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Population Pressure, the Environment, and Agricultural Intensification: Variations on the Boserup Hypothesis

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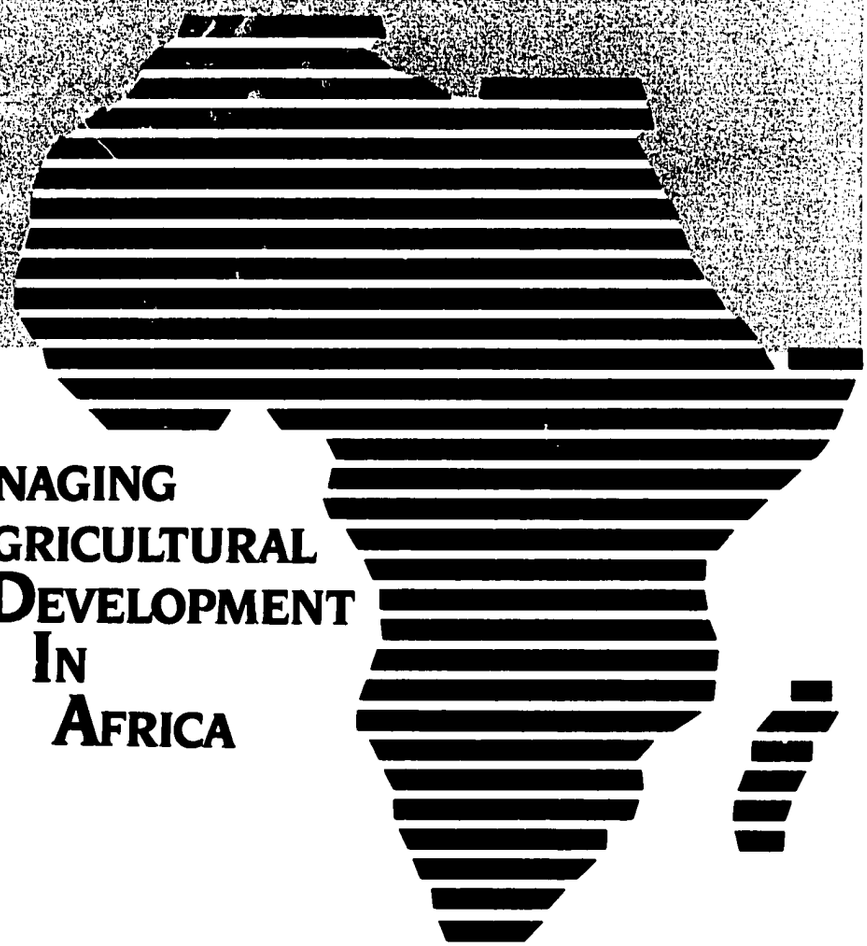

MANAGING AGRICULTURAL DEVELOPMENT IN AFRICA

THE MADIA STUDY

Although many generalizations have been made about the agricultural crisis in Africa, relatively few detailed country and cross-country studies of African agriculture based on systematic data analysis have been conducted. Similarly, although foreign aid has constituted a large part of total government expenditures in Africa for close to fifteen years, there has been little analysis of the role of external assistance in African countries that goes beyond political criticism of official assistance or the alleged self-serving objectives of donors. The impetus for the study "Managing Agricultural Development in Africa" (MADIA) was to begin the process of filling this gap and to explain the nature and sources of the agricultural crisis, particularly the extent to which it originated in resource endowments, historical and contemporary events, external and internal policies, and the economic and political environment.

The MADIA study involved detailed analysis of six African countries—Kenya, Malawi, Tanzania, Cameroon, Nigeria, and Senegal. In addition to the World Bank, seven donors, USAID, UKODA, DANIDA, SIDA, the French and German governments, and the EEC participated in the study. The analysis of country policies and performance during the last 20-25 years was carried out with the benefit of substantial input from the governments and nationals of each of the countries represented. The study had three main areas of focus: (1) the relationship between domestic macroeconomic and agricultural policy and agricultural performance, (2) donors' role in the development of agriculture, and (3) the politics of agricultural policy.

The MADIA study was the result of encouragement and support from many people. Anne Krueger, former Vice President for Economic Research Staff in the World Bank, encouraged the establishment of these studies on aid and development in 1984. Gregory Ingram, former Director of the Development Research Department, provided unstinting support for the study. During the reorganization of the World Bank in 1986, the strong support from Benjamin King, then acting Vice President for Economic Research Staff, proved invaluable. Barber Conable, President of the World Bank, and Mr. Edward V. K. Jaycox, Vice President for the Africa Region, have played a key role by ensuring support for the study's completion, as did Stanley Fischer, the Vice President for Development Economics. Yves Rovani, Director General of the Operations Evaluation Department, was particularly helpful as the MADIA study drew heavily on the works of OED.

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"Population Pressure, the Environment, and Agricultural Intensification: Variations on the Boserup Hypothesis"

The earlier draft of this paper, circulated with the beige MADIA cover, did not reflect comments from various reviewers. In this final version, some of the views of agronomists on the extent of soil degradation caused by population pressure and the issues of land quality are better represented.

POPULATION PRESSURE, THE ENVIRONMENT, AND AGRICULTURAL INTENSIFICATION IN SUB-SAHARAN AFRICA: VARIATIONS ON THE BOSERUP HYPOTHESIS

UMA J. LELE • STEVEN W. STONE

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Acronyms

ADD	Agricultural Development Division (Malawi)
ADMARC	Agricultural Development and Marketing Corporation (Malawi)
ADP	Agricultural Development Program (Nigeria)
DHS	Deloitte, Haskins, and Sells
DPGA	Direction Générale de la Production Agricole (Senegal)
FAO	Food and Agriculture Organization of the United Nations
GTZ	German Agency for Technical Cooperation
IIASA	International Institute for Applied Systems Analysis
IBRD	International Bank for Reconstruction and Development
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
KTDA	Kenya Tea Development Authority
MADIA	Managing Agricultural Development in Africa
NCPB	National Cereals and Produce Board (Kenya)
NMC	National Milling Corporation (Tanzania)
NRDP	National Rural Development Program (Malawi)
NSO	National Statistical Office (Malawi)
SAED	Société d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Senegal et de la Faleme (Senegal)
SEMRY	Société d'Expansion et de Modernisation de la Riziculture de Yagoua (Cameroon)
SODECOTON:	Société de Développement du Coton du Cameroun (Cameroon)
TCC	Tobacco Control Commission (Malawi)
UNEP	United Nations Environment Program
UNFPA	United Nations Fund for Population Activities

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Summary and Policy Recommendations

In this paper we explore the relationship among population densities, agricultural production, land, labor, and rural incomes to expand the explanatory base of the Boserup hypothesis, which holds that with increasing population densities, a corresponding shift to greater agricultural production and more intensive use of the land takes place autonomously through the development of market forces. The movement away from traditional area-extensive farming methods is associated in the model with higher levels of technology, labor, and capital investment in land. In view of the rapid rates of population growth in Africa and the decreasing frontier, the question arises: "how far can market forces alone induce a productivity-enhancing process of agricultural intensification in Sub-Saharan Africa, and to what extent must it be complemented by an active public policy to support broad-based agricultural development?" The answer is critical to the increasing concern about food security and environmental degradation prompted by rapid population growth on the one hand, and on the other, to the pressure on governments to privatize smallholder services because of fiscal problems and questions about the efficiency of the public sector. To address these issues, the paper surveys existing literature and compiles data at the regional level for the six MADIA countries to isolate variables in the equation linking the intensity of land use, the increasing opportunity costs of idle or fallow periods, the effects of continuous cropping on the soil, and their policy implications.

Two types of intensification are distinguished in the paper. The first type, identified by Boserup, occurs spontaneously as more land is cropped more frequently in response to higher population densities. The second depends more on policy and incentives for a shift to crops of higher value or higher yields, or to more productive land. The spontaneous movement toward better adapted technology and higher levels of productivity was observed first in the development of Europe and Asia, a process we have termed "autonomous intensification." This paradigm of demand-led growth has served as the standard model, but worsening conditions in Africa are casting doubt on its value as a historical precedent. A combination of apparently more fragile African soils, declining rainfall, and historically unprecedented population growth rates in circumstances of unequal political power between the mass of smallholders and the privileged few makes the exclusive dependence on the market for achieving rapid growth in productivity more questionable in Africa. The paper documents several inherent limitations in the original model, e.g., (i) the negative effects of extremely rapid population growth as compared to the slowly rising densities envisaged in the hypothesis; (ii) the substantial concentration of population, even in land-abundant countries; (iii) the conflict between social and private gain of large family size at low levels of labor productivity for poor households; (iv) the tendency to "mine" the land for immediate survival versus the social need to protect soils as a productive resource; and (v) unequal access to land and even expropriation from smallholders as land values increase. The limitations of the hypothesis have not been easy to document because of contradictory and inadequate information about such matters as the extent of arable land remaining, but the scattered evidence presented in the paper suggests that the environmental damage caused by deforestation, decline in soil fertility, and retrenchment into subsistence and wage labor may well outweigh the effects of autonomous intensification. The movement against autonomous intensification is associated with rapidly declining farm sizes for the majority and marketed surpluses coming from fewer sources.

The second, less obvious type of intensification must therefore extend the Boserup hypothesis to include measures of output and productivity as well as the frequency of cropping. The process of using an increased role of the state to enhance productivity we call "policy-led intensification." The paper shows that higher yields, better inputs, and larger incomes for small farmers do not axiomatically follow from higher population densities or more frequent cropping of the land. Three measures of this latter type of intensification are particularly salient. Research indicates that:

1. **Shifts to Areas of High Potential** (and subsequent expansions onto marginal areas) occur spontaneously, but are in some cases restricted either explicitly by public policy toward land use or by natural or social causes. In the MADIA sample, population naturally gravitates toward the most productive land (where returns per hectare are highest), except where disease and pests pose a significant health problem, or where land policy proscribes this type of shift by giving a few estates preferential access to land over small farmers (as in Malawi) or constrains population movement (as did the Ujamaa policy in Tanzania). In other cases (such as Kenya), smallholders have recourse to legal ownership, but the process of titlement is fraught with unequal access to capital and land, due to ethnic biases, conflicting tenure customs, and registration fees. In situations of high population densities, the paper documents a phenomenon of outward migration to marginal areas when land in high potential areas is no longer accessible. This type of "regressive intensification," which simply amounts to mining nutrients from the soil, is not sustainable but is becoming pervasive.

2. **Shifts to Higher-Yielding Crops** by a large number of small farmers are made urgent by population pressure but remain dependent on policy. One way of improving crop yields is to promote high-yielding varieties of seed and complementary modern inputs such as fertilizers. The extent to which research priorities are tailored to the needs of small farmers will critically affect whether the "improved" planting material will have local appeal. If new seeds require additional cash inputs, are vulnerable to drought, do not store, process, taste good, or in any

way increase the element of risk in cropping, they will probably not be adopted even where population density is high. Adopting hybrids or using more inputs to boost yields will depend on the degree of farmer confidence in the market to purchase crop surpluses. The case of hybrid maize in Malawi is one such example. Similarly, in Senegal the paper documents a return to planting sorghum and millet, reflecting the farmers' desire for greater food security over potential (but risky) gains from higher-yielding or higher value crops at international market prices.

3. **Shifts to Higher Value Crops** depend as above on farmer confidence in the market, but also on the legal right to grow such crops. Ironically, population density appears to have little bearing on whether governments encourage or circumscribe smallholder production of cash crops. (Nonfood crops mainly produced for export have in a traditional parlance been called cash crops and data for a number of countries is reported as distinguishing between cash and food crops although food crops are also frequently sold for cash.) Densities are extremely high in Malawi and low in Tanzania, but each has pursued policies effectively curbing the supply response of smallholders to export crops. Either they cannot grow high value crops, or they have until recently had no incentive to do so. At the other extreme are Kenya and Cameroon. Although densities run much higher in Kenya, both have adopted policies enabling the small farmer to reap the fruits of higher value crops. These policies include ensuring rural transport, passing along close to world prices, and providing a variety of support services that enable small farmers to grow these crops.

The paper demonstrates how over time the changing demography of a country will alter relative opportunity costs and factor endowments; these changes will be most visibly manifest in the first type of intensification. High on-land densities, however, do not lead directly to progress in intensification as defined in this paper. The shift to higher-yielding and higher value crops and more productive land, as opposed to merely cropping the land more intensively and "mining" soils, requires that changes in factor costs be reflected in agricultural pricing and marketing, land tenure, and crop research policy. Three countries in particular—Kenya, Malawi, and Cameroon—have provided a stable policy environment and performed well, but broad-based growth was achieved only in Kenya, and even there gains in the smallholder sector came mostly through shifts to higher value crops such as tea rather than improvements in yields per hectare, as was the case in the large farm sector. In circumstances where price distortions are not compensated for by public initiatives or policies do not facilitate the move to intensification, environmental degradation will increase as a very rational response to the conditions of rural households.

The paper finds that the most direct means of addressing the problems of rapid population growth and environmental stress include among others the following:

- **Redefining land policy:** The land base and the degree of population depending on it for their livelihood need to be assessed. When left to market mechanisms, access to land must be ensured by policy measures to overcome the various constraints (social, cultural, economic) to equal access. Land policy must be complemented by a detailed inventory of data on rights to land, its use, potentials, and availability. The paper documents that despite massive amounts of external aid to Africa for nearly a decade and a half, such most basic information is not widely available: it simply has not been a priority for either governments or donors. Such data facilitate public debate within each country on the sensitive land issue and obviate the tendency for it to become part of highly visible lending conditionality. Bilateral donors with lesser perceived power than multilateral agencies such as the World Bank need to take a lead in this crucial but basic task of helping African countries to develop and analyze information on land policy by encouraging African scholars to work on the issue, and by helping to implement an equitable legal framework.

- **Stabilizing production and consumption policies:** Production policy must aim toward rapid, equitable, and highly participatory growth. That process will require stable buying and selling prices to increase farmer confidence to grow high value crops and rely on the market to provide food staples. Predictable or reliable incentives and clearly stated national objectives will help farmers to plan ahead and finance investments in the land and sustain broad-based productivity increases. The following means are available to ensure that end:

  - **Targeting crop research:** introducing seed varieties that reduce risk and complement traditional farming strategies. Integrating soil management techniques, such as nitrogen-fixing fodder crops and leguminous trees that retain soil and moisture. In land-scarce countries, developing higher-yielding varieties, which may require complementary inputs, that meet consumer and producer preferences.

  - **Improving rural physical and social infrastructure:** especially in high potential areas, investments in roads, input and output marketing channels, schools, and health services will show high returns. They will also be vital in bringing new information in primary life expectancy and encouraging migration into lower density but potentially more productive areas.

  - **Accelerating fertilizer use:** introducing and maintaining affordable prices and physical access for smallholders to increase the productivity of scarce land in the short and medium term including the judicious use of subsidies when necessary. Although a more holistic and appropriate strategy will rely more on locally produced inputs, hybrid seed may have to be accompanied by other chemical inputs, such as herbicides, for adequate returns.

  - **Extending credit:** increasing the availability of rural capital to smallholders will facilitate the adoption of better tools, seeds, and other inputs. Institutional credit will be required until rural financial markets develop and rural savings can be mobilized.

  - **Granting access to export markets:** giving small farmers the right to grow high value crops and the means to market them.

- **Rethinking population policy:** In absence of the above, population policy by itself may be incapable of reigning in problems of food security. In addition to the above, governments must think about reevaluating a *laissez-faire* approach to population growth given the conflict between private household and social gains. Although traditionally considered land-surplus, weak agricultural performance and accelerating rates of population growth in Africa are making international donors and a growing number of African policymakers question the benefits of high population growth. But without pursuing policies that increase household labor productivity, which among other things includes use of modern inputs, and without investment in human capital (education, health, water) that increases labor productivity and life expectancy, this conflict between private and social gain will not be reduced and population growth will continue unabated.

Failure to address these crucial policy areas will lead to increasing stress on the environment. Neglect in one policy area will not remain isolated, but will because of interdependence between the environment, agriculture, and economic performance impact with negative repercussions in other sectors of the economy.

Introduction

The interaction between population growth, the environment, and agricultural intensification raises the most compelling and most controversial issues currently facing developing countries. Given low initial population densities, the benefits of increasing population on agricultural development have been widely documented (Boserup 1961, 1981; Ruthenberg 1982); these authors have argued that slowly increasing population densities have desirable effects on technical change, land and labor productivity, and rural per capita incomes through changes in relative factor prices. Others have pointed out that while high population densities may be desirable in stimulating rural markets and technological adaptation, rapid population growth is very costly to countries at early stages of development (World Bank 1984). This paper shows that the environmental damage from the reduction of bush fallow, the more intensive use of land without supplementary biological and chemical inputs, and the depletion of forestry resources complicates the transition from low to more densely populated areas as originally envisaged in the Boserup hypothesis.

Many of the benefits associated with high population densities are seen by Boserup, Ruthenberg, and more lately Binswanger et al. (1986) as being derived mainly through market forces, with relatively little emphasis on the role of public policy. They have described the effect of population densities on agricultural intensification assuming a benign or at least policy-neutral environment. This paper departs from the conventional view and demonstrates that a policy-led approach to intensification is critical to maintaining and preserving resources otherwise degraded through more intensive use. It argues that autonomous intensification, the result of population growth on factor scarcity and the freeplay of market forces, is by itself unlikely to achieve the expected gains in per capita agricultural production and rural income.

In the study, the environmental consequences of growing population pressure without gains in agricultural productivity in six Sub-Saharan African countries are documented.[1] The paper demonstrates 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 fertilizers and improved seed (see also Lele, Christiansen, and Kadiresan 1989). *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 the possibility that increased area can be left fallow or reforested. Given the higher rates of population growth and the absence of options to migrate, the movement to enhanced productivity will hinge on policy-led initiatives.

In the past, 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 also led it to support development projects in areas of marginal physical potential and indeed even in the areas of medium potential in support of subsistence food crops (Lele 1988a). The result for many countries has been *a regional redistribution of production but without substantial growth.* Thus to effectively address both growth and equity concerns in Africa—while simultaneously conserving the environment—will require both active production policies to stimulate growth in areas of high potential *and* consumption and welfare oriented efforts in areas of lower productive potential. Focusing on high potential areas alone risks increasing regional inequalities, as weak transport networks can prevent markets from functioning, integrating effectively, and allowing marginal areas to share in the gains. Alternatively, attempts to develop areas of lower productive potential, while justifiable on grounds of nation-building and encouraging participation of all groups in economic growth, carry implicit economic costs that must be recognized. Finally, in areas of lower potential but high densities (such as in northern Nigeria) or remote but productive areas (such as the Southern Highlands of Tanzania) 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.

Agricultural Intensification: What Does it Mean?

Defining Intensification

Agricultural intensification is traditionally associated with changes in land use and fallow periods. Following Joosten (1962), Ruthenberg (1980) defines the intensity of cultivation, among other ways, by measuring the length of fallow periods between plantings.[2] Ester Boserup (1965, 1981), whose work forms a theoretical foundation for the hypothesis, also argues that as the population density increases, changes occur in cropping techniques such as first expanding the area under cultivation, or when that is no longer possible, shortening fallow periods and increasing the labor input to satisfy the higher demand for food. The theory rests on the assumption that the "problem" of population pressure gives rise to its own solution; the very scarcity of land, by altering factor prices, results in its more intensive use.

Two basic concepts integral to the Boserup hypothesis are factor substitution and technological change. Rising opportunity costs of holding land fallow are compensated for by working the land harder, often with decreasing returns from each additional unit of labor. Instead of a "peak season" for agricultural labor, the shift to intensive agriculture implies year-round activities such as water collection, soil management practices, and staggered crop production. The surplus generated from more intensely cultivated land contributes to growth in other sectors through linkage effects in infrastructure, markets, credit, and services. This view of intensification is further elaborated by Binswanger, Pingali, and Bigot (1986) and is consistent with the "induced innovation" argument presented by Hayami and Ruttan (1985), who contend that changes in factor proportions will lead to conservation of the more scarce resource—in the case of several MADIA countries, land—and to increased use of the abundant resource in production—in this case, labor.

A critical dimension to Boserup's model of intensification is that the higher population densities increase agricultural production and off-set the diminishing returns to inputs on a fixed land base. Thus, even though the regenerative fallow cycle that restores organic matter to the soil may *initially* be abandoned, savings from higher output can later be reinvested in land, labor, and tools to keep soil productivity high and prompt growth in other sectors of the economy. The assumption of induced innovation in situations of extremely high population growth rates, however, may not be valid. In the face of high population growth from preexisting high levels of population density, the externalities of agricultural research to bring about technical change will require an active public role (Lele, Kinsey, and Obeya 1989).

Two important dynamics are simultaneously at work. The first concerns changes in cropping patterns occurring more or less *autonomously* in response to population pressure, or persons per square kilometer. (Cultivable land per capita is also considered as an indication of population pressure. Available agricultural land per person is often less than densities might reveal due to semiarid conditions.) These "pressures" are normally reflected in the frequency with which land is cropped. The second, perhaps unforeseen, dynamic concerns the damaging effects of rapid population growth on the environment. This occurs when the positive effects of population growth (as seen in the more intensive use of land) are superseded by the detrimental effects of continuous cropping (soil degradation and fertility loss) and deforestation. This is an especially serious problem given the fragile nature of African soils, their dependence on vegetative cover for moisture and stability, and the effects of continuous cultivation. Recent data show, for example, that for each 4,000 kilogram crop of maize produced on a hectare, 200 kilograms of nitrogen, 80 kilograms of phosphate, and 160 kilograms of potassium are removed from the soil (Higgins, personal communication). Other agronomists, while conceding these general effects, question the magnitude of losses being claimed, but few systematic studies exist that analyze these long-term effects. It seems clear that the role of policy in channeling "autonomous" forces and their long-term effects on the environment may be understated in Boserup's work. Developing countries facing heavy population pressure must adopt a strategy for *policy-led* intensification. This is a particularly serious issue in Africa. Not only is the environment more fragile, but the capacity of the governments to put together complex and finely-tuned packages to meet the diverse needs of a large number of small farmers and achieve marginal improvements in productivity is limited, especially in view of the lack of a clear consensus on appropriate policy. There is an acute need for policies that promote the interests of small farmers to ensure broad participation in economic growth.

Intensification of agriculture in this paper is therefore considered somewhat differently than in the Boserup-related literature, in that it considers *output* as well as changes in the length of fallow period. It can be measured in three interrelated ways: a shift from low to high value crops on any given land; increases in yield per hectare of any given crop; and a geographical shift in crop production from areas of poor potential to those of higher potential. Over the period 1960-1987, the three countries experiencing the fastest growth in per capita GNP—Cameroon, Kenya, and Malawi—achieved their growth not through increases in productivity, but through shifts to higher value crops (coffee and maize in Kenya being exceptions to this rule) (Lele Forthcoming). With less land available for expanding area under crops, especially high value crops, more attention and hard empirical study will have to be applied to the task of raising productivity in the agricultural sector. Research carried out in the MADIA study indicates that with increasing population pressure and the movement of people into marginal areas (reducing average yields), an increasing proportion of land in many countries is being allocated to food crop production. The number of people dependent on the market for food, even in rural areas, is increasing rapidly. There are very clear signs of reduced soil fertility and declining rainfall (Lele, Christiansen, and Kadiresan 1989). While some question the extent of decline in soil fertility, the relationship of reduced rainfall to environmental stress, or the decline in rainfall, they concede that more often than not public policy stands in the way of the shift to higher value crops, to increased input use or improved resource management that would otherwise occur. In Malawi, for instance, the practice of issuing licenses

prohibits smallholders from producing burley tobacco, a lucrative crop on the world market that is reserved exclusively for estate production.[3] It is not known, however, how unique the case of Malawi is. Another constraint is land policy. In Kenya and Malawi, having either no access to capital or constrained by ethnic and cultural barriers to land acquisition, many people are forced onto marginal land. Finally, initiatives to develop national research capacity, such as the programs in Senegal and Malawi, are focusing first on investment in large physical capital and technical assistance; their emphasis on the substance of agricultural research issues and on building human capital resources or developing seeds, fertilizers, and farm management practices appropriate to specific physical circumstances and requirements of low income households is relatively weak.

In defining intensification, the crucial issue is not the frequency of cropping, which with population pressure appears inevitable. That frequency is instead only one of many determinant variables, which include the choice of crops actually grown, the quality of land designated for cultivation, the permission to grow high value crops, and the size of output (and the market where it can be sold).

Limitations of the Hypothesis

In this section we briefly outline the first dynamic inherent in autonomous changes in cropping patterns outlined in the Boserup hypothesis and point out its limitations before taking up the second dynamic of environmental damage and its implication for policy.

The direct bearing of population density on frequency of land use is more obvious than the movement to higher levels of technology and more efficient resource use. The latter phenomenon is induced by what Pingali and Binswanger (1984) call "farmer-based innovation." It depicts the slow evolutionary process of adapting the means of production to changes in factor costs. As labor and credit, tools, and other inputs become less costly relative to land, the farmer will naturally select the cheapest combination of inputs that maximize output and lower his or her opportunity costs. However, the process of change is a slow one; Europe and Asia had centuries to perfect locally suited techniques of intensification to their high-density conditions. The relevant question in the context of Africa is whether the catalyzing factor of population is ahead of or behind the pace of farmer-based innovation. The question reveals a major limitation of the Boserup model. High rates of population growth in an initially high density area jeopardize the perceived benefits of autonomous intensification.

> ...the intensification of agriculture may compel cultivators and agricultural laborers to work harder and more regularly...[and] facilitates the division of labor and the spread of communications and education.... **This condition may not be fulfilled in densely peopled communities if rates of population growth are high.** (Boserup 1965, p. 118). (emphasis added)

Rapid population growth eats away at capital savings and investment and the physical resource base. That this is arguably the case in many parts of Africa constitutes a primary reason to try to extend Boserup's original hypothesis.

Another obvious limitation of the model is revealed when countries are confronted with a diminishing land frontier and none of the expected gains from population growth. Boserup explains that the high population density is a precondition of technological change, but it alone does *not* insure that new techniques will be adopted.

> If it is true, as suggested here, that certain types of technical change will occur only when a certain density of population has been reached, it of course does not follow, conversely, that this technical change will occur whenever the demographic prerequisite is present. It has no doubt happened in many cases that a population, faced with a critically increasing density was without knowledge of any types of fertilization techniques. They might then shorten the period of fallow without any other changes in methods. **This constellation would typically lead to a decline of crop yields and sometimes to an exhaustion of land resources. The population would then have to face the choice between starvation and migration** (Boserup 1965, p. 41). (emphasis added)

Whereas in the process of autonomous intensification that occurred in Europe and Asia the option to migrate was more widely available, especially to overseas colonies, in the case of many countries in Africa it seems no longer a viable solution. It is for this reason that agriculture and research policy must concern itself with the environment.

While acknowledging their intellectual debt to Boserup, Pingali and Binswanger (1984) also express skepticism about the situation in Sub-Saharan Africa. They observe that farmer-based innovations appear to be "incapable of supporting rapidly rising agricultural populations and/or rapidly rising non-agricultural demand for food." Furthermore, they suggest that "large-scale irrigation systems and science- and industry-based technical changes must become major sources of the rate of growth in agricultural output" (1984, p.2). Science- and industry-based innovations include technological and mechanical inputs that can be administered or overseen by the state to speed up the "natural" process of farmer-based innovations. Even though large-scale irrigation for the most part has turned out to be costly and difficult to maintain in Kenya, Nigeria, and Senegal, the point that the state must take the initiative in exploring, maintaining, and conserving resources is well taken.[4] Elsewhere the MADIA study documents the benefits of promoting small farmer organizations for the development of low-cost irrigation as a viable alternative to the more costly large-scale irrigation projects previously desired by governments and donors. However, potential for even small-scale irrigation is not fully known, and existing information suggests it to be much more limited in Africa (5 percent of total cultivated area in Nigeria is irrigated) than in Asia (where irrigated area represents 22 percent in India and 28 percent in Indonesia) (Lele and Meyers 1986; Lele, Oyejide, et al. 1989; Lele 1988a).

"Speeding up" the natural evolution of intensification is a complex task, especially for Africa's relatively young state bureaucracies. A crucial distinction separating Binswanger and Pingali from Boserup is their greater attention to policy and the role the state must play to encourage intensification. In addition to identifying salient technological priorities for Sub-Saharan Africa, they also warn that:

> ...the transition to these new technologies depends on many factors—the relative cost of labor, capital, and fertilizers; the cost and availability of credit; the reliability of markets for inputs and output; the access to spare parts and repair facilities; and the adequacy of information and training systems (Binswanger and Pingali 1988, p.84).

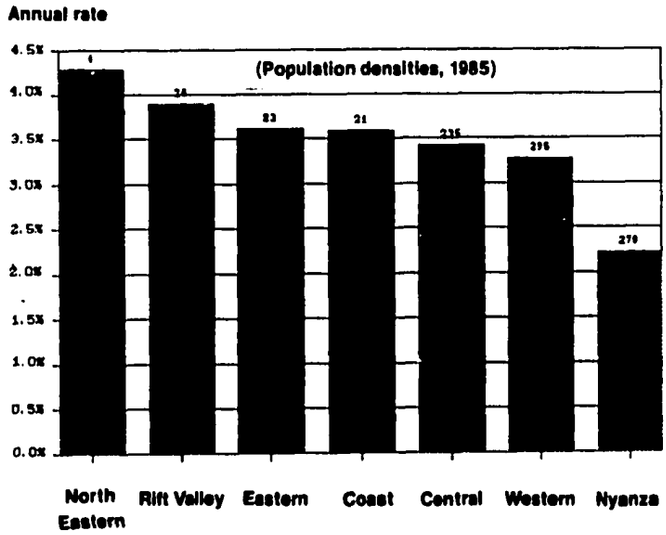
A successful transition to more intensive (i.e., sustainable) use of the land thus depends largely on the specifics of sectoral policies toward agriculture. Besides population densities, Boserup (1981) introduces other variables into her original formulation of the hypothesis to explain the weak showing of autonomous intensification in Africa; these include lack of infrastructure, inefficient extension and marketing, and rural-urban migration. A formal reading of her previous work suggests that these constraints would be lifted as population grew and new technologies were adopted. Our research indicates that they persist and indeed become compounded with population growth and high population densities, especially in circumstances where there is no correspondence between population densities and land quality.

The second, related dynamic that does not receive enough attention concerns, among other things, changes in soil quality as land is cropped more intensively. Boserup notes that when "the analysis is based on the concept of frequency of cropping, there can be no temptation to regard soil fertility exclusively as a gift of nature bestowed upon certain lands once and for all" (Boserup 1965, p. 15). She argues quite rightly that the soils' structure and nutrient levels will depend not only on initial status but also on the farming techniques selected. However, it is almost implicitly assumed that in the transition from extensive to intensive cultivation the farmer will invest more in labor (mulching, terracing) to minimize the negative effects of continuous cropping.[5]

A more realistic assessment may be that in the short-run not only does it makes economic sense to "mine" the land but also it may be inevitable. Ruthenberg, for instance, remarks that an agricultural surplus in the industrial countries came from the "exploitation of natural resources in terms of nutrients and humus which were used to feed laborers cheaply to facilitate industrial capital formation" (1980, p. 12). He argues that whereas the process of soil mining in the industrialized countries was accompanied by the accumulation of a surplus, in developing countries the practice is employed merely to maintain current levels of consumption. The natural process of intensification is far too slow in relation to the rate of mining, given the rapid growth of population. As pointed out earlier, according to the FAO, such soil mining is occurring in Africa on a large scale, causing much more irreparable damage than would be the case with soils in temperate climates, which tend to be structurally more sound (Higgins, personal communication).

Similarly, shifts onto marginal areas and stagnating overall crop yields may signal that intensification in terms of frequency of cropping is occurring, but that the envisioned reinvestments into productive assets (e.g., the land) are not.[6] In Kenya, for example, the fastest population growth between 1969 and 1979 occurred within those provinces (aside from Nairobi) that were least populated and least fertile, including districts in the North-Eastern, Rift Valley, Eastern, and Coast provinces (see figure 1). The provinces that grew least had the highest initial densities, suggesting a spillover effect into Kenya's less densely inhabited but more marginal regions. If the intensive margin in the high density area yields a lower return than the extensive margin in the low density area, a resource shift (including population) to the latter area is appropriate, but this has not been empirically established. Given the rising demographic pressure developing in low income areas, the environment may prove to be the weak link in the chain binding population densities to autonomous agricultural intensification. This paper argues that it is the government's role to reinforce that link with appropriate institutional and policy support.

Figure 1
Regional population growth in Kenya, 1969-70



Source: Government of Kenya 1981b.

Present and Projected Land Availability

Although the primary focus of this paper concerns policy measures available to tap *regional* advantage in cropping, an overview of the land constraints facing Kenya, Malawi, Tanzania, Cameroon, Nigeria, and Senegal will provide an idea of the urgency with which these issues must be addressed. In the discussion that follows, for more detailed information on disaggregated data, the reader is referred to the statistical annexes.

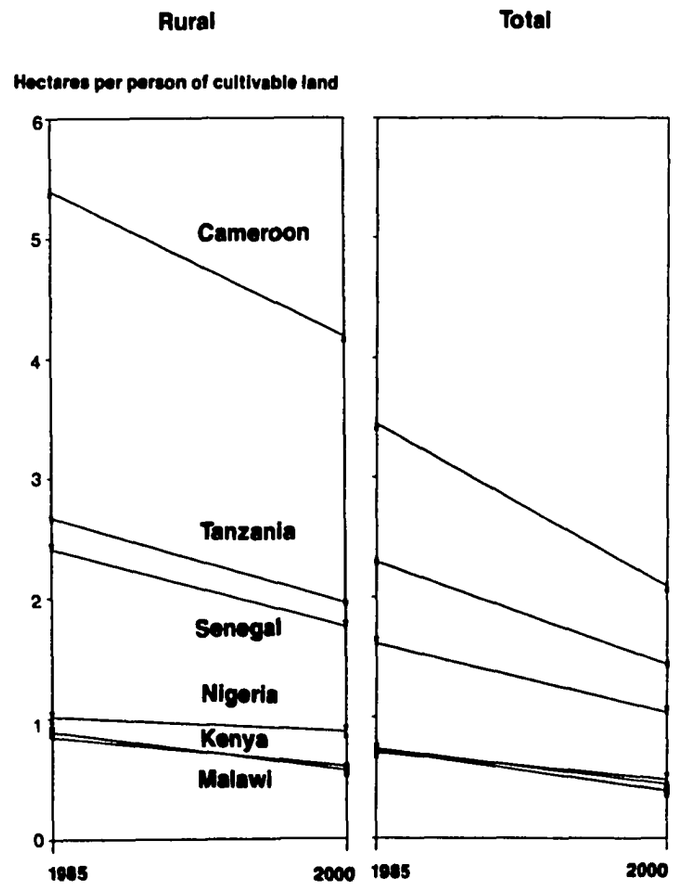
Introduction

In most MADIA countries, population has doubled since the independence period, and will double again shortly after the turn of the century. Yet even though population densities have reached quite high levels in some parts of Africa—up to 300 persons per square kilometer in the highlands of Kenya, in southern Malawi, and in coastal Nigeria—it is unclear whether reinvestments in land and labor are occurring in compensation. A very important consequence of higher density is that as the share of population depending on the market for food increases, including those moving to marginal land, the internal terms of trade move in favor of food crops (Lele 1988a). In theory growth in food imports should keep up with internal demand growth. However, in practice import capacity tends to be limited at early stages of development by slow growth of exports. Policies toward exchange rates and taxation of crops can make a significant difference in the speed at which relative prices between food and export crops move, but they may not be able to avert this shift altogether. This is especially true when the price of imported food increases with devaluation and population growth reduces land productivity while simultaneously increasing the demand for food. As relative prices shift, agricultural production moves away from traditionally high value export crops, posing a potential problem in the move to intensification as we have defined it.

