# AGRICULTURAL GROWTH, POPULATION, AND ENVIRONMENT NEXUS: HIGHLIGHTS OF THE DEBATE AND IMPLICATION FOR ETHIOPIA

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## *Abstract*

*This paper highlights the debate about the nexus between population growth, agricultural intensification and the environment. It deals with two central issues. These are: (1) whether population growth would lead to agricultural stagnation and (2) whether the poor are always there to destroy the environment. These questions are addressed by reviewing the contributions of the classical school, the neo-Malthusian school, the optimistic view of Ester Boserup and the neo-classical school. Some of the views presented here are reinforced by empirical evidence from the Philippines and Kenya. The paper provides food for thought for those who adamantly subscribe to the neo-Malthusian view of the nexus.*

## 1. INTRODUCTION

The interaction between population growth, the environment, and agricultural intensification raises the most compelling and most controversial issues currently facing developing countries" (Lele and Stone 1989:7). The purpose of this paper is to present the outstanding literature on the debate concerning the nexus between agricultural growth, population, and the environment. The paper first considers the pessimistic view of the classical school (section 2) and then reviews representative literature on the neo-Mathusian view (section 3). This is followed by a review of the optimistic view of Ester Boserup's model and its extensions (section 4 and 5). Next, a neo-classical model is presented (section 6). The argument that the poor are destroyers of the environment is refuted on the basis of empirical evidence from the Philippines (section 7). Empirical evidence from the Machakos district of Kenya presents a new challenge to researchers: population density could lead to environmental rehabilitation (section 8). The paper winds up the debate by presenting agenda for future research in Ethiopia.

## 2. THE CLASSICAL SCHOOL

The basic argument of the classical theory of population growth and agricultural development, as exemplified by Malthus, can be summarised as follows. Increased population growth causes a parallel increases in demand for food, which can be met either by bringing new land under cultivation or by intensifying the cultivation of already available land. However cultivation of additional land (extensive margin of cultivation) has limited prospects for overcoming the effects of population pressure, because the marginal product of labour is bound to decline as land at the margin is associated with lower fertility as compared to land already populated. In addition, production at the intensive margin (already available land) is subjected to the law of diminishing returns. Consequently, food production will always tend to grow less rapidly than population. In the long run population will always expand to the limit of available food supplies.

In the Malthusian 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 labour with fixed land endowments. Food production establishes the limit to population growth through disproportionate increases in death rates.

## 3. THE NEO-MALTHUSIAN VIEW: POPULATION GROWTH LEADS TO ENVIRONMENTAL DESTRUCTION

The neo-Malthusian view of the nexus between population growth and environment has remained popular among conventional economists and major donors. The following summary of a World Bank document (World Bank 1992) provides the essence of this view. Population growth increases the demand for goods and services, and, if practices remain unchanged, implies increased environmental damage. Population growth also increases the need for employment and livelihoods, which (especially in crowded rural areas) exerts additional direct pressure on natural resources. More peopled also produce more wastes, threatening local health conditions and implying additional stress on the earth's assimilative capacity.

Countries with higher population growth rates have experienced faster conversion of land to agricultural uses, putting additional pressures on land and natural habitat. In many places (Ethiopia, Southern Malawi, Eastern Nigeria, and Sierra Leon) farming is being intensified through shorter fallow periods rather than through the use of better inputs or techniques. Rapid population growth in these areas has led to the mining of soil resources and to stagnating or declining yields. In some circumstances, especially in rural Africa, population growth has been so rapid that traditional land management practices have been unable to adapt to prevent degradation. The result is overgrazing, deforestation, depletion of water resources, and loss of natural habitat.

The poor are both victims and agents of environmental damage. About half of the world's poor live in rural areas that are environmentally fragile, and they rely on natural resources over which they have little legal control. Land-hungry farmers resort to cultivating unsuitable areas-steeply sloped, erosion-prone rapid; and tropical forests where crop yields on cleared fields frequently drop sharply after just few years. Poor people in crowded squatter settlements frequently endure inadequate access to safe water and sanitation, as well as flooding and landslides, industrial accidents and emissions, and transport-related air pollution. Poor families often lack the resources to avoid their environmental degradation.

