alchian and Demsetz analysis (Demsetz, 1967; Alchian and Demsetz, 1973). This rests on three main premises: a sharp distinction between private property and communal property, the latter being described as an open-access situation and therefore associated with great externalities;21 the idea that the changes of property rights required to “internalize” the externalities imply costs (transaction costs); and the idea that property rights develop to internalize the externalities when the gains from such internalization become larger than the cost of internalization22. These latter two concepts play a critical role in the North and Thomas (1973) analysis, which explains the development of private land rights in modern European history as a consequence of population growth.23

Research on developing countries’ recent history on the one hand confirms the idea that the rise of the relative price of land induces a process of evolution from group control of land to private property and, although such a rise can be caused by many factors, population growth has been the most frequently studied; on the other, it dismisses the simplistic dichotomy between private property and common property and the description of the latter as an open-access situation, and accordingly describes the evolution of land rights as a very complex process, involving many adjustments (Feder and Feeny, 1991; Feder and Noronha, 1987; Hoff, 1993).

When resources are under group control, in the absence of collective action in the form of rules
limiting individual use, aggregate consumption of the resource will tend to be inefficiently high, resulting in degradation — an outcome that, following Hardin, is often referred to as the "tragedy of the commons" — and investment in the maintenance of the resource inefficiently low. Thus, if group control is identified with open access, the only way to avoid such an outcome is through privatization or nationalization. The inevitability of the tragedy of the commons, however, has been challenged by a vast economic literature on several grounds. The first is that this conclusion stems from a totally inadequate understanding of the complexity of property rights systems. In fact, unlike open access, common property implies that property rights are defined, although they are exercised (fully or partially) by a group rather than by an individual, and that membership of the group is limited. Empirical evidence from developing-country experience offers many examples of balanced management of common property resources within small local communities. The second ground is theoretical: ample economic literature explores the emergence of cooperative behavior when self-interested individuals are involved in repeated games. The final ground for doubt relates to policy prescriptions, since privatization disenfranchises the poorest and nationalization often does not translate into better resources management (Bardhan, 1993; Bromley and Cernea, 1989; Dasgupta, 1993; Seabright, 1993).

In the case of land, a system of property rights is a set of rules governing its different uses (cultivation, grazing, hunting, right to plant trees and so on), inheritability and transferability. The distinction between individual right to use and right to transfer is especially important: as recent studies point out (Hoff, 1993), in SSA indigenous systems usually ensure individual cultivators security of possession over a specific plot for a definite purpose and length of time, while transferability is limited in various degrees. Access is not open, but some of the rights are exercised by the group, rather than by individuals.

Property rights on land tend to evolve in response to changing population pressure following a broadly identifiable pattern. In land-abundant environments, with shifting cultivation, where labor is the limiting factor and uncultivated plots have no economic value, individual property rights are usually not defined, land tends to be under group control and membership of the group is easily acquired. As population increases and land becomes more scarce, there is a tendency to restrict the membership of the group and to transfer various rights from the group to individuals. This, in turn, provides the incentive to adopt the fertility restoring techniques required by shorter fallow cultivation.

Thus, theory and empirical evidence suggest both that balanced management of common property is possible, and that property rights evolve. As we shall discuss, however, in specific circumstances, and especially under the pressure of fast population growth and/or when population densities are very high, the process may not go from balanced management of communal property to a complete definition of individual property rights, but rather may result in a breakdown of traditional systems into de facto open access, with the associated environmental degradation.

4. ADJUSTMENT FAILURES

While the review of past experience and of the theories outlined so far basically confirms the essential argument of revisionists — that population growth triggers adjustments in agriculture, both in terms of intensification and of definition of property rights — it also reveals that adaptation processes are complex and difficulties are more likely to arise when population growth rates are very fast and/or densities are already high.

In some very poor, densely populated and intensive agricultural areas, further intensification may be very costly and the growth of effective demand too slow to provide incentives for Boserupian technological shifts. The problems experienced by national research systems in responding to rapidly changing underlying economic conditions, in the context of difficult physical and economic environments, have already been discussed in relation to the induced innovation model. Moreover, lack of congruence between population densities and land potential has been evidenced in research on several SSA countries (Lele and Stone, 1989; Matlon, 1987) and is explained by constraining factors such as colonial patterns of investment and infrastructure, barriers to migration linked to tribal history, or diseases. Finally, rural-rural migration linked to farmers' expansion along the receding land frontier may result in sudden changes in the population/resources balance, with negative consequences especially when farmers settle in fragile environments, are poor and have technological knowhow that may not fit the new location.