At present, Kenya, Malawi, Nigeria and, to a lesser extent, Senegal are experiencing substantial population pressure. The first three countries constitute 75 percent of the MADIA population and 30 percent of the total population in Sub-Saharan Africa. By government definitions, not one of them currently has more than three-quarters of a hectare of cultivable land per person (using total population). By FAO definitions, the per capita amounts are even *smaller*. Projecting to the year 2000, this figure will fall to less than half a hectare (see Figure 2) and to a miniscule 0.1 hectare per person in parts of Kenya, Malawi, and Nigeria (see Annexes 4, 5, and 6). Using only rural population to calculate the figures improves the ratio of people to land (especially in the more urbanized West African countries) but does not relieve the demand for food or lessen the degree of population pressure (see Table 3).

The per capita land figures are deceptive, however, in that they mask very important differences in land quality and in regional concentrations of population. It is noteworthy that even in land-surplus countries, population is concentrated on small amounts of land. In Cameroon, for instance, millions of hectares of well-watered land in the eastern tropical rainforests go unused while population pressure and declining rainfall in the semiarid Far North and North provinces have already begun to threaten fragile ecologies. The causes manifest in decreasing land availability are very much more complex than simple growth in population: they include such politically sensitive issues as the original expropriation of land by colonials and its subsequent transfer to elites, policy bias toward estate agriculture, health factors such as river blindness, tsetse infestation in more watered areas, and ethnic discrimination.[7] These and other factors can prevent the shift to more productive land. Such is the case in Senegal, where the predominance of the Mandinque tribe in Casamance presents an obstacle to Wolof migration from the crowded and less productive Groundnut Basin and in the Middle Belt of Nigeria, which has more assured rainfall and greater fertilizer responses but low densities. This section can only

Figure 2
"Arable" land per capita in the MADIA countries, rural and total populations, 1985 and 2000



Note: A similar graph was used by Binswanger and Pingali (1988) using agroclimatic densities, based on FAO/UNFPA/IIASA figures (Higgins 1982). The figures presented here are per capita amounts of arable land based strictly on government definitions. For treatment of FAO/UNFPA/IIASA findings, see Section 3.
Source: Government data (see Tables 2 and 3).

indicate the broad *statistical* parameters of the problem.

Because of these complexities, the regional dimension of policy-led intensification, in terms of where governments have been and should be investing their resources, should form the substance of policy debate. It makes a big difference whether populations are concentrated in areas of high or low potential, and whether the emphasis is on long- or short-term gains. If reaching the most people and increasing production with the quickest return on investment is the priority, it obviously makes sense to focus resources on high-density, "high-potential" areas. By the same token, it may then be essential to have education, employment, income, and consumption policies that protect those in the low potential areas. It is to the exploration of these issues that we now turn.

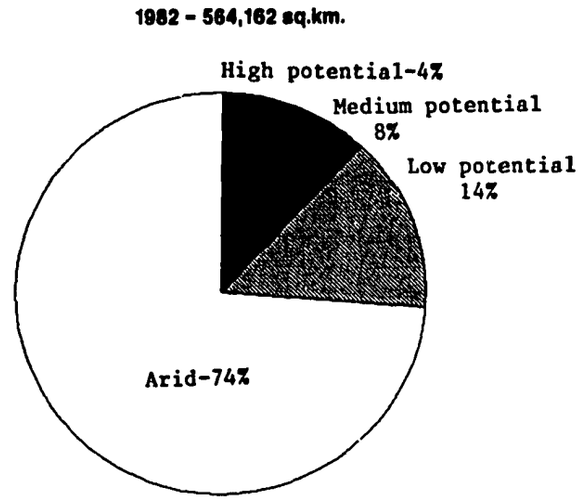
Aggregate Land Availability

There are vast differences in the amount of land classified as "arable" in Sub-Saharan Africa, ranging from 26 percent in Kenya to 75 percent in Cameroon and Nigeria. For Kenya, this means discounting the 400,000 square kilometers of land that receives less than 300 mm of rainfall per year and is considered barren (see Figure 3). Apart from variations in climate, these differences also result from methodology in land classification. Kenya's figure reflects a detailed analysis of agroclimatic growing zones and land potential for the entire country, carried out by the Ministry of Agriculture and the German Agency for Technical Cooperation (GTZ/ Jaetzold and Schmidt 1982). As a result, their estimate of 26 percent arable is thought to be quite reliable. In the cases of Nigeria and Cameroon, by contrast, government estimates of arable land are based on less extensive analysis and tend to be more optimistic.[8] The more accurate information on land availability makes it easier to assess the land constraint on a regional basis, and therefore to determine where to focus resources for intensification. For many countries in the MADIA sample and elsewhere in Africa, however, there is very little authoritative information on either land quality or land availability. Effective policy will depend directly on the quality of information about land as it becomes more scarce.

The extreme diversity in land quality between countries can be seen by comparing estimates of overall land availability. For example, Table 1 (and Figure 4) shows that, at any given level of population, there are dramatic differences between total land and arable land area. Land unsuitable for cultivation is considered to be quite high at 74 percent of the total in Kenya, 47 percent in Senegal, and 44 percent in both Malawi and Tanzania.

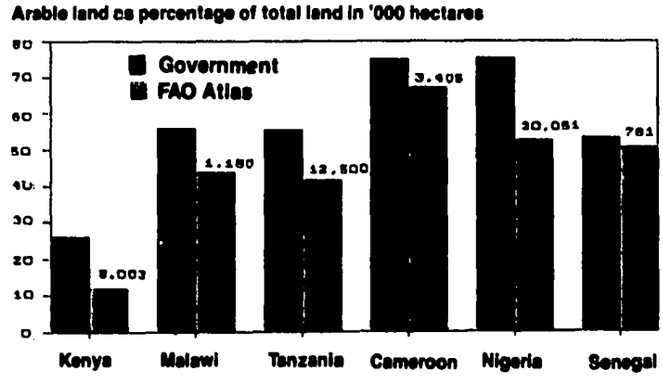
Second, Table 1 indicates that using "arable" as a generic term to mean "cultivable" can be misleading. The FAO (Production Yearbook) definition of arable land excludes areas under permanent pastures or permanent crops, forests/woodlands, and "other" land, and therefore reflects *cultivated* rather than *cultivable* land (FAO 1986a). Most governments, however, choose to include forests and permanent crops in their definitions as it yields a more generous estimate of arable land. Using the government figures sheds a more optimistic light on the room left for "extensification" than seems desirable from an environmen-

Figure 3
Classification of arable land in Kenya



Source: Jaetzold and Schmidt 1982.

Figure 4
Differences in arable land by country and source



Source: National Estimates (Table 2 and 3) and FAO *Atlas of African Agriculture* 1986b.

Table 1
Comparison of total land and arable land per capita availability, 1984 (government and *FAO Production Yearbook* definitions in hectares per person)

Item	Kenya	Malawi	Tanzania	Cameroon	Nigeria	Senegal
Per Capita						
Total land	2.79	1.31	4.13	4.59	0.94	3.04
Arable land (government)	0.73	0.73	2.30	3.45	0.71	1.62
Arable land (FAO)	0.09	0.32	0.19	0.58	0.30	0.81

Source: See tables 2 & 3.

tal point of view. Clearing forests has direct ecological consequences on the long-term effectiveness of intensification; whether rainforests, tropical cover, or bush trees are removed, the effect is to destabilize soils and render them more vulnerable to wind and water erosion. The distinction between forests and potentially cultivable land also underscores the crucial omission of environmental sustainability that needs to be added to the list of Boserup's original concerns.[9]

More recently the FAO published an *Atlas of African Agriculture* (1986), which lists "potentially cultivable" land figures that appear to share the broader definition used by government sources (see Table 2). In most cases, the Atlas figures are *still* more cautious about the absolute size of the available land base than are national estimates (see Figure 4). In Nigeria, the difference between the two estimates is on the order of 20 million hectares, or one-quarter of total land area. In Kenya, the new FAO figure is less than half of the national estimate. In Tanzania, the FAO Atlas figure is also 12 million hectares less than the government estimate, while in Malawi, the FAO estimate is about 1 million hectares—or 12 percent of total area—shy of government figures. Despite the lack of consensus over how much land is actually available for farming—in Malawi, government estimates have ranged from 19 to 56 percent of total area[10]—it is clear that using FAO figures merely increases the urgency for a policy-led intensification, including among other things the fundamental importance of improving the land statistics.

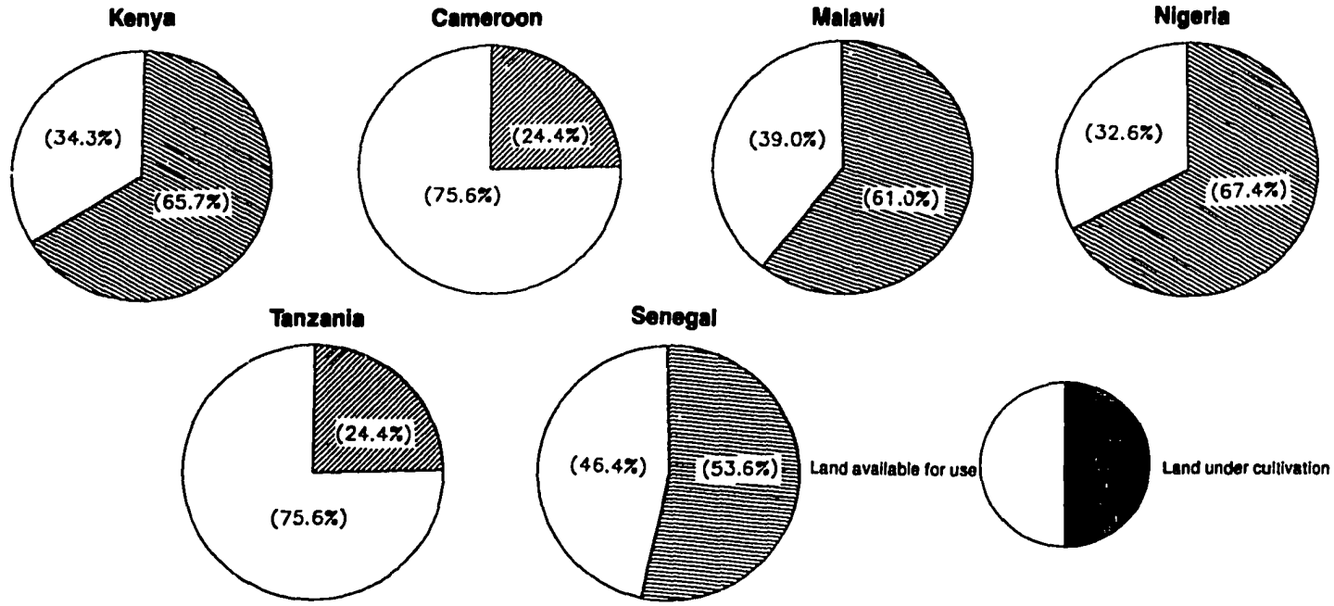
A final important point must be made before leaving this section. Elsewhere it has been documented (Lele and Meyers 1986; Oram 1987) that gains in agricultural output in the past few decades have come from increasing the area under cultivation.[11] According to the FAO Atlas, up to two-thirds of total cultivable land for Kenya, Malawi, and Nigeria is already in use (see Figure 5). When available, government data appear to confirm this trend: in the Groundnut Basin in Senegal, for instance, area under crops reached 70 to 80 percent of total cultivable area in 1976, the last year for which such data are available (see Annex 3). Likewise, government surveys in Malawi indicate that 60 to 70 percent of the declining amount of customary cultivable

Table 2
Comparison of FAO and national data on "arable" land (in thousand hectares)

Land	Year	East Africa			West Africa		
		Kenya	Malawi	Tanzania	Cameroon	Nigeria	Senegal
Total land area							
National	1985	56,416[b]	9,428[c]	88,366[d]	46,540[d]	90,241[f]	19,672[g]
FAO Yearbook[a]	1984	56,925	9,408	88,604	46,944	91,077	19,200
Area under cultivation							
National		2,577[h]	3,639[i]	4,465[j]	6,830[k]	12,542[l]	2,612[m]
(as % of total)		5%	39%	5%	15%	14%	13%
FAO Yearbook[n]	1984	2,335	2,345	5,190	6,965	31,035	5,225
(as % of total)		4%	25%	6%	15%	34%	27%
FAO Atlas[o]	1980	4,400	2,500	9,200	7,700	32,300	5,200
(as % of total)		8%	27%	10%	16%	35%	27%
"Arable" land							
FAO[p]	1985	1,850	2,320	4,130	5,910	28,500	5,220
(as % of total)		3%	25%	5%	13%	31%	27%
FAO Atlas (potentially cultivable)[q]	1980	6,700	4,100	36,600	31,500	47,900	9,700
(as % of total)		12%	44%	41%	67%	53%	51%
National Arable Estimate	1985	14,703[b]	5,280[r]	49,100[s]	34,905[t]	67,951[u]	10,481[v]
(as % of total)		26%	56%	56%	75%	75%	53%

Source: FAO 1985, FAO 1986, and National Data.
[a] FAO 1986.
[b] By Jaetzold and Schmidt 1982. Arable land estimate includes low potential land area.
[c] Malawi Population Census 1984.
[d] Bureau of Statistics 1983.
[e] Ministry of Agriculture, Cameroon 1980.
[f] Federal Ministry of Science and Technology 1985.
[g] Direction Statistique 1982.
[h] Smallholder Land: Central Bureau of Statistics 1981. Large-farm land: Central Bureau of Statistics 1980.
[i] Mkandawire and Phiri 1987. This is a 1983 estimate.
[j] Bureau of Statistics, Tanzania 1970.
[k] Cameroon Ministry of Agriculture, 1980. Defines area as "surfaces mobilizés," under cultivation or temporarily lying fallow.
[l] Federal Office of Statistics 1983. Compiled from area under production figures for crops (mostly food crops) for the year 1983.
[m] Direction Statistique 1982. Land under cultivation defined as "terres agricoles: superficies cultives."
[n] FAO 1986. Land Under Cultivation defined as Arable Land ("land under temporary crops, temporary meadows for mowing or pasture, land under market and kitchen gardens, and land temporarily fallow or lying idle") and Land Under Permanent Crops ("land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest... but excludes land under wood and timber").
[o] Atlas of African Agriculture 1986. Land Under Cultivation given as "Annual and Permanent Cropland," for 1980.
[p] FAO "Arable Land" (unadjusted) defined as "land under temporary crops, temporary meadows for mowing or pasture, land under market and kitchen gardens, and land temporarily fallow or lying idle."
[q] Atlas of African Agriculture 1986.
[r] Compendium of Agricultural Statistics 1977. We use the government estimate of 53 percent cultivable, based on the 1965 land survey. However, the figure is considered optimistic. A more conservative estimate of 37 percent is cited in Mkandawire and Phiri 1987.
[s] Tanzania Bureau of Statistics 1970. Calculated by subtracting from total area lands designated as swampland, desert, and urban areas. If "Other Woods, Forests" are included, the area for Tanzania rises to 86,760 hectares.
[t] Cameroon Ministry of Agriculture 1980. Arable land defined as "surface agricole utile."
[u] Lele, Oyejide, et al. 1989.
[v] Senegal Direction de la Statistique 1982; and Sénégal Direction d'Eaux, Forêts et Chasses 1978. Figure includes woodlands.

Figure 5
Remaining area frontier in the MADIA countries, 1985



Source: FAO *Atlas of African Agriculture* 1987.

land under the control of the Malawian smallholder population in the more crowded agricultural development districts (ADDs) of Blantyre and Lilongwe were already under crops in 1985 (see Annex 5). As more area comes under crops and is cultivated more frequently, soil degradation and ultimately complete loss of fertility become more likely. This is the most compelling evidence for policy-led intensification; the area frontier acts more or less like an hourglass by which to gauge the time remaining for autonomous intensification.

Aggregate Population Data

Population data (using government estimates) were held constant in the preceding calculation of per capita arable land to highlight differences between FAO and government estimates of land availability at the national level. Nonetheless, wide differences also exist in the population data. Ethnicity and population growth are much more explosive issues in some countries than in others and affect statistics differently. Whereas Kenya and Malawi have routinely published data on changes in the ethnic composition of the population, a census cannot be conducted in Nigeria because the publication of such information might spark a political controversy. Cameroon and Senegal did not conduct national censuses in the 1960s, and Nigeria has not conducted a census since 1963.[12] The 1963 census figures were themselves considered overinflated, with the result that government and World Bank projections to the year 2000 differ by as much as 16 percent, or 23 million persons. The lack of agreement between population estimates is reflected in Table 3.

Despite the inconsistencies in data, overall high rates of population growth—generally about 3 percent a year and around 4 percent in Kenya—leave little room for doubt about growing demographic pressure on the resource base. Table 4 shows that rates of population growth have risen in all cases since the 1960s, and are projected to continue at high rates through the year 2000. The question of how to effectively channel new demands for land, food, income, and fuel into a productive force for development becomes all the more pertinent in view of the limitations of the Boserup model and the inadequacy of autonomous intensification to accommodate high rates of growth.

Urbanization is more advanced in West Africa, where about one-third of the population lives in cities and towns of at least 5,000 persons, but rates of growth in urbanization are much higher in East Africa.[13] For Cameroon, Nigeria, and Senegal, the urban population is projected to increase by 5.7, 5.4, and 4.5 percent a year, respectively, from 1985 to 2000, whereas in East Africa, the urban populations in Kenya, Malawi, and Tanzania are expected to grow by 7.0, 8.3 and 7.6 percent a year, respectively (see Annex 7). Very little is known about the important subject of rural migration or the nature of the rural/urban/rural migration in most MADIA countries, with the exception of Kenya and Malawi, which have much better data than the other countries. Migration away from agriculture can relieve on-land pressure in per capita terms, but if there is no technological change in agriculture that increases labor productivity, increased urbanization only changes the terms of trade in favor of the food crop sector (Lele, Oyejide, et al. 1989).

Estimated Carrying Capacities[14]

The FAO, in coordination with the United Nations Fund For Population Activities (UNFPA) and the International Institute for Applied Systems Analysis (IIASA), has calculated the maximum amount of calories that could be produced in each country to determine its carrying capacity, based on agroclimatic conditions and varying levels of input use.[15] The results are necessarily rough, because they rely on a technical rather than a social estimation of ideal

Table 3
Comparison of FAO, IBRD and national population data: initial, present, and projected (in thousands)

Population	Year	East Africa			West Africa		
		Kenya	Malawi	Tanzania	Cameroon	Nigeria	Senegal
Initial (Census of 1960s)		10,942[a]	4,040[k]	12,313[m]	NA	55,670[x]	NA
Present Total							
National (Census of 1970s)		15,327[a]	5,547[k]	17,036[h]	7,761[s]	NA	5,069[bb]
National (current estimate)	1985	20,200[b]	7,200[k]	21,383[o]	10,130[t]	96,125[g]	6,478[cc]
FAO[c]	1985	20,600	6,944	22,499	9,873	95,198	6,444
IBRD[d]	1985	20,000	7,000	22,000	10,000	100,000	7,000
Present Rural							
National		16,596[e]	6,276[l]	18,389[p]	6,571[a]	67,288[z]	4,340[dd]
(as % of total)		82%	87%	86%	65%	70%	67%
FAO[g]	1985	16,242	5,440	18,574	6,036	63,484	5,121
(as % of total)		79%	78%	83%	61%	67%	79%
IBRD[g]	1985	16,000	6,160	18,920	5,800	70,000	4,480
(as % of total)		80%	88%	86%	58%	70%	64%
Projected Total	2000						
National		37,505[n]	11,783[k]	34,066[q]	16,682[v]	140,220[y]	10,093[ee]
IBRD[i]		36,000	11,000	37,000	17,000	163,000	10,000
Projected Rural	2000						
National		26,103[j]	8,837[k]	25,073[r]	8,341[w]	77,121[aa]	5,955[ff]
(as % of total)	70%	75%	74%	50%	55%	59%	

Source: World Bank 1987; FAO 1986; and National Data.
[a] Kenya Central Bureau of Statistics 1981.
[b] Kenya Central Bureau of Statistics 1987.
[c] FAO 1986a.
[d] World Bank 1987.
[e] Kenya Central Bureau of Statistics 1987b. Calculated from 15.1 percent level of urbanization in 1979 and projected level of 30.4 percent for 2000, to obtain 1985 figure.
[f] FAO 1986a. Referred to as "Agricultural Population."
[g] World Bank 1987, except for Malawi, World Bank 1986.
[h] Kenya Central Bureau of Statistics 1985.
[i] World Bank 1987.
[j] Kenya Central Bureau of Statistics 1985. Level of urbanization for Kenya in year 2000 given as 30.4 percent.
[k] Malawi National Statistical Office 1984a.
[l] Malawi National Statistical Office 1984a. Rural population derived by projecting from urbanization level of 8.5 percent of total population in 1977 to 25 percent in 2000.
[m] Tanzania Central Statistical Bureau 1969.
[n] Tanzania Bureau of Statistics 1981.
[o] Calculated by projecting 1978 base to year 1985 at 3.2 percent. The rate of growth came from Vol. IV of the Demography of Tanzania. Ministry of Finance and Planning and the Demographic Unit/ University of Dar es Salaam, p. 231. Table 14.3.
[p] World Bank 1987. Government estimates unavailable.
[q] Projected from 1978 base at 3.2 percent per year to 2000.
[r] Rural population derived from WDR estimates of 6 percent urbanized in 1965 and 14 percent in 1985 and then projecting to 2000.
[s] Cameroon Bureau Central du Recensement 1978.
[t] Projected from 1981 at 3.1 percent per year to 1985. Rate of growth cited in Sixth Plan.
[u] Level of urbanization calculated by government to be 35.13 percent in 1985. From Sixth Plan.
[v] 1985 base projected at 3.23 percent growth per year. From Sixth Plan.
[w] World Bank Cameroon Country Economic Memorandum 1987.
[x] Nigeria Federal Census Office 1963.
[y] Lele, Oyejide, et al. 1989. Population projected from 1963 base at 2.5 percent per year growth, except for Lagos, which was projected at an estimated rate of 4 percent.
[z] World Bank 1987. No government estimates available.
[aa] World Bank (Nigeria) 1981.
[bb] Senegal Bureau National du Recensement 1982.
[cc] Ministère du Plan et de la Cooperation 1985.
[dd] Sénégal Ministère du Plan et de la Cooperation 1984. Latest available Government of Senegal estimate for rate of urbanization is for 1982 (at 32 percent). Projected to 1985 at 1.45 percent.
[ee] National 1985 figure projected at 3 percent (World Bank 1987) to 2000.
[ff] Rural population derived from urbanization estimates for 1965 (27 percent) and 1985 (36 percent) (World Bank 1987) to get rate of 1.45 percent, projected to 2000 from 1982 level of urbanization.

crop allocation. Despite inaccuracies, the study is important as the first and only systematic attempt to quantify land potential in Africa. The results have been applied in many forms (Binswanger and Pingali 1988; Oram 1987) and are highly relevant to our current study.

The evidence presented in the FAO/UNFPA/IIASA study on carrying capacities suggests that of the six MADIA countries, Kenya is least able to produce enough food at low input levels to sustain its present and projected population. Looking strictly at arable land availability using government definitions, we find that Malawi, Nigeria, and to a lesser extent Senegal all face similar land constraints. The study results are complicated by the various assumptions used in the assessments, which include production from rangelands and fallow lands.

The most meaningful way of interpreting FAO's assessment is to use the data for carrying capacities from rainfed lands alone and to translate them into terms of *minimum*

Table 4
Rates of growth in population, 1960-2000 (in percent per annum)

Country	1960-70	1970-82	1980-86	1986-2000 (Projected)
Kenya	3.2	4.0	4.1	3.9
Malawi	2.8	3.0	3.2	3.3
Tanzania	2.7	3.4	3.5	3.4
Cameroon	2.0	3.0	3.2	3.3
Nigeria	2.5	2.6	3.3	3.3
Senegal	2.3	2.7	2.9	3.0

Note: The Nigerian government uses the rate of 4.0 percent growth for Lagos and 2.5 percent for the rest of the country. As a result its estimates are 16 percent lower than the Bank's for the year 2000.
Source: World Bank 1984; 1988.

amounts of rainfed arable land required to support one person. A *minimum land requirement* indicates the relative average productivity of the land, based on FAO/UNFPA/IIASA assumptions.[16] We compare these figures with those we have already calculated, the government-estimated amounts of arable land available per person. The results are presented below. One observes that for Kenya, Senegal, and Nigeria, the minimum "low-input" requirement is greater than the 1985 per capita available land and that this situation will extend to Malawi by 2000. Only with increased input levels and/or major land improvements (such as irrigation) will these countries be able to meet food needs on a sustainable basis. Another possible way of interpreting the results is that growing conditions, including land quality, are poorest in Kenya and Senegal because minimum rainfed land requirements are highest there.

Table 5
Per capita land requirements and land availability, rainfed arable land (in hectares per person)

	Rainfed land requirement		Available rainfed land (government estimate)	
Country	Low inputs	Intermediate inputs	1985	2000
Kenya	2.8	0.6	0.7	0.4
Senegal	2.7	0.5	1.6	1.0
Tanzania	1.1	0.3	2.3	1.4
Nigeria	0.9	0.2	0.7	0.5
Malawi	0.6	0.2	0.7	0.5
Cameroon	0.4	0.2	3.5	2.1

Source: FAO 1978; National Data (see Tables 2 and 3).

At first sight such a conclusion is counterintuitive. Who would imagine the more fertile parts of Kenya to just be reaching par with areas in Nigeria, Tanzania, or Malawi? A look at two further sets of data, however, confirm this view. First, a comparison of the proportion of cultivable land occurring in the subhumid or humid tropics shows how "moisture" advantaged countries such as Cameroon and Malawi are in comparison with Kenya and Senegal. In such moist environments, double cropping (e.g., of rainfed rice) is a possibility, and hence the FAO/UNFPA/IIASA study accords them a higher value than areas where only a single rainfed crop can be grown. Data showing the percentage of total cultivable area formed by subhumid and humid cultivable tropical areas are shown below:

Kenya	Senegal	Tanzania	Nigeria	Malawi	Cameroon
10%	30%	51%	60%	64%	91%

Second, a look at response coefficients for food crops provides further support. Although coefficients of variation, length of growth cycles, and rainfall dependability vary between Kenya and Nigeria, the high potential lands of Kenya appear roughly twice as responsive to fertilizer than land in Nigeria (see Table 6). The MADIA study on fertilizer documents in detail the range of response coefficients by ecological zones and population densities (Lele, Christiansen, and Kadiresan 1989).

A great deal of documentation accompanies these coefficients and so one should be cautious about generalizing them. The responses for Kenya, for instance, refer to the so-called high potential areas that receive high levels of moisture and enjoy deep, fertile soils. Since 74 percent of the land in Kenya is arid, however, carrying capacities as

Table 6
Fertilizer response coefficients for hybrid maize in Kenya, Malawi, Tanzania, and Nigeria

Source	Kenya	Malawi	Tanzania	Nigeria
Government	15-26	29	—	5-14
FAO	12-25	27-37	11-14	4-18
World Bank	—	30	—	5-8

Source: Lele, Christiansen, and Kadiresan 1989.

calculated by FAO/UNFPA/IIASA are higher on average in Tanzania, Nigeria, Malawi, and Cameroon on an *aggregate* basis. Obviously, some parts of Kenya and other countries will be much more productive in certain crops than will others. We turn briefly to an analysis of regional cropping patterns, rainfall, and population densities before closing the section on aggregate data with a look at deforestation.

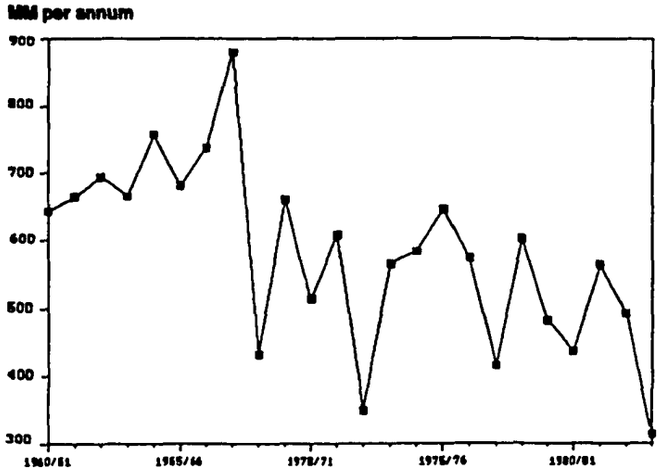
Soil and Rainfall Constraints

This section points out some sources in the literature for analyses on climate and soils in Africa. It cannot be authoritative, but will try to indicate prominent research and its relevance to intensification. In addition, it attempts to correlate population densities and rainfall, and rainfall level and production possibilities. Production possibilities afforded by the resource endowments of a given country determine the income opportunities available to different regions. A region's comparative advantage in growing high value crops such as tea, coffee, or cocoa can increase foreign exchange earnings, employment, and income to the benefit of different groups. It can speed the process of intensification, depending on price incentives and investments in government services. On the other hand, equity concerns may overshadow the investment and price incentives governments are willing to allow particular regions, especially if regional income inequalities threaten political stability.

It has been observed by Matlon (1987) that the soils of West African semiarid tropics and parts of the humid and subhumid tropics farther south are far more susceptible to rapid degradation with continuous use than was previously thought. Low and variable rainfall makes intensifying fertilizer use a risky and sometimes marginally productive proposition, especially in Sahelian countries such as Senegal, where fertilizer application can go unused in a dry season or can be washed away in a sudden downfall (see Figure 6). Even in eastern and southern Africa, considered to have slightly more stable agroclimatic conditions, increasing frequency of cropping and shorter fallow periods are reducing the soil's fertility and undermining its nutrient content. The process of degradation has accelerated as more people are moving onto marginal land with long fallow requirements.[17] These conditions complicate the evolutionary movement toward higher levels of technology and weaken the causal linkage between increasing population densities and agricultural output implicit in the Boserup hypothesis.

Broadly speaking, in the semiarid tropics of West Africa between the 200 and 800 millimeter isohyets (8 to 20 inches—see map), crop production is generally limited to lower value commodities through systems of mixed cropping: sorghum/millet, groundnuts, and cotton. According to some, research priorities in these areas (central and northern Senegal, northern Nigeria, and Far North Cameroon) should focus on faster maturing varieties that can

Figure 6
Mean annual rainfall in Senegal, 1960-84



Source: DPGA 1961-85.

deliver stable yields in the face of declining or erratic growing seasons (Oram 1987). A counter argument is that in the case of sorghum, early-maturing varieties conflict with traditional mixed cropping with millet and m: ' even impair yields if they flower before the rainy seaso. ends (Lele, Oyejide, et al. 1989).

In higher rainfall regions, between the 800 and 1000 millimeter isohyets (see map), soils are typically ferruginous, crusty, and prone to leaching. Clay content is generally below 20 percent (Matlon 1987). As a result, these soils tend to be shallow and have low natural fertility and poor moisture retaining capacity, as opposed to soils containing more clay or organic matter. Crop production in this climate, extending into southern Senegal, the Middle Belt states of Nigeria, and northern Cameroon, include more cereals such as wheat and maize and a variety of tubers such as yams and cassava. Soils are by comparison much more fertile in the Asian semiarid tropics (Matlon 1987). As a result, response coefficients to fertilizer tend to be low in many parts of tropical Africa and crop research must begin to consider new ways of maintaining soil fertility and increasing output. Even so, fertilizer response is higher than in the drier northern regions, indicating an untapped potential. The threat of trypanosomiasis, as well as other pests and diseases, prevents the extensive use of draft animals in the humid and subhumid tropical regions, and keeps population densities low, despite apparently higher potential for a wider range of crops than is possible in the North.

Eastward and to the South, in the lower parts of Nigeria and Cameroon, one finds similar problems with soils in the humid and subhumid tropics. Greater moisture and rainfall do not translate into better growing conditions. One popular study notes:

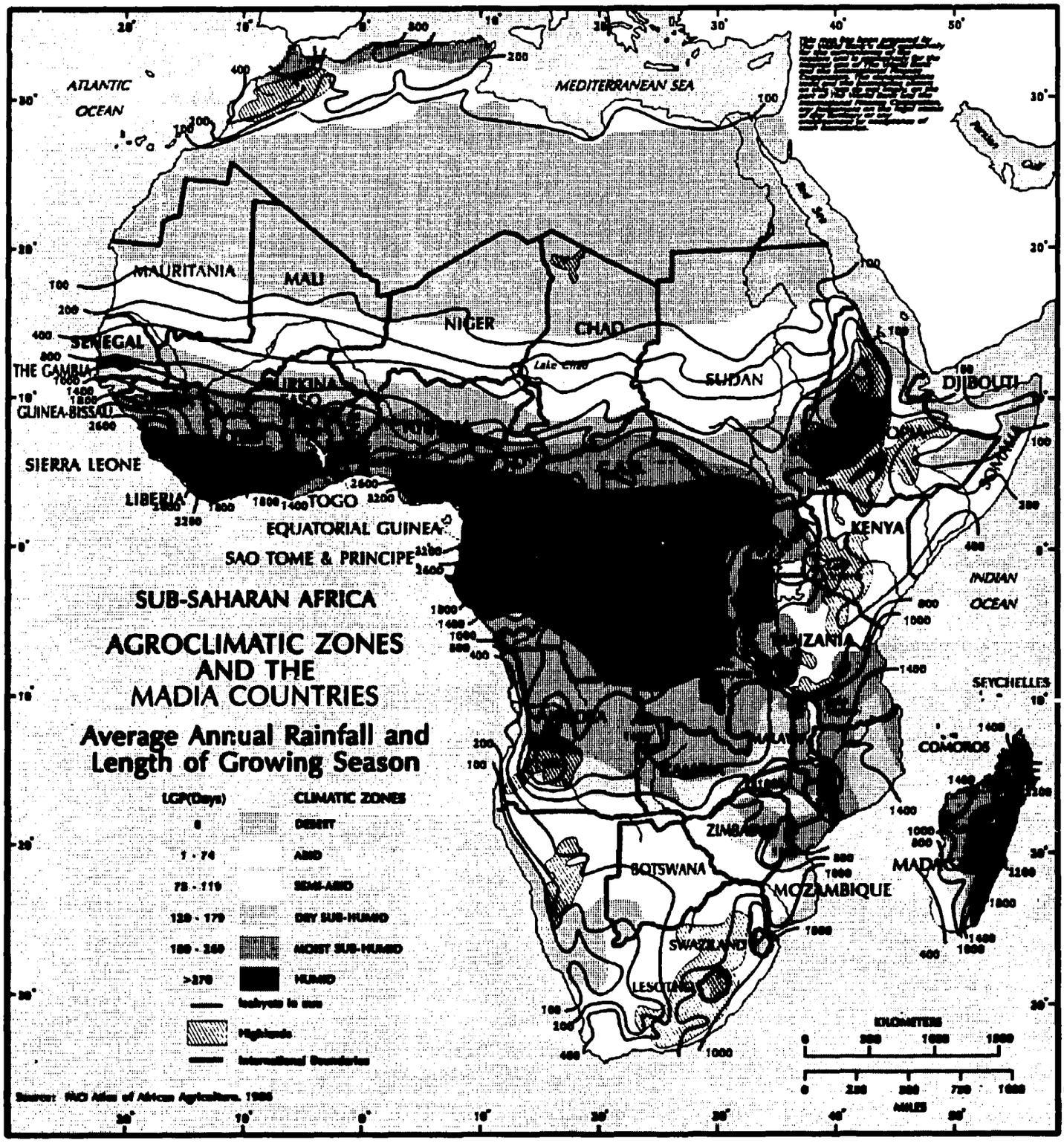
> Rainfall in tropical areas generally is highly erosive. Rain causes erosion when it falls at more than 25mm an hour. Only five percent of rainfall in temperate areas is erosive. The proportion in tropical areas is around forty percent—much of that at even higher and more destructive velocities. Downbursts of 100-150mm an hour are not uncommon—as much rain as New York gets in an average month (Harrison 1987, p. 36).

