Population and Sustainability: Understanding Population, Environment, and Development Linkages*

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ABSTRACT

The triple challenge of rapid population growth, declining agricultural productivity, and natural resource degradation are not isolated from one another; they are intimately related. However, strategic planning and development programming tend to focus on individual sectors such as the environment, agriculture, and population; they do not explicitly take into account the compatibilities and inconsistencies among them. Farm households and their livelihood strategies are at the core of the intersectoral linkages approach advocated in this chapter. Three key aspects of the population-environment-development debate are discussed: first, the finding that inconsistencies between public and individual household behavior regarding childbearing and family planning constitute a veritable "demographic tragedy of the commons;" second, the tendency to conceptualize population variables as "unmanageable," and exogenous to environmental and economic change; third, the importance of land markets and land tenure as critical population-sustainability policy issues.

1. INTRODUCTION

The challenge of achieving economic and environmental sustainability in the face of the most explosive population growth the world has ever known is daunting to developing country governments and to members of the donor community. What makes this challenge so formidable is that sustainability and population growth are not independent problems. They are intimately related. They cannot be isolated from one another and they cannot be addressed individually. Their solution is simultaneous and requires an understanding not of how they are unique, but of how they are linked.

Throughout the developing world, population growth is putting more pressure on farmland. Farmers with access to affordable inputs and in areas where agriculture is profitable are intensifying sustainably. That is, they are farming more on the same land but making appropriate land improvements and using inputs to maintain or enhance soil fertility. But far more common are the farmers who push their land to the limit without using enough fertilizer, manure and compost, or without protecting the land with terraces and bunds, or those who push their farming out into the commons to survive.[1] If they can foot the migration costs, they move to the cities and to the mines and plantations for work.

In turn, the degradation is reducing land productivity and increasing food insecurity. This growing poverty then results in higher birth rates, and the cycle is perpetuated. The policy and economic context has in some cases exacerbated this vicious circle by undermining the public agricultural support system. That system, in past decades (although in a costly and fiscally unsustainable way) helped make farm inputs affordable. Moreover, the reigning instability of

[1]The "commons" here refers to land under collective stewardship. It includes unexploited, virgin territories as well as heavily used farm and range lands.

prices and climate makes farming risky, which reduces the incentive to make the kinds of investments that would reduce the environment-agricultural tradeoff.

In short, the links in this system form a cycle as depicted in Figure 1. This figure draws our attention to population growth and its effects on how farming is practiced. In turn, the links are strong between the farm, the environment, and the rest of the economy, and these economic and physical outcomes in turn affect population growth. What happens to agriculture affects the farm environment, as well as the environment off farm in forests, hillsides and wetlands. And what happens to forests then affects food security strategies (wood and wild flora/fauna gathering and use of commons resources as inputs into service and small-scale manufacturing activities of rural families). It also affects the biodiversity of the ecosystem which is important to farming through species provision, and is often important culturally and socially, etc. What happens in the cities and the off-farm rural economy affects the alternatives farmers have to farming, as well as the means they can employ to buy inputs and hire labor to sustainably intensify farming. And, coming full circle, what happens to rural households' food security and incomes influences their health and decisions about childbearing.

In section 2 of this chapter we briefly describe our household livelihood strategies approach to the subject of sustainability and population growth. Section 3 reviews the cornerstones of the population-environment-development debate and some of the research literature that has fueled this debate. Section 4 summarizes what we have learned that will help inform the debate and lessons learned for development programming. We conclude in section 5 with a brief review of program and strategic implications.

2. APPROACH: HOUSEHOLD LIVELIHOOD STRATEGIES

Farm households and their livelihood strategies are at the core of the intersectoral linkages described above and depicted in Figure 1.[2] We take as our starting point the farm household surrounded by these conditions, and now pervasive in much of the developing world, particularly in sub-Saharan Africa: growing population pressure, declining agricultural productivity, and growing poverty. The approach focuses on the behavioral alternatives to demographic pressure, resource degradation, and poverty. The alternative paths, and the dynamic linkages among them, are far and away the farm household's most worrisome concern. As such, they must also constitute the top priority of the development planner, and figure prominently in major program decisions.