It may thus happen that, although communities try to adapt to changing underlying economic conditions, the rapidity of change coupled with various constraints may lead to a decline in long-term land productivity. For example, evidence from several Sahelian countries (Speirs and Olsen, 1992) shows that increasing land scarcity — due to growing population pressure — induces a deep transformation from separate crop and transhumant livestock production to mixed farming. In spite of such evolution, however, crop-land fertilization is not at
levels sufficient to maintain soil organic matter levels, while use of inorganic fertilizer is constrained by lack of capital and by farmers’ risk-averse strategies, in the context of unreliable climate. As a consequence, soil fertility is declining. In addition, in spite of the reduced weight of transhumant pastoralism, overgrazing of pasture land results in environmental degradation.

Several sources suggest that a decline in long-term land productivity has already occurred in many parts of Africa, where rapid population growth has resulted in the reduction or abandonment of fallow periods, not counterbalanced by the use of fertility restoring techniques;²⁰ the restriction of transhumant herders’ mobility — as more land is converted into permanent farm land — has had negative implications for the environmental integrity of pasture lands; and, finally, a reduction of farmers’ ability to cope with droughts has resulted from the constraints imposed on the two main adjustment mechanisms — namely long fallow and pastoralist mobility — (Lipton, 1990; World Bank, 1991; Speirs and Olsen, 1992). Blakie and Brookfield (1987) report that in some areas of densely populated Nepal, maintenance of soil fertility (and yields) — based on manuring from cattle that are fed forest products — is threatened by the depletion of forest resources, which in turn is due to the increasing use of these resources (for fertilization and fuel) by a growing population. It thus appears that optimism about adjustment processes may have to be substantially moderated when one takes into proper account the environmental resource base.

The linkages between population pressure and land degradation are complex. In the context of Nepal, Blakie and Brookfield (1987) observe that elaborate terracing, requiring high labor input, has probably diminished erosion; on the other hand, deforestation and the creation of larger areas of grazing has probably increased it. More generally, one effect of high population pressure is to provide the manpower required for complex land management.²¹ Links between population pressure and environment degradation are, however, likely to exist with already high densities and/or fast population growth and poverty. Farmers or pastoralists cannot postpone production if they are merely achieving subsistence. Furthermore, poverty greatly reduces the available options in terms of substitution of man-made inputs (such as chemical fertilizers, or non-wood fuel) for natural resources, and in terms of investments in resources maintenance. A self-reinforcing mechanism between environmental degradation, poverty and high fertility rates has been hypothesized by Dasgupta (1993).²² Poverty induces high fertility rates in developing countries because, in the absence of public health services and old age security, children are insurance goods. The scarcity of capital and of environmental resources (mainly water and fuelwood), with associated low productivity of labor, may provide an additional motivation for high fertility rates, since children are needed as workers and thus, also become producer goods.³³ The resulting population growth damages the environmental resource base, to the extent that this base consists of unprotected common property; this, in turn, is likely to provide further private incentives for large families (Dasgupta, 1993, pp. 358–359).

Disruptive pressures on the commons, which have been described so far without reference to distribution, are likely to occur within processes of social differentiation whereby, for instance, some groups appropriate resources while others become increasingly reliant on a shrinking resource base.³⁴ Furthermore, when land appropriation results in concentration of land in the hands of few, rental and share arrangements are likely to emerge. If such arrangements imply short-term use rights, they reduce the incentive to make long-term investments that prevent land degradation (Clay et al., 1994). More generally, it should be expected that the more inequitable the growth process is, the more likely it is to result in poverty and environmental degradation. Several aspects of the relationship between distribution and environmental degradation are discussed in a paper on India by Rao (1994), which stresses the role of inequity in ecological degradation.