Soils with few exceptions are vulnerable to acidification and other factors, have poor structural stability, and when cultivated intensively will be more susceptible to erosion. Likewise the removal of tree cover has grave implications for the structural stability of these soils. The problems of soil degradation and erosion are especially acute in this zone owing to high population densities, e.g., in Nigeria. Some of the more interesting material still in experimental stages coming out of the International Institute for Tropical Agriculture (IITA) in Nigeria to cope with these conditions includes alley cropping with leguminous trees and shrubs, new cassava varieties, and no-till cropping that increases soil fertility and retains vegetative cover, thus minimizing moisture loss and reducing erosion.

The higher level of rainfall in this area, between the 1400 and 3200 millimeter isohyets, is well suited to the production of tropical tree crops such as cocoa, oil palm, and rubber, and to the root crops yams and cassava. The higher returns per hectare from the higher value crops, assuming adequate yields in the humid and subhumid zones, give the government greater latitude in shaping its intensification strategy.[18] High value crops such as cocoa enable the government to extract a margin and still pass along profit to farmers; Cameroon is a case in point. Likewise, in Nigeria returns from planting improved cocoa were fully competitive with wages outside the agricultural sector even at the peak of the oil boom, but policy and institutional constraints inhibited expansion of new cocoa plantings (Lele, Oyejide, et al. 1989). The MADIA paper on fertilizer (Lele, Christiansen, and Kadiresan 1989) explains how exploiting regional comparative advantage is constrained by high costs of internal transportation and political and institutional barriers.

In East Africa, below 400 millimeters of rainfall, few crops other than sorghum and millet can survive; the diet is supplemented by livestock products such as meat, milk, and blood. Between the 400 and 800 millimeter isohyets, including large parts of Kenya and Tanzania, crop production is again limited to hardy and quickly maturing cereals like sorghum and millet, and to a smaller extent cotton, groundnuts, and tobacco. In regions with higher rainfall, between 800 and 1,200 millimeter isohyets, higher value grain crops like wheat and maize are possible, as is the production of tea, coffee, and pyrethrum in the higher altitude areas of East Africa (see map). The returns to labor per hectare are especially high for tea, coffee, and tobacco; but in Tanzania and Malawi, for instance, poor prices and other institutional constraints to export crop production have shifted incentives in favor of food crops. Other MADIA papers that address issues related to the development of cotton in anglophone and francophone Africa or structural adjustment in Malawi point out why, without intensification efforts on cotton in anglophone Africa or with improved maize in Malawi, the elasticity of acreage with respect to relative prices tends to explain much of the production response. These papers document how, with increasing population pressure and stagnant or declining yields, overall production increases are unlikely to occur simply through price corrections (Lele 1989a; Lele, van de Walle, and Gbetibouo 1989).

Soils in East Africa are thought to be structurally more sound than those in West Africa, but with the exception of subhumid highlands still thin and low in nutrients. They will initially give higher yields using higher inputs, such as chemical fertilizer, but will lose that capacity with repeated cultivation unless supplemented by organic matter, such as



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animal manure or humus.[19] The need for constant biological input underlies the growing importance of agroforestry for farm management (Boehnert 1988). Tree cover also helps reduce high rates of water evaporation that shorten the effective growing season; solar radiation in East Africa (150-180 kcal per square centimeter annually) is the highest in the world (Collinson 1987). Low levels of rainfall and high rates of transpiration limit the utility of high solar intake, which more often than not just bakes the earth.

Deforestation

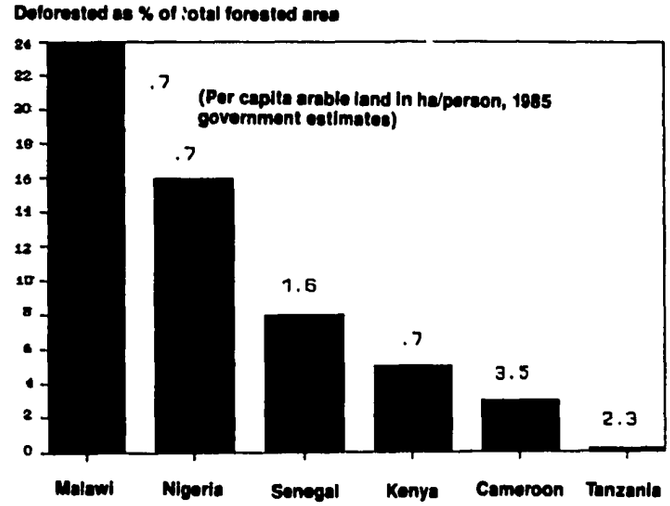
Deforestation relates back to the second, unforeseen dynamic of autonomous intensification. It represents an acute form of overexploitation of, rather than investment in, natural resources, contrary to the Boserup hypothesis. The central importance of forests for energy (fuelwood), for food (browse and fodder), and for environmental stability (soil and water retention), and their threatened position as the last easily accessible frontier for development, reinforce the argument for introducing a more comprehensive land policy to protect forests and encourage the use of trees in farming systems. This is why the FAO definition of arable land available for cultivation is of extreme relevance for policy governing the use of the forestry sector. Considering that fuelwood constitutes an estimated 90 to 95 percent of energy needs for rural populations in Sub-Saharan Africa and that it is also gathered for sale in urban areas, one would expect this resource to be in high demand in land-scarce countries and to observe a close correlation between population densities and a decline in forest area.[20]

The aggregate data presented in this section support this premise. The four countries under greatest population pressure correspond exactly to those suffering most from deforestation.[21] Nigeria, for instance, is often cited as a case where the sheer magnitude of deforestation is causing serious environmental damage. With only .71 hectares of arable land per person (by government definition), the country faces depletion of its tropical forest resources, as over one-quarter million hectares are cleared for agricultural and other uses *each year* (FAO 1981). Equally alarming in relative proportion is the case of Malawi, where population pressure is intense at just .73 hectares per capita of arable land. It is estimated that 120,000 hectares of woodland are cleared annually, almost half as much as is cleared in Nigeria on a yearly basis. If one extrapolates over 10 years, one finds that, because of its small size (91,000 square kilometers), Malawi faces losing up to 24 percent of its forest area in a decade (see Figure 7).

New recording methods should among other things consider removing this category from the calculations of arable land (as FAO Production Yearbook does); most governments—gauging by their definitions of arable land and vague or unarticulated policies—assume that forests can be brought under cultivation with relative ease and with few damaging consequences. A controversial issue is whether the Kenyan government's clearing of high altitude rainforest to make way for state tea plantations is causing permanent damage. Forest proponents argue that tree crops serve the double function of retaining soil cover and generating export revenues, but there is no consensus on the issue, nor is there likely to be until more research is completed.[22] Other high priority policy areas include promoting tree-planting campaigns at the national level and moving more land into state parks.

The role of forests extends well beyond being a source of

Figure 7
Deforestation in the MADIA countries relative to per capita cultivable land



Note: Includes broad-leaved, coniferous, and bamboo forests.
Source: FAO/UNEP 1981.

fuel and potential cropland; trees are an indispensable component of soil fertility management in tropical agriculture. In the drier Sahelian and Sudanian zones, for instance, it has been shown that trees not only protect soils against wind and water erosion and restore subsoil nutrients by shedding leaves, but they also provide fruits and leaves, firewood and building poles, bark for cord and medicine, and thorn branches for fencing, as well as serving as a critical source of browse for livestock in the dry season (Gorse and Steeds 1985). Forestry research in these climatic zones is said to be promising, including the use of plant tissue cultures for propagating well-suited clones and symbiotic root microorganisms to enhance the nitrogen-fixing capacity of certain species.[23] The importance of maintaining soil fertility and stability in the humid rainforest regions and the potential use of trees as part of integrated farming systems in the tropics have been pointed out previously.

What are the long-term effects of deforestation? The reduction of tropical, high altitude, and other forests has spawned a great deal of controversy. The Tropical Forest Resources Project undertaken by the FAO observes:

> One of the most serious consequences related to forest clearing is the loss of genetic plasma and of the seed bearers which leads to the complete disappearance of many species. On the contrary the impact of deforestation on the neighboring zones is much more complex to assess: changes in water regimes, erosion, climatic modifications, spreading of diseases, diffusion of polluting agents, change of carbon dioxide content of the air (FAO 1981).

Evidence turned up in the MADIA study points to marked changes in rainfall patterns over the past 20 years. For instance, annual rainfall in Senegal has decreased by 2.2 percent a year over the past two decades (Jammeh and Lele 1988). The MADIA studies of Nigeria and Cameroon also note a sharp decrease in rainfall in the northern parts of both countries (Lele, Oyejide, et al. 1989; Lele, van de

Walle, and Gbetibouo 1989). These trends are alarming in West Africa because of the more intense pressure on the land in the lower rainfall Sudano-Sahelian zones. Although these trends may be temporary, there is little evidence to suggest that they do not reflect a permanent change resulting from tree loss. Most will agree that consuming forest resources faster than they grow back is causing a slow but steadily growing environmental crisis.[24]

Slowly rising population densities may have once been enough in themselves to bring about positive changes associated with technological adaptation in production, resource conservation, and consumption behavior, but arguably this is no longer the case in Africa; the transition to high density populations has been too rapid. There has been little technological change in agriculture. The traditional farming systems of bush fallow were meant for low levels of population, not rapidly rising densities. They make the need for "intensification" and changes in farming systems more urgent. Limited resources, fragile ecosystems, and skewed incentives make it more difficult for the smallholder to plan beyond the subsistence horizon. They make the short-term overuse of resources such as trees and land rational, if only for immediate survival.

Land Policy

In this section a brief presentation is given of the various approaches taken toward land policy in the MADIA sample and the impact they have had on the intensification process. The analysis focuses on the East African countries as they have experienced the more rapid and abrupt changes in land tenure patterns; despite growing population pressure in at least two of the three countries, land in West Africa has been a surprisingly unimportant issue in public discussion and policy formulation.

In Kenya, land titles and licenses to grow export crops have been far more freely available than in Malawi, as shown by the fact that smallholder tea hectarage has increased almost tenfold and coffee hectarage doubled between 1970 and 1985 (Lele 1989). The World Bank has consistently supported land registration in Kenya, since the early 1960s. The amount of land registered in Kenya increased from 1.8 to 6.5 million hectares between 1970 and 1983, constituting 97 percent of all high and medium potential land, or, including semiarid and transitional areas, 44 percent of the cultivable land. The share of smallholders in total registered land was 43 percent overall, but it was well over 80 percent in Western, Nyanza, Central, and Eastern provinces, the heart of smallholder production areas in Kenya (Lele and Meyers 1987). Institutional rights to the land for smallholders have played a critical role in encouraging intensification, but differential access to institutional credit and a combination of social and ethnic factors have rendered the land market in Kenya imperfect.

In Malawi, customary rights to cultivate and transfer smallholder land are conferred by traditional tribal chiefs, while the expansion of estate agriculture has been determined by explicit government policies. Burley and flue-cured tobacco production has been reserved for estates through a licensing policy that accompanies the establishment of leaseholds on "unused" customary land. The transfer of land from smallholders to estates has contributed to economic growth through estate production but has worsened land distribution over time and led to a decline in average farm size in both sectors (Lele 1988a). Although the process of technical change may be slower for smallholders than for estates, land policy will be for Malawi one of the most important factors determining future growth in smallholder productivity (Lele and Agarwal 1989). Without a clear policy, a three-tier land ownership of estates, smallholders, and marginal or landless will emerge.

Similarly in Tanzania, smallholder control over land has suffered as a result of state policy. Tanzania formally abolished traditional tribal village authority, replacing it with public ownership of land whereby an individual has no right of ownership or sale. In fairness to Tanzania, it should be added that the World Bank's 1963 report provided a major intellectual justification for the so-called "transformation approach." The policy of forced "villagization" resulted in the resettlement of more than 9 million people—about 60 percent of the population—into 6,000 villages by mid-1975. Given the weak soils (the reason for traditionally sparser settlements), the Ujamaa policy toward land increased environmental stress and led to greater problems of erosion and deforestation (Lele, van de Walle, and Gbetibouo, 1989). Attempts at collective woodlots failed (according to one source because when one sites and plants a tree, it is tantamount to claiming ownership (Leach and Mearns 1988)), and production of wood-related crops like tobacco and pyrethrum has declined (Lele 1988a).

Interaction between Population Densities, Cultivable Area, and Land Productivity: Some Empirical Evidence

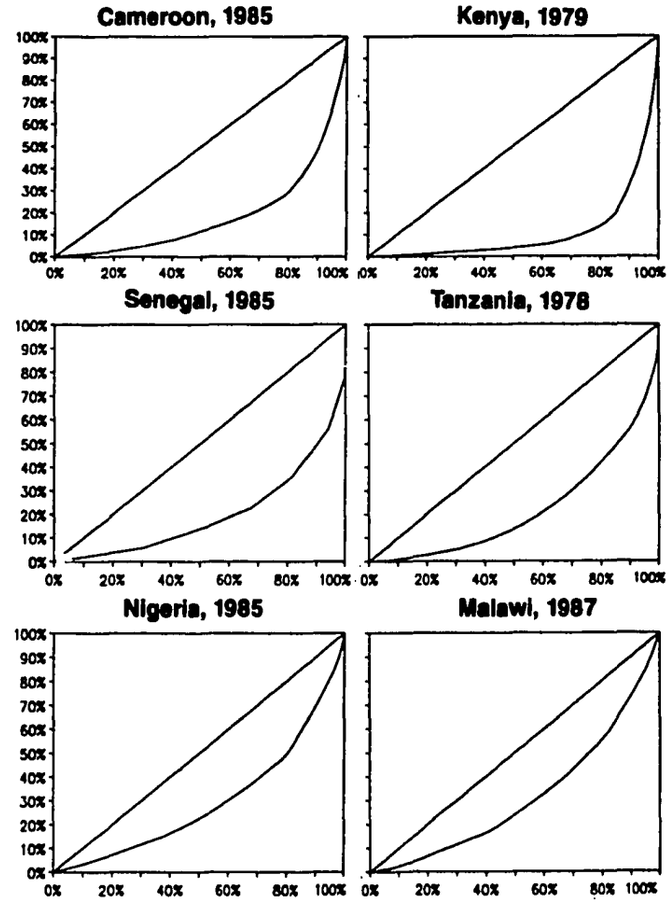
Distribution of Population on Land

A relevant question for designing a policy-led intensification strategy involves the location and degree of population concentration in relation to land quality. Are people more densely settled in the fertile "high potential" areas (defined by agricultural production and income possibilities), or are settlements—because of such factors as health hazards—located in drier areas of more limited crop production potential? To the extent that population densities are highest in the areas of high land potential, the answer will determine where future investment priorities in physical infrastructure such as roads, schools, clean water, and health facilities will have the greatest impact. Regional concentrations, and the land base beneath them, will also figure in policy discussions of where it makes most sense to promote the use of chemical fertilizers and to direct the efforts of agricultural research for the quickest returns.

This section therefore tries to sketch the proportions of population density on a regional basis and to assess the implications for development planning. Surprisingly, there is a high degree of population concentration in *both* land-scarce and land-abundant countries. Even in large countries considered to have ample land, the population is very much more concentrated than usually believed: In Cameroon, for example, between 70 and 80 percent of the rural population is concentrated on only 20 percent of the land (see Figure 8). According to government estimates, over 80 percent of the land remains to be brought under cultivation. In land-scarce Kenya, the same proportion of the population is concentrated on even less land, just 10 to 15 percent of total area—but for very different reasons (see Figure 8). In the case of Cameroon, most people have tended to avoid the humid tropical rainforest areas (despite the higher agricultural incomes reported there from the production of cocoa, coffee, and oil palm) and farm in the milder climates; whereas in Kenya arable land forms such a small fraction of the total that the population is highly concentrated by necessity.

In fact, only in Kenya was there more or less a complete congruence between high population densities and high land potential, although as pointed out earlier people are now moving to more marginal areas. This congruence has profoundly affected the regional development of crop production. It has intensified regional specialization in food and cash crops, rather than promoting shifts into areas of lower density but good cropping possibilities. In Cameroon, Nigeria, Tanzania, and Senegal, the population has settled in the areas of highest "potential" or best cropping possibilities or lowest risk of disease, but large amounts of apparently fertile land remain with low population densities. In these latter countries and in the geographically smaller and climatically less diverse Malawi, the issue of population pressure on land has been framed largely as a "North-South" phenomenon; length of growing season and amount of rainfall are critical in determining the range of possible population movement. Especially in the West African countries, there is extreme population pressure in the drier northern reaches (between 500 and 800 millimeter isohyets) but an apparent gap of low density areas in the higher rainfall Sudano-Guinean zone to the South (e.g., the Casamance and Tambacounda regions of Senegal, the Middle Belt states of Nigeria, and the Adamaoua region of Cameroon). Not all the movement has been spontaneous, as the Boserup model would suggest: Governments have used a range of policy inputs to affect the movement onto these lower density lands, including producer prices, regional public investment, and the development of smallholder institutions. Before analyzing shifts in production, we first consider the regional distribution of population, land use, and land productivity by region.

Figure 8
Distribution of population on total land area



(X-axis: Area, Y-axis: Population)

Sources: Cameroon: Sixth Plan 1986; Kenya: ISNAR 1986; Senegal: Seventh Plan 1985; Tanzania: FAO/IBRD 1987; Nigeria: Lele, Oyejide, et al. 1989; Malawi, National Statistical Office 1988.

Population Densities in Relation to Quality of Land

"High potential" can be considered in terms of yield and response to fertilizers or in terms of income-producing capacity, such as the capacity to grow high value crops. The

two are not always synonymous. An analysis of the price effect on shifts in production is given in Lele (1988a) and will not be repeated here; we will focus exclusively on yield data insofar as they are available.

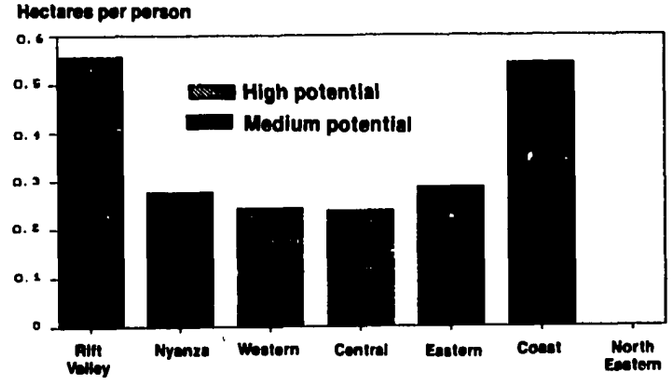
The substantial regional variation in population densities is not apparent in either the aggregate figures or the distribution curves. The degree of regional variation can be seen more clearly by looking at the annexes, which give the regional breakdown in population for each country by province or other geographical subunit. As mentioned earlier, the data on land quality and land use cannot be treated as authoritative in most cases. They are used here to give a rough idea of *how* population is distributed over *what* kind of land.

According to the FAO/UNFPA/IIASA study, Kenya faces the worst land constraint and has the greatest need for intensification. This observation is supported by the fact that population is heavily concentrated in the high productivity areas and, as we saw earlier (Figure 1), is migrating into more marginal areas. Roughly 65 percent of Kenya's population is concentrated on just 9 percent of the land, which constitutes three-quarters of all high potential (i.e., humid and subhumid zones) land. As a result, the amount of per capita arable land is lowest in the three provinces with the *greatest* proportions of high potential land: Western, Nyanza, and Central provinces (see Figure 9).[25] In fact, while constituting only 6 percent of the total area in Kenya, these three provinces support almost 50 percent of the total population.

Two points bear mentioning with respect to crops yields: first, yields in the high potential areas of Central province for tea, coffee, and maize are on the order of two to three times higher than in the drier parts of the country such as the Coast province and sections of the Eastern province. Second, yields have not improved significantly in the smallholder sector due to increased production on marginal areas (Lele and Meyers 1986). Table 7 indicates that the Central province has a clear advantage in the production of coffee and tea. Striking in the data is the difference in yield between smallholders and estates; estate yields for coffee approached 1 metric ton per hectare in 1981, whereas smallholder production lagged behind at an average of .53 metric ton per hectare (see also Lele and Agarwal 1989). Smallholder coffee yields were highest in the Central province, as were smallholder tea yields—generally 25 percent higher than in its closest competitor, the Nyanza province, for the period 1973 to 1981. Nonetheless, the tea subsector in Kenya is also remarkable for its consistently equitable high rates of growth. For all provinces, growth in production fluctuated less than 1.1 percent, between 11.8 percent in Central and 10.7 percent in Nyanza. Thus, while output shares and yields may differ significantly, growth in production was largely balanced over the 1973-82 period (see Annex 3). The Rift Valley and Western provinces have a distinct advantage in the production of staple foods, reflected in their superior yields in maize production.

In Cameroon, almost 50 *percent* of the population is concentrated in the fertile Western Highlands and the high rainfall western lowlands, which cover less than 20 percent of total area. Data from the 1984 Agricultural Census and the Bilan Diagnostic indicate that on the whole the intensity of land use (as measured in percentage of area planted and fallow) is below 35 percent, but as expected is most intense in the more densely populated areas such as the Western Highlands region (see Figure 10). Similarly, the proportion

Figure 9
Kenya: Per capita high and medium potential land by province



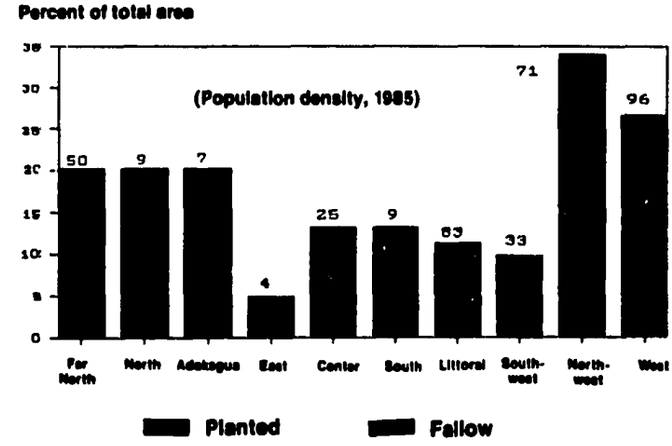
Source: Jaetzold and Schmidt 1982.

Table 7
Kenya: Average yields for selected crops by province, selected years (in kilograms per hectare)

Province	Coffee		Tea	Maize
	Smallholder	Estate	(Smallholder)	
Central	723	1,286	711	1,700
Nyanza	465	—	536	1,760
Eastern	420	818	524	850
Western	356	—	260	1,960
Rift Valley	250	219	522	2,310
Coast	250	—	—	920
Average	538	1,024	688	1,650

Source: Coffee: de Graaff 1986; for 1981/82 only.
Tea: Kenya Ministry of Agriculture; for 1973-1981.
Maize: Kenya Ministry of Agriculture; for 1970-1981.

Figure 10
Cameroon: Area planted and fallow by region, 1984



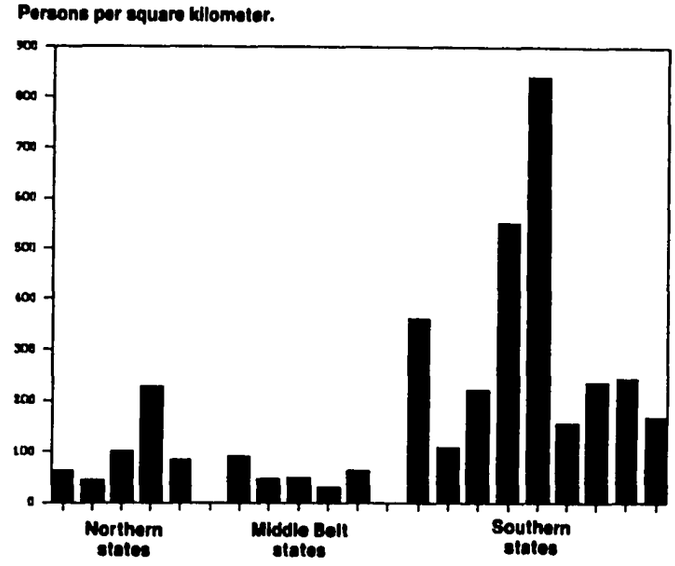
Sources: Bilan Diagnostic 1986; 1984 Agricultural Census.

lying fallow appears to be lower in the higher density regions such as the Far North. The data should be taken as a rough approximation as they are derived from two different sources, but they indicate a correspondence between cultivated area and population densities. Furthermore, Table 8 indicates that yields of high value crops in these regions were generally higher than elsewhere in the country. Although the yield data are for a single year (1984, a dry year) and do not represent an average, they are still indicative of relative land productivity. One of the principal characteristics of Cameroon, in addition to its overall land abundance and relatively high concentration of population, is the use of parastatals to promote regional smallholder development (see Lele, van de Walle, and Gbetibouo 1989).

Soil surveys completed in 1986 also support the premise that the West and Northwest provinces show better potential than either the rainforest areas to the East or the savannah zones to the North (IFDC 1986). The large concentration of people in these high potential areas makes the provision of services and the creation and maintenance of roads and physical infrastructure relatively efficient, and consequently a smallholder-led strategy of intensification a realistic and cost-effective way to raise rural incomes. Investments in these areas, especially for transport capacity and human capital, are likely to have strong multiplier effects throughout the economy, not unlike those envisioned by Boserup as occurring spontaneously.

The lack of accurate data in Nigeria on either land, population or crop yields makes an accurate assessment difficult, but it appears that almost 50 percent of the population is concentrated in the *southern rainforest area*. Population densities in the southern states are as high as those found in the East African highlands (see Figure 11). Before the oil boom, this area—which covers just under 20 percent of the total area—earned a high agricultural income from the cocoa and oil palm tree crops. Since then, an overvalued exchange rate, a shift in terms of trade toward food crops, and unstable marketing institutions have undermined the returns from growing these crops, and

Figure 11
Population densities in Nigeria by region, 1986



Source: Lele, Oyejide, et al. 1989.

Nigeria has lost its former position as a supplier on the world market. Given intense population pressure in the South, which has from 200 to 500 persons per square kilometer, the government is moving to develop its less densely settled areas. Since the oil boom and Sahelian drought of 1973, two important policy instruments used to promote its objective of increasing food production have been fertilizer subsidies and the construction of large-scale irrigation schemes in the Northern region (Lele, Oyejide, et al. 1989). Those familiar with Nigeria expect that the greatest room left for area expansion is in the lower density Middle Belt states with an estimated 53 persons per square

Table 8
Cameroon: Average yields in the traditional sector, by province, 1984

Province	Average yield per hectare (in kilograms)						
	Cocoa	Robusta Coffee	Arabica Coffee	Yams	Maize	Cassava	Oil Palm (liters)
The North (Savannah)							
Far North	—	—	—	—	665	—	—
North	—	—	—	—	—	—	—
Adamaoua	—	1,445	—	—	1,811	2,768	—
South-Center (Tropical Rainforest)							
East	202	1,119	—	—	2,012	6,906	2,107
Center	377	699	—	6,535	1,327	20,925	4,438
South	273	341	—	—	1,455	15,097	709
Western Lowlands (Tropical Rainforest)							
Littoral	531	1,321	—	4,295	983	19,154	2,891
Southwest	597	387	—	4,953	1,581	19,550	1,413
Western Highlands (Guinea Savannah)							
Northwest	200	726	440	4,213	2,820	17,466	2,627
West	580	706	358	4,406	1,894	29,716	1,323
Cameroon	381	885	392	4,900	1,987	12,011	1,646

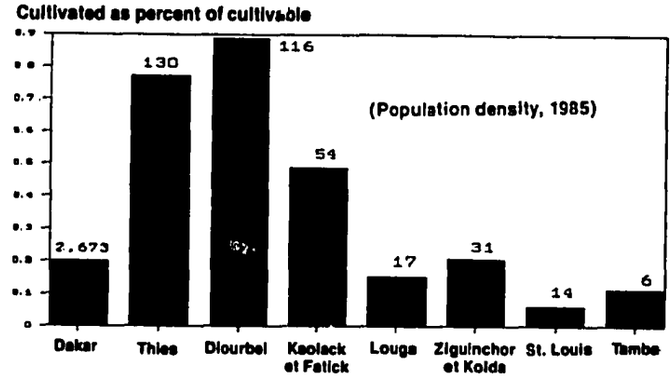
Note: Yield totals may include more than one harvest for certain crops.
Source: 1984 Agricultural Census of Cameroon.

kilometer. As pointed out earlier, densities are lower here than in the North for reasons of health, a factor contributing to labor shortages in the Middle Belt. The government's emphasis on promoting regional food crop specialization and mechanization in the Middle Belt is underscored by the recent import ban on grains and extension efforts in the North using the World Bank-sponsored agricultural development projects (ADPs).

In Tanzania, a land-abundant country, as much as 60 percent of the population lives on 20 percent of the land. Population in this case is concentrated around the Lake Victoria Basin (26 percent of the total) and the coffee producing Northeastern Highlands (11 percent), areas of traditionally higher value and higher-yielding crops. Both these regions have a history of intensive land use, including irrigation, but the farming techniques that have evolved there have to date not been complemented by public policy to intensify production. Smallholders, for instance, receive only one-third to one-half of the world price for dark-fired and sun/air-cured tobacco (see Lele 1988a). Concerned about population pressure, the government has tried to open up new areas of high potential in the Southern Highlands. This strategy makes sense in the long term, but in the short run it has high opportunity costs in terms of returns foregone that would occur more immediately in the more accessible Northeastern Highlands. The fiscal problems encountered by Tanzania illustrate the dilemma of giving regional equity a higher national priority than growth in overall production.

In Senegal, there appears to be even less congruence between population and land potential. It may be that historical and health-related factors have militated against the movement into high response areas. The purposeful concentration of infrastructure—roads, schools, railways—in the Groundnut Basin of Senegal, and subsequent settlement by Wolof "visionaries" may, for instance, help to explain why its densities are higher than in the regions to the South. If the data are reliable, Figure 12 shows that in the most densely populated areas (those in the Groundnut Basin) farmers are reaching the limit of the area frontier. Data presented in Table 9 suggest that crop yields for groundnuts and sorghum/millet are on average as much as two times higher in Casamance than in the rest of Senegal but that average population densities there are substantially below those found in the Groundnut Basin: 14 as compared to 45 persons per square kilometer. Almost half of the total population lives in the Groundnut Basin. In fact,

Figure 12
Intensity of land use in Senegal by region



Source: Seventh Plan 1985.

the majority of the Senegalese—72 percent, including the population of Dakar—live in the drier Sahelo-Sudanian zone (350-600 millimeters per annum). Rainfall is likely to become more of an issue insofar as it has declined significantly over the past two decades. The relatively better performance for Casamance and its more favorable placement in the Sudano-Guinean zone suggest greater production possibilities for groundnuts as well as other crops; according to government estimates, over two-thirds of the arable land in Casamance remains to be brought under cultivation.

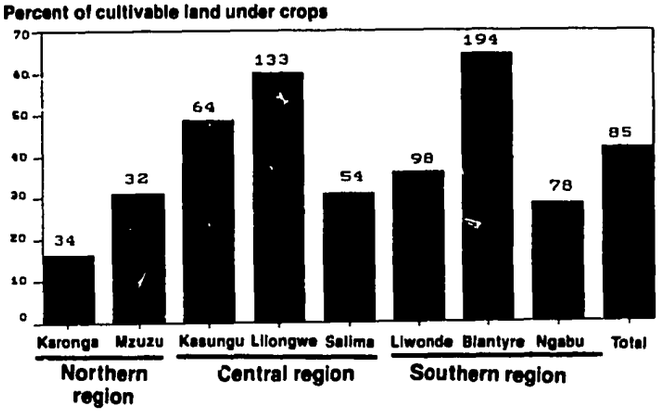
Finally, the population in Malawi is largely concentrated in the Southern region—a full 49 percent of the total. Of the 5.3 million hectares classified as cultivable in the most recent land survey, 42 percent is already under cultivation.[26] The extent of land use, expressed as the proportion of cultivable land that is already cultivated, is highest in the crowded Blantyre agricultural development district at over 60 percent, followed by Lilongwe and Kasungu ADDs, with just below 60 and 50 percent, respectively (see Figure 13). These figures *do not* include land held fallow; they are merely the crop estimates for total area. Were they to include land held fallow it is likely they would approach 100 percent of cultivable land. In fact, if one uses the more conservative estimate of only 22 percent arable (without forests), over 100 percent of available land would already be under cultivation.

Table 9
Population densities, average crop yield, and mean rainfall, by region in Senegal (densities in persons/square kilometer; yields in metric tons per hectare; rainfall in millimeter per annum)

Province	Population density	Average yields (1960-1987) Groundnuts	Millet/Sorghum	Average rainfall in mm./annum
Dakar	2,673	560	470	438
Thies	130	790	460	520
Diourbel	116	730	480	500
Kaolack et Fatick	54	840	610	585
Louga	17	690	320	347
Ziguinchor et Kolda	31	1,020	840	1,118
Fleuve	14	490	390	284
Tambacounda	6	840	670	825

Source: Jammeh and Lele 1988.

Figure 13
Intensity of land use and population densities in Malawi by region



Source: National Statistical Office 1977; 1988.

A probable cause for the high concentrations in southern Malawi is the location of the former capital of Blantyre; although the capital has moved since independence to Lilongwe in the Central region, the area around the former capital—Blantyre ADD—still contains over one-quarter of Malawi's population. The problem is complicated by refugee movement onto the land from neighboring Mozambique. Contrary to what one might expect in the Boserup model, the yield data presented in Table 10 suggests higher yields in the Central region for maize, groundnuts, and tobacco, apparently unrelated to population densities.

Two other important features in Malawi bear mentioning; first, Table 10 indicates much higher yields for estate-grown tobacco, generally twice as high as those found in the smallholder sector. Lele and Agarwal (1989) document that the lower yields for smallholders reflect their lack of access to inputs and better performing burley and flue-cured varieties. It is estimated that more than 80 percent of estate tobacco area is underutilized (Deloitte, Haskins, and Sells 1986). The second salient feature of land use in Malawi is the apparent decline in yields over time: In the most intensely cropped areas like Lilongwe, a decline in soil fertility has reduced response coefficients for fertilizer on hybrid maize from 23 to 13 between 1957-62 and 1982-84 (Twyford 1988). This observation squares well with recent data from FAO showing that, in general, for each 4,000 kilograms per hectare crop of maize, 200 kilograms of nitrogen, 80 kilograms of phosphate, and 160 kilograms of potassium are removed from the soil (Higgins). Others argue that soils either have or do not have the major plant food elements, which if they are there are not easily exhausted by cropping. If not there they must be added. Nitrogen is an exception as it is generally very quickly exhausted. The drain on soil nutrients caused by continuous cultivation and reduction in fallow periods underscores the need for more resourceful cropping patterns, such as including leguminous, nitrogen-fixing shrubs in the plot. Also, changing the structure of output to higher-yielding and higher value crops—both a function of policy—will by producing higher incomes alleviate the pressure brought to bear by increasing population.

The main thrust of this section has been to point out the production possibilities of the various regions where populations are concentrated, and what the implication is for a policy-led approach to intensification. In countries where population is highly concentrated on the most productive lands, investment choices are easier from an economic standpoint: The marginal cost per head of extending smallholder services, such as credit, marketing channels, and inputs are small given the potential returns. Elsewhere, investments in infrastructure and social services are more costly but may be required to attract population to underutilized land. The Casamance region in Senegal or the Southern Highlands in Tanzania are cases in point.