The very poor, struggling at the edge of subsistence, are preoccupied with day-to-day survival. It is not that the poor have inherently short horizons; poor communities often have a strong ethic of stewardship in managing their traditional lands. But their fragile and limited resources, their often poorly defined property rights, and their limited access to credit and insurance markets prevent them from investing as much as they should in environmental protection. The core of the neo-Malthusian narrative of the nexus can be presented using Hoben's (1995) synoptic review of this view based on the Ethiopian experience. Long ago when there were fewer people in Ethiopia, indigenous farming systems and technology enabled them to make a living without seriously depleting their natural resources. Over the present century human and animal populations have grown. Indigenous farming systems have been unable to keep up. Population has exceeded carrying capacity, causing ever-increasing and perhaps irreversible environmental damage. Only a massive investment in environmental reclamation can reverse this process. People are unable to make this investment without outside assistance because they do not know how, and because they are too poor to forego the present for future income or to provide for their children.

## 4. BOSERUP'S MODEL

As described above, the force limiting agricultural progress in the classical growth theory is population growth and diminishing returns to labour. However, this pessimistic view has been rejected by optimists like Ester Boserup, who ends by "standing Malthus on his head." Boserup (1965) analyses the problem of agricultural progress in pre-industrial communities from an entirely different angle: she regards the growth of population as the autonomous factor making a steady intensification in agriculture, which in turn brings a host of economic and institutional changes in its train. Boserup's contra-Malthusian view of the relationship between agriculture and population growth stems from one basic thesis: technological progress in agriculture is spurred by autonomy population growth. Boserup's model postulated that (although in the short-run there may be diminishing returns to agricultural labour), in the long-run, the aggregate agricultural production function will always shift upwards in response to population pressure, at what rate is required to maintain output per capita. The shift variable in agricultural technology arises from changes in the

cultivation method (e.g. increased application of manure, higher frequency of weeding), changes in the choices of farm tools, (e.g., switch from the use of the hoe to plow culture), and changes in the system of land use (progressive reduction in the fallow period). Thus Boserup explicitly rejects the classical notion of a continuous agricultural production function and proposes a discontinuous production function suggesting dynamism of pre-industrial agriculture to the extent that technological progress is concerned.

Boserup identifies a succession of increasingly intensive systems of land use in pre-industrial agriculture, associated with growing population density. That is, population pressure is behind successive transition from " forest fallow" (20-25 years of fallow) to " bush fallow " (6-10 years), then to "short fallow" (1-2 years) to be followed by annual cropping, The most intensive system of land use is "multiple cropping", a system that is made possible by availability of irrigation schemes.

The successive transition from "forest fallow" to "multiple cropping" system obviously implies a continuous deforestation process that does not necessarily give rise to a fall in per capita consumption, thanks to technological progress that accompanies changes in land use systems. The process of soil depletion, which is evident in the "extensive margin" of the classical school is irrelevant to Boserup's model.

## 5. AN EXTENSION OF BOSERUP'S MODEL: POLICY-LED INTENSIFICATION

In a study of six Sub-Sahara African countries Lele and Stone (1989) documented the environmental consequences of growing population pressure without gains in agricultural productivity. The study demonstrated that the most pragmatic means of achieving rapid growth in agricultural production, employment, and incomes in circumstances of rapid population growth and declining extensive margin is to focus resources and policy attention on areas most responsive to chemical fertilisers and improved seeds. The author argued that: "raising agricultural productivity in such areas offers the prospect of achieving quicker relief to the environmental problems such as soil depletion and deforestation." The faster the improvement in factor productivity, the smaller the proportion of land and population needed for employment in agriculture to feed the total population and the greater that increases area can be left fallow or reforested.

To achieve higher productivity in high potential areas, Lele and Stone underlined the importance of policy-led approach to intensification of agriculture, in contrast to Boserup's theory of automatic intensification arising from mere growth in population pressure overland. In the past, the authors argued, political pressures within countries to spread resources and government services to as much of the population as possible after independence led to the expansion of development projects in virtually all parts of the countries. The equity and food security concerns of the donor community in the 1970s led to the expansion of development projects in IQW potential

areas. The result for many countries has been "a regional redistribution of production but without substantial growth" (Lele and Stone 1989:7). The authors argue that attempts to develop areas of lower productive potential (while justifiable on grounds of national building and encouraging participation of all groups in economic growth) carry implicit economic costs that must be recognised. In areas of lower potential but high population densities or remote but productive areas development policies must inevitably be accompanied by a willingness to tolerate "slower growth" while an appropriately targeted long-term strategy is given a chance to work. Finally, the authors recommend policies favouring consumption and welfare-oriented efforts in areas of lower potentials and active production policies to stimulate growth in areas of high potentials.