Similar observations apply to the issue of property rights adjustment. Theory predicts that as population pressure on land increases there is a tendency to establish private land rights, which, in turn, create incentives for the maintenance of long-term productivity. But, even if one adhered to a functionalist view by which institutions respond or new institutional arrangements emerge simply because this is called for by (and better suited to) the new underlying economic conditions — a view that is subject to a wide variety of criticisms (Bardhan, 1989; Matthews, 1986) — it cannot be denied that the pace at which such underlying conditions change, and/or specific circumstances, may hamper adaptation.

As already discussed, traditional land tenure systems are not open-access situations, but rather common property regimes where use is regulated by a set of norms that may prevent the “tragedy of the commons.” Population growth, by changing relative prices, should induce, and historically has in fact typically induced, a more precise definition of property rights on land. Common property, however, may collapse into open access in several circumstances, most of which include population growth as the leading factor.

Bromley and Cernea (1989) suggest one possible mechanism, the simplest, whereby egalitarian communities may experience population growth coupled
with “the unwillingness of the group to evict redundant individuals when that eviction will almost certainly relegate the evicted to starvation.”

Resource degradation, however, is more likely to result under complex circumstances including, aside from population growth, land concentration and inappropriate public policies. Increasing population pressure tends to induce privatization of Common Property Resources (CPRs), but this is likely to involve a certain degree of land concentration in the hands of the more powerful groups in the community. Public policies may play a role in this process, as the state attempts to establish formal management systems to replace customary ones — often with very poor results — and as former common or open-access resources are transformed into state property. Thus, a process of concentration of the more productive resources in the hands of traditionally powerful groups within communities living in the area — or into those of outside interests with strong links to the administration — may result in the disenfranchised poor placing increasing pressure on the residual commons, in the context of conflicting formal and informal management rules. Finally, rural-rural migration may be the source of much conflict since, with a rapidly growing number of “strangers” to the community, traditional norms may fail to provide adequate protection to land that is not already in the farming cycle, and hence, not under individual or family management (World Bank, 1991).

5. CONCLUSIONS

Within the general debate on the linkages between population growth and economic development, references to agriculture are often used as examples of the ability of societies to produce the right economic and institutional responses to demographic shifts. Such a view is supported by the models of endogenous, population-driven, technical progress and of induced, factor-saving innovations, as well as by the theory of the evolution of property rights on land and by a related body of empirical evidence on contemporary poor countries.

The analysis carried out in this article suggests a somewhat less optimistic picture. Indeed, population growth induces adjustments that on the whole make it possible to meet growing food needs, and to maintain agricultural incomes (although much less successfully) and land quality. Optimism about such adjustment mechanisms may not be justified, however, in the context of very fast population growth and/or already high population densities, and other circumstances, such as very strong economic or political inequalities, inappropriate policies, or drought, especially when the environmental resource base is taken into account.

If population densities are already high and population growth is associated with increasing landlessness, income inequality and unemployment, large groups are exposed to hunger or starvation and also, the stimulus to intensify may be reduced because of the slow growth of effective demand. Furthermore, agricultural intensification requires an adequate response of the research system but, in difficult natural environments, with fast population growth, this response may not be rapid enough. In addition, although communities try to adapt to changing underlying economic conditions by intensifying land use, very rapid demographic growth may lead to a decline in long-term land productivity, especially when it is coupled with constraints such as limited use of man-made inputs because of poverty, or inadequate research responses. Finally, although theory and empirical evidence suggest that balanced management of common property is possible and that property rights evolve, in some circumstances — most often including already high population densities, and/or fast population growth and poverty — the process may not go from balanced management of communal property to a complete definition of individual property rights, but rather may result in a breakdown of traditional systems into de facto open access, with the associated environmental degradation.

NOTES

1. Different strands of “new growth models” — introducing endogenous technological change and the endogenous accumulation of human capital — yield a variety of results and have differing implications for the population and economic growth nexus. Models with endogenous technological change tend to show that the pace of innovation (and of economic growth) is increasing in the size of population but, as Kremer (1993, p. 681) observes, “this implication is typically dismissed as empirically undesirable.” In a model (Becker et al., 1990) where growth is driven by the accumulation of human capital, higher fertility discourages investments in both human and physical capital and higher stocks of capital reduce the demand for children. Countries may be trapped in a Malthusian, underdeveloped steady state, with high birth rates and a low level of human capital.