A final note before closing this section: Investment decisions must be extremely sensitive to the social constraints to migration, such as ethnicity. Latent antagonisms may rise to the surface with migration. 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. One observer notes that:

> 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...if "development" comes in the attache cases of northern technocrats, the unhappy story of the Southern Sudan or even of East Pakistan may well be repeated (Waterbury 1989).

Similarly, ethnic tensions between the Hausa of the North and Yoruba and Ibo of the South may interfere with planned development to induce migration into the lower density Middle Belt states. Interregional migration has reportedly more or less stopped since the civil war, but even before that, migration to the Middle Belt from adjacent areas in the North and South appears to have been largely confined to homogeneous ethnic groups (Lele, Oyejide, et al. 1989).

Table 10
Average yields for selected crops in Malawi, by region (in kilograms/hectare)

Region	Maize	Groundnut	Tobacco	
	Smallholders Only (1984-87)	(1984-87)	Estate (1970-85)	Smallholder (1984-86)
Northern	1,190	410	900	400
Central	1,280	480	1,160	430
Southern	880	360	1,200	400
Average	1,110	450	1,160	420

Source: Ministry of Agriculture Spreadsheets 1987.
Estate Tobacco: Tobacco Control Commission Circulars.

Population Densities and Incomes

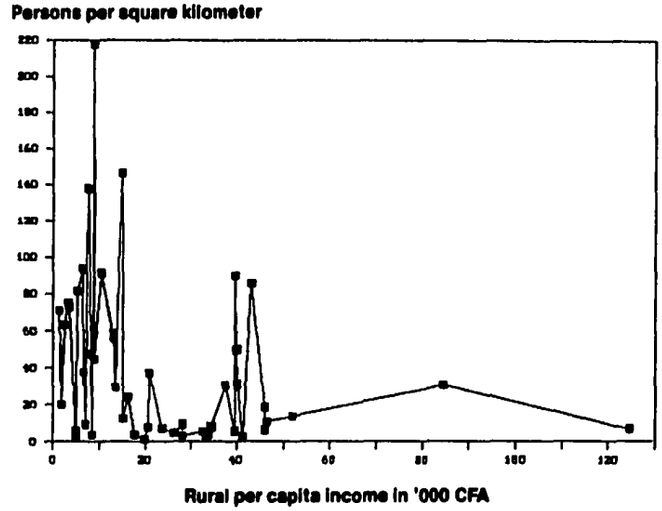
Integrally related to the "potential" of the land is the income that derives from agricultural production. In terms of income, land potential is determined by such variables as the length of growing season and quality of soil (i.e., the standard agronomic definition), as well as by access to land and secure land tenure, legal right to grow high value crops, extension, input and output marketing services, and the degree of implicit or explicit taxation of crops. As the level and quality of these services in developing countries are largely tied to government initiative to provide them, income potential by region is as much a function of policy as it is of regional resource endowments. The interaction of smallholders and government changes the simple dynamic outlined in Boserup's model, especially when land becomes scarce throughout a country. The evidence uncovered from the MADIA sample suggests that income levels do not always follow population densities, in either land-abundant or land-scarce countries.

The point can be illustrated by taking two extremes. In Cameroon, for instance, it is estimated that 80 percent of its arable land remains to be brought under cultivation. Given appropriate cultivation techniques (retaining vegetative cover), it has a wide margin for area expansion. The highest agricultural income-earning areas in Cameroon were those areas *least densely populated* (see Figure 14); the high density areas received lower incomes, based more on the sale of food crops than of what are traditionally termed cash crops (see Figure 15). These findings relate back to the definition of *high potential* land that looks more at income and therefore uses value of crops grown to measure land potential, as opposed to FAO definitions that classify potential simply in terms of soil quality and rainfall patterns. The data suggest that people chose to forgo the better income opportunities of the tropical rainforest areas and instead are concentrated in regions of more moderate climate.

In Senegal, by way of contrast, populations are concentrated in the high income areas. The production of groundnuts, Senegal's principal export crop, is concentrated in the high density Groundnut Basin. Four-fifths of total groundnut production accrues to the regions in the Groundnut Basin, and close to 50 percent is produced in the Sine-Saloum (Kaolack and Fatick) region alone (see Annex 3). The latest available data from 1975 suggest that almost one-third of total crop income, or 22 billion CFA, accrued to the Sine-Saloum (see Table 11). The higher density Groundnut Basin, with 49 percent of total population, received 58 percent of total rural income in 1975, with well over two-thirds of its total income derived from crops. Waterbury (1987) argues that the Groundnut Basin also had preferential treatment in institutional arrangements in the colonial era for marketing groundnuts and in some years received substantially more than the world price. The lack of more recent data on income makes it hard to assess what has happened in more recent years, especially in light of erratic and declining rainfall and soil erosion. But it is evident that development of the Basin is no more the priority it once was. Lele, Christiansen, and Kadiresan (1989) have documented that fertilizer consumption has virtually collapsed in the Groundnut Basin, and that investment has shifted to irrigated rice production in the Fleuve region.

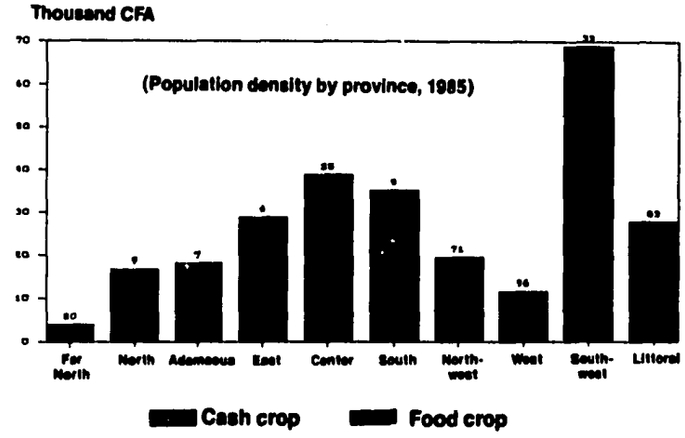
These two cases contradict a commonsense interpretation of the Boserup hypothesis: One would expect, all things being equal, that the acute demand for productive land in Senegal would force people into the Casamance area to exploit its apparent higher yields in crop production. However, variables other than population density appear to be affecting the natural processes of autonomous intensification (here, area expansion) observed elsewhere by Boserup. These variables include social and ethnic factors, the choice of crops grown, the prices received for those crops, and public expenditure. Even though one region may be densely settled—for reasons of better infrastructure, social services, or climate—it does not axiomatically lead to higher incomes. Incomes also depend on the congruence between land potential and adequate labor to produce high value crops. Incomes are higher in the low density areas of Cameroon, for example, because the crops grown there, cocoa and oil palm, fetch a premium

Figure 14
Population density and per capita agricultural income in Cameroon



Source: Government of Cameroon 1985.

Figure 15
Agricultural income by region in Cameroon



Source: Government of Cameroon 1985.

Table 11
Rural incomes by source and region in Senegal, 1975 (in billions of 1975 CFA; per capita income in 1975 CFA)

Region	Crops	Livestock	Fishing	Forestry	Crops as % of total	Total rural income	Total per capita income 1975
Dakar	1.3	0.7	5.7	1.3	14%	9.0	10,088
Groundnut Basin	45.3	7.5	4.4	4.7	73%	61.9	31,313
Thies	9.9	1.4	3.1	1.9	61%	16.3	24,291
Diourbel	13.7	3.0		0.6	79%	17.3	41,051
Sine-Saloum	21.7	3.1	1.3	2.2	77%	28.3	28,597
Louga							
Outlying Regions	20.3	9.8	3.9	2.4	56%	36.4	24,493
Casamance	12.8	4.4	1.5	1.0	65%	19.7	28,143
Saint Louis	3.4	3.4	2.4	0.8	34%	10.0	19,563
Senegal Oriental	4.1	2.0		0.6	61%	6.7	24,367
Total Senegal	66.9	18	14	8.4	62%	107.3	21,992

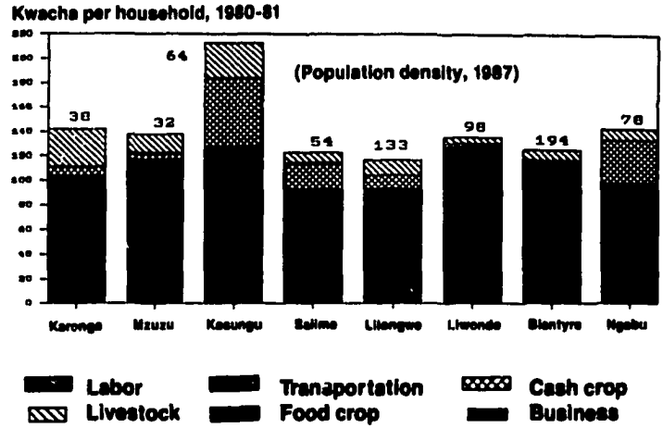
Sources: Jammeh 1987. Population densities from Seventh Plan for 1985, 19, table 4. Per capita incomes calculated by dividing total rural income by 1976 population figures.

on the world market, and even though the government of Cameroon taxes cocoa production heavily, farmers still receive a healthy margin. This would be impossible under the production of low value crops.

Just as in land-abundant Cameroon, incomes in land-scarce Malawi are highest per household in regions of *lowest population density* (see Figure 16). Kasungu, Ngabu, and Karonga are the lowest density ADDs (57, 54, and 34 persons per square kilometer, compared to the national average of 76) but they have the highest average household incomes, at 213, 143, and 142 kwacha a year, respectively (about US$70-100). In the high density areas, land is so short that small farmers have difficulty earning an adequate income from crop production. Despite the greater role of agriculture in the Malawian economy, crops contribute only 34 percent to total rural household income. The dominant source of income for smallholders is business or trading, at 27 percent of the total; the second largest source of cash income is *food crops*, at 23 percent of the total. Cash crops—generally higher value crops typically grown for export—contribute only 11 percent on a national average to smallholder incomes (see Figure 17). The data indicate that where crops have contributed significantly to total household incomes, the absolute level of income is higher. The observation is consistent with the literature on Asia that emphasizes the importance of agriculturally-led growth (Mellor and Johnston 1984). Were the government to allow or encourage the production of higher value crops, it could potentially alleviate the land constraint by raising the incomes of smallholders.

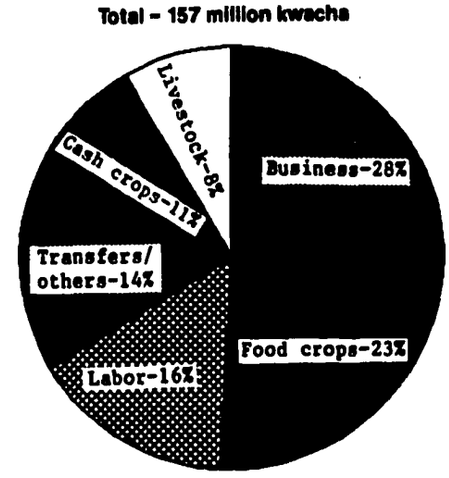
In Kenya and Tanzania, high incomes were found in areas of high population density, but lack of recent data makes it difficult in the case of Tanzania to assess the income effects of shifts in production to the Southern Highlands. For Kenya, a high correspondence between population densities and good land quality means that incomes have tended to be higher and remain localized in the areas growing high value crops. Table 12 indicates that the 1974-75 survey, the last to include income data, shows that over half of the households surveyed in the Central and Rift Valley provinces of Kenya earned more than 3,000 Kenya shillings. Likewise, the mean value of farm assets for the two provinces was substantially above those found in other provinces. The Nyanza, Eastern, and Coast provinces had

Figure 16
Population densities and rural incomes in Malawi



Source: National Statistical Office 1984b; 1988.

Figure 17
Sources of household income in Malawi by region, 1981



Source: National Statistical Office 1984b.

Table 12
Percentage distribution of holdings by household income group and mean value of assets per holding by province (1974/75)

Income Group	Central	Coast	Eastern	Nyanza	Rift Valley	Western	Total
Less than 0	10%	4%	5%	4%	16%	5%	7%
0- 999	8%	10%	9%	12%	10%	21%	12%
1,000-1,999	14%	21%	26%	26%	9%	29%	22%
2,000-2,999	14%	17%	13%	13%	15%	15%	14%
3,000-3,999	10%	15%	15%	11%	10%	10%	12%
4,000-5,999	15%	20%	13%	14%	15%	9%	14%
6,000-7,999	11%	4%	11%	4%	8%	7%	8%
8,000 and over	17%	8%	8%	17%	17%	3%	12%
Mean Value of Farm Assets	11,233	7,397	6,438	4,357	10,327	4,471	6,905

Note: Mean Value of Farm Assets includes land, buildings, farm equipment, transportation equipment, livestock, crops in store, planted crops, and inputs in store.
Source: Integrated Rural Surveys 1974-1975.

lower proportions of households above the 3,000 Kenya shilling mark, and the Western province had the lowest—70 percent below the 3,000 Kenya shilling line. Remarkably, only the Rift Valley had a higher proportion of households earning no cash income than did the Central province, at 16 versus 10 percent, indicating a concentration of subsistence farmers in the two most well-to-do provinces. The apparent distribution problems in these two provinces point to the need for more accurate and up-to-date information to assess the effects of rapid growth in high potential areas.

Although data on regional income are even more limited in Tanzania, it appears that the traditionally most densely populated districts (Kilimanjaro, Mwanza) also received the highest incomes. However, owing to shifts in production from North to South, the picture may have changed. In former times the coffee-producing Kilimanjaro region had the second-highest regional GDP (1970), after Dar es Salaam (see Annex 2). More recent data on regional incomes are not available, making it difficult to distinguish whether incomes still follow population densities as they do in Kenya. Other piecemeal data on fertilizer consumption, investment in roads, and marketed surpluses of tobacco, tea, coffee, and maize suggest a clear shift away from the northeastern and Lake Victoria areas toward the South.

The specialization in high-value crops by certain regions such as the Central province or Northeast Highlands raises interesting questions about regional comparative advantage. In the next section we examine the shifts in production in the most important crops, treating the shifts as outcomes to autonomous changes arising from localized population pressure (autonomous intensification); supply response to price changes; supply response to regional investment patterns, and supply response to other non-price factors such as institution-building at the regional level.

Population Densities and Regional Crop Production

Data on regional crop production over time—insofar as they are available—indicate a shift in production among regions, generally away from high density areas, and apparently owing more to policy initiatives than to spontaneous migration. Only in Kenya was there no perceivable shift in marketed production, a fact attributable to the apparent congruence between population concentrations and cropping potential of the land. In Tanzania, as mentioned above, government investment policy encouraged production in the low density Southern Highlands. In Senegal, investments in irrigation in the Fleuve region have caused rice production to shift to the North and away from Casamance. Reliable time-series data for Nigeria, Cameroon, and Malawi are not available, but there too it appears that production has shifted into lower density regions. The spontaneous movement into new areas sits well with the Boserup model, but as the following sections try to demonstrate, the picture is somewhat more complicated.

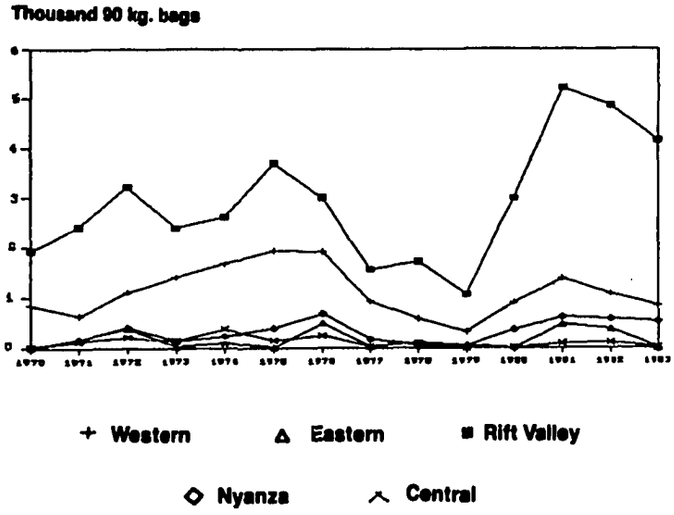
Food crops

We begin by looking at maize in East Africa, because it is marketed and records of official purchases are readily available. While there is a good deal of informal marketing, official sales nevertheless provide some important insights. In Kenya, for example, maize is produced throughout the country but in largest quantities in the Rift Valley. Between 1970 and 1985, 38 percent of maize production on average came from Rift Valley, from 27 percent of the area under cultivation (see Annex 4). The Eastern province, which grew by 1 percent in production and 4 percent in area, registered a 26 percent share of total area on the average, but produced only 13 percent of total output. The lower returns on the increased area in Eastern province may indicate an expansion onto marginal lands.

Furthermore, the Rift Valley sold the highest percentage of maize to the National Cereals and Produce Board (NCPB) with 63 percent on average, followed by Western province with a 24 percent share (see Figure 18). These figures are substantially higher than those given above for total output, where the Rift Valley had a 38 percent share of production. This suggests that a large part of the Rift Valley and Western maize output is channeled through the NCPB, whereas for other provinces, such as Eastern and Central, output bypassed the parastatal and was consumed locally. Central and Eastern provinces, for example, produced 13 percent and 12 percent of total output for maize, but accounted for only 3.4 percent and 2.5 percent, respectively, of maize sold to the NCPB for the 1970-84 period. Percentage amounts of maize *purchased for consumption* are shown in Figure 19, and confirm this observation; they indicate that households in Eastern and Central provinces purchase over 40 percent of their grain (for their own consumption) on the market. What Figure 19 cannot show is the extreme fluctuation in regional market dependence, especially in drought-prone or marginal areas.

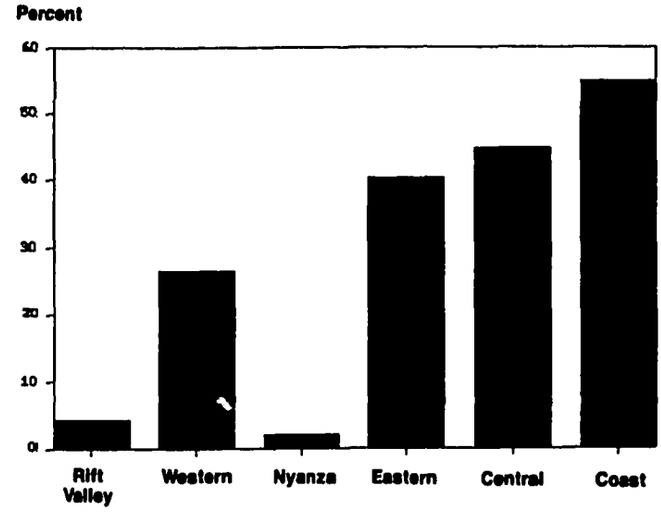
The problem of market dependence is complicated by

Figure 18
Official maize purchases in Kenya by region, 1970-83



Source: NCPB 1985.

Figure 19
Maize purchases for own consumption in Kenya

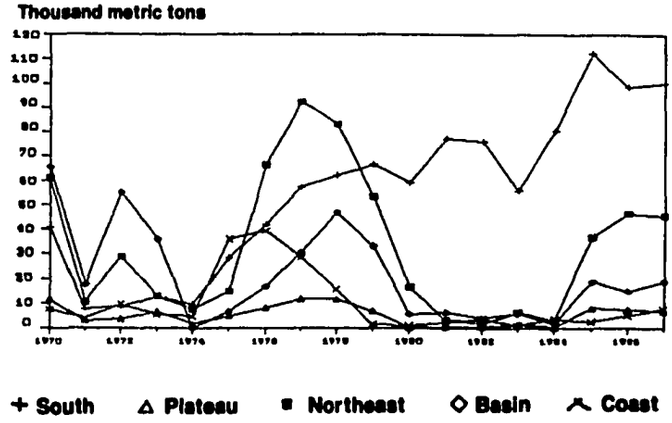


Source: Government of Kenya 1983.

projected decreases in per capita arable land. Little agricultural land is available per person in these areas already, and Table 13 shows that in most cases those amounts will fall by up to 40 percent by the year 2000. As population grows, more of the land will be allocated to maize production. Table 14 indicates that projected maize deficits will grow in many districts and that many districts formerly showing a surplus will record a deficit. Especially in the more marginal districts, the difference between a good year and a bad one can have serious implications; based on the projections in Table 14 four out of the six districts in Eastern province would slip from maize self-sufficiency to a deficit in maize without a "good" harvest. The rapid population growth and shrinking per capita land supply emphasize the need for policy-led intensification, especially in countries such as Kenya where little remains of the area frontier. The MADIA paper on fertilizer explores the implications for input use in high and low potential areas for both growth and equity; another explores the implications for food policy (Lele, Christiansen, et al. 1989).

In the case of Tanzania, as a result of policies such as pan-territorial pricing that discriminated against the Northeast Highlands, the production of marketed maize shifted over time from the Northeast Highlands and Dodoma province to the Southern Highlands. In 1970, the Kilimanjaro, Arusha, and Dodoma provinces accounted for over 64 percent of National Milling Corporation (NMC) purchases; by 1987 that figure had dropped to less than one-third. Regions in the Southern Highlands, by contrast, rose from about 22 percent in 1970 to over 55 percent in 1987 (see Figure 20). The shift in marketed production is away from the relatively high density regions to the North to lower density highlands in the South. For the 1978-87 period, for which data are available, between 40 and 60 percent of the officially marketed surplus was sold in the Coast region, including Dar es Salaam (see Annex 2). Even though the high potential Northeast Highlands have stopped selling surplus maize to the NMC, it appears they are roughly self-sufficient and—with the notable exception of Dodoma—have not increased purchases of officially marketed maize.

Figure 20
Official maize purchases in Tanzania by region, 1970-87



Source: Government of Tanzania 1980; 1987.

Given the high population densities in the northeast, there is an urgent need for intensification of high value crops.

In Malawi, yield differences across regions are not so large (see Table 4) as to confer a regional advantage in maize production. Nevertheless, because of extreme population densities in the South, regional surpluses have shifted over time, and two trends stand out. The Central region emerged in 1974 to become the leading supplier of maize (see Figure 21). Concurrently, the limited data for sales show an increasing dependency on the market in the Southern region, where population pressure is most intense. Between 1983 and 1986, the Southern region accounted for one-half to three-quarters of total maize sales from the Agricultural Development and Marketing Corporation (ADMARC) to smallholders. As referred to earlier, Twyford documents the decline in response to fertilizers in this region as it has been most intensively cropped, which could signal mining of the soils and perpetuate the circle of

Table 13
Maize deficit and maize surplus areas by province and district in Kenya, and distribution of population on high and medium potential land, 1985 and 2000

Province / District	Maize balance[a] ('000 MT) Moderate year 1980	Moderate year 2000	Good year 1980	Good year 2000	High and medium potential land: Total square km.	Percent of total	Hectares per person 1985	2000
Nairobi	-79.82	-224.65	-79.82	-224.65				
Kiambu	-46.73	-169.25	-34.34	-151.79	1,248	51%	0.14	0.08
Kirinyaga	5.84	-7.17	19.10	18.36	950	66%	0.29	0.15
Muranga	-35.49	-125.27	-21.29	-97.69	1,808	73%	0.21	0.11
Nyandarua	-8.38	-32.24	0.18	-16.94	1,988	56%	0.67	0.39
Nyeri	-33.93	-97.93	-24.22	-80.39	1,380	42%	0.22	0.12
Central	-118.69	-431.26	-60.57	-328.45	7,374	56%	0.25	0.13
Kilifi	-21.44	-71.57	-5.91	-41.47	2,541	20%	0.45	0.25
Kwale	-29.43	-60.10	-26.50	-69.80	2,085	25%	0.58	0.30
Lamu	-3.02	-10.22	-2.02	-7.40	3,887	60%	6.54	3.02
Mombasa	-34.32	-79.85	-33.99	-79.20	0		0.00	0.00
Taita/Taveta	-6.67	-24.13	-1.11	-14.73	703	4%	0.37	0.21
Tana River	-8.18	-29.74	-6.59	-26.64	418	1%	0.32	0.15
Coast	-103.06	-275.61	-76.22	-239.24	9,634	12%	0.55	0.30
Embu	-11.37	-11.37	-3.99	14.84	800	29%	0.23	0.12
Isiolo	-2.18	-3.03	-0.86	1.49	0		0.00	0.00
Kitui	-36.98	-38.89	-29.04	0.65	2,902	10%	0.48	0.27
Machakos	-22.91	-3.73	53.51	234.70	3,657	26%	0.27	0.14
Marsabit	-9.01	-28.33	-7.80	-24.20	0		0.00	0.00
Meru	-34.17	-20.63	-16.38	40.19	2,870	29%	0.27	0.14
Eastern	-116.62	-105.98	-4.57	267.47	10,229	7%	0.29	0.15
Garissa	-2.37	-8.77	-2.37	-8.76	0		0.00	0.00
Mandera	-1.96	-3.74	-1.97	-3.75	0		0.00	0.00
Wajir	-2.62	-7.88	-2.62	-7.88	0		0.00	0.00
North Eastern	-6.95	-20.39	-6.95	-20.40	0		0.00	0.00
Kisii	-13.35	-65.20	-0.12	-38.52	1,925	88%	0.16	0.09
Kisumu	-35.77	-87.48	-33.12	-82.61	1,597	76%	0.24	0.13
Siaya	3.81	-26.68	23.15	6.64	2,039	81%	0.31	0.19
South Nyanza	-1.43	-35.30	18.00	2.78	4,124	72%	0.37	0.22
Nyanza	-46.74	-214.66	7.92	-111.71	9,685	77%	0.27	0.15
Baringo	-18.76	-43.21	-16.42	-40.29	1,976	20%	0.77	0.46
Elgeyo Marakwet	21.32	35.83	33.91	51.55	1,104	48%	0.67	0.63
Kajiado	-8.31	-40.49	-5.50	-34.33	311	2%	0.15	0.07
Kericho	44.77	81.85	72.94	144.90	3,354	85%	0.41	0.23
Laikipia	-5.10	-28.98	-0.63	-19.19	1,330	14%	0.69	0.30
Nakuru	-8.49	-24.38	0.57	4.39	2,678	46%	0.36	0.17
Nandi	99.13	177.40	127.27	229.89	1,926	70%	0.49	0.30
Narok	-10.71	-53.23	-6.49	-44.00	5,435	34%	1.87	0.89
Samburu	-9.71	-17.09	-9.37	-16.39	0		0.00	0.00
Trans Nzoia	98.21	183.09	121.01	236.88	1,550	75%	0.41	0.18
Turkana	-20.80	-20.62	-20.77	-20.68	0		0.00	0.00
Uasin Gishu	43.72	74.70	52.10	93.83	2,781	82%	0.68	0.33
West Pokot	-2.54	-50.14	1.78	-43.54	1,368	15%	0.60	0.27
Rift Valley	222.73	274.73	350.38	545.09	23,840	15%	0.55	0.29
Bungoma	28.63	53.53	43.80	88.72	1,992	65%	0.30	0.16
Busia	0.08	-26.05	8.69	-9.63	1,349	83%	0.35	0.18
Kakamega	43.58	101.39	85.37	198.23	2,548	73%	0.20	0.11
Western	72.29	128.87	137.86	279.33	5,889	72%	0.25	0.14
Total	-176.86	-868.95	268.03	167.43	66,652	12%	0.33	0.18

Note: For maize balance 15% deducted for fodder and losses. Assumes 2.5% overall yield growth distributed in accordance with districts' growth potential. Area growth 1% in Central, Nyanza, and Western provinces, otherwise 2%.

Some have expressed doubts about the district maize balance results in this table. For instance, G. Stern observes, "...Machakos production fluctuates between feast and famine depending on the weather, but it is hard to believe that in a favorable year, by 2000 its surplus would be second in the country and very close to first.... Kakamega data [are also] surprising. At one time, the district (called North Nyanza) included Busia and Bungoma, and it was Bungoma that generated major surpluses.... [it is] hard to believe that Kakamega with some of the most densely populated areas could generate sizeable surpluses. One can divide the district into the heavily populated South that will be as or more food deficient than Kiambru district; a reasonably self-sufficient, fairly heavily populated center and a potential surplus, less densely populated North. The surpluses in the North could not do more than meet the deficit of the South" (Personal communication with the authors).

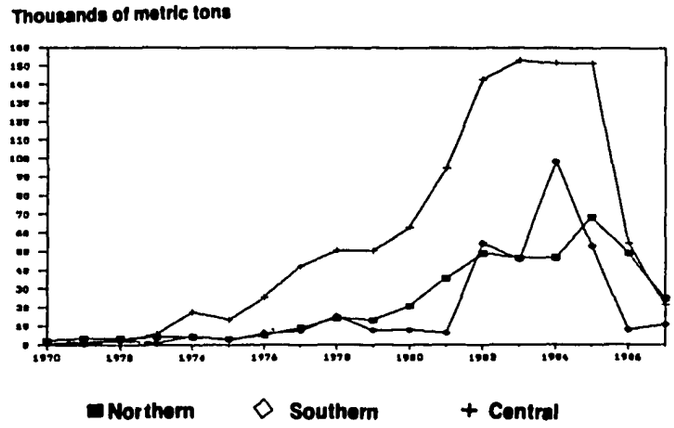
Source: Maize Balance and Population Data: Githongo & Associates 1983. Agricultural Land Statistics: Farm Management Handbook of Kenya Vol. II, as reported in ISNAR 1986.

Table 14
Regional investment as percent of total in Senegal, 1977-84

Region	Population density 1985 per/sq.km	Fifth Plan Investment	Sixth Plan Investment
Dakar	2,673	31.2%	21.7%
Groundnut Basin	49	28.2%	13.5%
Thiès	130	10.7%	5.0%
Diourbel	116	3.4%	0.2%
Kaolack et Fatick	54	10.7%	5.0%
Louga	17	3.4%	3.3%
Outlying Regions	14	30.0%	23.7%
Ziguinchor et Kolda	31	11.5%	9.7%
Saint Louis	14	11.5%	10.0%
Tambacounda	6	7.0%	4.0%
Nonlocal	-	6.0%	40.0%
Total Senegal	26	95.4%	98.9%

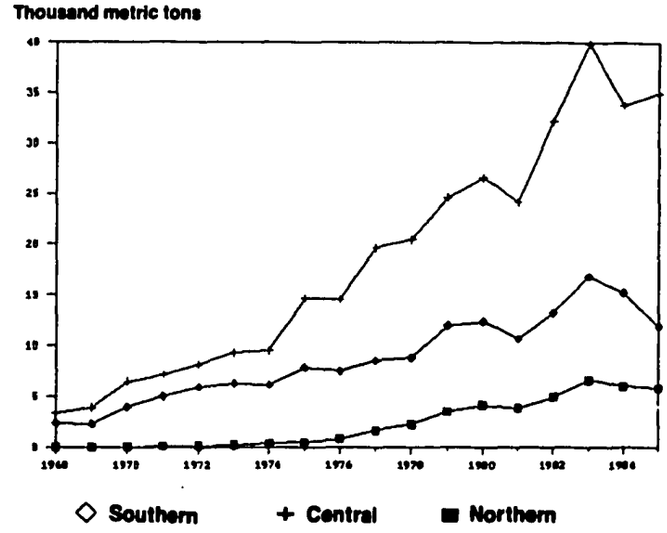
Source: John Waterbury 1986; Population Densities from Seventh Plan 1985.

Figure 21
Official maize purchases in Malawi by region, 1970-87



Source: ADMARC/DHS 1987.

Figure 22
Production of estate tobacco in Malawi by region, 1960-85



Source: Tobacco Control Commission Circulars 1972-86.

lower crop yields and greater market dependence.

Data for West Africa are more scarce, making it hard to point to areas of food surplus or deficit. In Senegal, for instance, it appears that the country as a whole is shifting into sorghum and millet. Its share of total cultivated area grew from 42 percent in 1963 to 53 percent in 1987. Jammeh and Lele (1988) argue that the shift into millet and sorghum reflects an attempt to manage climatic uncertainties and reduce risk. The most dramatic increase in area and production occurred in the densely populated Groundnut Basin, particularly in the Sine-Saloum (Kaolack and Fatick) region, where between 1961 and 1976 area and production doubled, from 157,000 metric tons to 322,000 metric tons, dropping slightly in 1987 to 290,000 metric tons (see Annex 3). The problem of area expansion in this high density region is compounded as we saw earlier by the fact that, according to government estimates, little arable land remains to be brought under cultivation in these regions (refer to Figure 22). Area and production of sorghum and millet rose much less in the lower density Casamance region, which instead showed a steady increase in maize production and variable performance in rice production. Rice production increased in the irrigated northern Fleuve region. The lack of data on officially marketed production makes it difficult to pinpoint food surplus areas, but from production data it appears that the shift in food crops has consisted mainly of a diversification in the better watered regions to the South and more rice production in the North. While this is a desirable move in principle, the remoteness of these regions and their very small populations make improvements in employment and income generation less effective than would be the case if the Groundnut Basin were the focus of development.

In Cameroon, information on marketed production is available from survey data only for 1984, which was a drought year. The Northwestern Highlands accounted for over half the marketed maize (100,000 metric tons), just under a third (122,000 metric tons) of the plantain, and about one-quarter of marketed cassava (85,000 metric tons), making it a food-surplus region despite its high densities (see Annex 1). Gaviria (1988) points out that the major food flows are from the West province, while the primary destination is the Littoral province. As we saw earlier, the proportion of income deriving from food crops was highest in the Northwest and West provinces, at 79 and 57 percent of the total, respectively.

Nonfood crops

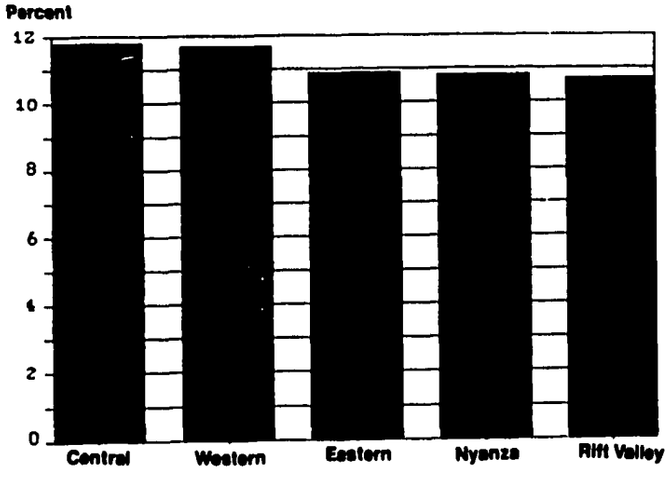
Shifts in the production of high value export crops among regions were most significant in Nigeria, Tanzania, Malawi, and to a lesser extent Cameroon. In all four cases, the shift away from the traditional centers of export production resulted from explicit policy objectives, not from spontaneous or autonomous migration as might be thought under the Boserup paradigm. Although it is common sense that policy will figure largely in the structure and location of

agricultural production, it is important to underline this point to dispel the belief that a *laissez-faire* approach to population growth, by allowing market forces to operate, will correct for factor scarcities.

In East Africa, two points emerge: Production shifted into low density areas in Tanzania and Malawi, and production concentrated in the high potential regions of Kenya. In the case of Tanzania, as pointed out above, the government encouraged a shift in production away from the Northeastern Highlands to the Southern Highlands. Although total production of coffee grew at only 2.3 percent and tobacco at -4.8 percent, the relatively low density Southern Highlands doubled its share of total coffee production to 25 percent in 1981-85, and increased its share of tobacco production from 18 percent in 1970-74 to 60 percent in 1982-86 (see Annex 2). The redistribution in production was not associated with substantial growth in overall output, due to a decline in traditional areas.