The above constellation of household-level paths and alternatives is depicted in the lower half of Figure 2. Farm/rural households can adopt a mix of activities in the farm and nonfarm sectors. To undertake these activities, they use family or hired labor, land they own or rent, and capital equipment and other inputs. Based on their "means of production" (family size and wealth in terms of land, money, and equipment), their short-term problem is to pursue activities that meet the income and food needs of the household. These choices, both in the short and the longer term, affect their health and nutrition, they affect the quality of their land, and they affect the forests, wetlands, and hillsides around them. In the longer run, choosing to invest in the "means of production" will affect household welfare. How many children they have, health care and education they invest in, and their migration patterns will affect labor availability for farm and nonfarm activities. Investment in farm capital or purchase of fertilizer and animals will affect their

[2]Support for the household strategies approach is gleaned from the recent conclusion by Falcon (1996) that the reformulation of the household as an economic entity is one of the most important research breakthroughs of the past decade, and that additional research on households and how they work is one of the most interesting analytical issues for the future.

ability to intensify production sustainably on the land they have. Their capacity to make investments will be conditioned by credit markets, but also by the wealth available from livestock husbandry, cash cropping, and nonfarm activity. The latter is often of special importance both as a source of cash to make farm investments, or, alternatively, as an "escape valve" to relieve growing demographic pressure.

Hence, the farm household sees that what it does in the nonfarm sector affects what it can do in the farm sector, what education investments it can make, and how reliant it is on the land. It also sees that its childbearing and education decisions affect what chances it has to work off-farm (and at what wage), and how much family labor it will have to meet farming and land improvement needs. In short, the household must engage in cross-sectoral strategic planning to meet its needs. It can combine complementary sectoral choices, or choose between alternative paths.

We argue here that governments and donor missions face very similar sets of choices and opportunities, but at an aggregate level. We posit further that these actors, unlike households, are less likely to recognize the links among these choices and take them into account in their strategic planning, and this to their detriment. The top half of Figure 2 shows the interrelated challenges to development programming, and one can see that they parallel those faced by rural households. Where the household weighs investments in human capital (in education, in health, in numbers) and in "social capital" (in connections to local governments, in social status, in links to other households), governments and donors weigh investments in education, public health, democracy and governance structures, and so on. Where households make decisions about household members and labor (childbearing, training, time allocation, etc.), governments and donors weigh the relative merits of family planning programs, worker training, extension service funding, and so

on. Where households make choices about farm and off-farm capital investments, governments and donors weigh the hard and soft infrastructure alternatives such as roads, dams, dikes, irrigation systems, agricultural research institutions, communications, and so on. Where households strike a balance between farm and off-farm income generation, governments and donors strike a similar balance in their support for agricultural development and nonfarm small business promotion. Finally, where households struggle with erosion and degradation of their farm lands, as more and more time is spent searching for grazing land or fuelwood or clean water, governments and donors struggle with the aggregate consequences of peasant survival strategies, of logging, mining, and plantation land-use, and of profit-making strategies on the land and its water and biodiversity resources, both on-farm and in the commons.

Hence, the parallels are striking between what the household must decide in a "multisectoral world," and what the government and donor face. But where the household sees naturally the links because it must (for instance, it knows it must start an off-farm business to generate the cash to buy a plow), very different thinking and strategizing prevails in many governments and donor missions. For instance, rarely does a ministry of agriculture meet with a ministry of industry to confer on complementary strategies for rural development to make the links and create "virtuous spirals" of growth in the two sectors. Rarely would a small business promotion unit in a donor mission mesh its strategy with that of the agricultural development office; rarely would the population unit take into close account the rural household's economic survival strategies on and off the farm, and how these relate to their fertility, migration, health care, and education decisions.

This lack of strategic linkage can be dangerous, not only because it means stopping short of finding the best possible complementary solutions, but because a seemingly well-conceived "sectoral" strategy can be easily undermined by factors developing outside that sector, factors that

need to be spotted and dealt with as part of the larger program strategy. For example, a program designed to protect a biodiversity-rich forest in Madagascar cannot neglect imposing problems in the farm sector. To survive, demographically-squeezed farmers will relentlessly push farming up the hillsides and into the forest. If fertilizer becomes too expensive, or roads too poor, or farmland too degraded, farming is undermined and desperate extensification ensues. A good farm strategy can thus be at least as important as a good forest strategy or population control strategy in saving those forests.