2. In the first version of the Solow model, the economy tends to a balanced growth path where capital and output per worker remain constant, while in the later version, where technical progress is introduced, both ratios increase at the exogenous rate of growth of technical progress.
3. The qualitative implications of the Solow model are retained in Mankiw et al. (1992). Their model is a standard neoclassical model (where growth is exogenous) "augmented" with the inclusion of human capital in the production function. Such inclusion amplifies the quantitative effect of changes in savings rates and population growth and gives the model the potential to account for large crosscountry income differences.

4. Although at the opposite side of the spectrum, population enthusiast positions exist, and they are strongly argued for in the several publications of J. Simon.

5. Population growth positively affects technological change — albeit indirectly — in vintage models, since it quickens the pace at which new technology can be incorporated into production (Kelley, 1988). Simon (1986) provides a survey and extensions of models which hypothesize a direct, positive impact of population growth on the rate and/or bias of technical change.

6. "Limits to growth" considerations, for instance, are contested by a National Research Council (1986) study, an authoritative "revisionist" document, which opposes the view that increased demand and prices for exhaustible resources will induce adaptive strategies (search for alternative materials) and that in the long run population growth might create greater incentives to develop the social and political institutions necessary for the conservation of renewable common property resources.

7. Thus, in the historical perspective of North and Thomas (1973), the evolution of the Middle Ages can be summarized as a change in the land and labor markets, with labor becoming free and the common uses of land being progressively limited.


9. In discussing the transition from long to short fallow, for instance, Boserup comments that a new technology — the introduction of the plough — is to be regarded as a means to prevent a fall in output per man hour, rather than a means to raise it (Boserup, 1965, p. 34). She is more generally inclined to think that a period of sustained population growth will result in a decline of agricultural labor productivity, although, in the long run, the positive effects of population growth in terms of general economic development may eventually lead to increased agricultural labor productivity (Boserup, 1965, p. 118).

10. In a more recent essay Boserup (1981) argues for a virtuous circle of population growth and technical progress and a vicious circle of sparse population and slow technical progress as explanations for many historical processes (such as the emergence of urbanization in ancient societies and the technological advances preceding Europe's Industrial Revolution) besides agricultural development.

11. All developing countries of Africa, Asia and Latin America with a population of at least seven million inhabitants in 1993 are included. The data are 1961–63 and 1991–93 averages. The changes refer to the ratios between: active population in agriculture and agricultural land (x axis in Figure 1 and 2); agricultural production at constant 1989–91 international prices and agricultural land (y-axis in Figure 1); agricultural production at constant 1989–91 international prices and numbers of active in agriculture (y-axis in Figure 2).

12. The exceptions are mostly countries which have experienced rapid industrial development and countries in oil-producing regions, where there has been a significant absorption of labor in the non agricultural sectors. In some cases, notably Brazil, an important role has also been played by a great expansion of agricultural land.

13. The countries which show increased population pressure and stagnant yields have the common characteristic of having suffered harsh and prolonged civil strife (Angola, Ethiopia and Mozambique).

14. In addition, Pingali and Binswanger (1987) find that improved access to markets through better roads and transport facilities also leads to more intensive systems of land use, and that population pressure leads to a sharp change in preference and price of different types of land (except in arid zones), with a movement to heavier bottomland soils that are more responsive to intensification inputs but require high levels of labor for drainage and water control.

15. Sen very effectively observes that the reason why there are no famines in the rich developed countries is not because people are richer on the average, but because of the social security system.

16. The model does not explain the entire process of technical change, which includes research, discovery and adoption. In her 1981 essay, Boserup states that it is more important to focus on the conditions for transmission of techniques than on the conditions for the appearance of inventions, since societies have more often advanced technologically by introducing technologies already known in other societies.

17. In a similar vein, Binswanger et al. (1989) describe the transition from low-density, land-abundant communities, to high-density, land-scarce communities as a process which encompasses Boserupian induced innovation and investment, the transition from general to specific land rights, and a set of endogenous changes in production relationships.

18. Ruttan also observes that with environmental resources priced below their social cost the inducement mechanism reinforces the tendency to excessive consumption of such resources.