In Kenya, the data indicate little change in relative shares of cash crop production. For the period 1973 to 1981, for instance, the Central province dominated, accounting for half of all tea production. A striking feature of tea production in Kenya is that it grew evenly among the provinces, generally above 10 percent a year (see Figure 23). In view of the country's very tight land constraints, the story of tea development there is a model of policy-led intensification. Data on coffee production, while more limited, again point to a concentration in the Central province, where growing conditions are the best, and to a lesser extent the Eastern province (see Annex 5).

Figure 23
Growth in tea production in Kenya by region, 1973-82



Source: KTDA Annual Reports.

In Malawi, it is striking that the government policy favoring estate agriculture led to the dramatic expansion of such production throughout the country, even in the high density Central and Southern regions. One consequence of estate agriculture in areas of tight land supplies was to increase environmental stress on land under smallholders (see Lele and Agarwal 1989).

In West Africa, a series of price, investment, and institutional policies affected the regional production of export crops. Especially in Nigeria, traditional export crops in the South declined as oil revenues supplemented them. The effects of this shift away from the South and on the economy as a whole are documented in Lele, Oyejide, et al. (1989). In Cameroon, no time series data are available, but important gains in cotton and rice production in the North are documented by Lele, van de Walle, and Gbetibouo (1989). These authors point out how parastatals played a vital role (SODECOTON, SEMRY) in encouraging this regional shift. The allocation of resources to develop the dry northern area raises questions about optimal efficiency that must be reconciled with the government's agenda of equitable development as a nation. Similarly in Senegal, large investments in the North do not provide the government with the highest economic return but may meet other politically important criteria. It is to a brief analysis of expenditures that we now turn.

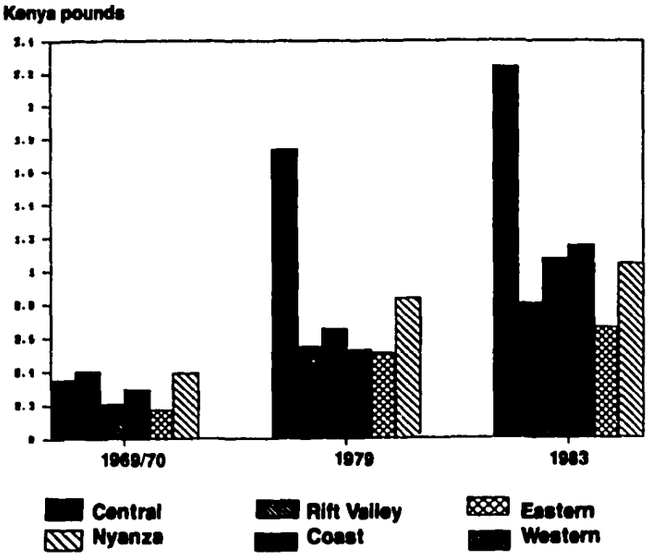
Population Densities and Regional Public Expenditures

Data on regional public expenditures must be treated with caution, as there is no preexisting methodology to calculate rates of return, nor are there enough adequate or reliable data on which to base such an analysis. However, it is possible to make some tentative observations based on the limited data available. The most important point to emerge is that, beyond the simple mechanics of increasing population densities, regional and sectoral allocations by governments will shape the pace, direction, and location of intensification.

The point can be simply illustrated by considering expenditure patterns in Kenya and Tanzania. Both countries inherited fertile highlands endowed with an indigenous labor supply. Yet their responses were almost exactly opposite. Kenya chose to develop its high potential areas explicitly (some would say was compelled out of political expediency) whereas Tanzania shifted expenditures in favor of its high potential but less developed, less populated regions.

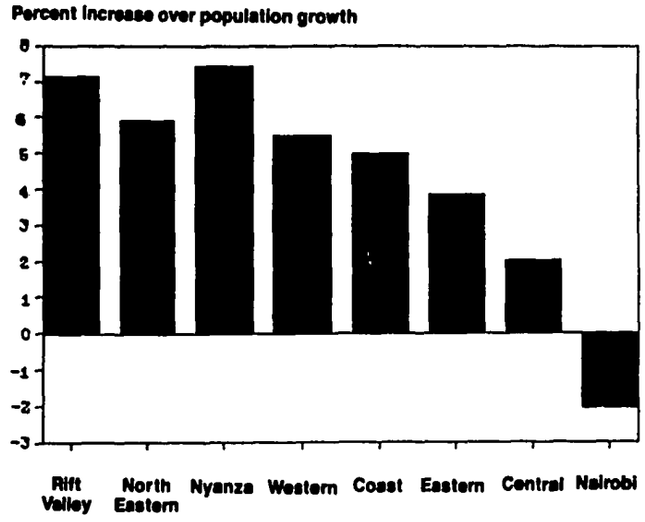
In Kenya, for instance, expenditures on main services between 1970 and 1983 grew fastest in the high income, high potential Central province, at 6.2 percent in real terms. In the second half of this period, subsequent to the death of President Jomo Kenyatta in 1978, the Central province received consistently up to one-third of regional expenditures; similarly, per capita expenditures were substantially above those in other provinces (see Figure 24). It was followed by the Western province, where expenditures grew by 4.9 percent in real terms, compared to the national average of 2.4 percent real growth. The provinces exhibiting the fastest growth in expenditure also showed the greatest degree of ethnic homogeneity: The Kikuyu dominated the Central province, composing 95 percent of its population in 1979, as did the Luhya, with 86 percent, in the Western province, with both groups exceeding 1.5 million persons. The data suggest that rather than trying to reduce regional income disparities, as was the case in Tanzania, the government used its expenditures to reward its most vocal, active, and vital constituents. In the process, the government spent more to develop high potential areas than it did on other provinces, a policy that paid off in high rates of growth. Significantly, growth rates for primary school enrollment for the 1968-84 period show that, despite higher spending in the Central province, other provinces benefited from more rapid growth in jobs and education (see Figure 25; see also Annex 4).

Figure 24
Per capita regional expenditure in Kenya by region, 1969, 1979, and 1983



Source: Kenya Statistical Abstracts.

Figure 25
Growth in primary school attendance in Kenya by region, 1968-84



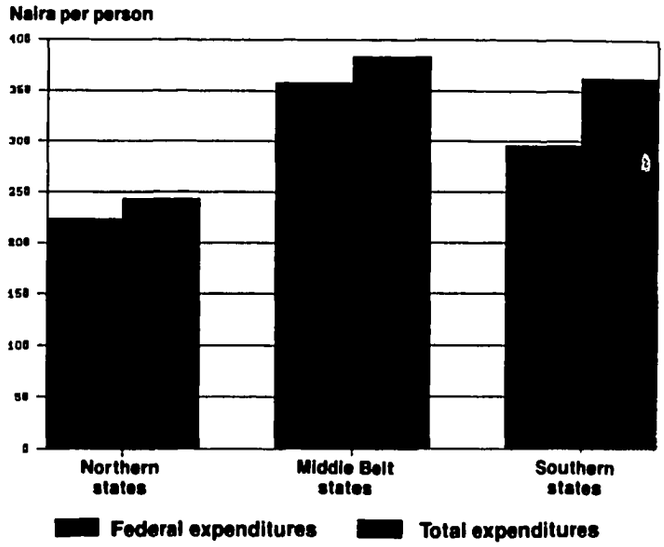
Source: Kenya Statistical Abstracts.

In Tanzania the government adopted a totally different approach: Rather than try to develop the high density, high income areas, as was the case in Kenya, it used regional expenditures to try and narrow regional income disparities. This was politically feasible because no one particular ethnic group dominates in Tanzania. Total expenditures were lowest in the high potential Northeast Highlands, at roughly 12 percent of total for the period, while a greater share (in both absolute and per capita terms went to the lower potential coastal belt which received 25 percent, and the central and western plateau, which got 20 percent) (see Annex 2). Tanzania's regional redistribution problem was complicated by changes in intersectoral patterns. Government expenditures on the directly productive agricultural sector declined, while increasing on social services, especially education. For Tanzania, the emphasis on equity and provision of social services to the exclusion of growth caused many problems. Chief among them was the inability to finance recurrent expenditures (Tanzania Agricultural Sector Report 1983). Total expenditures rose rapidly until they peaked at 3.4 billion Tanzania shillings in 1983, before falling to one-third of that level in 1984. Further, expenditures on transportation declined, aggravating the already poor mobility of labor and goods in Tanzania. Whether redistributing national income on equity grounds is a prudent approach toward intensification is debatable. This paper argues that when resources are scarce, the most productive investments are in areas with the highest returns.

We close this section on regional expenditures by citing the cases of Senegal and Nigeria where neither the Kenyan nor the Tanzanian pattern is repeated. Senegal chose to invest a slightly higher proportional share in the outlying (i.e., non Groundnut Basin) areas. In fact, although almost half of the population is concentrated in the Basin, only 28 and 14 percent, respectively, of total investment went to this area in the Fifth and Sixth Plans (1977-84, see Table 14). In both absolute and relative terms, more money was directed to the outlying regions. Significantly, the drier Fleuve region in the North of Senegal received as much investment as the Casamance region in the Fifth Plan, at 11.5 percent each, and slightly *more* in the Sixth Plan, at 10.0 compared with 9.7 percent, despite the fact that Casamance has a greater share of the total population (14 compared to 9 percent), higher population densities, and according to the latest land statistics four times more "unused but potentially cultivable" area. In fact, investments in the Fleuve area (mostly in irrigation) fell less than in any other region in the Sixth Plan, indicating the government's commitment to (or inability to withdraw from) costly investments already made. One might be led to conjecture that investments in the Fleuve region have a good deal to do with local and ethnic allegiances: The largest proportion of "fonctionnaires" in the government, roughly one-fifth, were born in the Fleuve region (*Le Senegal en Chiffres* 1982/83). Our judgment is that investments in Casamance, a low density/higher rainfall region, will pay off more quickly and do more to ease population pressure in the Groundnut Basin.

Finally, capital expenditures in the agricultural sector in Nigeria have shifted since the early 1970s from the highest density Southern regions to the relatively less dense North. In 1981-1985, for instance, less than 10 percent of the regional budget, or 1.3 billion naira, was allocated to investment in agriculture in the Southern states, whereas the figure for the Northern states (thought to be more economically depressed yet politically quite important) is higher, at 1.5 billion naira, and accounts for a larger share of its regional budget, at 18 percent. The expenditures in the North increased in 1981-85 because of the statewide agricultural development projects in Sokoto, Kano, Bauchi, and Kaduna. On a per capita basis, however, the Middle Belt states came out favorably, given its lower population (see Figure 26). Another tack pursued by the federal

Figure 26
Per capita government expenditures in Nigeria by region, 1981-85



Source: Lele, Oyejide, et al. 1989.

government was to subsidize fertilizer sales, two-thirds of which were consumed in the North. The salient point is that public policy plays a crucial role in the intensification process, and that regional expenditures are an effective way of guiding the autonomous forces that arise out of population growth.

Population Densities and Input Use

One of the main tenets of the Boserup hypothesis holds that the incentive to use more inputs (land, labor, and capital) grows in proportion to population densities. The most common and readily available input is labor; it is estimated that on average, up to 80 percent of value added in Africa's agriculture comes from labor. In this section we therefore survey available evidence on labor use by region before turning to examine the use of other inputs such as farm implements, seeds, and fertilizer that can increase the productivity of land and labor. Three findings are significant: First, on-farm labor use increased commensurately with higher densities, especially in areas that tended to specialize in export crops or food crops for the market; second, the use of hired labor is correspondingly higher in high income areas; and third, data on consumption of fertilizer and improved seed indicate that the model of increasing input use with higher densities is at best only partially true, even for the most land-scarce countries; government priority for promoting fertilizer use has been determined by other priorities (Lele, Christiansen, and Kadiresan 1989). In Kenya improved seed adoption has increased to 60 percent, but fertilizer use on small farms is apparently growing less impressively. The reverse is true for Malawi, suggesting the absence of a well coordinated strategy emphasizing the complementarity of inputs. The evidence supports the contention that at early stages of development, national and regional policy initiatives will be of critical importance in adopting inputs to improve factor productivity.

The cases of Cameroon and Malawi, both of which have excellent and up-to-date rural survey data compared with the other MADIA countries, set a striking contrast in patterns of labor use. In Cameroon, the fact that land is still abundant is reflected in the low proportion of hired labor in the agricultural labor force, just under 2 percent in 1984. Significantly, the highest proportion of hired labor in agriculture (roughly 6 percent) obtained in the high income Southwest province (see Table 15). This province alone produced one-third of the total cocoa (35,000 metric tons) and one-fifth of the oil palm production (17,000 liters), earning over one-fifth of the country's total cash crop income in 1985. A strong correlation between high income and high hired labor input would seem to be borne out, regardless of population densities: The Southwest province had one of the lowest densities in lower Cameroon, at 33 persons per square kilometer. The absolute amount of labor per farm is highest, by contrast, in the higher density Northwestern Highlands, at roughly 4.5 workers per farm, compared with the national average of 3.7. Hired labor is higher where cash crops are grown, but total labor input corresponds more to population densities.

The case of Malawi presents an extreme contrast. According to the 1980-81 rural survey, 55 percent of all households cultivate less than one hectare of land. Even more striking, those 55 percent account for a meager 25 percent of the total area cultivated (see Table 16). Lele and Agarwal (1989) document the implications of land distribution and shrinking plot size, including the effects on intensification. In the Southern region, population densities reach 200 to 300 persons per square kilometer. There is a growing number of individuals selling their labor to earn an income; the Southern region accounts for over half of the number of people earning wages through agricultural work (see Figure 27). Plot size has become so small that the "normal path" of intensification is bypassing Malawi. The negative effects of Malawi's emphais on growth is a sobering counterpart to the extreme emphasis on equity in Tanzania.

That the traditional path of moving to higher levels of production has not been achieved is also shown by the means of cultivation used in Malawi. In the most densely populated regions, over 90 percent of the land is cultivated by hand (see Annex 5). Oxen are used more extensively, in the lower density Northern regions, where almost one-third of the total area is cultivated using draft animals. This option is precluded in the Southern region as no land is available for growing fodder. The prevalence of hand tools in Cameroon, used by 85 percent of the farming population, is less of a handicap to land productivity given the abundance of land that can be brought under crops and consequently the initially much higher returns to labor (see Annex 1).

We now turn to examine other inputs that increase the productivity of labor, such as fertilizer and seed.

In countries that have pursued a deliberate policy of smallholder intensification, such as Kenya, the use of purchased inputs like fertilizer and seed is much more common and corresponds to areas of high potential and high density (see Figure 28). According to the 1978 survey, farmers in the Central province of Kenya applied four times more fertilizer per hectare than did those in its closest competitor, the Eastern province—116 as compared to 27 kilograms per hectare. The Central province also accounted for over half of all sprays, seeds, feeds, and hired labor used in the smallholder sector for that year (see Annex 4). Because world prices for coffee and tea were reflected in producer prices, the production of higher value crops and the more intensive use of land naturally gravitated to the

Table 15
Family, hired, and total labor working on farms by province in Cameroon

Province	Family Labor		Hired Labor		Total Labor		Percent hired
	Number	Average farm	Number	Average farm	Number	Average farm	Labor in Total
The North							
Far North	978,000	3.4	9,000	*	987,000	3.4	0.91%
North	286,000	2.9	4,000	*	290,000	2.9	1.38%
Adamaoua	171,000	3.1	15,000	0.3	186,000	3.4	8.06%
Subtotal	1,435,000		28,000		1,463,000		1.02%
Tropical Rainforest							
East	209,000	3.1	1,000	*	210,000	3.1	0.48%
Central	542,000	3.3	8,000	*	550,000	3.3	1.45%
South	172,000	3.1	2,000	*	174,000	3.1	1.15%
Subtotal	923,000		11,000		934,000		1.18%
Western Lowlands							
Littoral	201,000	3.1	9,000	0.1	210,000	3.2	4.29%
Southwest	276,000	3.7	17,000	0.2	293,000	3.9	5.80%
Subtotal	477,000		26,000		503,000		5.17%
Western Highlands							
Northwest	546,000	4.1	9,000	0.1	555,000	4.2	1.62%
West	763,000	4.8	4,000	*	767,000	4.8	0.52%
Subtotal	1,309,000		13,000		1,322,000		0.98%
Total	4,144,000	3.6	78,000	0.1	4,222,000	3.7	1.85%

Notes: Total number who worked on farm 30 days or more during 1984 crop year. Hired labor includes permanent labor only.
*Less than 0.1 worker average.
Source: 1984 Agricultural Census.

Table 16
Smallholder land distribution in Malawi, 1980/81

Size of holding (hectares)	Households			Area Cultivated			
	Total	%	Cumulative %	Total area ('000 Ha)	%	Cumulative %	Average per Household
Total	1135.6	100.0	-	1332.0	100.0	-	1.2
Under 0.5	267.4	23.5	23.5	80.6	6.1	6.1	0.3
0.5-0.99	356.0	31.4	54.9	258.5	19.4	25.5	0.7
1.0-1.49	215.9	19.0	73.9	265.2	19.9	45.4	1.2
1.5-1.99	121.5	10.7	84.6	209.9	15.8	61.1	1.7
2.0-2.99	118.2	10.4	95.0	283.8	21.3	82.4	2.4
3 and Over	56.6	5.0	100.0	234.1	17.6	100.0	4.1

Source: Government of Malawi 1984b.

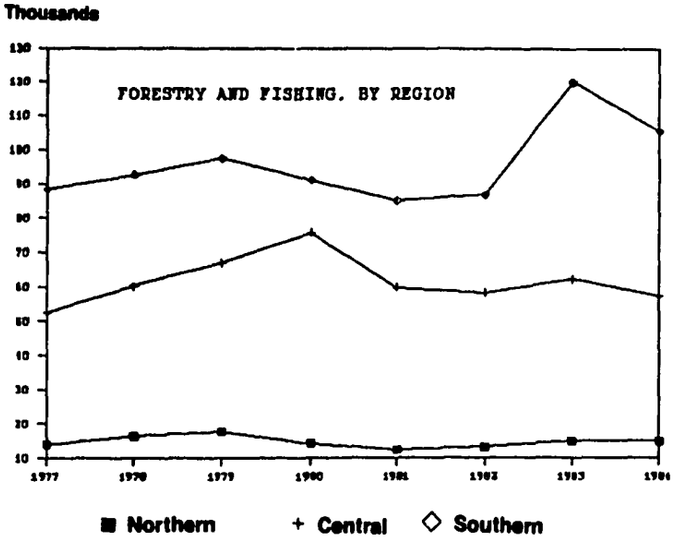
Central province. As a result, incomes there were the highest in Kenya outside Nairobi, but distribution was the worst, confirming the Kuznetzian view that income inequalities may initially worsen with growth before they improve.

In Cameroon, another case presents itself: Input use is concentrated *both* in the higher density Western Highlands *and* in targeted cotton-producing regions in the North. Table 17 indicates that the ratio of farms using fertilizer and purchased seed in the highlands reached 74 and 64 percent, respectively—about 20 percentage points above the national average. Surprisingly, in the lower density Northern region (with 17 persons/per square kilometer), the ratio of farms using fertilizer was not much less: 61 percent. It would be useful to have data on levels of fertilizer application by regions and family size to carry out more detailed work, but such farm surveys are limited in Africa. Those familiar with Cameroon attribute greater fertilizer use in the North to the success of state-sponsored SODECOTON projects in the region, reinforcing the argument for policy-led intensification.

Similarly, many attribute high rates of input use in the Southern region of Tanzania to explicit public policy objectives. Less than 10 percent of all fertilizer was applied in the high potential Northeast Highlands, but the Iringa region of the Southern Highlands (with a relatively low density of 20 persons per square kilometer) accounted for 22 percent of all fertilizer and 13 percent of the seed in 1980; by no small coincidence it also had five of the twelve state-financed national retail outlets serving farmers in 1980 (see Table 18). This suggests room for increasing yields and adds weight to the idea that input use follows regional planning more closely than it does population density.

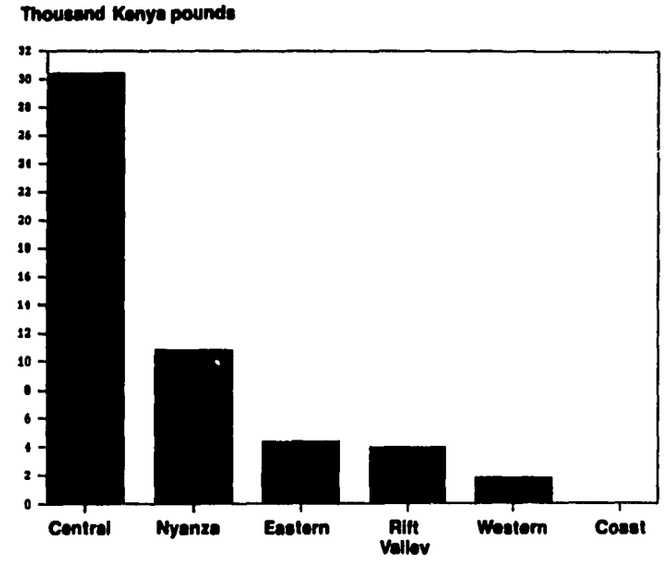
Fertilizer use in Nigeria is directly related to state policy. Since 1977, the subsidy on fertilizer has been on average about 25 percent of the total agricultural budget. Nearly two-thirds of the total 580,000 metric tons of product

Figure 27
Agricultural wage labor in Malawi by region, 1977-84



Source: National Statistical Office 1985

Figure 28
Fertilizer purchases in Kenya by region, 1976-79



Source: Rural Integrated Surveys 1976-79.

Table 17
Population density, proportion of land cultivated, and ratios of farms using purchased inputs in Cameroon (persons per square kilometer)

Region Province	Population density 1986	Proportion of land cultivated (%)	Farms purchasing seeds	Ratio of farms purchasing seeds to total farms	Farms using fertilizer	Ratio of farms using fertilizer to total
Far North	50.4	12.0%	103,400	39%	182,900	68%
North	9.0	2.2%	40,500	42%	61,100	63%
Adamaoua	6.8	1.3%	12,700	24%	13,400	25%
The North	16.8	3.9%	156,600	37%	257,400	61%
East	4.4	1.3%	27,500	41%	17,700	27%
Center	25.4	3.8%	90,700	56%	4,700	3%
South	8.6	2.4%	24,100	44%	400	1%
Tropical Rainforest	11.7	2.3%	142,300	50%	22,800	8%
Littoral	83.0	4.0%	43,900	69%	29,300	46%
Southwest	33.1	8.0%	48,600	66%	17,400	24%
Western Lowlands	55.4	6.2%	92,500	67%	46,700	34%
Northwest	70.6	13.2%	92,800	71%	58,400	45%
West	95.8	21.1%	121,600	77%	126,700	80%
Western Highlands	81.8	16.7%	214,400	74%	185,100	64%
Total	22.4	4.2%	605,800	54%	512,000	45%

Source: Land data from Bilan Diagnostic, Ministry of Agriculture 1986. Agricultural Census 1984 table 38.

consumed in 1984 went to the Northern states (see Figure 29). Food crops account for 80 percent of all fertilizer use (Lele, Christiansen, Kadiresan 1989). The strong regional emphasis to fertilizer policy apparently does not complement regional potential; responses are reportedly higher in the low density Middle Belt states. Data on soils from FAO (see Annex 6) suggest that the majority of low productivity soils in Nigeria are located in the South.

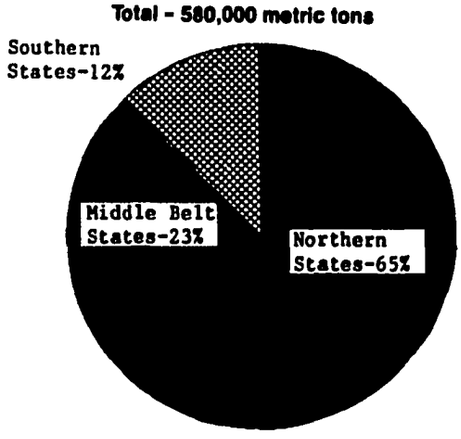
In Malawi, land has become so scarce in the Southern region that small farmers can no longer produce enough food to feed their own families, let alone purchase inputs on the market. In the southern parts of Malawi, the ratio of households using inputs is significantly below the national average of 33 percent for fertilizer and 17 percent for purchased seed, at 23 and 8 percent, respectively (see Figure 30). The percentage of households purchasing seeds from ADMARC is also highest in the Central and to a lesser extent the Northern region (see Annex 5). Both the Northern and Southern regions of Malawi have a relatively lower population density than the Central region. In the North, the resultant greater land availability has contributed to the low level of intensification through increased use of inputs, whereas in the South the small farmers have lacked the financial means and the ability to undertake the risks associated with the purchase and utilization of fertilizer and hybrid seed. The degree of population pressure in the

Table 18
Fertilizer use, purchased seeds, and irrigated area in Tanzania by region, 1980

Area Region	Population density 1986 per/sq.km	Fertilizer use 1980 (MT) Export crops	Food crops	Share of total	Purchased grain seed 1980 (MT)	Share of total	Retail outlets 1980	Estimated irrigated area 1973 (ha.)	As % of cultivated area
Northeast Highlands	25	4,071	4,639	8.8%	1,213	22.1%	2	63,854	18.8%
Arusha	15	1,800	846	2.7%	973	17.7%	1	19,394	11.8%
Kilimanjaro	85	2,271	3,793	6.1%	240	4.4%	1	44,460	25.4%
Coastal Belt	21	4,211	5,973	10.3%	1,327	24.2%	4	11,692	0.9%
Coast	18	550	678	1.2%	331	6.0%	2	660	0.3%
Lindi	9								
Mtwara	54	251	177	0.4%	11	0.2%		238	0.1%
Tanga	48	3,410	465	3.9%	436	7.9%	1	4,535	1.3%
Morogoro	17	-	4,653	4.7%	549	10.0%	1	6,259	1.6%
Central and Western	19	5,800	7,946	13.9%	374	6.8%		3,687	0.4%
Dodoma	29	-	319	0.3%	243	4.4%		1,857	0.7%
Singida	15							287	0.2%
Tabora	15	5,200	6,743	12.1%	81	1.5%		1,213	0.5%
Kigoma	22	600	884	1.5%	50	0.9%	1	330	0.1%
Southern Highlands	15	26,888	31,707	59.4%	1,473	26.8%	6	23,393	3.4%
Mbeya	23	10,969	4,116	15.3%	238	4.3%	1	7,499	2.9%
Iringa	20	8,030	14,090	22.4%	730	13.3%	5	1,233	0.5%
Ruvuma	11	7,455	9,220	16.9%	23	0.4%		14,661	12.2%
Rukwa	9	434	4,281	4.8%	482	8.8%			
Lake Victoria Basin	48	4,594	2,858	7.6%	823	15.0%		23,944	1.9%
Mwanza	91	1,566	1,231	2.8%	177	3.2%		3,109	0.8%
Mara	41	475	567	1.1%	320	5.8%			
Shinyanga	34	1,770	837	2.6%	283	5.2%		14,204	4.2%
Kagera	47	783	223	1.0%	43	0.8%		6,631	2.3%
Total	25	45,564	53,123	100.0%	5,489	100.0%	12	126,570	2.8%

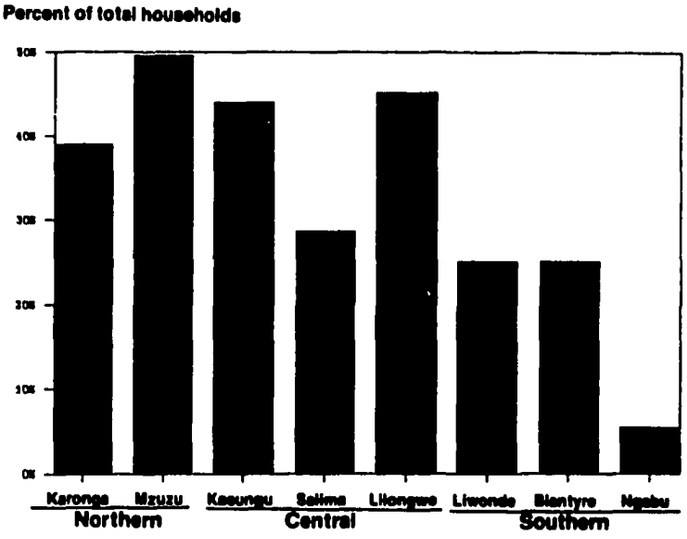
Source: FAO/World Bank 1987; World Bank 1983.

Figure 29
Fertilizer consumption in Nigeria by region, 1984



Source: Lele, Oyejide, et al. 1989.

Figure 30
Fertilizer use in Malawi by region, 1981



Source: National Statistical Office 1984b.

Southern region, coupled with the failure to intensify agriculture there, has reached the point where it no longer acts as a positive inducement to intensify production but rather has begun a downward spiral of declining fertility, declining input use, and declining output. An unfortunate omission from the Boserup hypothesis is the effects of inadequate public policy. In Malawi, the problems arising from population pressure have as much to do with poor policy as they do with high population densities: The still inadequate access to sources of cash, credit (less than 20 percent of all small farmers receive credit), and purchased inputs have stifled the autonomous movement toward intensification.

Conclusion

Whether higher population densities are an important aid to development or a hindrance will remain an intensely complex and highly controversial issue. Boserup provides an intellectual justification for high population densities; a powerful body of opinion in Africa believes that higher population densities are necessary and desirable for future development. Fertility is highly valued culturally at the local level, and children are seen as assets in labor and insurance for old age; many social and cultural factors that resist empirical analysis will shape a country's movement toward more intensive, productive, and tenable use of land.

In this paper we have shown that:

1. Data on some of the most basic facts needed to plan agricultural development are scarce in Africa. They raise more questions than they answer.
2. Targeting policies and investments in the areas of high productive potential and high population densities offers the greatest scope for achieving growth in the short and medium run.
3. Achievement of this objective is complicated in Africa by the fact that there is less congruence between land potential and population densities due to factors such as disease, cultural barriers to migration, and colonial patterns of investments in infrastructure.
4. The political and welfare considerations of including the largest proportion of people in the growth process have influenced past patterns of public policy toward regional development. These considerations have been addressed differently in various countries. Only in Kenya and to a lesser extent in Cameroon did they achieve broad-based growth by using their regional comparative advantages. Elsewhere policies resulted in considerable redistribution in the sources of production and perhaps helped to commercialize agriculture. Countries will need to make difficult choices in the future to realize growth.
5. The policy-led process of intensification conceived here is different than the autonomous intensification envisaged by Boserup. Its implications are outlined in the Summary and Policy Recommendations section and will not be repeated here.

Annex 1: Cameroon

Table 1
Per capita arable land

REGION Province	Population ('000) Total 1986 1/	Share of Total	Rural 1986 2/	% Rural	Total 2000 3/	Land ('000) Total 4/	Planted 5/	Planted & Fallow 4/	% Fallow	Arable 6/	Population Density 1986 Pop. per/sq.km	Per Capita Arable Land 1986 Total Pop	Rural Pop	2000 Total Pop
THE NORTH (Savannah)	2,758	26%	2,377	86%	3,910	18,405	645	3,321	81%	12,304	16.8	4.46	5.18	3.15
Far North	1,728	17%	1,550	90%	2,449	3,426	412	693	41%	2,570	50.4	1.49	1.66	1.05
North	608	6%	500	82%	861	6,780	150	1,373	89%	5,085	9.0	8.37	10.17	5.90
Adamaoua	423	4%	327	77%	599	6,199	83	1,255	93%	4,649	6.8	11.00	14.23	7.76
SOUTH-CENTER (Tropical Rainforest)	2,635	25%	1,452	55%	8,950	22,503	518	2,079	75%	16,877	11.7	6.41	11.63	1.89
East	476	5%	362	76%	808	10,890	142	539	74%	8,168	4.4	17.16	22.58	10.11
Center	1,752	17%	788	45%	2,922	6,894	262	914	71%	5,171	25.4	2.95	6.56	1.77
South	407	4%	302	74%	678	4,719	115	626	82%	3,539	8.6	8.70	11.73	5.22
WESTERN LOWLANDS (Tropical Rainforest)	2,502	24%	811	32%	4,542	4,513	282	472	40%	3,385	55.4	1.35	4.17	0.75
Littoral	1,678	16%	322	19%	3,285	2,022	82	228	64%	1,517	83.0	0.90	4.71	0.46
Southwest	825	8%	489	59%	1,257	2,491	201	244	18%	1,868	33.1	2.27	3.82	1.49
WESTERN HIGHLANDS (Guinea Savannah)	2,552	24%	1,977	77%	3,872	3,119	522	959	46%	2,339	81.8	0.92	1.18	0.60
Northwest	1,222	12%	1,010	83%	1,732	1,730	229	589	61%	1,298	70.6	1.06	1.29	0.75
West	1,330	13%	968	73%	2,140	1,389	293	371	21%	1,042	95.8	0.78	1.08	0.49
CAMEROON	10,446	100%	6,671	64%	16,682	46,540	1,967	6,830	71%	34,905	22.4	3.34	5.23	2.09

SOURCES: 1/ Population data from Sixth Plan (1986-1991), p.4, Table
2/ Rural population calculated from "Taux D'Urbanization" figures (for 1986) in the Sixth Plan (1986-1991), p.3, Table 1.1.
Rural population may be alternately calculated by taking ratio of "nonfarm population" by province in the Agricultural Census of 1984, p. 24, Table 11. with slightly different (lesser overall nonfarm population) results. Minor computational errors in the line.
3/ Population growth projected at an national average of 3.4%, disaggregated to provincial growth rates.
4/ "Total" land area and "Area Planted and Fallow" given in Bilan Diagnostic, 1986.
"Planted and Fallow" given in Bilan Diagnostic as "surfaces mobilisees", land under cultivation or lying fallow in 1986.
5/ Area planted from the 1984 Agricultural Census, p. 61, Table 44.
6/ Arable Land officially estimated as 75% of total land area by Bilan Diagnostic, Government. Also cited by World Bank.