## 6. A NEO-CLASSICAL MODEL: A U-SHAPED NEXUS

The nexus between agriculture, population and environment is rarely debated by conventional economists. What follows, however, is an exposition of a neo-classical model of this nexus. That is, Pender (1998) provides a simple application of neo-classical theory as follows. At low levels of population density and economic development, households are well endowed with natural resources (natural capital) in the form of forests, soil fertility, etc., relative to their stock of human produced capital. As economic development proceeds, development of infrastructure, markets and technology tend to reduce the price and/or increase the marginal value product of investments in human produced capital. This includes substitution of human produced capital for natural capital, resulting in depletion of natural capital in the short-term. Once the rate of return to these different types of capital have equalised, however, output effects take over and accumulation of both natural and man-made capital will occur. If man-made capital and natural capital are complementary, output effects will outweigh substitution effects in the long-run.[1] If labour supply is complementary to both types of capital, then population growth induces investment in both types of capital after their rates of return are equalised.

This argument emphasises the positive role of complementarily between renewable natural capital and man-made capital in promoting sustainable development.

The model presented by Pender could be characterised as 'Boserupian' given its optimistic predictions about the impacts of population growth on investment in renewable resources and other forms of capital. However, it also shares the Malthusian pessimism regarding the impacts of population growth on per capita production and consumption (holding technology and market development fixed). This is based on the assumption that agricultural production technology exhibits constant or decreasing returns to scale.

Population growth may also induce development of infrastructure, markets, and technological or institutional innovation by reducing the fixed costs per capita of these

factors, though these developments may not occur automatically. Government policies can play an important role in affecting whether these potential benefits of population growth are realised. In addition, credit policies may reduce resource degradation caused by substitution of man-made capital for natural capital, by allowing farmers to accumulate man-made capital (such as fertilisers) without depleting their natural capital. Policies to internalise the external environment costs of using man-made capital will reduce both types of capital and production, indicating a clear trade-off between addressing environmental concerns, on the one hand, and reducing poverty and promoting resource conservation investments, on the other. By contrast, internalising the external benefits of investments in resources increases wealth and production per capita in the long-run.

Pender's (1998) neo-classical model implies that the population growth may not be responsible for resource degradation in developing countries, when degradation is due to substitution of more profitable forms of capital for natural capital. Indeed, population growth eventually induces investments in resource improvements, where land is becoming scarce and tenure is relatively secure. Nevertheless, reducing the growth of population can increase (or reduce the decline in) per capita income and consumption. The case for population control, thus, may hinge more on considerations of poverty than on considerations or resource degradation or improvement.

These results suggest that there may be no conflict among the objectives of increasing agricultural productivity, improving resource conditions, reducing rural poverty, and addressing environmental concerns, if subsidies are used to internalise external benefits of improving resource conditions. On the other hand, there are clear trade-offs involved if taxes or regulations are used to internalise the external costs associated with agricultural production. Although an optimal intervention will increase aggregate social welfare and reduce environmental costs, it will reduce investment in natural capital as well as other capital, reduce agricultural production and income per capita. There may also be adverse distributional consequences since farmers in poor countries are often poorer than their urban neighbours (and certainly poorer than those in advanced countries), who benefit from, reducing the external costs of developing country agriculture.

Thus, using a mathematical model (which is not presented here), Pender established the theoretical basis for a U-shaped relationship between the condition of the natural resources used in agricultural production and population or economic growth. This hypothesis is opposed to the inverted U-shaped relationship between economic growth and environmental degradation (e.g. see World Bank 1992).

## 7. POVERTY AND THE ENVIRONMENT: THE CASE FROM THE PHILIPPINES

The conventional literature[2] on the fields of environment and development often presents a rather deterministic view of the relationship between poverty and the environment, centring around the negative impact the poor have on the environment. Based on extensive fieldwork among rural communities across the Philippines, Broad (1994) refuted the conventional paradigm of poor people as destroyers of the environment and investigated a set of conditions under which poor people become environmental protectors and activists.