3. KNOWLEDGE GAPS IN THE POPULATION-ENVIRONMENT-DEVELOPMENT DEBATE

The population-environment-development debate is important to us because it provides a framework for understanding intersectoral linkages, and because it helps us define the context and very nature of the individual linkages. In turn, policy and development programming can be improved by taking into account what we know about the compatibilities and inconsistencies among strategic objectives in key sectors. This section provides an overview of the ongoing debate and identifies shortcomings in previous research and associated gaps in the literature. We begin with a short review of the defining parameters of the debate.

Ecological theory tells us that, over the long term, there are two interrelated sets of responses that populations will muster in adapting to greater population pressure and resource scarcity (Gibbs and Martin 1959, Bilsborrow 1987). They are systemic adaptations that occur gradually, usually over periods of one or more decades, that can profoundly change the structure of rural life. The first response is to change the population's size through lower fertility, higher mortality,

and/or emigration. The second is to change the productive economy of the population toward more diversified and specialized use of labor, and using more productive technologies (Cohen 1968). We note that the economic response often entails a demographic change when household members are obliged to migrate to cities and mines and other places where more diversified and specialized jobs can be found.

These two adaptive responses, one largely demographic and the other economic, have received considerable research attention over the years, and their relative importance to understanding present day development issues has been hotly debated. Our objective in this section is not to review the many twists and turns in this great volume of literature.[3] Rather, we briefly discuss some of the cornerstone positions and research directions that define the debate.

3.1 Cornerstones of the population-environment-development debate

The demographic response has been a focal point the debate since the time of Malthus, whose writings depicted the dangers of population growth—notably higher mortality through disease, war, famine, and other "positive checks" that populations endure as they readjust to the carrying capacity of their resource base (Malthus 1798). To Malthus, and to his latter-day disciples (e.g., Meadows et al. 1972, Demeny 1981, Ehrlich and Ehrlich 1991), demographic change is necessary to avert continued resource degradation and a declining standard of living.

Yet a main, perhaps the main, place where environment, population, and development interact is *on* the farm itself, and this is important because farmers constitute the vast majority of the Third World population. What happens on the farm affects whether and how much farmers need to rely on the commons for new farm land to extensify, or for alternative income through selling wood or

[3]See Weeks (1989) for a detailed review of the population-development debate.

herding. Hence, whether farmers can derive greater output from their landholdings—through sustainable intensification—is the crucial issue.

Boserup (1965, 1981), Ruthenburg (1980) and others have focused the debate on the economic (income generating) response (intensification) with the hypothesis that demographic pressure causes populations to intensify their systems of agricultural production with more labor, improved inputs, etc. Boserup (1965) outlines a number of technology and investment paths to agricultural intensification that farmers follow in the wake of increased land constraints—conditions that result from population growth, increased demand for agricultural products, or reduced transportation costs (Boserup 1965, Pingali et al. 1987). To set the stage for our subsequent discussion, we distill and stylize from her work two broad paths.

The first we refer to as *capital-led* intensification, which entails, in addition to the use of farm labor and land, the use of "capital," the latter broadly defined to include nonlabor variable inputs that enhance soil fertility (such as fertilizer) and quasi-fixed capital that protects the land. The second path makes little or no use of "capital" (as defined above), so we refer to it as *labor-led* or *labor-only* intensification. Farmers merely add (unaugmented) labor to the production process on a given unit of land, allowing them to crop more densely, weed and harvest more assiduously, and so on.

Empirical research on agricultural intensification in developing countries has illustrated the two intensification paths initially described by Boserup, and here labeled the capital-led and labor-led paths. In the African context, several studies have categorized the agricultural systems in certain regions where demographic pressure has pushed farmers to intensify along these paths. For example, Matlon and Spencer (1984) note that the capital-led path is more sustainable and productive in fragile, resource-poor areas. Lele and Stone (1989) categorize a variety of agro-

climatic and policy settings in terms of these two paths, focusing especially on the need for the capital-led path (which they term "policy-led"). They maintain that the labor-led path (the "autonomous model" in their words) has not led to land productivity growth in sub-Saharan Africa, and that policy-led intensification is needed so that land quality and productivity will be maintained and even enhanced as cropping is intensified.

In much of the tropics, the labor-led path to intensification is unsustainable, and leads to land degradation and stagnation of land productivity (Matlon and Spencer 1984). This danger is at its maximum in the East African highland tropics and other highland areas in Asia and Latin America, which are characterized by heavy rainfall and steep slopes. In the latter setting, the capital-led path of intensification that incorporates land conservation investments with the use of organic matter and fertilizer is much more sustainable. By contrast, areas that follow only the labor-led path in that setting are on course for long-run ecological degradation and poverty.