Table 2
Agricultural production by crop and by province

	PRODUCTION IN METRIC TONNES Cocoa	Coffee Arabica	Coffee Robusta	Cotton	Tobacco	Maize	Sorghum	Rice	Cassava	Yams	Taro	Groundnuts	Plantain	Bananas	White Potatoes	Beans	Oil Palm '000 liters	TOTAL TONS
THE NORTH																		
Far North	0	0	0	33,340		6,790	142,670	27,844				14,050				9,810		234,504
North	0	0	0	48,870		13,110	40,890	1,707				18,800				3,280		126,657
Adamaoua	0	0	5,780	0	100	43,310	22,290		79,700			3,100						154,280
Sub-Total	0	0	5,780	82,210	100	63,210	205,850	29,551	79,700			35,950		42,500		13,090		515,441
TOPICAL RAINFOREST																		
East	6,840	0	22,810	0	1,820	26,420			197,300		9,940	9,320	144,400	42,500			2,950	464,200
Center	45,880	0	7,540	0	170	15,440			373,300	18,550	28,260	18,530	190,700	116,000			23,580	837,950
South	19,960	0	210	0		3,810			128,700		8,340	6,670	57,100	21,700			4,110	250,600
Sub-Total	72,680	0	30,560	0	1,990	45,670			699,300	18,550	46,440	34,520	392,200	183,800			30,640	1,552,750
WESTERN LOWLANDS																		
Littoral	5,580	0	37,420	0		6,900			98,000	7,860	11,540	3,870	63,500	46,100			9,830	290,600
Southwest	35,020	0	12,900	0		11,210			303,800	11,200	49,330	2,520	245,000	169,000			16,810	856,790
Sub-total	40,600	0	50,320	0		18,110			401,800	19,060	60,870	6,390	308,500	215,100			26,640	1,147,390
WESTERN HIGHLANDS																		
Northwest	140	16,160	4,870	0		168,990	1,420	20,457	109,500	19,780	39,860	11,730	158,900	128,300	25,760	21,980	19,700	747,547
West	580	19,240	27,300	0		112,760			87,600	38,140	40,330	10,590	126,900	156,800	15,350	16,150	4,630	656,370
Sub-total	720	35,400	32,170	0		281,750	1,420	20,457	197,100	57,920	80,190	22,320	285,800	285,100	41,110	38,130	24,330	1,403,917
TOTAL	114,000	35,400	118,830	82,210	2,090	408,740	207,270	50,008	1,377,900	95,530	187,500	99,180	986,500	726,500	41,110	51,220	81,610	4,619,498

Source: Agricultural Census 1984

Table 3
Tonnage marketed by product and by province, 1985 (in metric tons)

	PRODUCTION IN METRIC TONNES																
	Cocoa	Coffee Arabica	Coffee Robusta	Cotton	Tobacco	Maize	Sorghum	Rice	Cassava	Yams	Taro	Groundnut	Plantain	Bananas	White Potatoes	Beans	Oil Palm '000 liters
THE NORTH																	
Far North	0	0	0	30,573	0	2,159	4,993	13,170				7,081				2,354	
North	0	0	0	48,528	0	3,291	2,617	490				6,542				800	
Adamaoua	0	0	5,780	0	95	23,214	5,662		25,584			2,062					
Sub-Total	0	0	5,780	79,101	95	28,664	13,272		25,584			15,685					
TOPICAL RAINFOREST																	
East	6,840	0	22,810	0	1,754	5,548			35,711		2,608	3,532	48,518	20,103			590
Center	45,880	0	7,540	0	125	2,995			81,379	5,194	9,524	3,243	78,568	55,680			2,853
South	19,960	0	210	0	0	751			15,058		3,069	807	11,077	2,908			247
Sub-Total	72,680	0	30,560	0	1,879	9,294			132,149	5,194	15,200	7,582	138,164	78,690			3,690
WESTERN LOWLANDS																	
Littoral	5,580	0	37,420	0	0	1,208			26,656	1,006	1,316	998	22,924	5,302			4,984
Southwest	35,020	0	12,900	0	0	3,744			147,039	4,301	11,691	1,260	123,725	50,869			6,774
Sub-total	40,600	0	50,320	0	0	4,952			173,695	5,307	13,007	2,258	146,649	56,171			11,758
WESTERN HIGHLANDS																	
Northwest	140	16,160	4,870	0	0	36,164	1,059	17,020	61,101	6,903	9,965	4,915	79,609	55,939	14,142	10,616	10,086
West	580	19,240	27,300	0	0	16,463			23,740	5,111	4,920	1,663	42,258	22,893	3,592	5,475	1,982
Sub-total	720	35,400	32,170	0	0	52,627	1,059		84,841	12,014	14,885	6,578	121,867	78,832	17,734	16,091	12,068
TOTAL	114,000	35,400	118,830	79,101	1,974	95,537	14,331	0	416,268	22,515	43,092	32,103	406,679	213,892	17,734	16,091	27,516

Source: Agricultural Census 1984

Table 4
Percentage of harvest marketed, 1985

	Area Cultivated (Hectares)	% OF PRODUCTION MARKETED IN METRIC TONNES																
		Cocoa	Coffee Arabica	Coffee Robusta	Cotton	Tobacco	Maize	Sorghum	Rice	Cassava	Yams	Taro	Groundnut	Plantain	Bananas	White Potatoes	Beans	Oil Palm '000 liters
NORTH																		
Far North	411,700				91.7%		31.8%	3.5%	47.3%				50.4%				24.0%	
North	150,000				99.3%		25.1%	6.4%	28.7%				34.8%				24.4%	
Adamaoua	83,000			100.0%		95.0%	53.6%	25.4%		32.1%			66.5%					
Sub-Total	644,700																	
TOPICAL RAINFOREST																		
East	142,300	100.0%		100.0%		96.4%	21.0%			18.1%		26.5%	37.9%	33.6%	47.3%			20.0%
Center	261,600	100.0%		100.0%		73.5%	19.4%			21.6%	28.0%	33.7%	17.5%	41.2%	48.0%			12.1%
South	114,500	100.0%		100.0%			19.7%			11.7%		36.8%	12.1%	19.4%	13.4%			6.0%
Sub-Total	518,400																	
WESTERN LOWLANDS																		
Littoral	81,500	100.0%		100.0%			17.5%			27.2%	12.8%	11.4%	25.8%	36.1%	11.5%			50.7%
Southwest	200,500	100.0%		100.0%			33.4%			48.4%	38.4%	23.7%	50.0%	50.5%	30.1%			40.3%
Sub-total	282,000																	
WESTERN HIGHLANDS																		
Northwest	229,100	100.0%	100.0%	100.0%			21.4%	74.6%	83.2%	55.8%	34.9%	25.0%	41.9%	50.1%	43.6%	54.9%	48.3%	51.2%
West	292,600	100.0%	100.0%	100.0%			14.6%			27.1%	13.4%	12.2%	15.7%	33.3%	14.6%	23.4%	33.9%	42.8%
Sub-total	521,700																	
TOTAL	1,966,800																	

Source: Agricultural Census 1984

Table 5
Rural per capita agricultural income, by department, 1985

Department PROVINCE	CASH CROPS INCOME ('000 CFA)	FOOD CROPS INCOME ('000 CFA)	TOTAL CROPS INCOME ('000 CFA)	SHARE OF CASH CROP INCOME	SHARE OF TOTAL INCOME	RURAL POPULATION 1985	RURAL PER CAPITA INCOME 1985
1 Logone et Chari		417,888	417,888	0.0%	0.3%	228,656	1,828
2 Mayo Sava	348,870	95,467	444,337	0.5%	0.3%	185,661	2,393
3 Mayo Tsanaga	927,862	267,495	1,195,357	1.3%	0.8%	341,454	3,501
4 Diamare	369,337	36,006	405,343	0.5%	0.3%	326,632	1,241
5 Mayo Danai	1,262,862	996,783	2,259,645	1.8%	1.6%	255,103	8,858
6 Kaele	1,047,156	192,832	1,239,988	1.5%	0.9%	191,057	6,490
FAR NORTH	3,956,087	2,006,471	5,962,558	5.7%	4.1%	1,528,563	3,901
7 Mayo Louti	1,310,776	310,540	1,621,316	1.9%	1.1%	197,079	8,227
8 Benoue	2,086,557	512,057	2,598,614	3.0%	1.8%	171,238	15,175
9 Faro	40,756	848,266	889,022	0.1%	0.6%	50,080	17,752
10 Mayo Rey	2,834,930	343,571	3,178,501	4.1%	2.2%	76,955	41,303
NORTH	6,273,019	2,014,434	8,287,453	9.0%	5.8%	495,352	16,730
11 Faro Edeo		334,915	334,915	0.0%	0.2%	39,346	8,512
12 Vina		383,661	383,661	0.0%	0.3%	77,486	4,951
13 Mayo Banyo	176,811	406,966	583,777	0.3%	0.4%	82,743	7,055
14 Djekem		127,860	127,860	0.0%	0.1%	26,254	4,870
15 Mbere	69,645	4,258,465	4,328,110	0.1%	3.0%	93,996	46,046
ADAMAOUA	246,456	5,511,867	5,758,323	0.4%	4.0%	319,825	18,005
16 Lomedjerem	133,685	3,075,708	3,209,393	0.2%	2.2%	95,036	33,770
17 Kadei	1,359,579	1,482,457	2,842,036	1.9%	2.0%	119,662	23,751
18 Haut Nyong	1,829,202	1,533,286	3,362,488	2.6%	2.3%	100,621	33,417
19 Boumbae Ngoko	482,576	278,296	760,872	0.7%	0.5%	38,415	19,807
EAST	3,805,042	6,369,747	10,174,789	5.4%	7.1%	353,734	28,764
20 Mbam	5,436,397	2,574,990	8,011,387	7.8%	5.6%	202,662	39,531
21 Haute Sanaga	543,892	475,464	1,019,356	0.8%	0.7%	36,267	28,107
22 Lekie	7,295,808	3,922,837	11,218,645	10.4%	7.8%	260,892	43,001
23 Mefou	1,803,712	3,100,905	4,904,617	2.6%	3.4%	130,947	37,455
24 Nyong et Mfoumou	737,945	251,356	989,301	1.1%	0.7%	48,077	20,577
25 Mfoundi	53,698	211,454	265,152	0.1%	0.2%	42,357	6,260
26 Nyong et Kelle	1,139,840	2,796,410	3,936,250	1.6%	2.7%	75,662	52,024
27 Nyong et Soo	2,314,203	802,398	3,116,601	3.3%	2.2%	67,745	46,005
CENTER	19,325,495	14,135,814	33,461,309	27.6%	23.3%	864,609	38,701
28 Ocean	805,684	631,951	1,437,635	1.2%	1.0%	54,539	26,360
29 Ntem	3,418,171	975,305	4,393,476	4.9%	3.1%	127,513	34,455
30 Dja et Lobo	3,890,304	631,009	4,521,313	5.6%	3.1%	114,382	39,528
				0.0%			
SOUTH	8,114,159	2,238,265	10,352,424	11.6%	7.2%	296,434	34,923
31 Metchum	977,282	1,427,150	2,404,432	1.4%	1.7%	179,571	13,390
32 Ndonga Mentoum	656,390	2,451,280	3,107,670	0.9%	2.2%	240,688	12,912
33 Momo	154,563	1,216,031	1,370,594	0.2%	1.0%	105,389	13,005
34 Mezam	1,442,757	8,783,434	10,226,191	2.1%	7.1%	258,638	39,539
35 Mbui	749,736	1,417,179	2,166,915	1.1%	1.5%	210,331	10,302
NORTHWEST	3,980,728	15,295,074	19,275,802	5.7%	13.4%	994,617	19,380
36 Noun	382,559	2,741,061	3,123,620	0.5%	2.2%	193,016	16,183
37 Bamboutos	1,370,786	1,309,542	2,680,328	2.0%	1.9%	180,058	14,886
38 Menoua	1,921,357	668,501	2,589,858	2.7%	1.8%	296,329	8,740
39 Mifi	454,698	795,258	1,249,956	0.6%	0.9%	166,246	7,519
40 Haut Nkam	103,851	261,966	365,817	0.1%	0.3%	71,196	5,138
41 Nde	524,965	422,143	947,108	0.8%	0.7%	45,514	20,809
WEST	4,758,216	6,198,471	10,956,687	6.8%	7.6%	952,359	11,505
42 Manyu	1,412,102	3,620,424	5,032,526	2.0%	3.5%	108,358	46,444
43 Ndian	723,307	4,478,864	5,202,171	1.0%	3.6%	41,843	124,326
44 Memo	11,896,492	4,994,578	16,891,070	17.0%	11.7%	200,010	84,451
45 Fako	972,147	3,116,783	4,088,930	1.4%	2.8%	102,503	39,891
SOUTHWEST	15,004,048	16,210,649	31,214,697	21.4%	21.7%	452,714	68,950
46 Moungo	3,280,089	1,348,824	4,628,913	4.7%	3.2%	115,602	40,042
47 Nkam	21,768	1,098,438	1,120,206	0.0%	0.8%	34,180	32,774
48 Sanaga Maritime	1,206,857	1,184,258	2,391,115	1.7%	1.7%	85,096	28,099
49 Wouri		212,064	212,064	0.0%	0.1%	67,240	3,154
LITTORAL	4,508,714	3,843,584	8,352,298	6.4%	5.8%	302,118	27,646
TOTAL	69,971,964	73,824,376	143,796,340	100%	100%	6,560,325	21,919

Source: BCEOM Inventory of Feeder Roads, 1985. Cited in Gaviria, 1988. Rural Population calculated from Sixth Plan, 1985.

Table 6
Population density, proportion of land cultivated, and ratios of farms using purchased inputs

REGION Province	Population Density 1986	Proportion of Land Cultivated (%)	Farms Purchasing Seeds	Ratio of Farms Purchasing Seeds to Total Farms	Farms Using Fertilizer	Ratio of Farms Using Fertilizer to Total
Far North	50.4	12.0%	103,400	39%	182,900	68%
North	9.0	2.2%	40,500	42%	61,100	63%
Adamaoua	6.8	1.3%	12,700	24%	13,400	25%
THE NORTH	16.8	3.9%	156,600	37%	257,400	61%
East	4.4	1.3%	27,500	41%	17,700	27%
Center	25.4	3.8%	90,700	56%	4,700	3%
South	8.6	2.4%	24,100	44%	400	1%
TOPICAL RAINFOREST	11.7	2.3%	142,300	50%	22,800	8%
Littoral	83.0	4.0%	43,900	69%	29,300	46%
Southwest	33.1	8.0%	48,600	66%	17,400	24%
WESTERN LOWLANDS	55.4	6.2%	92,500	67%	46,700	34%
Northwest	70.6	13.2%	92,800	71%	58,400	45%
West	95.8	21.1%	121,600	77%	126,700	80%
WESTERN HIGHLANDS	81.8	16.7%	214,400	74%	185,100	64%
TOTAL	22.4	4.2%	605,800	54%	512,000	45%

Source:
Land data from Bilan Diagnostic, Ministry of Agriculture 1986.

Population data from Sixth Plan, 1986.

Use of Modern Inputs data from Agricultural Census, 1984.

Table 7
Transport owned

Province		Total Farms	Number of Farms Owning Transport by Type of Transport Owned: Farms Owning Transport 1/	Cart	Bicycle	Motorcycle	Automobile	Truck/Lorry	Number of Farms that Used Tractors and Carts: Tractor	Cart
			number/(percent) 2/							
THE NORTH	Extreme North	285,400	101,300 (35.5)	4,100 (1.4)	95,200 (33.4)	17,500 (6.1)	400 (0.1)	300 (0.1)	6,900 (2.4)	23,300 (8.2)
	North	98,700	32,700 (33.1)	4,800 (4.9)	29,800 (30.2)	3,900 (4.0)	300 (0.3)	100 (0.1)	6,900 (7.0)	8,800 (8.9)
	Adamaoua	55,600	11,000 (19.8)	2,600 (4.7)	6,700 (12.1)	4,000 (7.2)	1,100 (2.0)	200 (0.4)	2,800 (5.0)	2,900 (5.2)
	Sub-Total	439,700	145,000 (33.0)	11,500 (2.6)	131,700 (30.0)	25,400 (5.8)	1,800 (0.4)	600 (0.1)	16,600 (3.8)	35,000 (8.0)
TROPICAL RAINFOREST	East	66,700	15,200 (22.8)	2,700 (4.0)	10,900 (16.3)	3,600 (5.4)	900 (1.3)	500 (0.7)	1,100 (1.6)	2,700 (4.0)
	Central	162,900	27,600 (16.9)	13,400 (8.2)	15,900 (9.8)	9,400 (5.8)	2,800 (1.7)	600 (0.4)	2,000 (1.2)	17,800 (10.9)
	South	55,100	9,600 (17.4)	6,500 (11.8)	3,700 (6.7)	5,600 (10.2)	700 (1.3)	200 (0.4)	<100	7,600 (13.8)
	Sub-Total	284,700	52,400 (18.4)	22,600 (7.9)	30,500 (10.7)	18,600 (6.5)	4,400 (1.5)	1,300 (0.5)	3,100 (1.1)	28,100 (9.9)
WESTERN LOWLANDS	Littoral	65,400	9,000 (13.8)	8,500 (13.0)	4,900 (7.5)	2,200 (3.4)	1,700 (2.6)	600 (0.9)	<100	9,900 (15.1)
	Southwest	74,600	14,000 (18.8)	8,300 (11.1)	7,000 (9.4)	5,000 (6.7)	3,600 (4.8)	700 (0.9)	<100	14,500 (19.4)
	Sub-Total	140,000	23,000 (16.4)	16,800 (12.0)	11,900 (8.5)	7,200 (5.1)	5,300 (3.8)	1,300 (0.9)		24,400 (17.4)
WESTERN HIGHLANDS	Northwest	131,800	25,400 (19.3)	400 (0.3)	18,400 (14.0)	4,500 (3.4)	3,500 (2.7)	1,600 (1.2)	1,200 (0.9)	2,300 (1.7)
	West	159,300	51,600 (32.4)	24,000 (15.1)	30,400 (19.1)	19,500 (12.2)	4,700 (3.0)	1,100 (0.7)	100 (0.1)	34,500 (21.7)
	Sub-Total	291,100	77,000 (26.5)	24,400 (8.4)	48,800 (16.8)	24,000 (8.2)	8,200 (2.8)	2,700 (0.9)	1,300 (0.4)	36,800 (12.6)
TOTAL TRADITIONAL		1,155,500	297,400 (25.7)	75,300 (6.5)	222,900 (19.3)	75,200 (6.5)	19,700 (1.7)	5,900 (0.5)	21,000 (1.8)	124,300 (10.8)

1/ Parts do not sum to totals due to multiple counts 2/ Percentages expressed in terms of total farms and shown in parentheses.
Source: 1984 Agricultural Census; cited in Gavirla, 1988.

Table 8
Farming method used to cultivate fields and province (first crop cycle only)

Province	Hand Only	Tractors	Cattle	Donkeys	Farms With Crops 1/
	<---------- number/percent 2/ ---------->				
THE NORTH					
Far North	168,600 (63.6)	6,900 (2.6)	83,600 (31.5)	6,000 (2.3)	265,100 (100.0)
North	38,700 (40.2)	6,800 (7.1)	46,300 (48.0)	4,500 (4.7)	96,300 (100.0)
Adamaoua	46,900 (87.0)	2,800 (5.2)	4,100 (7.6)	100 (0.2)	53,900 (100.0)
Sub-Total	254,200 (61.2)	16,500 (4.0)	134,000 (32.3)	10,600 (2.6)	415,300 (100.0)
TROPICAL RAINFOREST					
East	65,700 (98.5)	1,000 (1.5)	3/	3/	66,700 (100.0)
Central	160,000 (98.8)	2,000 (1.2)	3/	3/	162,000 (100.0)
South	55,000 (100.0)	3/	3/	3/	55,000 (100.0)
Sub-Total	280,700 (98.9)	3,000 (1.1)			283,700 (100.0)
WESTERN LOWLANDS					
Littoral	64,000 (100.0)	3/	3/	3/	64,000 (100.0)
Southwest	73,500 (100.0)	3/	3/	3/	73,500 (100.0)
Sub-Total	137,500 (100.0)				137,500 (100.0)
WESTERN HIGHLANDS					
Northwest	128,900 (98.7)	1,200 (0.9)	100 (0.1)	400 (0.3)	130,600 (100.0)
West	158,700 (100.0)	3/	3/	3/	158,700 (100.0)
Sub-Total	287,600 (99.4)				289,300 (100.0)
Total Traditional	960,000 (85.3)	20,700 (1.8)	134,100 (11.9)	11,000 (1.0)	1,125,800 (100.0)

1/ Includes only farms with first cycle crops.
2/ Percentages shown in parentheses.
3/ Less than 100 farms.

SOURCE: 1984 AGRICULTURAL CENSUS

Table 9
Breakdown of planned regional investments, by province, 1971-1986 (in million FCFA)

PROVINCE	THIRD PLAN			FOURTH PLAN			FIFTH PLAN		
	Planned Spending	% of Total	Per Capita (in CFA)	Planned Spending	% of Total	Per Capita (in CFA)	Planned Spending	% of Total	Per Capita (in CFA)
NORTH	84,336	24.3%	37,768	51,219	9.3%	20,829	254,000	16.4%	92,112
EAST	8,478	2.4%	23,291	9,768	1.8%	23,038	63,000	4.1%	132,381
CENTRAL-SOUTH	83,147	24.0%	55,729	91,221	16.5%	53,221	471,000	30.4%	218,167
LITTORAL	117,610	33.9%	125,786	301,373	54.7%	267,887	416,000	26.8%	247,973
SOUTHWEST	22,326	6.4%	36,010	89,429	16.2%	129,046	124,000	8.0%	150,358
NORTHWEST	6,886	2.0%	7,019	2,745	0.5%	2,558	60,000	3.9%	49,120
WEST	24,142	7.0%	23,303	5,439	1.0%	4,653	163,000	10.5%	122,529
CAMEROON	346,925	100.0%	45,285	551,194	100.0%	63,670	1,551,000	100.0%	148,472

Source: The World Bank, Agricultural Sector Review, 1986.
Note: Figures in 1980/81 FCFA. Does not include recurrent expenditure.

Annex 2: Tanzania

Table 1
Population density and per capita agricultural land by region, 1986 and 2000

AREA Region	Population ('000) Total 1988 1/	% of Total	Urban 1988 1/	% Rural 1,988	Rate of Growth 1/	Total 2000 2/	Land ('000 Ha.) Total 3/	Cultivated 1970 3/	Cultivable 1970 3/	Cultivated as percent of Cultivable	Population Density 1,988	Per Capita Land 1,988
Dar-es-Salaam	1,361	6%	1,361	0%	4.8%	2,708	139	n.a.	n.a.	n.a.	977	n.a.
NORTHEAST HIGHLANDS	2,461	11%	97	96%		3,646	9,535	340	8,889	3.8%	26	3.6
Arusha	1,352	6%		100%	3.8%	1,902	8,210	165	7,775	2.1%	16	5.8
Kilimanjaro	1,109	5%	97	91%	2.1%	1,744	1,325	175	1,114	15.7%	84	1.0
COASTAL BELT	4,681	21%	237	95%		7,038	21,260	1,336	10,501	12.7%	22	2.2
Coast	638	3%		100%	2.1%	913	3,255	255	2,643	9.6%	20	4.1
Lindi	647	3%	42	94%	2.0%	956	6,604	148 5/	1,221 5/	12.1%	10	1.9
Mtwara	889	4%	77	91%	1.4%	1,391	1,671	213 5/	1,758 5/	12.1%	53	2.0
Tanga	1,284	6%		100%	2.1%	1,969	2,668	340	2,118	16.1%	48	1.6
Morogoro	1,223	5%	118	90%	2.6%	1,809	7,062	380	2,761	13.8%	17	2.3
CENTRAL AND WESTERN	3,921	17%	464	88%		6,036	20,384	849	10,122	8.4%	19	2.6
Dodoma	1,238	5%	204	84%	2.4%	1,866	4,131	265	3,511	7.5%	30	2.8
Singida	792	4%	81	90%	2.5%	1,163	4,934	160	2,960	5.4%	16	3.7
Tabora	1,036	5%	94	91%	2.4%	1,761	7,615	144 6/	2,440 6/	5.9%	14	2.4
Kigoma	855	4%	85	90%	2.8%	1,246	3,704	280	1,211	23.1%	23	1.4
SOUTHERN HIGHLANDS	4,163	18%	417	90%		5,971	24,950	695	10,033	6.9%	17	2.4
Mbeya	1,476	7%	153	90%	3.1%	2,138	6,035	255	3,518	7.2%	24	2.4
Iringa	1,209	5%	85 4/	93%	2.7%	1,753	5,685	240	3,343	7.2%	21	2.8
Ruvuma	783	3%	87	89%	3.4%	1,105	6,367	120	1,572 7/	7.6%	12	2.0
Rukwa	695	3%	92	87%	4.3%	975	6,864	80 6/	1,600 6/	5.0%	10	2.3
LAKE VICTORIA BASIN	5,948	26%	217	96%		8,898	12,068	1,245	9,165	13.6%	49	1.5
Mwanza	1,878	8%		100%	2.6%	2,770	1,968	410	1,382	29.7%	95	0.7
Mara	971	4%	69	93%	2.9%	1,372	2,176	205	2,137	9.6%	45	2.2
Shinyanga	1,773	8%	101	94%	2.9%	2,665	5,076	340	3,315	10.3%	35	1.9
Kagera	1,326	6%	47	96%	2.7%	2,091	2,846	290	2,331	12.4%	47	1.8
Total Mainland	22,535	100%	2,793	88%	2.8%	34,297	88,334	4,465	48,710	9.2%	26	2.2

Sources: 1/ 1988 Population Census, Preliminary Results. Bureau of Statistics.
2/ By calculation, using 3.181%. From The Demography of Tanzania
3/ 1970 Statistical Abstract. Cited in 1974 Agricultural and Rural Sector Study, World Bank, Vol. III, Table 23. "Cultivable" does not include forests.
4/ By calculation; initial census report in error.
5/ Derived; total figure of 360,000 ha. given for Mtwara and Lindi, combined.
6/ Derived; total figure of 225,000 given for Tabora and Rukwa, combined.
7/ From Van Velthizon, "An Assessment of Land Resources for Rainfed Maize, Wheat and Rice in Tanzania." Southern Africa Department, The World Bank. June, 1988. Original figure 160,000 ha.

Table 2
Share of marketed production, by region (selected years)

AREA Region	Export Crops	Production Share	Food Crops	Production Share
Dar-es-Salaam				
NORTHEAST HIGHLANDS		By Region		
Arusha	Coffee A.	15%	Maize Wheat	29% 75%
Kilimanjaro	Coffee A.	36%		
COASTAL BELT				
Coast	Cashews	27%		
Lindi	Cashews	22%		
Mtwara	Cashews	42%	Cassava	51%
Tanga			Cattle	26%
Morogoro			Cattle	20%
CENTRAL AND WESTERN PLATEAU				
Dodoma			Maize Sorghum	13% 43%
Singida				
Tabora			Rice	25%
Kigoma				
SOUTHERN HIGHLANDS				
Mbeya	Coffee A.	21%	Rice	53%
Iringa			Maize	12%
Ruvuma	Coffee A.	15%	Maize	10%
Rukwa			Maize	11%
LAKE VICTORIA BASIN				
Mwanza	Cotton	38%	Cassava	21%
Mara			Cattle	
Shinyanga	Cotton	38%	Rice	12%
Kagera	Coffee R.	99%		

Sources:

Maize data from NMC/MDB. Based on six-year (1976-1982) mean shares of NMC purchases.
Cassava data from NMC. Based on six-year (1976-1982) mean share of marketed production.
Wheat data from NMC/MDB. Based on six-year (1976-1982) mean share of marketed production.
Rice data from M.O.A./DSM (Price Policy Recommendations for 1981-82). Based on five-year (1975-1980) purchases of rice and paddy (converted at rate of 65%).
Sorghum Data from NMC. Based on six-year (1976-1982) mean share of marketed production.
Coffee data from TCMB. Shares represent TCMB purchases of Arabica and Robusta for 1985/86.
Cattle data from Statistical Abstract, 1973-1979. Total indigenous cattle holdings on large-scale farms (no. of cattle less significant for "Ujamaa" category.
Cotton data from TCMB (as cited in Agr. Sector Report 1987). Based on share of purchased seed cotton in 1984/85.
Cashew data from TCMB (as cited in FAO, op. cit). Based on six-year (1980-1986) mean share share of marketed production.

Table 3
Regional maize production, 1970-1985

		North East Highlands			Coastal Belt						Central and Western Plateau				
Year	DAR ES SALAAM	ARUSHA	KILI-MANJARO	Share of Total	COAST	LINDI	MTWARA	TANGA	MOROGORO	Share of Total	DODOMA	SINGIDA	TABORA	KIGOMA	Share of Total
1970															
1971		110,000	28,000	19.2%	2,000		12,000	65,000	30,000	15.2%	67,000	27,000	30,000	26,000	20.9%
1972		60,000	28,000	14.1%	2,000		19,000	70,000	65,000	25.1%	65,000	19,000	30,000	27,000	22.7%
1973		60,000	40,000	11.3%	2,000		31,000	160,000	25,000	24.7%	120,000	25,000	80,000	28,000	28.7%
1974	100	106,500	42,000	14.2%	1,400	31,000	17,500	85,300	100,500	22.5%	32,000	24,200	67,200	20,100	13.7%
1975	1,700	82,000	28,000	8.6%	1,900	32,900	50,000	160,000	53,000	23.4%	60,000	15,200	67,200	41,600	14.4%
1976	8,200	173,000	35,000	12.5%	34,300	36,600	43,000	142,400	157,700	24.9%	43,900	17,600	129,800	48,900	14.5%
1977	2,800	201,000	22,800	13.5%	23,200	27,000	40,500	99,200	158,200	21.0%	23,500	12,200	152,900	59,900	15.0%
1978	1,200	11,000	45,500	3.7%	33,700	30,000	57,000	215,000	90,100	28.2%	63,500	13,500	98,800	61,700	15.7%
1979	1,700	135,900	49,500	12.9%	15,400	32,700	24,000	112,200	12,700	13.7%	51,200	22,900	102,400	44,900	15.4%
1980	1,700	139,400	58,500	12.9%	24,600	9,800	9,200	108,500	99,700	16.4%	57,400	11,600	48,300	40,500	10.3%
1981		123,900	70,700	11.4%	34,600	17,300	25,500	151,500	91,400	18.8%	67,200	22,800	57,500	38,200	10.9%
1985		127,000	60,000	8.9%	11,000	22,000	22,000	60,000	110,000	10.8%	47,400	23,000	166,000	73,000	14.8%

	Southern Highlands					Lake Victoria Basin					
Year	MBEYA	IRINGA	RUVUMA	RUKWA	Share of Total	MWANZA	MARA	SHINYANGA	KAGERA	Share of Total	TOTAL PRODUCTION
1970											
1971	67,000	90,000	29,000		25.9%	74,000	23,000	36,000	3,000	18.9%	719,000
1972	62,000	72,000	51,000		29.7%	30,000	13,000	5,000	4,000	8.4%	622,000
1973	62,000	90,000	44,000		22.2%	31,000	23,000	59,000	3,000	13.1%	883,000
1974	126,800	57,000	103,800	20,000	29.4%	31,000	83,100	56,600	40,900	20.2%	1,047,000
1975	101,500	138,400	115,400	43,000	31.2%	113,000	69,300	45,400	55,700	22.2%	1,275,200
1976	152,800	156,400	125,000	57,000	29.6%	139,600	57,700	49,400	52,600	18.0%	1,660,900
1977	133,900	175,900	129,600	85,700	31.8%	157,900	62,500	52,800	32,200	18.5%	1,653,700
1978	138,900	200,500	150,000	91,000	38.4%	73,700	70,400	53,600	12,500	13.9%	1,511,600
1979	157,900	216,000	92,200	101,200	39.4%	83,500	55,800	89,700	38,100	18.5%	1,439,900
1980	189,100	232,800	89,100	202,100	46.4%	27,100	39,600	102,700	46,500	14.0%	1,538,200
1981	189,200	252,100	113,900	207,900	44.8%	27,600	58,500	113,300	38,700	14.0%	1,701,800
1985	240,000	367,000	142,000	160,000	43.5%	76,000	31,000	286,000	68,000	22.0%	2,091,400

SOURCES:
1974-1978 ESTIMATED HARVESTED, KILIMO STATISTICS
1979-1982 PRODUCTION, MADIA TANZANIA DATABASE
1985 ESTIMATED PRODUCTION, MADIA TANZANIA DATABASE

Table 4
NMC purchases of maize by region, 1970/71-1987/88 (mt)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
Cst/DSM						1,500	2,400	2,100	800		12	39	107	95	25	0	0	0
Morogoro	6,700	3,900	9,600	5,400	1,000	10,500	9,200	14,500	4,500	1,100	733	418	300	106	584	776	640	1,000
Tanga	900	100			3,800	20,200	20,800	7,200	7,300	400	89	1,351	2,915	966	3,046	623	3,591	4,000
Mtwara						2,700	4,400	1,800	1,000		197	5	13	36	36	588	214	2,000
Lindi						1,200	2,700	3,000	2,000		164	359	465	26	89	627	774	900
Arusha	45,100	7,600	17,100	7,000	2,900	10,100	60,300	69,500	69,500	47,400	16,519	3,238	1,193	6,315	2,969	36,060	46,398	45,000
Kilimanjaro	16,000	2,900	11,800	6,000	4,800	4,800	6,100	22,900	13,600	5,900	134	43	523	101	50	769	23	300
Dodoma	58,600	15,600	54,100	34,500		6,000	11,500	17,800	36,600	27,100	2,671	4,373	1,496	5,251	1,143	12,020	7,057	10,000
Singida	5,400	1,000	700	1,600		500	1,100	1,000	3,600	700	447	228	42	57	67	5,084	4,750	5,000
Tabora	1,300	900	500			100	3,500	10,900	5,700	4,900	2,381	1,151	2,000	311	376	1,428	2,189	3,000
Kigoma	200					200	700	900	1,000	400	180	429	360	259	198	90	881	800
Rukwa					700	3,000	11,800	8,500	5,300	15,900	17,818	15,956	17,645	10,143	16,563	29,338	28,196	36,700
Mwanza	1,300	100	200	400		2,900	1,300	2,400	4,200	2,000	30	13	26	6	10	5,016	2,009	400
Mara	10,000	1,600	3,600	6,200	1,700	1,100	5,900	5,500	4,200	3,000	60	286	116	1,098	149	0	377	500
Shinyanga	200	1,400				700		2,500	2,400	1,100	132	228	271	78	187	2,745	4,140	5,500
Kagera						200	1,100	1,300	800	700	42	12	108	409	21	221	1,000	500
Iringa	36,500	7,700	8,200	11,200	4,100	10,500	14,700	20,900	27,200	26,300	21,754	33,054	26,147	25,138	22,982	38,006	38,428	20,000
Mbeya	2,500	200	100	1,400	700	2,200	5,500	11,700	6,700	6,400	5,351	7,141	9,484	7,705	7,341	15,987	11,804	8,500
Ruvuma	1,700		500	100	4,200	12,700	10,000	16,100	22,800	17,800	14,082	21,116	22,750	12,858	33,641	29,116	22,305	35,000
National Total	1/ 186,400	43,000	106,400	73,800	23,900	91,100	173,000	220,500	219,200	161,100	82,796	89,440	85,961	70,961	89,477	178,494	172,778	179,100

Source: 1970/71-1979/80 data from Ministry of Agriculture, "Price Policy Recommendations for the 1981-82 Agricultural Price Review", 1980
1980/81-1987/88 data from Government of Tanzania, Min. of Ag. & Livestock Development, "Annual Review of Maize, Rice and Wheat, "1987
Notes: 1/ National Total treats blanks as zero purchases, which may not be a correct assumption.