Using the political economy perspective Broad raises a fundamental question: "Who protects which environment from whom?" To address this question he desegregates the tern "poverty" into its component parts, i.e. the "merely poor" (peasants with secure tenure who could be environmental sustainers) and the "very, very poor" (the landless squatters who may destroy the environment as a matter of survival). In addition, he points out that commercial logging is most often behind widespread destruction of the environment.

He then raises another fundamental question: "What are the conditions under which poor people become environmental activists?" (To start with, the author makes assumption: 1) environmental degradation is threatening the natural resource base on which the lives of the poor are based; 2) poor people have lived in the area for some time or have some sense of permanency there; and 3) civil society is politicised and organised.

Regarding the first condition the author hypothesised that once environmental degradation (caused by, say, commercial logging) began to transform poor people who lived in a stable ecosystem into marginal people living in vulnerable and fragile ecosystems; they acted to protect the environment.

Regarding sense of permanency, the author argues that migrants or people pushed onto fragile ecosystems by, say, commercial loggers tend to degrade the environment. A relevant argument here is while length of tenure affects a community's perception of land and relationship to their land and other natural resources, equally important is the security of people in terms of their control over the land or resources.

Regarding the role of civil society in the conservation of the environment, Broad's research suggested that civil society organisations are key for understanding how poor people choose to react to the loss of what has historically been their source of subsistence. In Philippines, civil society organisations were able to agitate against the process of environmental degradation, which threatened the livelihoods of the poor.

Several research hypotheses have emerged from Broad's study of the link between poverty and environment in Philippines: 1) countries or areas with rapid rates of environmental degradation are likely sites for activism among the poor; 2) newly displaced or migrant communities are more likely to degrade the environment than stable communities; and 3) tenurial insecurity is likely to have adverse effect on the environment.

## 8. MORE PEOPLE, LESS EROSION: EVIDENCE FROM THE MACHAKOS DISTRICT OF KENYA

This title goes with Mary Tiffen and others' (1994) book on environmental rehabilitation in Kenya. This work substantiates a modified form of the optimistic view of the nexus between population growth, technological change and per capita income. It identifies **capital formation and technological progress as the key link** between population, environment, and agricultural development. The model is based on the experience of the Machakos district of Kenya. In what follows, I will present the essence of Tiffen's model.

The author's concern with the impact of population growth differs from the terms of the traditional debate about **output**, in being primarily concerned with resource **management**.[3] Since management is concerned with the choice of technologies, the authors are interested in the relationship between population growth and the rate of adoption of new technologies. New technologies frequently demand new investments or labour and capital. This leads to the concern with incentives to invest, the mechanism of raising capital formation and with the need to improve information flows.

Drawing from Boserup (1965, 1981, 1990), Tiffen and others built a model (see Fig. 1) that takes into account agro-ecological donation. Population is first attracted to the higher potential areas, where livelihood can be earned with least effort. As the rural population grows, land per capital diminishes, the average farm size becomes smaller, and household food sufficiency is threatened as farm income declines. The land degrades under extensive technology, as fallow periods shorten. However, the authors argue that the Malthusian trap can be avoided by three strategies:

A. Temporary or short-term migration to urban areas, or to non-agricultural occupations such as the police and the army. The main cost of this strategy is the private and social capital invested in schooling for the qualifications. If any, needed for employment. Security for personal movement is a precondition.

B. Permanent migration to lower-potential agricultural areas, maintaining the same agricultural technologies, but varying the mix of enterprises (for example, more livestock in drier zones). This strategy is costly, because the household will need farm equipment, new family housing and the means of surviving until the first harvest.

Access to farmland, water and adequate security from wild animals are other preconditions. In time, as population grows and vacant land disappears, the conditions will be recreated for another choice of A, B or C in Figure 1.

C. Sustainable development **in situ**. This strategy breaks down into two options:

1). Agricultural intensification, including both farming and livestock production technologies, and accompanied by measures to conserve the land and water resources for this option, capital is needed for land improvements, new technologies, and improved livestock. Not all of these investments can be created by extra family labour, so transfers of capital from members of the household who have earlier adopted option A can facilitate this choice. Given the level of investment and enhanced value of the land, cash incomes must be generated, so crops are grown for sale, this needs market access, Investment also requires a secure form of tenure

2). Income diversification, linked to market growth and the opportunities for employment in the processing, trading and transporting of farm output, and to service provision as living standards slowly rise (Tiffen et al., 1994: 27-28).