Hence, the question of what determines the particular technology and investment paths that households follow in response to growing demographic pressure is of critical importance in the current debate on sustainable development. The following two research gaps are areas we believe to be germane to advancing the population-environment-development debate in general and to understanding household livelihood strategies in particular.

First, household strategies as the behavioral basis of population-environment-development links have not been adequately explored. We need to know how households integrate demographic, income, and resource use strategies, and how opportunities in one sector reinforce those in another. Understanding the interactions between households' employment off-farm, for example, and their incentive and capacity to invest in sustainable intensification, food purchases, education of their children, and so on, is instrumental to strategic thinking and the way we

approach development programming. The same is true for household decisions about childbearing, decisions that are intimately linked to both income and sustainable land management strategies.

Second, though sustainable agricultural intensification has become necessary and common in densely populated regions throughout the developing world, the "classical model" (Boserup 1965) of the context and characteristics of intensification is conditioned by three factors that subsequent macro-level analysis and debate have not taken into account.[4] The household strategies approach adopted here draws the three factors into clear view and provides a framework for examining alternative intensification paths. These conditioning factors include: the growing importance of non-farm employment/income diversification (Reardon et al. 1994), growing participation in the market economy, and the recognition that peasant strategies that promote intensification may require labor—an incentive for higher childbearing, which in turn increases the need for intensification, diversification and cash cropping.

4. INFORMING THE DEBATE: OBSERVATIONS AND CONCLUSIONS

Based on our work in Rwanda, Madagascar and elsewhere in Africa, we derive three key sets of observations and conclusions that we believe help inform population-sustainability dimensions of the debate described above. The first of these observations leads to the conclusion that inconsistencies between public (official) and individual household (couples) behavior regarding childbearing and family planning constitute a veritable "demographic tragedy of the commons." The second addresses the tendency of development frameworks to conceptualize population

[4]These three factors were first described by Clay and Reardon (1996) in their discussion of population-environment-development linkages in Rwanda.

variables as "unmanageable," and exogenous to environmental and economic change. The third targets land markets and land tenure as critical population-sustainability policy issues. We return to each of these observations and conclusions in greater detail below.

4.1 Government and donor attempts to slow population growth (via family planning) are not always seen by households as complementary to their income strategies

Nearly all countries of the Third World are under considerable ecological stress due in large measure to decades of unprecedented demographic growth. Reports from PRB... (19??) conclude that the governments of the vast majority of these countries are committed to relieving the pressure of population growth through lower birth rates.

However, even though policy-makers and public opinion in these countries recognize the importance of slowing high birth rates, fertility behavior at the household level often runs counter to this antinatalist position. Particularly among farm households, having *more* children increases family "success" and continuity through greater household wealth, security, and social standing. More hands mean more land is farmed and more food is grown; a larger family helps diversify income sources and manage risk; some land improvement and intensification practices are labor intensive and require a larger pool of household and/or hired labor; a large family is a sign of household standing in the community, and can help ensure that parents are cared for in their old age. Research in Rwanda (Clay and Reardon 1996) illustrates the importance of increased fertility to household success. Evidence from Madagascar (Shaikh et al. 1995), and many other parts of sub-Saharan Africa shows a similar pattern.

Thus, we conclude that at the household level, the level at which fertility and family planning decisions are made, the classic demographic response discussed earlier is flawed. Reducing fertility, for households in sub-Saharan Africa facing land constraints, is *not* perceived to be an alternative to other strategies such as income diversification, cash cropping, and intensification. Indeed, to make these income strategies work, households often see the need for even greater household labor through higher birth rates.

What factors account for these incongruous views? We posit that the contradiction between public (national and community) and private (households) fertility goals is tied to the notion of intergenerational wealth flows. In rural settings across the developing world, the net flow of wealth moves from the younger generation to the older generation—from children to parents.[5] Despite the initial costs of raising and feeding children (among the Z-good costs), their labor, beginning as early as six years of age and continuing through the parents' lifetime, will far surpass these initial outlays to raise them. Labor provided by the younger generation can take a number of forms, from herding cattle, gathering wood, and looking after younger siblings as children, to adult tasks such as tilling the fields and caring for parents in their old age. On balance, parents see children as a net asset to the household economy, not as a liability (Caldwell 1976, p. 343). Thus, more children are better than fewer, and this is true even for poor households whose access to land and other opportunities are limited.