Table 5
Shares of NMC purchases by region, 1970/71-1987/88[1]

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
Cst/DSM	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	1.4%	1.0%	0.4%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Morogoro	3.6%	9.1%	9.0%	7.3%	4.2%	11.5%	5.3%	6.6%	2.1%	0.7%	0.9%	0.5%	0.3%	0.1%	0.7%	0.4%	0.4%	0.6%
Tanga	0.5%	0.2%	0.0%	0.0%	15.9%	22.2%	12.0%	3.3%	3.3%	0.2%	0.1%	1.5%	3.4%	1.4%	3.4%	0.3%	2.1%	2.2%
Mtwara	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%	2.5%	0.8%	0.5%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.3%	0.1%	1.1%
Lindi	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	1.6%	1.4%	0.9%	0.0%	0.2%	0.4%	0.5%	0.0%	0.1%	0.4%	0.4%	0.5%
Arusha	24.2%	17.7%	16.1%	9.5%	12.1%	11.1%	34.9%	31.5%	31.7%	29.4%	20.0%	3.6%	1.4%	8.9%	3.3%	20.2%	26.9%	25.1%
Kilimanjaro	8.6%	6.7%	11.1%	8.1%	20.1%	5.3%	3.5%	10.4%	6.2%	3.7%	0.2%	0.0%	0.6%	0.1%	0.1%	0.4%	0.0%	0.2%
Dodoma	31.4%	36.3%	50.8%	46.7%	0.0%	6.6%	6.6%	8.1%	16.7%	16.8%	3.2%	4.9%	1.7%	7.4%	1.3%	6.7%	4.1%	5.6%
Singida	2.9%	2.3%	0.7%	2.2%	0.0%	0.5%	0.6%	0.5%	1.6%	0.4%	0.5%	0.3%	0.0%	0.1%	0.1%	2.8%	2.7%	2.8%
Tabora	0.7%	2.1%	0.5%	0.0%	0.0%	0.1%	2.0%	4.9%	2.6%	3.0%	2.9%	1.3%	2.3%	0.4%	0.4%	0.8%	1.3%	1.7%
Kigoma	0.1%	0.0%	0.0%	0.0%	0.0%	0.2%	0.4%	0.4%	0.5%	0.2%	0.2%	0.5%	0.4%	0.4%	0.2%	0.1%	0.5%	0.4%
Rukwa	0.0%	0.0%	0.0%	0.0%	2.9%	3.3%	6.8%	3.9%	2.4%	9.9%	21.5%	17.8%	20.5%	14.3%	18.5%	16.4%	16.3%	20.5%
Mwanza	0.7%	0.2%	0.2%	0.5%	0.0%	3.2%	0.8%	1.1%	1.9%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	1.2%	0.2%
Mara	5.4%	3.7%	3.4%	8.4%	7.1%	1.2%	3.4%	2.5%	1.9%	1.9%	0.1%	0.3%	0.1%	1.5%	0.2%	0.0%	0.2%	0.3%
Shinyanga	0.1%	3.3%	0.0%	0.0%	0.0%	0.8%	0.0%	1.1%	1.1%	0.7%	0.2%	0.3%	0.3%	0.1%	0.2%	1.5%	2.4%	3.1%
Kagera	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.6%	0.6%	0.4%	0.4%	0.1%	0.0%	0.1%	0.6%	0.0%	0.1%	0.6%	0.3%
Iringa	19.6%	17.9%	7.7%	15.2%	17.2%	11.5%	8.5%	9.5%	12.4%	16.3%	26.3%	37.0%	30.4%	35.4%	25.7%	21.3%	21.1%	11.2%
Mbeya	1.3%	0.5%	0.1%	1.9%	2.9%	2.4%	3.2%	5.3%	3.1%	4.0%	6.5%	8.0%	11.0%	10.9%	8.2%	9.0%	6.8%	4.7%
Ruvuma	0.9%	0.0%	0.5%	0.1%	17.6%	13.9%	5.8%	7.3%	10.4%	11.0%	17.0%	23.6%	26.5%	18.1%	37.6%	16.3%	12.9%	19.5%

Source: 1970/71-1979/80 data from Ministry of Agriculture, "Price Policy Recommendations for the 1981-82 Agricultural Price Review", 1980
1980/81-1987/88 data from Government of Tanzania, Min. of Ag. & Livestock Development, "Annual Review of Maize, Rice and Wheat, "1987
Notes: 1/ Shares were calculated assuming that blanks equal zero purchases, which may not be a correct assumption.

Table 6
NMC sales of maize by region, 1978/79-1987/88 ('000 mt)

	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1987/88
Cst/DSM	88.0	107.0	133.0	137.0	127.8	127.9	135.2	100.8
Morogoro	3.0	8.0	8.0	9.0	4.8	4.8	3.0	5.4
Tanga	15.0	26.0	31.0	13.0	3.7	3.7	8.4	5.4
Mtwara	4.0	4.0	7.0	6.0	3.5	3.6	3.2	3.1
Lindi	3.0	5.0	6.0	3.0	2.4	2.4	1.1	2.4
Arusha	4.0	16.0	17.0	10.0	7.9	7.9	6.0	6.8
Kilimanjaro	2.0	8.0	10.0	6.0	2.0	2.1	6.5	2.0
Dodoma	5.0	15.0	16.0	30.0	21.6	21.8	11.2	20.5
Singida	2.0	7.0	2.0	2.0	0.7	0.7	2.0	5.0
Tabora	1.0	2.0	5.0	9.0	2.4	2.4	6.8	3.0
Kigoma	0.0	1.0	1.0	2.0	1.4	1.4	1.8	1.3
Rukwa	1.0	2.0	4.0	4.0	0.5	0.5	4.2	3.1
Mwanza	6.0	5.0	15.0	19.0	5.6	5.6	8.3	10.2
Mara	2.0	3.0	11.0	11.0	6.1	6.0	4.8	6.8
Shinyanga	1.0	2.0	12.0	14.0	6.0	6.1	7.5	6.8
Kagera	13.0	2.0	7.0	4.0	2.8	2.9	3.4	6.5
Iringa	4.0	7.0	6.0	6.0	5.2	5.1	5.7	2.7
Mbeya	2.0	2.0	3.0	1.0	3.3	3.3	1.1	0.7
Ruvuma	0.0	1.0	1.0	1.0	0.6	0.6	1.3	0.7
Total	156.0	223.0	295.0	287.0	208.3	208.8	221.6	193.2

Source: Government of Tanzania, Min. of Ag. & Livestock
1987/88 data from "Annual Review of Maize, Rice and Wheat" 1987.
Other data from "Price Policy Recommendation: Maize, Rice & Wheat," various years

Table 7
Regional coffee production, 1970-1985 (in metric tons)

			North East Highlands			Coastal Belt						Central and Western Plateau				
Year	T.C.G.A.	Share of Total	ARUSHA	KILI-MANJARO	Share of Total	COAST	LINDI	MTWARA	TANGA	MOROGORO	Share of Total	DODOMA	SINGIDA	TABORA	KIGOMA	Share of Total
1963	1,301	6.0%	1,161	5,989	33.0%				561	0	2.6%				14	0.1%
1964	9,867	27.6%	1,659	11,122	35.8%				531	0	1.5%				21	0.1%
1965	7,777	24.1%	1,418	10,232	36.2%				383	0	1.2%				11	0.0%
1966	12,027	23.4%	1,968	16,710	38.4%				906	98	2.0%				95	0.2%
1967	11,184	25.1%	2,027	14,815	37.8%				490	100	1.3%				65	0.1%
1968	9,535	20.7%	2,371	12,746	32.9%				1082	46	2.5%				70	0.2%
1969	14,004	28.6%	2,558	16,067	35.5%				692	70	1.4%				53	0.1%
1970	11,161	24.6%	1,648	10,761	27.4%				472	174	1.4%				47	0.1%
1971	11,352	24.4%	2,496	13,067	33.5%				466	83	1.2%				22	0.0%
1972	16,413	28.4%	3,879	17,510	37.0%				882	127	1.7%				18	0.0%
1973	11,223	23.8%	3,461	14,133	37.3%				817	93	1.9%				73	0.2%
1974	6,794	16.1%	2,116	11,483	32.2%				664	76	1.8%				82	0.2%
1975	5,027	9.7%	3,938	22,320	50.9%				975	127	2.1%				39	0.1%
1976	5,764	10.5%	4,398	22,764	49.3%				466	237	1.3%				18	0.0%
1977	4,530	9.3%	5,327	19,409	51.1%				768	161	1.9%				17	0.0%
1978	3,918	7.6%	4,312	20,054	47.0%				890	430	2.5%				35	0.1%
1979	6,772	13.6%	4,147	13,140	34.8%				504	383	1.8%				67	0.1%
1980	3,503	7.3%	3,787	14,658	38.6%				314	226	1.1%				41	0.1%
1981	5,166	7.6%	6,567	25,937	47.8%				679	97	1.1%				33	0.0%
1982	1,185	2.3%	5,051	18,421	46.3%				694		1.4%				52	0.1%
1983	2,939	5.7%	4,557	17,120	42.1%				898		1.7%				16	0.0%
1984	4,032	8.2%	4,402	13,023	35.3%				717		1.5%				56	0.1%
1985			4,207	15,361	41.9%				439		0.9%				93	0.2%

	Southern Highlands					Lake Victoria Basin					
Year	MBEYA	IRINGA	RUVUMA	RUKWA	Share of Total	MWANZA	MARA	SHINYANGA	KAGERA	Share of Total	TOTAL PRODUCTION
[illegible]	[illegible]	56	1,805		20.6%	0			8,200	37.8%	21,693
[illegible]	[illegible]	71	1,729		9.9%	250			8,719	25.1%	35,698
[illegible]	[illegible]	85	1,001		8.8%	93			9,473	29.7%	32,216
[illegible]	3,4[illegible]	172	1,980		10.7%	254			13,798	27.4%	51,360
[illegible]	3,21[illegible]	[illegible]9	1,637		11.1%	448			10,494	24.6%	44,549
196[illegible]	2,6[illegible]	[illegible]22	2,298		11.5%	524			14,354	32.3%	46,003
1969	[illegible]	85	3,065		12.6%	300			12,145	23.7%	52,556
1970	[illegible]	78	2,902		13.0%	312			14,882	33.5%	45,339
197[illegible]	[illegible]	48	2,810		14.8%	339			11,766	26.0%	46,489
19[illegible]	[illegible]	91	2,039		10.7%	314			12,496	22.1%	57,854
[illegible]	[illegible]	98	2,174		11.5%	310			11,691	25.4%	47,216
197[illegible]	[illegible]	68	3,046		15.4%	208			14,337	34.4%	42,271
19[illegible]	[illegible]	91	3,121		13.8%	266			11,808	23.4%	51,601
1976	[illegible]	106	3,250		15.3%	427			12,585	23.6%	55,104
1977	[illegible]23	36	2,297		10.6%	171			12,911	27.0%	48,450
1978	3,[illegible]61	57	4,155		15.8%	165			13,862	27.0%	51,859
1979	4,702	24	4,686		19.1%	315			14,873	30.6%	49,683
1980	4,297	31	4,231		17.9%	280			16,401	34.9%	47,769
1981	6,770		6,578		19.6%	297			15,836	23.7%	67,960
1982	7,196		4,800		23.7%	467			12,844	26.2%	50,710
1983	6,725		6,452		25.6%	247			12,548	24.8%	51,502
1984	8,859		5,210		26.6%	220			12,809	26.4%	49,368
1985	6,746		7,320		30.1%	290			12,257	26.9%	46,713

Source: Tanzania Agricultural Sector Mission Technical Papers, FAO 1986

Table 8
Regional tobacco production, all types (in mt)

Year	DAR ES SALAAM	North East Highlands: ARUSHA	KILI-MANJARO	Share of Total	Coastal Belt: COAST	LINDI	MTWARA	TANGA	MOROGORO	Share of Total	Central and Western Plateau: DODOMA	SINGIDA	TABORA	KIGOMA	Share of Total
1970				0.0%						0.0%			2,903		100.0%
1971				0.0%						0.0%			4,911		100.0%
1972				0.0%						0.0%			5,215		62.8%
1973				0.0%						0.0%			7,065		70.9%
1974				0.0%						0.0%			9,951		76.4%
1975				0.0%						0.0%			7,210		62.4%
1976				0.0%	1			39	9	0.4%			8,528		71.0%
1977				0.0%	6			14	10	0.2%			8,242		68.4%
1978				0.0%	3			19	11	0.3%			8,009		65.1%
1979				0.0%		12		19	11	0.2%		287	8,182		49.5%
1980				0.0%		14		22	12	0.3%		292	6,451		39.5%
1981				0.0%		8		28	5	0.2%		546	6,722		43.4%
1982				0.0%		4		39	11	0.3%		391	7,003		45.5%
1983				0.0%		0		34	4	0.3%		447	4,489		38.2%
1984				0.0%		5		38	1	0.4%		248	5,193		49.4%
1985				0.0%		9		57	0	0.5%		269	7,153		52.2%
1986				0.0%					0	0.0%					0.0%

Year	Southern Highlands: MBEYA	IRINGA	RUVUMA	RUKWA	Share of Total	Lake Victoria Basin: MWANZA	MARA	SHINYANGA	KAGERA	Share of Total	TOTAL PRODUCTION
1970					0.0%					0.0%	2,903
1971					0.0%					0.0%	4,911
1972		3,093			37.2%					0.0%	8,308
1973		2,901			29.1%					0.0%	9,966
1974		3,081			23.6%					0.0%	13,032
1975		4,345			37.6%					0.0%	11,555
1976		3,434			28.6%					0.0%	12,011
1977		4,145			33.4%					0.0%	12,417
1978		4,265			34.7%					0.0%	12,307
1979	971	3,721	2,625	561	46.1%			670	39	4.1%	17,098
1980	1,639	3,350	3,958	672	56.4%			587	60	3.8%	17,057
1981	1,813	2,404	3,589	831	51.6%			738	54	4.7%	16,738
1982	1,675	1,786	3,987	843	50.9%			482	40	3.2%	16,241
1983	1,569	2,033	3,928	752	60.8%			289	75	2.7%	13,620
1984	1,021	1,797	1,946	511	47.9%			237	22	2.4%	11,019
1985	1,430	1,439	2,818	363	42.6%			651	21	4.7%	14,210
1986			1,000		100.0%					0.0%	1,000

SOURCES: 1979-83 PPR for the 1983 Ag Price Review, MDB; 1984-86 MADIA Tanzania database.

Table 9
Public expenditure (in millions of current Tanzania shillings)

Year	Northeast Highlands: ARUSHA	KILIMANJARO	As %	Coastal Belt: COAST	LINDI	MTWARA	TANGA	MOROGORO	As %	Central and Western Plateau: DODOMA	SINGIDA	TABORA	KIGOMA	As %
1974/5	68.6	66.1	12.0%	43.5	43.4	51.9	84.1	64.3	25.6%	65.4	57.0	45.3	39.9	18.5%
1975/6	69.5	62.0	12.1%	41.3	40.1	47.2	82.2	62.8	25.2%	66.4	42.7	47.6	39.3	19.0%
1976/7	72.6	76.2	12.1%	45.9	48.4	54.1	84.9	69.6	24.6%	76.0	51.7	51.9	45.8	18.3%
1977/8	96.7	105.7	12.0%	61.5	61.3	76.2	118.8	98.7	24.7%	106.2	71.6	72.0	63.5	19.6%
1978/9	106.2	98.7	12.6%	72.8	61.3	80.8	106.5	93.1	25.7%	100.2	75.0	68.0	62.0	18.8%
1979/80	112.7	133.0	12.6%	90.5	69.2	102.6	115.9	106.6	24.8%	114.3	90.6	86.4	86.6	19.3%
1980/1	137.4	143.4	12.2%	102.2	86.7	119.6	144.5	124.5	25.2%	137.3	98.5	112.5	92.6	19.2%
1981/2	159.5	167.0	12.4%	114.2	100.1	133.6	172.1	154.2	25.7%	157.5	112.3	127.1	106.4	19.1%
1982/3	198.6	218.5	12.9%	128.2	135.1	141.8	183.3	187.8	24.0%	185.8	151.6	161.7	136.0	19.6%
1983/4	197.4	208.8	11.9%	152.9	134.1	157.7	217.8	211.5	25.6%	197.6	147.2	159.7	143.3	19.0%
1984/5	74.3	71.7	12.2%	46.9	44.6	62.5	73.1	83.9	26.0%	83.8	51.4	62.4	51.0	20.8%
1985/6	87.5	79.2	11.8%	54.7	54.1	75.7	82.0	97.1	25.8%	92.6	56.9	72.9	59.5	20.0%
GROWTH RATE	5.4	5.6		6.2	5.8	6.8	3.0	7.1		6.1	3.4	3.1	7.3	

Year	Southern Highlands: MBEYA	IRINGA	RUVUMA	RUKWA	As %	Lake Victoria Basin: MWANZA	MARA	SHINYANGA	KAGERA	As %	DAR ES SALAAM	As % of Total	TOTAL EXPENDITURE
1974/5	60.5	50.5	46.9	34.1	17.1%	72.9	42.2	53.6	61.7	20.5%	69.8	6.2%	1,121.7
1975/6	62.4	55.5	41.8	29.4	17.4%	67.3	50.6	48.6	59.4	20.8%	70.3	6.5%	1,086.4
1976/7	69.5	61.4	46.5	33.2	17.1%	81.3	56.5	60.2	72.3	21.9%	73.5	6.0%	1,231.5
1977/8	94.1	83.5	63.5	46.7	17.1%	111.7	77.0	81.5	103.0	22.2%	90.7	5.4%	1,683.9
1978/9	96.0	90.8	66.0	52.3	18.8%	122.6	79.9	69.9	97.9	24.1%		0.0%	1,622.0
1979/80	118.0	113.1	89.2	68.0	19.8%	133.5	89.3	103.4	117.7	22.7%	15.7	0.8%	1,956.4
1980/1	142.3	120.2	89.8	79.5	18.8%	162.0	135.7	118.2	128.0	23.7%	19.8	0.8%	2,2[illegible].7
1981/2	164.4	138.8	107.0	93.2	19.2%	181.7	131.9	137.3	150.2	22.9%	19.8	0.8%	2,928.3
1982/3	184.1	195.6	142.6	111.4	19.6%	224.5	151.4	195.4	176.9	23.1%	25.8	0.8%	3,238.1
1983/4	212.4	196.5	147.8	123.0	19.3%	233.2	176.9	167.5	185.8	22.9%	26.4	0.8%	3,417.5
1984/5	66.4	52.7	46.2	40.0	17.2%	78.4	60.6	65.8	47.6	21.1%	32.0	2.7%	1,195.3
1985/6	100.6	68.8	54.2	46.5	19.2%	90.8	70.1	76.1	53.5	20.6%	37.1	2.6%	1,409.9
GROWTH RATE	6.9	6.0	3.5	7.8		5.7	7.4	3.3	4.1		(9.8)		

SOURCE: An Analysis of Budgertary Allocations by M. Schluter, 1982 and Estimates of Public Expenditure Supply Votes (Regional), 1984-1985.

Table 10
Public expenditure

TOTAL EXPENDITURE BY SECTOR (In millions of Current Tanzania Shillings)

	TOTAL	AGR/ LVSTK	EDUCA-TION	HEALTH	RURAL WATER	ROADS	REMAINDER
1974/5	1,121.7	69.1	275.0	184.1	42.1	77.7	482.9
1975/6	1,086.4	76.2	318.3	208.4	43.4	57.6	390.8
1976/7	1,231.5	88.3	424.7	258.8	49.7	55.9	361.0
1977/8	1,683.9	98.5	692.8	331.2	91.2	86.7	394.5
1978/9	1,637.7	100.1	683.1	316.3	101.2	108.1	348.9
1979/80	1,959.5	121.3	850.1	355.7	108.7	113.7	430.4
1980/1	2,294.7	130.6	932.1	397.7	128.0	122.2	605.5
1981/2	2,608.5	148.0	1,090.3	455.5	139.2	135.2	664.4

TOTAL EXPENDITURE BY SECTOR

	Total	Agr/Lvstk	Educ.	Health	Water	Roads	Remainder
1974/5	100.0%	6.2%	24.5%	16.4%	3.8%	6.9%	43.1%
1975/6	100.0%	7.0%	29.3%	19.2%	4.0%	5.3%	36.0%
1976/7	100.0%	7.2%	34.5%	21.0%	4.0%	4.5%	29.3%
1977/8	100.0%	5.8%	41.1%	19.7%	5.4%	5.1%	23.4%
1978/9	100.0%	6.1%	41.7%	19.3%	6.2%	6.6%	21.3%
1979/80	100.0%	6.2%	43.4%	18.2%	5.5%	5.8%	22.0%
1980/1	100.0%	5.7%	40.6%	17.3%	5.6%	5.3%	26.4%
1981/2	100.0%	5.7%	41.8%	17.5%	5.3%	5.2%	25.5%

NORTHEAST HIGHLANDS AS PERCENT OF TOTAL

	Total	Agr/Lvstk	Educ.	Health	Water	Roads	Remainder
1974/5	12.0%	13.9%	14.4%	13.5%	14.7%	8.9%	11.3%
1975/6	12.1%	15.1%	11.5%	12.7%	14.3%	8.7%	13.0%
1976/7	12.1%	13.0%	12.6%	12.6%	13.7%	7.7%	12.3%
1977/8	12.0%	15.1%	12.2%	11.1%	16.4%	9.0%	13.0%
1978/9	12.5%	15.4%	13.6%	10.9%	10.4%	13.0%	14.8%
1979/80	12.5%	16.0%	12.5%	11.9%	10.3%	12.8%	15.5%
1980/1	12.2%	20.3%	11.4%	12.4%	12.5%	12.5%	13.7%
1981/2	12.5%	20.2%	12.2%	12.1%	12.7%	12.6%	13.7%

SOUTHERN HIGHLANDS AS PERCENT OF TOTAL

	Total	Agr/Lvstk	Educ.	Health	Water	Roads	Remainder
1974/5	17.1%	22.1%	17.1%	16.3%	14.3%	16.0%	17.3%
1975/6	17.4%	21.5%	17.1%	16.7%	12.9%	20.7%	17.7%
1976/7	17.1%	19.6%	16.9%	15.8%	13.3%	18.1%	18.4%
1977/8	17.1%	18.4%	17.6%	16.0%	13.9%	17.5%	17.8%
1978/9	18.6%	21.3%	18.6%	19.3%	13.6%	20.5%	18.9%
1979/80	19.8%	17.6%	19.8%	18.9%	14.6%	20.0%	23.0%
1980/1	18.8%	18.6%	19.3%	16.8%	14.1%	20.4%	20.5%
1981/2	19.3%	17.9%	20.1%	18.3%	14.9%	19.8%	20.1%

COASTAL BELT AS PERCENTAGE OF TOTAL

	Total	Agr/Lvstk	Educ.	Health	Water	Roads	Remainder
1974/5	25.6%	14.6%	21.1%	27.5%	25.4%	29.7%	27.9%
1975/6	25.2%	19.9%	23.0%	25.2%	24.0%	29.5%	26.9%
1976/7	24.6%	18.6%	26.6%	25.9%	25.6%	29.5%	21.4%
1977/8	24.7%	19.6%	23.0%	28.7%	23.7%	29.6%	24.2%
1978/9	25.4%	19.3%	24.2%	27.2%	31.1%	29.9%	23.5%
1979/80	24.7%	20.4%	23.6%	26.7%	30.4%	28.1%	23.2%
1980/1	25.2%	18.5%	24.3%	26.9%	29.0%	28.4%	24.5%
1981/2	25.8%	20.6%	23.9%	27.7%	28.2%	29.1%	26.9%

LAKE VICTORIA BASIN AS PERCENT OF TOTAL

	Total	Agr/Lvstk	Educ.	Health	Water	Roads	Remainder
1974/5	20.5%	23.9%	24.3%	17.2%	18.8%	19.6%	19.1%
1975/6	20.8%	24.9%	26.1%	17.8%	20.5%	19.4%	17.0%
1976/7	21.9%	27.2%	22.9%	20.1%	22.1%	18.1%	21.0%
1977/8	22.2%	25.9%	25.1%	19.0%	21.4%	19.6%	18.9%
1978/9	23.6%	26.0%	24.9%	21.9%	20.9%	16.4%	24.6%
1979/80	22.7%	21.6%	23.6%	22.8%	20.6%	19.8%	21.1%
1980/1	23.7%	23.6%	25.0%	22.2%	20.1%	19.1%	23.6%
1981/2	23.0%	22.4%	24.8%	21.7%	20.8%	19.6%	21.6%

CENTRAL AND WESTERN PLATEAU AS PERCENT OF TOTAL

	Total	Agr/Lvstk	Educ.	Health	Water	Roads	Remainder
1974/5	18.5%	23.0%	18.9%	18.1%	28.8%	15.2%	17.2%
1975/6	18.0%	16.8%	16.9%	18.3%	28.3%	17.0%	17.7%
1976/7	18.3%	19.7%	16.6%	17.7%	25.4%	17.9%	19.1%
1977/8	18.6%	19.1%	18.4%	17.3%	24.6%	14.5%	18.9%
1978/9	18.6%	16.4%	18.1%	20.3%	22.4%	19.4%	16.4%
1979/80	19.3%	23.2%	19.9%	19.2%	22.6%	18.4%	15.5%
1980/1	19.2%	18.0%	19.5%	20.8%	22.9%	18.5%	16.7%
1981/2	19.3%	18.9%	19.0%	20.3%	23.3%	18.9%	17.7%

SOURCE: An Analysis of Budgetary Allocations by M. Schluter, 1982 and Estimates of Public Expenditure Supply Votes (Regional), 1984-1985.

Table 11
Enrollment in primary school by region, 1978, and percent of children ages 5-14 enrolled

AREA Region	Enrollment 1978 Public	Private	Total	Children 5-14 Rural Only Males	Females	Total	Children 5-14 Urban Only Males	Females	Total	Total Children Age 5-14	Percent Enrolled
Dar-es-Salaam	99,055	6,034	105,089	8,551	8,311	16,862	83,834	90,894	174,728	191,590	55%
NORTHEAST HIGHLANDS	349,088	0	349,088	263,119	255,622	518,741	15,175	15,821	30,996	549,737	64%
Arusha	137,733	0	137,733	127,572	120,215	247,787	7,720	8,075	15,795	263,582	52%
Kilimanjaro	211,355	0	211,355	135,547	135,407	270,954	7,455	7,746	15,201	286,155	74%
COASTAL BELT	656,852	5,537	662,389	456,544	445,842	902,386	54,780	58,161	112,941	1,015,327	65%
Coast	96,894	813	97,707	63,987	60,588	124,575	4,301	4,614	8,915	133,490	73%
Lindi 13/	86,805	203	87,008	60,074	59,010	119,084	6,008	6,466	12,474	131,558	66%
Mtwara	132,765	4,202	136,967	88,275	87,159	175,434	11,060	11,356	22,416	197,850	69%
Tanga	184,629	319	184,948	134,049	131,366	265,415	17,793	18,985	36,778	302,193	61%
Morogoro	155,759	0	155,759	110,159	107,719	217,878	15,618	16,740	32,358	250,236	62%
CENTRAL AND WESTERN PLATEAU	487,575	22,443	510,018	393,396	376,906	770,302	39,932	39,663	79,595	849,897	60%
Dodoma	169,965	5,854	175,819	137,815	127,482	265,297	10,225	10,951	21,176	286,473	61%
Singida	97,561	6,241	103,802	79,339	77,565	156,904	9,165	7,471	16,636	173,540	60%
Tabora	106,537	10,348	116,885	96,447	92,726	189,173	12,068	12,775	24,843	214,016	55%
Kigoma	113,512	0	113,512	79,795	79,133	158,928	8,474	8,466	16,940	175,868	65%
SOUTHERN HIGHLANDS	562,392	31,690	594,082	401,168	400,627	801,795	33,559	37,055	70,614	872,409	68%
Mbeya	202,005	11,382	213,387	142,294	140,993	283,287	11,763	13,165	24,928	308,215	69%
Iringa	179,251	9,421	188,672	127,599	129,089	256,688	9,907	11,301	21,208	277,896	68%
Ruvuma	112,706	202	112,908	74,450	74,361	148,811	5,143	5,492	10,635	159,446	71%
Rukwa 13/	68,430	10,685	79,115	56,825	56,184	113,009	6,746	7,097	13,843	126,852	62%
LAKE VICTORIA BASIN	757,022	14,885	771,907	617,249	614,238	1,231,487	31,535	33,754	65,289	1,296,776	60%
Mwanza	242,732	10,136	252,868	188,349	186,153	374,502	15,409	16,336	31,745	406,247	62%
Mara	159,247	0	159,247	103,872	104,019	207,891	6,371	7,102	13,473	221,364	72%
Shinyanga	195,707	4,749	200,456	190,790	190,070	380,860	6,553	6,921	13,474	394,334	51%
Kagera	159,336	0	159,336	134,238	133,996	268,234	3,202	3,395	6,597	274,831	58%
Total	2,911,984	80,589	2,992,573	2,140,027	2,101,546	4,241,573	258,815	275,348	534,163	4,775,736	63%

SOURCE: Tanzania Central Bureau of Statistics, 1979. "Statistical Abstract, 1973-1979." Ministry of Planning and Economic Affairs. Dar es Salaam.

Annex 3: Senegal

Table 1
Population density, land use, and per capita agricultural land use by region, 1985 (hectares per person)

REGION	POPULATION ('000) Total 1/ 1985	As % of Total	Rural 1985	% Rural	Total 2/ 2000	Total Area 3/	Population Density 1985 per/sq.km	LAND ('000 Hectares) Under Cult. 4/	% of total	Unused but Potent. Cult. 5/	% of total	Under Woods and Forest	% of total	Available Cultivable Land	% of total	PER CAPITA AGRICULTURAL LAND (Includes Woodlands) Cultivable 1985 Total Pop.	Rural Pop.	Cultivable Total Pop. 2000
DAKAR	1,470	23%	221	15%	2,290	55	2,673	3	5%	6	11%	6	11%	15	27%	0.01	0.07	0.01
GROUNDNUT BASIN	3,153	49%	2,858	91%	4,912	6,409	49	1,987	31%	1,200	19%	2,155	34%	5,342	83%	1.69	1.87	1.09
THIES	860	13%	774	90%	1,340	660	130	361	55%	9	1%	98	15%	468	71%	0.54	0.60	0.35
DIOURBEL	504	8%	444	88%	785	436	116	311	71%	0	0%	39	9%	350	80%	0.69	0.79	0.45
KAOLACK et FATICK	1,289	20%	1,173	91%	2,008	2,394	54	910	38%	240	10%	716	30%	1,866	78%	1.45	1.59	0.93
LOUGA	500	8%	465	93%	779	2,919	17	405	14%	951	33%	1,302	45%	2,658	91%	5.32	5.72	3.41
OUTLYING REGIONS	1,855	29%	1,535	83%	2,890	13,208	14	622	5%	692	5%	3,825	29%	5,139	39%	2.77	3.35	1.78
ZIGUINCHOR et KOLDA	880	14%	730	83%	1,371	2,835	31	296	10%	454	16%	685	24%	1,435	51%	1.63	1.96	1.05
SAINT LOUIS	610	9%	531	87%	950	4,413	14	110	2%	104	2%	1,572	36%	1,786	40%	2.93	3.37	1.88
TAMBACOUNDA	365	6%	274	75%	569	5,960	6	216	4%	134	2%	1,568	26%	1,918	32%	5.25	7.01	3.37
TOTAL SENEGAL	6,478	100%	4,340	67%	10,093	19,672	26	2,612	13%	1,898	10%	5,986	30%	10,496	53%	1.62	2.42	1.04

SOURCES: 1/ From "VII Plan de Developpement Economique et Social: 1985/1989. Situation de L'Economie Senegalaise, Strategie de Developpement." Ministere de Plan et de la Cooperation. p.19, Table 4.
2/ 1985 Population projected at rate of 3.0% for all regions.
3/ From VII Plan. See Note 1/ above.
4/ From Situation Economique du Senegal 1982, Direction Statistique, et Rapport Annuel Direction Eaux, Forets et Chasses, 1978. Land Under Cultivation Defined as "Terres Agricoles: superficies cultives."
5/ Potentially Cultivable defined as "Terres inutilisees et susceptibles d'utilization agricole ou forestiere." See Note 4/ for source.

Table 2
Average annual rainfall by region, 1960-1983 (in mm)

YEAR	SENEGAL	DAKAR	ZIGUINCHOR/ KOLDA	DIOURBEL	ST. LOUIS	LOUGA	TAMBACOUNDA	KAOLACK/ FATICK	THIES
1960/61	643	582	1,079	739	379	523	602	601	640
1961/62	664	586	1,254	566	371	448	789	664	635
1962/63	694	577	1,319	621	264	346	862	592	969
1963/64	665	547	1,219	579	382	451	943	644	556
1964/65	757	531	1,310	726	369	495	1,024	876	727
1965/66	680	400	1,458	563	438	449	939	655	544
1966/67	738	515	1,251	604	416	371	1,235	981	530
1967/68	880	918	1,560	858	342	667	964	907	828
1968/69	432	208	830	340	276	237	792	441	330
1969/70	660	687	1,198	571	426	372	745	654	624
1970/71	513	196	1,136	386	243	285	690	482	684
1971/72	607	410	983	564	283	296	1,225	771	327
1972/73	349	120	702	410	118	205	622	415	202
1973/74	565	964	1,118	307	197	272	723	464	476
1974/75	583	367	1,110	538	229	341	957	564	555
1975/76	645	675	1,322	453	302	267	783	694	668
1976/77	573	392	1,282	443	260	284	970	540	415
1977/78	415	152	813	302	159	250	932	415	290
1978/79	601	269	1,258	571	281	331	575	941	580
1979/80	482	260	968	478	227	247	691	571	412
1980/81	436	378	760	349	237	327	609	436	394
1981/82	563	339	1,108	437	263	356	878	599	528
1982/83	492	311	1,072	388	198	324	736	584	321
1983/84	313	119	723	197	157	182	515	355	255
MEAN	581	438	1118	500	284	347	825	585	520
STD. DEV.	132	229	229	155	89	112	190	178	188
C.V. (%)	23	52	21	31	32	32	23	30	36
Rate of Growth		-4.09 *	-1.5 *	-3.2 *	-3.1 *	-2.7 *	-1.2 **	-1.5 **	-3.1 *

Source: Ministere du Developpement Rural/DGPA
* Significant a 1%.
** Significant at 5%.