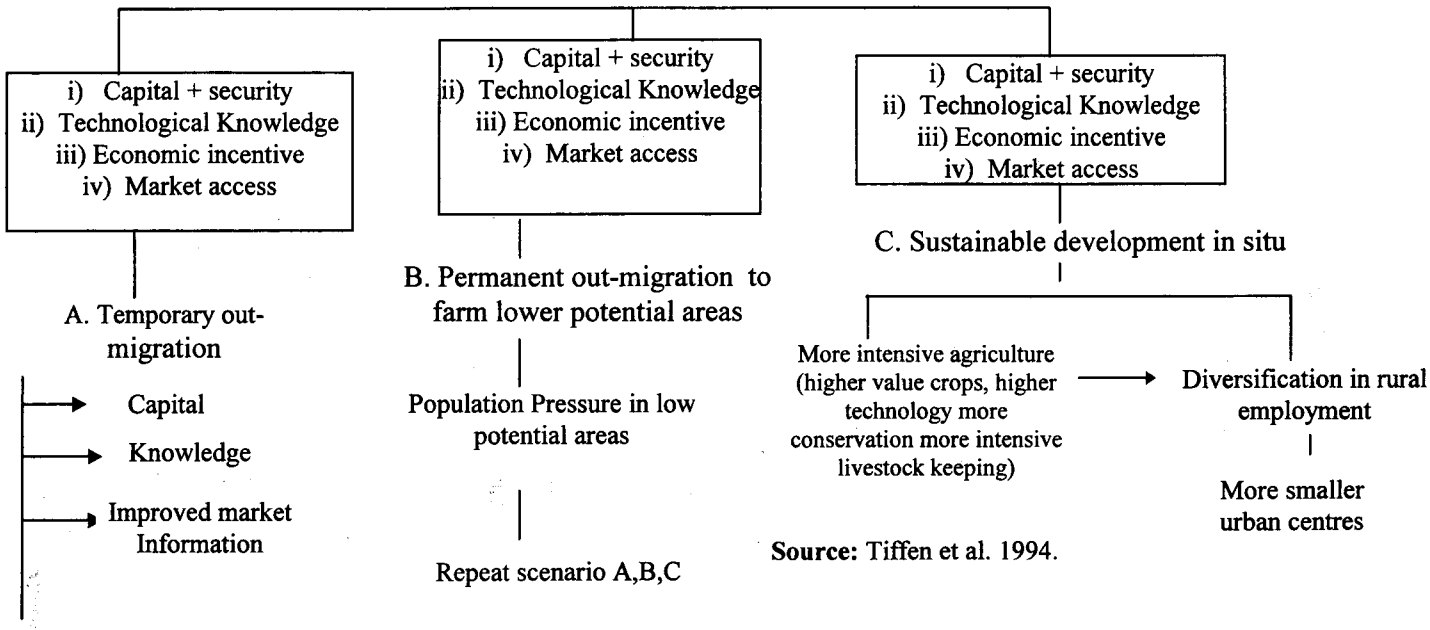
The link between the adoption of conservation technology and intensification is particularly important for this model. According to this model, conservation pays when land becomes scarce under existing technological conditions. It is in this way that, for a given population, long-term conservation (rather than degradation) becomes a necessary outcome of demographic growth.

The evidence for a reversal of environmental degradation has been provided by the experience of the Machakos district of Kenya. In pursuing improvements in their livelihoods, "**the Machako People have not destroyed their environment, despite their poverty and the risky climate**" (Tiffen et al., 1994:261). The environmental problem of the 1930s (which was supported by photographic record) has been reversed by the people themselves. And, the change that has taken place was not due to changes in rainfall systems.

Moreover, according to the authors, agricultural output on a per head and per hectare basis has increased in value substantially, with food output tracking population growth (p. 263). "In addition, agricultural incomes are now supplemented by much more non-farm work than was formerly available" (p. 263). The growth in the output of non-subsistence products has created jobs in marketing, processing and the satisfaction of new consumer goods.

The explanation regarding success in environmental conservation lies on investment, knowledge, management, and local-level leadership, at times assisted by external advice and capital.