19. In the de Janvry, Sadoulet, Fafchamps model, supervision costs on hired labor and fixed costs in land transactions imply that the effective price of labor increases with employment and the price of land decreases with farm size. The fact that agents do not face the same prices implies that: different classes of farmers have conflicting demands for technological innovations; a larger average farm-size is associated with the choice of a more labor
saving technology; inequality in the distribution of land introduces a bias in favor of mechanization. Moreover, both collective action and the state’s objectives and degree of autonomy have implications for the outcome of the innovation process.

20. See Cleaver (1993) and the numerous other World Bank studies on SSA. Lele and Stone (1989) emphasize this point, by stating that one shortcoming of the Boserup hypothesis is that it is based on the assumption of a benign, or at least neutral, policy environment.

21. In his 1967 essay, Demsetz admits that in principle members of a community could establish and enforce rules that limit individual use of resources, but considers this an unlikely outcome, since negotiating and policing costs would be too high.

22. Demsetz concedes that these legal and moral experiments may be hit-and-miss procedures to some extent.

23. It is worthwhile to recall that North and Thomas in general assert that the growth of the Western world results from a set of institutional innovations and that the predominant parameter shift that induced such innovations (by making their potential benefits larger than their costs) has been population growth.

24. One should note that such a process of change involves several institutions (the formal legal system, the system of cultural norms and customary law, enforcement mechanisms) and that, as Feder and Feeny (1991) have pointed out, in many contemporary developing countries changes at these different levels are not necessarily congruent. A society in which the formal legal system contemplates private property might lack the corresponding registration and enforcement mechanism; or, the transfer of land to another clan or ethnic group may be allowed by the legal system but not by cultural norms.

25. In turn, the system of property rights influences the demand and supply of children of the different social groups, as, for instance, privatization of land weakens the insurance motivation for large family size for the landowners, while increasing landlessness may retard fertility decline, since agricultural workers have less motivation than landowners for fertility limitation (Boserup, 1990; Stokes and Schutjer, 1984).

26. Lipton (1990) quotes the examples of the most inviolated areas of eastern India and southern Bangladesh.

27. An example from Senegal is given by Lele and Stone (1989): “The long standing antipathy between the Wolof, for example, who dominate the Groundnut Basin, and the Diola, a non Muslim group inhabiting the lower Casamance, is likely to complicate migration in Senegal. If the relatively well watered Casamance is to become an agricultural growth area for Senegal, the Diola will have to be given a greater share of national resources and be represented in the elite.”

28. Such as onchocerciasis in many of the major river valleys.

29. As land is increasingly devoted to crops, farmers are led to keep their own livestock, since manuring of fields by transhumant herds diminishes, while decreasing fallowing increases the demand for manure for fertilization. At the same time, pastoralists have an incentive to settle and become farmers, as pasture areas shrink and their dependence on crop residues increases.

30. Similar processes are reported by Watson (1989) in Malaysia.

31. Moreover, when such systems are created, out-migration may provoke serious degradation.

32. Partly confirmed by the empirical evidence of a World Bank (1991) study on sub-Saharan Africa.

33. A different view is expressed by Rao (1994), who argues that, since children are a drain on family incomes at least until age five or six, with plausible discount rates, they lower, not increase, expected incomes. Their employment as workers would therefore be a consequence, not a cause, of high dependency rates.

34. Thus, while the Boserup’s thesis implies that households confer an external benefit on the community when they reproduce, this may not be the case when population size is large in relation to the local environmental resource base. In these circumstances, even though a high demand for children may be rational for individual households, population externalities are likely to be negative.

35. One such process, where inequality in access to land (and the consequent investment pattern of large landowners) has critically reinforced the negative effects of population pressure on the environment, is outlined in a study of a region of Honduras (De Walt et al., 1993) characterized by rapidly growing population and highly unequal distribution of land.

36. A different process is described by Jodha (1987) in reference to a semiarid area of India, where the 1952 agrarian reform and subsequent public policies, intended to provide land to the landless and smallholders, translated into a large-scale privatization of marginal common-property land and the abolition of former regulatory measures. This resulted in a qualitative decline of residual common property and increased soil erosion and declining yields in the privatized, former common-property grazing land that was converted to crops.

37. The breakdown of a system of management of common-property resources that had evolved over hundreds of years in the inland Niger Delta of Mali is described in a study by Moorehead (1989). It was the result of a combination of the factors in question and of a prolonged drought that diminished the resource base of the area.
REFERENCES