Yet, the entry barriers to eventually finding employment off-farm are high and often insurmountable, especially for children of landless and near-landless households. These include school fees and related costs, the expense of sending migrant adolescent children to the city and maintaining them during their search for work, and the on-farm opportunity costs of their

[5]See Clay and Vander Harr (1993) for a review of intergenerational support and childbearing in the Third World.

schooling and/or migration. Thus, when asked about what children will need to do to survive in the absence of sufficient land, we found that the Rwandan parents in our study sample responded overwhelmingly that their children will just have to "make do on their own."[6]

This response reflects the peasant farmer's preoccupation with the survival of the household and extended family group, even if it means that some of its members may be marginalized and left to their own devices. Focusing on what's best for the household is what has ensured household success in the past.[7] High fertility and a large pool of household labor is what's best for households in which wealth flows upward.

As a result, many of these children fall short of parental aspirations. More often than not, the social costs associated with their failure to find productive employment falls on the shoulders of the larger population, and not on those of the parental household. But therein lies the dilemma—it is a veritable "demographic tragedy of the commons" (Clay and Reardon 1996). While households maximize their fertility to enhance their own station in life, those landless and unskilled children who are unable to find ways to contribute to the household economy are left to fend for themselves. Often they make their way to the city or to labor-deficit rural areas (Clay and Ngenzi 1990). The fortunate ones find employment as occasional wage laborers, but many others do not. Their costs in terms of schooling, housing, medical care, crime prevention, criminal justice, and social instability are borne by the larger community.

Indeed, we contend that the perception of "population pressure" is unknown to households where wealth flows from the younger to the older generation. The smallholder does not "feel"

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[6]Source: unpublished tables from the 1988 Rwanda Non-farm Strategies Survey conducted by the Rwanda Ministry of Agriculture.

[7]Indeed, elevating the household/family group above individual needs is a cultural imperative, a universal cultural adaptation that has helped ensure the continuation of human populations through the course of time.

demographic pressure any more than the largeholder does. The two face the very same challenge: to keep the *household* out of poverty—which can be hard work and fraught with uncertainty even for those with resources. To be sure, those with little access to land are closer to the margin and more uncertain since their strategies for employing household labor are not as simple as for those with plenty of land to till. But in either case, a larger family is more likely to secure the future of the household than is a smaller family, since only those children who manage to contribute to the household economy count toward household success. Those who do not or cannot contribute are not viewed as a sign of failure where wealth flows from children to parents.

Thus, from the household's point of view, the challenge is one of working out a livelihood strategy that maximizes the use of household labor vis-a-vis available land and capital. Our research shows that the challenge is greater and the linkages among strategies are stronger among households with the least land. The pressure is to find employment, either on the farm or off, for all able household members. All else equal, prosperity accrues to households that are large in number and that manage their numbers effectively. Failure to do so is a missed opportunity for the household; it is a tragedy for the child who faces a potential lifetime of poverty, and for the community that shares this cost.

Even though fertility rates in many Third World countries have begun to decline in recent years, resistance to fertility control measures will remain strong in these countries because of the importance of household labor to the success of intensification and income diversification strategies. Until the intergenerational flow of wealth reverses direction, as it has already throughout the West and other parts of the developed world, the tragedy will play on. Other research has shown that reversing the direction of wealth flows is closely linked to investments in human capital, notably the education and autonomy of women (Caldwell 1980, 1982).

4.2 Population changes are not independent of changes in household strategies, environmental degradation, and income growth

The separation of strategic planning in the population domain from that in the environment, agriculture, and enterprise development domains is unfortunate for the reasons described in section 2. Conventional NRM and economic development frameworks and literature have tended to reinforce sectoral thinking and sectoral boundaries by characterizing population variables (fertility, mortality, and migration) as "unmanageable," i.e., as an immutable force that lies outside of the "influenceable" realm. The treatment of population in AID's NRM framework (???? 19??) is illustrative of this limitation. It groups population with agro-ecological conditions (such as rainfall and soil type) and other non-behavioral, exogenous variables.