Figure 1. Population Pressure in High Potential Areas of Machako, Kenya




**Source:** Tiffen et al. 1994.

Conservation has been the result of the farmers' own investments of labour and capital into land improvement and development, at times assisted by external advice and capital. The physical changes have been accompanied, and underpinned, by changes in Machakos society which developed its knowledge and management capacity, and which broadened the basis of local leadership. This enabled it to select, evaluate, develop and use different technologies to react to changes in the markets for its labour, land, and feasible outputs (Tiffen et al., 1994: 263).

Finally, I will summarise the essence of Tiffen's model using Figure 2. The necessary conditions to enable people successfully respond to population pressure (either to out-migration to seek jobs, or by settlement of new lands) or by intensification of agriculture and the diversification of the local economy **in situ**, constitute availability of capital and security, knowledge of opportunities and technologies, economic incentives and access to jobs, land, or markets.

The integrative development model suggested by the authors, places the generation and use of new technologies (in conjunction with capital investments of labour and cash) as the central element in a nexus which leads from the initial point (population increase), via interactions of capital, technologies, aspirations, and effective demand, to more sustainable dry land management, diversification of the economy and higher per capita income.

At the theoretical level, these interactions (and their consequences) led the authors to the conclusion "that technological change is both impelled by' population growth and facilitated by the increased human interaction to which it gives rise (Tiffen et al., 1994:264). In addition, the authors underlined that the Machakos experience between 1930 and 1990 "lends no support to the view that population growth, even rapid population growth, leads inexorably to environmental degradation" (p. 284). Population has made land a scarce and increasingly valued asset. High rates of population growth (as much as 3 % in Machakos) "**are not intrinsically inimical to sustainable environmental management**", and these rates "were not exceeding the capacity of the system to evolve, and the capacity of the institutions to cope". Thus, according to the authors, "to argue for population limitation on environmental grounds weakens the case for it both theoretically and practically" (p. 284).

Lastly, the question of replicability of the Machako experience can be raised. In this connection, it is important to note the main features of Machakos, which included bimodal but low and variable rainfall, a strong economic base in export agriculture (with supporting institutions and infrastructure), a strong social cohesion at the village level, absence of a major breakdown of law and order or the horrors of civil war, low average soil fertility and increasing population densities. Noting these features and drawing from comparative studies (e.g. Pingali et al., 1987) the authors concluded that "the Machakos experience is being replicated elsewhere and is likely to have wide applicability".

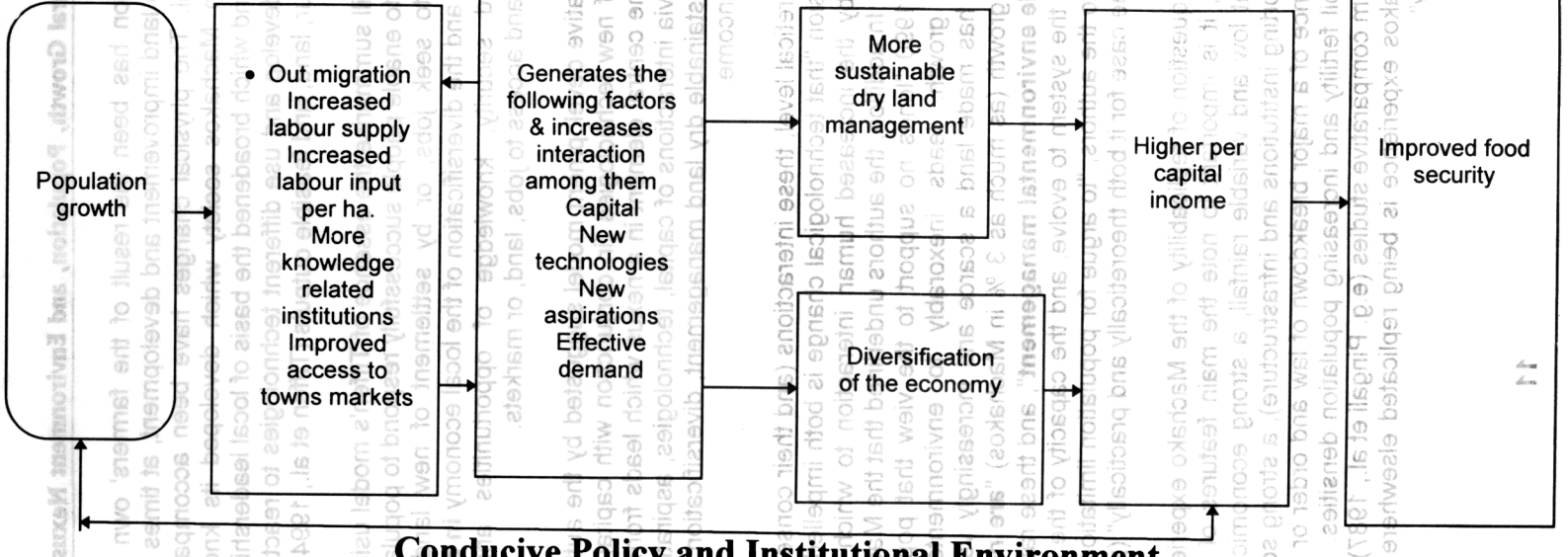



**Fig. 2. Positive Effects of Population Growth on Environment and Food Security**

**Source:** Adapted and simplified model of Tiffen et al. (1994:262)

## 9. AGENDA FOR RESEARCH IN ETHIOPIA

In Ethiopia, the dialogue on the relationship between population growth and environment has been dominated by the neo-Malthusian view. Authors like Abbi (1995) and have underlined the pessimistic view in the Ethiopian experience. This view was further popularised by the donor-funded Ethiopian Highland Reclamation Study of mid 1980s. Few authors ( e.g. Hoben 1995) entertain the optimistic view of the nexus in the Ethiopian context. On the other hand, authors like Singh (1999) argue that environmental problems in Ethiopia should not be discussed in isolation from the prevailing international economic order and associated injustices, which may be leading to environmental degradation. However, further study is required to settle the debate on the nexus in the Ethiopia context.

In this light it is possible to formulate the following questions to be investigated in the Ethiopian context:

1. The most densely-populated parts of Ethiopia, i.e. the enset growing areas are not the most degraded areas. Why? Do the intensive farming systems of the enset areas substantiate Boserup's hypotheses'?
2. To what extent have the globalisation process and commercial logging contributed to environmental degradation in Ethiopia?
3. To what extent have government policies contributed to environment degradation (and environmental rehabilitation) in the country?
4. What role have civil societies (e.g. Lem Ethiopia, Ethiopian Heritage) played in creating awareness about environmental problems and in rehabilitating degraded areas?
5. Some people propose that settlers from the North have caused more environmental damage than the native population. The resettlement scheme of the 1980s must have contributed to serious environmental problems in the Southwest.
6. Can the Machakos (Kenya) experience be replicated in parts of Ethiopia? Does Ethiopia satisfy the pre-conditions for the realisation of a strategy of "more people, less erosion"?
7. Currently, an interactive computer simulation model (population, environment, development, and agriculture; PEDA modelling) has gained currency within the ECA (see UN/ECA 1999) To what extent is this modelling exercise relevant to the Ethiopian experience?

### NOTES

[1] These adjustments occur sequentially, rather than instantaneously as in the standard static theory of production, if the changes involved are large, credit markets are not well functioning, and natural capital is non-marketable.

[2] See a review given in (Broad 1994).

[3] However, they do recognise that the two, i.e. changes in output and management, are closely related as shown by Boserup (1965), Ruthenburg (1980), Binswanger arid McIntire (1987), Pingali et al. (1987).

## REFERENCES


Abbi Mamo 1995, Environment, Population and Agriculture Development in Ethiopia. Ethiopian Agricultural Problems Transformation. In Proceedings of the Fourth Annual Conference on the Ethiopian Economy, Dejene Aredo and Mulat Demeke (eds.), Addis Ababa.

Alemneh, Dejene (1990). ***Environmental famine and Policies in Ethiopia: A view from the village.*** Boulder and London. Publisher.

Bilbsborrow, Richard (1987) 'Population Pressure and Agricultural Development in Developing Countries: A Conceptual Framework and Recent Evidence', ***World Development Journal***, 15(2): 183-203. Great Britain.

Boserup, E. (1965). ***The Conditions of Agricultural Growth: the Economics of Agrarian Change under Population Pressure.*** London: Allen and Unwin (Republished 1993, Earthscan Publications).

——— (1981). ***Population and Technological Change: A Study of Long-term Tends.*** Chicago: University of Chicago Press.

——— (1990). ***Economic and Demographic Relationships in Development.*** Ester Boserup: Essays Selected and Introduced by T. Paul Schultz. Baltimore, MD: The Johns Hopkins University Press.