One factor that has contributed to the practice of treating the demographic side of the population-environment-development nexus as exogenous to the others is the notion of "population momentum," i.e., that even if children alive today reduced their own childbearing to replacement-fertility levels, because of their sheer numbers, it would take 30 years or more for the population to actually stop growing. While this is fundamentally true, we must note that the adverse impact of population growth would decline steadily to zero during these 30 years.

Not often recognized is the fact that environmental changes and improvements in household incomes can be equally slow in coming, and generally require far greater human and physical capital investment by households, governments, and donors. For example, land lost to poor land management practices (e.g., lack of conservation investments in Rwanda, hillside and forest slash-and-burn (*tavy)* production in Madagascar, bush-cover removal and desertification in Niger) will

take decades to turn around and make productive again. And changes that have led to a decline in livestock inventories, pasture, and knowledge of animal husbandry practices in Rwanda, Madagascar, and other parts of sub-Saharan Africa, coupled with low income levels, mean that development of more intensive livestock systems in these countries will now be doubly difficult to regenerate. There is an entire generation of young farmers in these countries who hold little or no experience in how to integrate livestock and cropping systems and it will take decades to rebuild this lost momentum.

Treating population as an exogenous variable is especially problematic in that it obscures the fact that population-environment-development links are highly interactive. Fertility, mortality, and migration patterns can all influence income strategies and the ways in which households manage land and other resources, but these population variables are in turn affected by household income and resource management (i.e., reverse effects). As countless studies have shown, incomes and access to resources can be important determinants of household migration. Likewise fertility and mortality rates are known to vary with income levels and landholding. In Rwanda, for example, we show that access to land, resulting higher incomes and better nutrition, has increased household labor through lower mortality (Clay and Johnson 1992).

Labor availability and use is never taken for granted by households in their efforts to generate income and keep a step ahead of poverty. Governments and donor organizations can learn from this insight, and not treat population variable as "given" in their approach to development programming.

4.3 Land markets and land tenure are critical policy issues mediating how population increase translates into problems for agriculture and the environment

The link between population pressure and land degradation is indirect. To address this link in terms of policy or program action we must focus on the intermediate mechanisms that connect the household's labor supply to its land management strategy (land use and investments in land conservation and fertility). Our research has demonstrated that the *structure of landholding* is central to on-farm population-environment interactions. The structure of landholding includes that set of bio-physical characteristics (size of holdings, fragmentation and dispersion, fragility, and years of cultivation, etc.) and economic/social characteristics (land tenure and profitability of land use) that define the farmer's incentive to invest in the long-term sustainability of his/her land.

Increasing population pressure and the ensuing competition for scarce land resources precipitates a restructuring of these physical and social attributes of landholding. Observations from our studies reveal some of these changes. More than ever before, farmers must rent the land they operate (shorter term use rights), family landholdings have radically diminished in size, and in highland areas farmers see little alternative to farming the steep and fragile slopes that once were held almost exclusively in pasture, woodlot and fallow.

How have these changes affected the long-term sustainability of farming? In Rwanda and Madagascar, for example, we found that traditional inputs such as compost, manure, and mulch invariably go on fields owned by the farmers and especially on those located nearer to the family compound. The same principle holds for field improvements such as the installation of terraces, hedgerows, grass strips, and drainage ditches—rented fields, distant fields, and the steep, fragile fields are largely ignored. Unless farmers can anticipate an economic return commensurate with

their level of investment there will be little incentive for them to adopt such practices. As fields become more distant, steeper (less stable) and increasingly farmed under short-term lease agreements, cost-benefit ratios of conservation technologies will become even less favorable to the individual farmer—the net result being an acceleration of land degradation.

Thus, apart from the obvious need for political stability in countries like Rwanda and Madagascar, our focus on population-environment-development linkages shows that farmers need confidence in the longer term through secure land tenure. This means reducing the risk of appropriation and the right to transact land. Enhancing farmer access to the land market will require reform of existing and antiquated land laws prevalent throughout the developing world.

5. CONCLUDING REMARKS

The challenges of achieving economically and environmentally sustainable development under conditions of surging population growth will require the right analytical tools and strategic approach. Government officials and development programmers must seek effective synergies and balance among "sectoral" program goals such as agricultural intensification, income diversification, and family planning. Government and donor strategic and program planning needs to mirror the same set of interactions made by poor rural households. Understanding how rural households behave, how they plan, how their strategies are formed and linked, is critical to understanding how programs and policies can best increase their welfare and reduce conflicts among goals.