Binswanger, H. P. and McIntire, J. (1987) 'Behavioural and Material Determinants of Production Relations in Land Abundant Tropical Agriculture', ***Economic and Cultural Change,*** 36(1), pp. 73-100.

Broad, Robin (1994) 'The Poor and the Environment: Friends or Foes?', ***World Development Journal,*** 22(6): 811-822.

Cuffaro, Nadia (1997) 'Population Growth and Agriculture in Poor Countries: A Review of Theoretical Issues and Empirical Evidence', ***World Development Journal,*** 25(7): 1151-1163. Great Britain.

Green, H. Regiuld (1991) 'Structural Adjustment and National Environmental Strategies, What Interactions? Notes from Namibia', ***IDS Bulletin***, 22(4), October.

Grigg, David (1979) 'Easter Boserup's Theory of Agrarian Change: a Critical Review', ***Progress in human Geography,*** 3(1): 64-84.

Hinchclitte, F., John Thompson and Jules N. Prelty (1996) ***Sustainable Agriculture and Food Security in East and Southern Africa. A Study by Sustainable Agriculture Programme.*** (2nd ed.), London: International Institute for Environment and Development.

Hoben, Allan (1995) 'Paradigms and Politics: The Cultural Construction of Environmental Policy in Ethiopia', ***World Development Journal,*** 23(6): 1007-1021.

Lele, Uma & Steven W. Stone. (1989). ***Population Pressure. The Environment, and Agricultural Intensification in Sub-Sahara Africa: Variations on the Boserup Hypotheses***. Washington DC

Lie, Koven and Chung-Chilu 1992, Sustainable Land use and Sustainable Development Critical Issues, in Margot Bellamy and Bruce Green shields (eds.), in Agricultural Development Sustainability and Development.

Panayotou, T. ( 1993) 'Population, Environment, and Development Nexus', In Cassen, R. (ed.) ***Population and Development: Old Debates.*** New Brunswick: New Conclusions Transaction Publishers.

Pender Jon L. (1998) 'Population Growth, Agricultural Intensification, Induced Innovation and Resource Sustainability: An Application of Neo-classical Growth Theory', ***Agricultural Economics,*** 19(1-2): 99-112.

Pingali, Prabhu, Hons P. Binswanger (1987). ***Population Density and Agricultural Intensification: A Study of the Evolution of Technologies in Tropical Agriculture.***

Robinson, W. and Wayne Schutier (1984). ***Agricultural Development and Demographic Change: A Generalisation of Boserup Model, Economic Development and Cultural Change***. Chicago: University of Chicago.

Ruthenberg, H. (1971). ***Farming Systems in the Tropics***. Oxford: Vlarendon Press.

Senait Seyoum 1999, Linkage between Food Security and Sustainability: A Policy Perspective. In Proceedings of the First National Workshop of NOVIB Partners Forum on Sustainable Land use. Taye Assefa (ed.) In Food Security Through Sustainable Land Use. Addis Ababa, Ethiopia.

Singh, K. N. (1999), 'Population, Environment and Development Syndrome: Some Interlocking Patterns and the case of Ethiopia', In Tegegn, G/Egziabher et al., (eds.) ***Aspects of Development Issues in Ethiopia.*** IDR, Addis Ababa University.

Swift, Jermy (1991) Local Customary Institutions as the Basis for Natural Resource Management in the West African Forest Zone',. ***IDS Bulletin,*** 22(4).

Tiffen, Mary. (1995) 'Population Density, Economic Growth and Societies in Tradition on: Boserup Reconsidered in a Kenyan Case Study', ***Development and Change,*** V, 26: 32-66. Institute of Social Studies, Oxford, UK.

Tiffen, Mary; Michael Mortimore and Francis Gichuki (1994). ***More People Less Erosion. Environmental Recovery in Kenya***. London: Wiley Publishers.

Toulmin, Camilla (1991) 'Natural Resource Management at the Local Level: Will this Bring Food Security to the Sahel?', ***IDS Bulletin,*** 22(3).

UN/ECA (1999) 'An Advocacy Tool Modelling the Interrelationships Between Population, Development, the Environment and Agriculture in Africa', ***Africa's Population and Development Bulletin,*** June-July, ECA, Addis Ababa.

World Bank (1992). ***World Development Report 1996***. Washington DC