Not too late, we think, there are moves afoot to start making these strategic links, in a practical way, in governments and donor missions. "Reengineering" at the U.S. Agency for International Development has that idea at its base, as did the Rio conference, the GREAN

initiative,[8] and others. This chapter has provided grist and support for making these links—deeper and faster in donor mission and government strategizing and programs—and has provided examples of where links are important and action is called for. Though we have focused here on the demographic dimensions of sustainable development, we have also demonstrated that insights into the environmental and agricultural linkages are equally scarce and every bit as essential to the challenge. Other chapters in this volume will take up these complementary topics.

[8]GREAN (Global Research on the Environmental and Agricultural Nexus for the 21st Century) is a strategy designed to promote and fund collaboration between U.S. scientific institutions, centers in the Consultative Group for International Agricultural Research (CGIAR), and the National Agricultural Research Systems (NARS). The goal of this three-way collaboration is to address simultaneously the triple global challenge of environmental degradation, population increase in the worlds poorest nations, and declining agricultural productivity (GREAN 1995).

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Figure 1. Dynamic Links

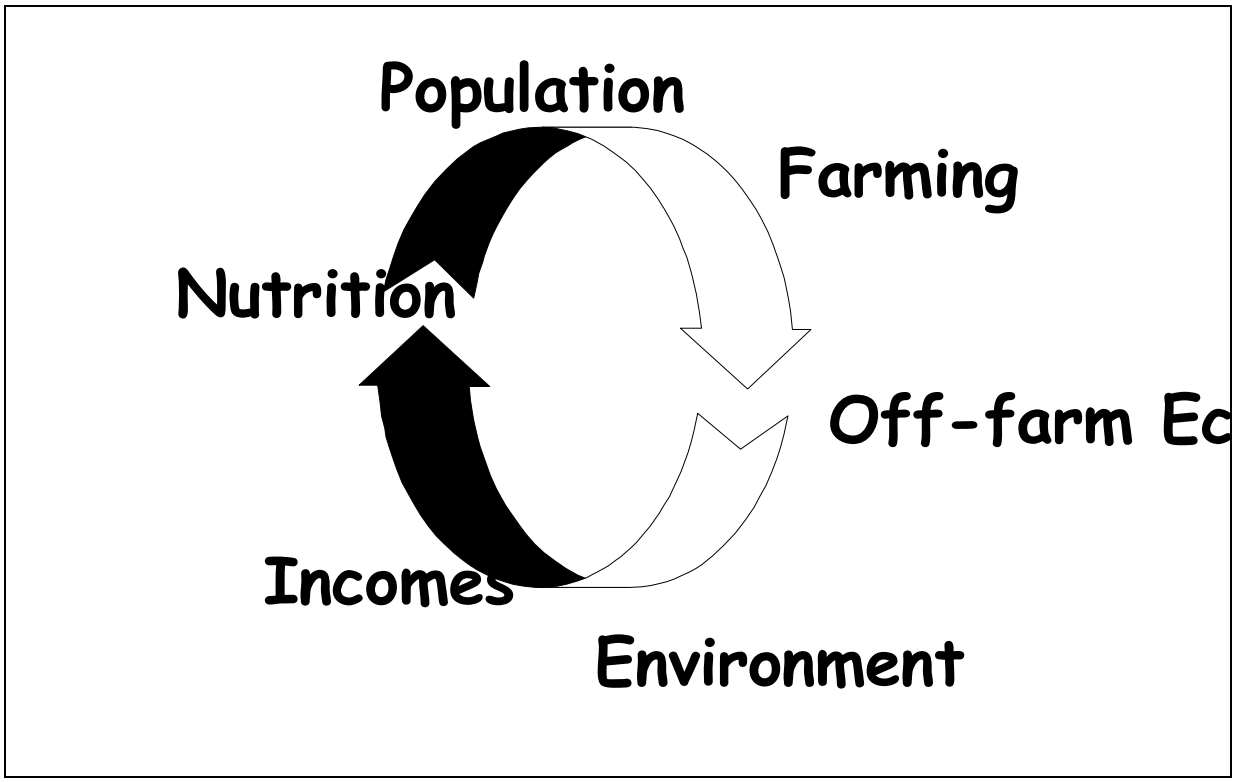

Figure 2. Linking natural resources, human resources and farm/non-farm activities is as important for development programmers as for farm households. Investments in human and physical capital cross-cut these linkages at both levels.