Table 3
Regional groundnut production, 1961-1987 (area in hectares; production in mt; yield in mt/ha)

YEAR	CAP-VERT AREA	CAP-VERT PROD	% of Total	YIELD	CASSAMANCE (Z et K) AREA	CASSAMANCE (Z et K) PROD	% of Total	YIELD	DIOURBEL AREA	DIOURBEL PROD	% of Total	YIELD	FLEUVE (St. Louis) AREA	FLEUVE (St. Louis) PROD	% of Total	YIELD
1961	3,500	3,500	0%	1.00	123,931	112,797	13%	0.91	146,480	117,164	13%	0.80	6,525	5,094	1%	0.78
1962	5,000	3,000	0%	0.60	126,000	118,000	12%	0.94	144,000	148,000	15%	1.03	9,300	3,550	0%	0.38
1963	3,000	2,100	0%	0.70	110,241	120,098	13%	1.09	139,000	121,500	14%	0.87	10,948	3,509	0%	0.32
1964	5,380	2,155	0%	0.40	110,200	124.962	13%	1.13	172,489	143,878	15%	0.83	16,241	5,862	1%	0.36
1965	4,180	1,860	0%	0.44	103,630	129,023	13%	1.25	146,000	125,580	13%	0.86	15,270	6,320	1%	0.41
1966	4,000	2,400	0%	0.60	118,600	132,350	12%	1.12	130,000	132,200	12%	1.02	27,000	15,900	1%	0.59
1967	3,578	1,965	0%	0.55	121,246	126,809	15%	1.05	144,000	34,169	4%	0.24	11,132	7,895	1%	0.71
1968	4,000	3,232	0%	0.81	120,000	120,000	12%	1.00	155,500	144,400	14%	0.93	12,348	6,837	1%	0.55
1969	2,836	713	0%	0.25	113,586	103,500	13%	0.91	146,750	76,742	9%	0.52	12,000	21,500	3%	1.79
1970	2,500	2,000	0%	0.80	118,050	91,700	12%	0.78	125,000	67,000	8%	0.54	10,200	5,100	1%	0.50
1971	3,800	1,000	0%	0.26	115,860	115,830	20%	1.00	141,500	44,010	7%	0.31	9,800	980	0%	0.10
1972	4,920	4,168	0%	0.85	126,822	131,235	13%	1.03	129,300	110,000	11%	0.85	11,963	2,006	0%	0.17
1973	1,998	75	0%	0.04	103,450	118,062	20%	1.14	152,300	51,500	9%	0.34	4,520		0%	
1974	2,130	488	0%	0.23	111,153	117,835	17%	1.06	126,850	67,332	10%	0.53	6,680	597	0%	0.09
1975	2,000	982	0%	0.49	126,219	119,390	12%	0.95	136,556	116,325	12%	0.85	5,890	1,444	0%	0.25
1976	2,500	2,000	0%	0.80	139,060	149,949	10%	1.08	184,227	220,000	15%	1.19	6,835	5,125	0%	0.75
1977	1,421	515	0%	0.36	118,820	136,570	11%	1.15	179,000	175,000	15%	0.98	5,962	957	0%	0.16
1978			0%		104,107	89,343	17%	0.86	178,493	87,773	17%	0.49	5,770	1,320	0%	0.23
1979	1,000	750	0%	0.75	141,779	142,911	13%	1.01	174,925	152,221	14%	0.87	7,047	4,047	0%	0.57
1980	900	400	0%	0.44	110,234	91,070	13%	0.83	135,383	96,475	14%	0.71	2,543	517	0%	0.20
1981	1,600	1,200	0%	0.75	78,721	37,158	7%	0.47	136,030	41,624	8%	0.31	3,780	1,755	0%	0.46
1982	1,400	1,040	0%	0.74	91,864	98,570	11%	1.07	123,841	115,262	13%	0.93	3,942	3,045	0%	0.77
1983	2,440	1,465	0%	0.60	98,690	104,974	9%	1.06	167,104	150,395	13%	0.90	7,100	4,260	0%	0.60
1984	950		0%		90,407	107,984	19%	1.19	150,969	50,690	9%	0.34	7,570		0%	
1985	11,115	2,251	0%	0.20	94,015	112,992	17%	1.20	104,000	80,000	12%	0.77			0%	
1986	60	39	0%	0.65	97,382	102,442	17%	1.05	57,670	51,903	9%	0.90	496	317	0%	0.64
1987	395	279	0%	0.71	103,382	134,379	16%	1.30	67,731	48,014	6%	0.71	1,085	337	0%	0.31

YEAR	LOUGA AREA	LOUGA PROD	% of Total	YIELD	SEN ORIENTAL (Tamba) AREA	SEN ORIENTAL (Tamba) PROD	% of Total	YIELD	SINE SALOUM (K et F) AREA	SINE SALOUM (K et F) PROD	% of Total	YIELD	THIES AREA	THIES PROD	% of Total	YIELD	TOTAL PRODUCTION	TOTAL AREA
1961	105,769	84,635	9%	0.80	31,020	31,020	3%	1.00	429,669	408,184	46%	0.95	130,100	130,100	15%	1.00	892,494	976,994
1962	103,000	112,000	11%	1.09	35,200	37,200	4%	1.06	471,000	425,000	43%	0.90	132,000	148,000	15%	1.12	994,750	1,025,500
1963	96,000	69,450	8%	0.72	38,200	41,000	5%	1.07	482,540	416,925	47%	0.86	133,200	119,280	13%	0.90	893,862	1,013,129
1964	135,091	101,039	11%	0.75	43,380	43,380	5%	1.00	475,130	400,265	42%	0.84	126,304	130,660	14%	1.03	952,201	1,084,215
1965	120,000	94,420	10%	0.79	33,100	4,100	0%	0.12	495,661	497,983	51%	1.00	137,000	122,000	12%	0.89	982,086	1,054,901
1966	153,000	132,300	12%	0.86	34,500	36,275	3%	1.05	499,000	528,000	47%	1.06	146,000	142,600	13%	0.98	1,122,025	1,112,100
1967	163,263	78,821	9%	0.48	35,058	33,271	4%	0.95	514,720	488,735	57%	0.95	121,063	85,391	10%	0.71	857,056	1,114,065
1968	145,900	132,850	13%	0.91	36,164	35,858	4%	0.99	531,500	406,819	40%	0.77	157,319	158,155	16%	1.01	1,008,151	1,162,731
1969	192,249	97,907	12%	0.51	32,154	28,903	4%	0.90	522,200	377,484	46%	0.72	169,252	112,843	14%	0.67	819,592	1,191,027
1970	138,000	111,000	14%	0.80	29,000	25,000	3%	0.86	389,300	372,500	47%	0.96	151,000	114,500	15%	0.76	788,800	963,050
1971	163,600	40,490	7%	0.25	44,250	17,540	3%	0.40	441,810	298,024	50%	0.67	136,340	72,360	12%	0.53	590,234	1,056,960
1972	142,000	131,400	13%	0.92	41,760	30,930	3%	0.74	458,957	420,097	42%	0.92	155,478	169,205	17%	1.09	998,041	1,071,200
1973	155,700	14,600	2%	0.09	43,861	28,219	5%	0.64	466,151	355,682	61%	0.76	158,796	18,802	3%	0.12	586,940	1,086,776
1974	125,253	63,283	9%	0.51	47,399	22,420	3%	0.47	473,005	309,265	46%	0.65	151,026	92,346	14%	0.61	673,566	1,043,496
1975	159,570	118,486	12%	0.74	41,985	43,625	4%	1.04	447,426	449,772	45%	1.01	154,813	150,973	15%	0.98	1,000,997	1,074,459
1976	190,000	191,650	13%	1.01	59,738	58,782	4%	0.98	559,287	639,131	44%	1.14	195,800	191,305	13%	0.98	1,457,942	1,337,447
1977	180,860	108,549	9%	0.60	51,762	61,267	5%	1.18	613,699	596,198	50%	0.97	160,485	119,926	10%	0.75	1,198,982	1,312,009
1978	175,530	47,975	9%	0.27	43,370	34,037	7%	0.78	542,521	227,499	44%	0.42	135,000	33,025	6%	0.24	520,972	1,184,841
1979	180,379	172,774	16%	0.96	65,531	66,149	6%	1.01	501,950	383,962	36%	0.76	105,911	137,268	13%	1.30	1,060,082	1,178,522
1980	200,227	84,092	12%	0.42	62,518	37,118	5%	0.59	396,254	260,637	39%	0.66	161,116	105,714	16%	0.66	676,023	1,069,175
1981	177,197	127,030	24%	0.72	58,253	30,009	6%	0.52	468,242	235,781	45%	0.50	150,313	51,446	10%	0.34	525,003	1,074,136
1982	187,922	159,829	18%	0.85	60,086	53,623	6%	0.89	431,855	358,580	41%	0.83	117,262	81,286	9%	0.69	871,235	1,018,172
1983	185,170	172,775	15%	0.93	52,842	49,402	4%	0.93	488,603	515,871	44%	1.06	165,319	164,555	14%	1.00	1,163,697	1,167,268
1984	142,470	22,417	4%	0.16	61,734	32,286	6%	0.52	507,621	284,910	49%	0.56	148,040	77,801	14%	0.53	576,088	1,109,761
1985	120,000	60,000	9%	0.50	59,793	60,150	9%	1.01	409,168	309,023	45%	0.76	86,000	60,000	9%	0.70	684,416	884,691
1986	45,714	47,039	8%	1.03	59,960	59,732	10%	1.00	293,331	289,814	48%	0.99	49,960	49,960	8%	1.00	601,246	604,573
1987	59,466	51,932	6%	0.87	65,258	68,374	8%	1.05	412,699	461,576	55%	1.12	97,722	76,161	9%	0.78	841,052	807,738

SOURCES: Direction de la Production Agricole. Rapport Annuel.
Bilan de la Campagne de Production Agricole for 1986-1987

Table 4

Regional millet/sorghum production, 1961-1987 (area in hectares; production in mt; yield in mt/ha)

MARKETING YEAR	CAP-VERT AREA	CAP-VERT PROD	CAP-VERT YIELD	CASSAMANCE AREA	CASSAMANCE PROD	CASSAMANCE YIELD	DIOURBEL AREA	DIOURBEL PROD	DIOURBEL YIELD	FLEUVE AREA	FLEUVE PROD	FLEUVE YIELD	LOUGA AREA	LOUGA PROD	LOUGA YIELD
1961	1,600	640	0.40	72,370	62,070	0.86	79,085	30,254	0.38	77,504	38,597	0.50	109,300	25,208	0.23
1962	1,600	640	0.40	80,600	61,985	0.77	89,200	59,400	0.67	109,000	51,500	0.47	113,800	26,310	0.23
1963	1,600	640	0.40	77,768	68,265	0.88	131,428	54,425	0.41	113,800	54,907	0.48	89,600	22,040	0.25
1964	771	231	0.30	88,365	72,452	0.84	132,750	69,500	0.52	110,585	39,176	0.35	152,217	50,642	0.33
1965	932	280	0.30	102,866	83,714	0.81	135,000	73,900	0.55	125,000	65,200	0.52	150,000	51,000	0.34
1966	990	346	0.35	112,400	94,410	0.84	149,000	72,900	0.49	122,000	52,650	0.43	156,000	51,800	0.33
1967	1,023	386	0.38	88,311	76,026	0.86	148,000	22,750	0.15	123,101	52,903	0.43	110,250	31,000	0.28
1968	1,145	451	0.39	125,146	114,048	0.91	147,000	84,800	0.58	140,063	72,616	0.52	153,000	78,500	0.51
1969	691	134	0.19	112,993	87,988	0.78	128,300	38,395	0.30	106,746	37,837	0.35	127,500	39,311	0.31
1970	1,417	665	0.47	121,208	121,415	1.00	110,121	56,308	0.51	104,150	68,775	0.66	123,900	41,657	0.34
1971	2,295	1,031	0.45	123,358	100,216	0.81	101,000	27,200	0.27	91,140	29,030	0.32	129,200	27,120	0.21
1972	946	746	0.79	92,215	90,900	0.99	99,000	59,055	0.60	118,389	49,352	0.42	107,260	49,630	0.46
1973	285	38	0.13	94,782	74,771	0.79	103,500	43,750	0.42	49,491	1,142	0.02	138,500	8,250	0.06
1974	700	1,122	1.60	99,349	83,698	0.84	146,150	58,500	0.40	86,503	27,443	0.32	179,910	43,179	0.24
1975	2,000	1,400	0.70	95,496	101,935	1.07	162,262	103,642	0.64	120,551	53,201	0.44	156,433	82,200	0.53
1976	2,200	1,340	0.61	90,717	74,050	0.82	167,950	88,690	0.53	94,582	41,071	0.43	148,700	73,980	0.50
1977	1,124	507	0.45	91,069	75,897	0.83	161,489	100,635	0.62	99,865	23,100	0.23	132,390	39,874	0.30
1978	900	130	0.14	87,268	64,597	0.74	149,227	37,766	0.25	76,060	8,550	0.11	135,700	27,535	0.20
1979	640	274	0.43	103,202	30,785	0.30	161,200	128,025	0.79	91,569	37,561	0.41	160,993	88,618	0.55
1980	500	200	0.40	104,539	81,424	0.78	172,406	95,625	0.55	38,533	11,989	0.31	142,549	46,995	0.33
1981	1,550	915	0.59	104,149	58,838	0.56	145,550	52,921	0.36	86,364	27,853	0.32	155,058	66,235	0.43
1982	1,250	735	0.59	99,274	94,706	0.95	168,701	133,796	0.79	97,327	48,666	0.50	185,839	72,344	0.39
1983	1,050	620	0.59	95,731	90,835	0.95	130,713	58,428	0.45	30,765	4,338	0.14	176,271	50,672	0.29
1984	139			84,303	67,648	0.80	108,235	31,896	0.29	24,361	6,930	0.28	65,140	8,090	0.12
1985	130	9	0.07	55,922	58,243	1.04	154,668	58,688	0.38	2,204	783	0.36	145,054	4,789	0.03
1986	150	105	0.70	106,333	89,917	0.85	204,788	153,363	0.75	28,338	16,152	0.57	201,345	116,999	0.58
1987	970	461	0.48	97,512	90,902	0.93	123,486	51,877	0.42	18,215	9,230	0.51	124,783	37,526	0.30

MARKETING YEAR	SEN ORIENTAL AREA	SEN ORIENTAL PROD	SEN ORIENTAL YIELD	SINE SALOUM AREA	SINE SALOUM PROD	SINE SALOUM YIELD	THIES AREA	THIES PROD	THIES YIELD
1961	51,500	34,625	0.67	244,352	156,635	0.84	126,500	44,350	0.35
1962	52,100	34,150	0.66	265,500	127,175	0.48	128,000	45,350	0.35
1963	53,300	35,337	0.66	270,115	141,741	0.52	127,000	46,700	0.37
1964	53,085	37,934	0.71	291,500	157,070	0.54	132,100	51,400	0.39
1965	59,500	41,800	0.70	298,520	172,822	0.58	139,000	43,050	0.31
1966	67,000	46,600	0.70	315,000	184,050	0.58	147,000	52,700	0.36
1967	71,637	49,974	0.70	308,469	187,770	0.61	145,875	41,931	0.29
1968	73,446	53,490	0.73	352,465	182,770	0.52	163,100	68,285	0.42
1969	72,027	49,985	0.69	347,330	155,581	0.45	158,100	45,141	0.29
1970	87,873	68,960	0.78	323,710	204,244	0.63	164,872	72,619	0.44
1971	80,100	30,844	0.38	287,040	133,510	0.47	152,400	33,360	0.22
1972	72,810	54,852	0.75	319,730	197,584	0.62	160,100	81,013	0.51
1973	73,556	40,065	0.54	319,964	140,703	0.44	155,863	13,166	0.08
1974	71,557	32,513	0.45	343,060	160,375	0.47	175,600	103,350	0.59
1975	62,530	38,162	0.61	421,959	332,223	0.79	123,521	83,525	0.68
1976	69,738	60,027	0.86	262,330	179,080	0.68	128,471	98,[illegible]45	0.76
1977	59,456	18,315	0.31	281,815	199,589	0.71	121,631	49,358	0.41
1978	58,623	34,165	0.58	333,018	165,779	0.50	102,000	21,495	0.21
1979	60,326	52,426	0.87	366,823	296,646	0.81	110,049	117,665	1.07
1980	66,429	29,635	0.45	328,901	192,418	0.59	113,816	62,357	0.55
1981	56,258	36,134	0.64	410,811	236,126	0.57	156,927	66,050	0.42
1982	53,694	57,924	1.08	428,465	466,793	1.09	150,402	111,031	0.74
1983	65,675	55,773	0.85	338,742	220,182	0.65	151,981	104,375	0.69
1984	61,728	23,531	0.38	349,793	169,081	0.48	134,074	44,844	0.33
1985	77,020	43,600	0.57	402,202	239,092	0.59	165,651	66,252	0.40
1986	111,340	111,691	1.00	506,286	322,269	0.64	177,165	139,074	0.78
1987	106,904	68,040	0.64	378,111	290,629	0.77	143,167	68,040	0.48

SOURCES: Direction de la Production Agricole.
Rapport Annuel.
Bilan de la Campagne de Production Agricole for 1986-1987

Table 5

Regional rice paddy production, 1961-1987 (area in hectares; production in mt; yield in mt/ha)

MARKETING YEAR	CASSAMANCE AREA	CASSAMANCE PROD	CASSAMANCE YIELD	FLEUVE AREA	FLEUVE PROD	FLEUVE YIELD	SEN ORIENTAL AREA	SEN ORIENTAL PROD	SEN ORIENTAL YIELD	SINE SALOUM AREA	SINE SALOUM PROD	SINE SALOUM YIELD	THIES AREA	THIES PROD	THIES YIELD	TOTAL PRODUCTION
1961	52,550	62,070	1.18	65,599	15,748	0.24	1,550	1,326	0.86	7,016	2,146	0.31	249	248	1.00	65,790
1962	53,300	59,970	1.13	7,509	18,343	2.44	1,550	1,384	0.89	11,040	3,777	0.34	419	345	0.82	65,476
1963	55,734	66,970	1.20	7,962	18,889	2.37	1,595	1,239	0.78	6,180	2,788	0.45	443	479	1.08	71,476
1964	57,648	77,479	1.34	8,343	22,743	2.73	1,469	1,323	0.90	6,885	3,788	0.55	415	479	1.15	83,069
1965	67,934	80,866	1.19	9,541	21,083	2.21	1,528	1,427	0.93	7,410	4,894	0.66	485	535	1.10	87,722
1966	61,000	88,250	1.45	12,913	27,513	2.13	1,650	1,470	0.89	6,520	4,632	0.71	470	410	0.87	94,762
1967	65,348	82,216	1.26	15,513	38,101	2.46	1,905	1,414	0.74	4,547	2,961	0.65	610	554	0.91	87,145
1968	78,531	101,099	1.29	16,382	28,064	1.71	2,314	1,850	0.80	3,558	2,805	0.79	524	683	1.30	106,437
1969	54,477	43,015	0.79	15,915	15,521	0.98	2,950	2,631	0.89	3,459	19	0.01	654	621	0.95	46,286
1970	84,588	105,607	1.25	15,823	30,992	1.96	1,660	1,847	1.11	1,337	1,162	0.87	602	666	1.11	109,282
1971	74,511	68,486	0.92	15,766	23,000	1.46	1,946	1,417	0.73	1,105	235	0.21	649	388	0.60	70,526
1972	65,346	73,010	1.12	11,748	27,940	2.38	4,255	4,222	0.99	2,737	2,390	0.87	596	380	0.64	80,002
1973	34,952	27,661	0.79	11,534	6,541	0.57	3,971	3,487	0.88	2,846	152	0.05	676	148	0.22	31,448
1974	49,737	49,154	0.99	8,049	9,809	1.22	5,028	6,008	1.19	2,050	180	0.09	550	430	0.78	55,772
1975	63,771	86,360	1.35	9,391	17,220	1.83	7,716	12,509	1.62	4,260	4,271	1.00	242	202	0.83	103,342
1976	70,944	97,397	1.37	10,522	12,955	1.23	10,365	18,384	1.77	1,679	1,423	0.85	298	335	1.12	117,539
1977	65,068	88,767	1.36	10,725	23,315	2.17	11,033	12,705	1.15	1,840	1,560	0.85	240	57	0.24	103,089
1978	41,914	34,088	0.81	7,777	17,300	2.22	12,444	11,362	0.91	1,165	168	0.14				45,618
1979	71,786	108,421	1.51	9,490	27,380	2.89	8,813	9,831	1.12	1,205	794	0.66				119,046
1980	57,832	56,821	0.98	9,798	30,775	3.14	10,115	8,500	0.84	973	471	0.48				65,792
1981	48,744	26,805	0.55	9,692	31,584	3.26	7,016	5,556	0.79	1,723	713	0.41				33,074
1982	56,866	76,700	1.35	10,312	36,850	3.57	5,870	13,482	2.30							90,182
1983	50,281	55,135	1.10	13,699	35,930	2.62	4,185	3,960	0.95							59,095
1984	31,803	35,780	1.13	14,226	61,595	4.33	5,364	4,125	0.77							39,905
*1985	45,189	52,168	1.15	16,601	79,241	4.77	4,300	4,419	1.03							56,587
*1986	59,175	66,106	1.12	15,346	72,378	4.72	3,299	7,712	2.34	333	809	2.43				74,627
1987	50,540	58,631	1.16	16,437	80,663	4.91	4,545	8,080	1.78	462	906	1.96				

SOURCES: Direction de la Production Agricole. Rapport Annuel.
Bilan de la Campagne de Production Agricole for 1986-1987

Table 6

Regional maize production, 1961-1987 (area in hectares; production in mt; yield in mt/ha)

YEAR	CASSAMANCE AREA	CASSAMANCE PROD	CASSAMANCE YIELD	FLEUVE AREA	FLEUVE PROD	FLEUVE YIELD	SEN ORIENTAL AREA	SEN ORIENTAL PROD	SEN ORIENTAL YIELD	SINE SALOUM AREA	SINE SALOUM PROD	SINE SALOUM YIELD	TOTAL PRODUCTION
1961	13,305	13,078	0.98	4,285	3,344	0.78	10,700	8,980	0.84	2,250	1,800	0.80	27,200
1962	13,717	13,053	0.95	5,450	4,310	0.79	10,700	9,280	0.87	2,100	1,780	0.84	28,403
1963	12,253	11,787	0.96	4,916	2,377	0.48	12,000	10,557	0.88	2,215	1,861	0.84	26,842
1964	13,810	12,121	0.88	4,072	1,482	0.36	12,268	11,058	0.90	2,440	1,966	0.81	26,667
1965	17,785	16,286	0.92	14,500	8,096	0.56	12,500	10,900	0.87	2,365	1,883	0.80	37,165
1966	22,585	19,196	0.85	16,000	7,800	0.49	13,600	12,115	0.89	2,100	1,680	0.80	40,793
1967	21,954	19,983	0.91	14,484	8,359	0.58	16,574	13,223	0.80	753	338	0.45	41,903
1968	33,664	32,080	0.95	19,506	9,104	0.47	17,331	14,731	0.85	1,164	883	0.76	56,798
1969	21,696	16,604	0.77	6,950	3,749	0.54	6,842	4,358	0.64	857	590	0.69	25,301
1970	29,610	28,162	0.95	10,221	6,998	0.68	14,917	13,093	0.88	666	589	0.88	48,842
1971	25,159	18,549	0.74	8,359	5,272	0.63	16,553	8,879	0.54	569	375	0.66	33,075
1972	19,540	16,545	0.85	10,088	6,816	0.66	18,499	14,167	0.77	707	574	0.81	37,902
1973	13,018	9,726	0.75	352	191	0.54	18,184	9,857	0.54	765	436	0.57	20,210
1974	14,080	13,929	0.99	1,609	2,722	1.69	19,822	16,220	0.82	875	1,010	1.50	33,881
1975	15,297	16,470	1.08	7,698	5,747	0.75	24,411	19,012	0.78	1,218	2,038	1.67	43,267
1976	13,607	14,891	1.09	5,660	0	0.00	27,138	23,379	0.86	2,920	5,640	1.93	44,387
1977	16,013	19,380	1.21	3,000	0	0.00	15,770	7,192	0.46	12,920	16,264	1.26	43,421
1978	16,019	11,382	0.71	2,500	1,207	0.48	22,346	10,625	0.48	12,777	9,893	0.77	33,107
1979	22,780	19,082	0.84	5,621	4,069	0.72	17,883	16,478	0.92	10,123	14,419	1.42	54,048
1980	25,799	23,490	0.91	2,810	3,533	1.26	23,856	16,327	0.68	15,220	2,943	0.19	46,293
1961	24,393	19,132	0.78	5,855	4,723	0.81	22,859	12,972	0.57	24,952	19,950	0.80	57,015
1982	29,599	23,684	0.80	6,597	4,467	0.68	27,412	39,409	1.44	14,256	27,213	1.91	94,825
1983	25,485	22,794	0.89	18,607	3,246	0.17	24,949	26,797	1.07	27,000	29,311	1.09	82,268
1984	26,961	35,000	1.30	3,798	1,610	0.42	25,739	16,209	0.63	13,924	7,739	0.56	60,558
*1985	35,528	54,240	1.53	1,072	2,315	2.16	29,850	26,865	0.90	16,155	15,030	0.93	98,457
*1986	38,063	59,512	1.56	1,797	2,321	1.29	30,321	38,126	1.26	31,080	46,910	1.51	146,934
1987	39,988	46,619	1.17	446	177	0.40	29,031	31,160	1.07	23,759	27,675	1.16	106,930

SOURCES: Direction de la Production Agricole. Rapport Annuel.
Bilan de la Campagne de Production Agricole for 1986-1987

Table 7

Regional cotton production, 1961-1987 (area in hectares; production in mt; yield in mt/ha)

YEAR	CASSAMANCE (Z et K) AREA	CASSAMANCE PROD	% of Total	YIELD	FLEUVE (St. Louis) AREA	FLEUVE PROD	FLEUVE YIELD	SEN ORIENTAL (Tamba) AREA	SEN ORIENTAL PROD	% of Total	YIELD	SINE SALOUM (K et F) AREA	SINE SALOUM PROD	% of Total	YIELD	TOTAL PRODUCTION	TOTAL AREA
1961	850	68	83%	0.08	130	13	0.10			0%		6	1	1%	0.17	82	986
1962	850	91	78%	0.11	150	23	0.15			0%		10	2	2%	0.20	116	1,010
1963	804	61	52%	0.08	46	52	1.13			0%		20	4	3%	0.20	117	870
1964	1,996	187	67%	0.09	62	65	1.05	55	21	8%	0.38	20	5	2%	0.25	278	2,133
1965	990	151	25%	0.15	100	85	0.85	567	360	59%	0.63	25	10	2%	0.40	606	1,682
1966	599	157	23%	0.26				813	515	75%	0.63	44	17	2%	0.39	689	1,456
1967	962	1,185	59%	1.23				1,235	792	39%	0.64	76	43	2%	0.57	2,020	2,273
1968	1,560	769	18%	0.49				2,200	3,267	77%	1.49	282	225	5%	0.80	4,261	4,042
1969	1,181	1,820	19%	1.54				4,587	7,142	73%	1.56	919	793	8%	0.86	9,755	6,687
1970	1,778	2,682	23%	1.51				6,713	7,445	65%	1.11	1,318	1,373	12%	1.04	11,500	9,809
1971	3,138	4,086	35%	1.30				7,886	5,624	48%	0.71	2,594	1,900	16%	0.73	11,610	13,618
1972	5,818	7,694	36%	1.32				8,415	10,101	48%	1.20	4,085	3,374	16%	0.83	21,169	18,318
1973	6,799	9,845	42%	1.45				10,509	11,066	47%	1.05	3,051	2,391	10%	0.78	23,302	20,359
1974	11,503	16,661	51%	1.45				12,130	12,785	39%	1.05	4,494	3,163	10%	0.70	32,609	28,127
1975	15,729	17,045	42%	1.08				16,251	17,410	43%	1.07	5,976	6,144	15%	1.03	40,599	37,956
1976	16,376	10,885	35%	0.66				17,195	15,079	49%	0.88	5,632	4,721	15%	0.84	30,685	39,203
1977	18,100	20,985	46%	1.16				19,768	18,966	42%	0.96	5,977	5,256	12%	0.88	45,207	43,845
1978	20,145	23,536	63%	1.17				19,240	11,090	30%	0.58	7,720	2,540	7%	0.33	37,166	47,105
1979	22,598	17,064	50%	0.76				17,706	11,895	35%	0.67	7,995	4,847	14%	0.61	33,806	48,299
1980	13,048	12,956	48%	0.99				11,651	9,308	34%	0.80	6,209	4,964	18%	0.80	27,228	30,908
1981	14,750	11,489	55%	0.78				10,207	6,324	30%	0.62	4,957	3,151	15%	0.64	20,964	29,914
1982	15,895	23,187	57%	1.46				11,092	12,489	30%	1.13	4,990	5,331	13%	1.07	41,007	31,977
1983	24,466	32,395	69%	1.32				11,604	10,848	23%	0.93	5,948	3,838	8%	0.65	47,081	42,018
1984	19,465	26,805	72%	1.38				10,995	8,553	23%	0.78	2,890	1,615	4%	0.56	36,973	33,350
*1985	26,670	39,969	67%	1.50				14,101	16,465	28%	1.17	5,566	3,061	5%	0.55	59,495	46,337
*1986	20,725	21,135	56%	1.02				12,179	10,880	29%	0.89	5,923	5,626	15%	0.95	37,641	38,827
1987	15,465	16,829	94%	1.09						0%		1,457	1,122	6%	0.77	17,951	16,922

SOURCES: Direction de la Production Agricole. Rapport Annuel.
B1987 Ministere du Developpement Rural, Bilan de la Campagne de Production Agricole 1986-1987

Table 8

Origin of state "fonctionnaires" by place of birth, by region, 1971, 1976, and 1979

REGION	1971 Number	1971 %	1976 Number	1976 %	1979 Number	1979 %
DAKAR	5,306	16%	7,041	18%	8,038	18%
GROUNDNUT BASIN	10,910	33%	13,784	36%	15,517	36%
THIES	3,670	11%	4,792	12%	5,462	13%
DIOURBEL	3,229	10%	3,917	10%	4,300	10%
SINE SALOUM	4,011	12%	5,075	13%	5,755	13%
LOUGA	na		na		na	
OUTLYING REGIONS	11,855	36%	13,141	34%	13,978	32%
CASAMANCE	4,037	12%	5,012	13%	5,417	12%
SAINT LOUIS	6,992	21%	7,188	19%	7,549	17%
SENEGAL ORIENTAL	826	3%	941	2%	1,012	2%
OUTSIDE SENEGAL	1,978	6%	2,588	7%	3,909	9%
N.D.	2,507	8%	2,098	5%	2,151	5%
TOTAL SENEGAL	32,626	100%	38,652	100%	43,593	100%

SOURCES: Le Senegal en Chiffres, Edition 1982-1983. Societe Africaine d'Edition. p. 82.

Annex 4: Kenya

Table 1
Per capita arable land, 1985 and 2000

Province	Population				Total Area ('000 ha)	Arable as % of Total	Population Density 1985	Per Capita Arable Land		
	Total 1985 1/	As % of Total	Rural 1985 2/	Total 2000 1/				1985 Total	1985 Rural	2000 Total
Nairobi	1,092	5%	na	1,886	68		1,596			
Central	3,094	15%	2,924	5,346	1,317	60%	235	0.25	0.27	0.15
Coast	1,771	9%	1,234	3,060	8,304	41%	21	1.94	2.78	1.12
Eastern	3,587	18%	3,279	6,198	15,576	25%	23	1.08	1.18	0.62
No. Eastern	493 *	2%	414	852	12,690		4			
Nyanza	3,487	17%	3,213	6,025	1,253	80%	278	0.29	0.31	0.17
Rift Valley	4,273 *	21%	3,827	7,384	16,388	31%	26	1.17	1.31	0.68
Western	2,417 *	12%	2,278	4,176	820	72%	295	0.24	0.26	0.14
TOTAL	20,200 *	100%	17,158	34,927	56,416	26%	36	0.73	0.86	0.42

Source: Population Statistics: Republic of Kenya, Central Bureau of Statistics, Vol. II, Analytical Report, p. 1, Table 1.1
Agricultural Land Statistics: Farm Management Handbook of Kenya Vol. II, as reported in ISNAR.

Notes: 1/ Assumes a 4.0% Population Growth Rate.
2/ Calcuted using 1979 Census figures for Urban Centers with population above 2,000 (Table 1.2, p. 5)
*Minor computational errors in the line. Original (incorrect) totals are used.
Errors in total amounts due to rounding.

Table 2
Land classification by district

			Land Quality							
			Humid & Sub-Humid		Semi-humid Transitional		Transitional Semi-arid			
PROVINCE	DISTRICT	AREA (Sq. Km.)	High Potential	% of Total	Medium Potential	% of Total	Low Potential	% of Total	ARABLE LAND ('00 ha.)	ARABLE AS % OF TOTAL
NAIROBI		684								
CENTRAL	Kiambu	2,448	778	54.7%	470	33.1%	174	12.2%	1,422	58.1%
	Kirinyaga	1,437	285	29.8%	665	69.6%	5	0.5%	955	66.5%
	Muranga	2,476	961	53.2%	847	46.8%			1,808	73.0%
	Nyandarua	3,528	763	36.6%	1225	58.8%	97	4.7%	2,085	59.1%
	Nyeri	3,284	695	43.7%	685	43.1%	209	13.2%	1,589	48.4%
	SUB-TOTAL	13,173	3482	44.3%	3892	49.5%	485	6.2%	7,859	59.7%
COAST	Kilifi	12,414			2541	35.7%	4572	64.3%	7,113	57.3%
	Kwale	8,257	235	3.2%	1850	25.3%	5228	71.5%	7,313	88.6%
	Lamu	6,506			3887	70.5%	1630	29.5%	5,517	84.8%
	Mombasa	210								
	Taita/Taveta	16,959	40	0.7%	683	11.3%	5139	88.0%	5,842	34.4%
	Tana River	38,694			418	4.9%	8132	95.1%	8,550	22.1%
	SUB-TOTAL	83,040	275	0.8%	9359	27.3%	24701	71.9%	34,335	41.3%
EASTERN	Embu	2,714	161	8.0%	639	31.7%	1213	60.3%	2,013	74.2%
	Isiolo	25,605								
	Kitui	29,388			2902	14.5%	17162	85.5%	20,064	68.3%
	Machakos	14,178	131	1.2%	3526	31.3%	7616	67.6%	11,273	79.5%
	Marsabit	73,952								
	Meru	9,922	743	14.0%	2127	40.0%	2447	46.0%	5,317	53.6%
	SUB-TOTAL	155,759	1035	2.7%	9194	23.8%	28438	73.5%	38,667	24.8%
NORTH EASTERN	Garissa	43,931								
	Mandera	26,470								
	Wajir	56,501								
	SUB-TOTAL	126,902								
NYANZA	Kisii	2,196	1914	99.4%	11	0.6%			1,925	87.7%
	Kisumu	2,093	605	37.9%	992	62.1%			1,597	76.3%
	Siaya	2,522	985	47.8%	1054	51.2%	20	1.0%	2,059	81.6%
	South Nyanza	5,714	2033	45.2%	2091	46.5%	375	8.3%	4,499	78.7%
	SUB-TOTAL	12,525	5537	54.9%	4148	41.2%	395	3.9%	10,080	80.5%
RIFT VALLEY	Baringo	9,885	207	2.9%	1769	24.6%	5209	72.5%	7,185	72.7%
	Elgeyo Marakwet	2,279	603	41.5%	501	34.5%	350	24.1%	1,454	63.8%
	Kajiado	19,605	3	0.1%	308	9.2%	3019	90.7%	3,330	17.0%
	Kericho	3,931	2553	75.6%	801	23.7%	21	0.6%	3,375	85.9%
	Laikipia	9,718	75	0.9%	1255	15.5%	6757	83.6%	8,087	83.2%
	Nakuru	5,769	1138	30.3%	1540	41.1%	1073	28.6%	3,751	65.0%
	Nandi	2,745	1136	59.0%	790	41.0%			1,926	70.2%
	Narok	16,115	2179	18.4%	3256	27.4%	6438	54.2%	11,873	73.7%
	Samburu	17,521								
	Trans Nzoia	2,078	344	22.1%	1206	77.4%	9	0.6%	1,559	75.0%
	Turkana	61,768								
	Uasin Gishu	3,378	328	11.8%	2453	88.2%			2,781	82.3%
	West Pokot	9,090	522	10.8%	846	17.4%	3487	71.8%	4,855	53.4%
	SUB-TOTAL	163,883	9115	18.2%	14725	29.3%	26363	52.5%	50,203	30.6%
WESTERN	Bungoma	3,077	1210	60.7%	782	39.3%			1,992	64.7%
	Busia	1,626	927	68.7%	422	31.3%			1,349	83.0%
	Kakamega	3,495	1918	75.3%	630	24.7%			2,548	72.9%
	SUB-TOTAL	8,198	4055	68.9%	1834	31.1%			5,889	71.9%
	TOTAL	564,162	23500	16.0%	43152	29.3%	80382	54.7%	147,034	26.1%

Source: Jaetzold and Schmidt, 1982, as reported in ISNAR, 1986.

Table 3
Population, area, and arable land by province and district

PROVINCE	DISTRICT	AREA (Sq. Km.)	POPULATION 1969	POPULATION 1979	% CHANGE 1969-79	POPULATION 2000 1/	DENSITY 1969	DENSITY 1979	ARABLE LAND ('00 ha.)	ARABLE AS % OF TOTAL	PER CAPITA ARABLE LAND 1979 (ha./pers.)	PER CAPITA ARABLE LAND 2000 (ha./pers.) 1/
NAIROBI		684	509,286	827,775	62.5%	1,886,307	745	1210				
CENTRAL	Kiambu	2,448	475,576	686,290	44.3%	1,563,896	194	280	1,422	58.1%	0.21	0.09
	Kirinyaga	1,437	216,988	291,431	34.3%	664,104	151	203	955	66.5%	0.33	0.14
	Muranga	2,476	445,310	648,333	45.6%	1,477,401	180	262	1,808	73.0%	0.28	0.12
	Nyandarua	3,528	176,928	233,302	31.9%	531,641	50	66	2,085	59.1%	0.89	0.39
	Nyeri	3,284	360,845	486,477	34.8%	1,108,568	110	148	1,589	48.4%	0.33	0.14
	SUB-TOTAL	13,173	1,675,647	2,345,833	40.0%	5,345,609	127	178	7,859	59.7%	0.34	0.15
COAST	Kilifi	12,414	307,568	430,986	40.1%	982,117	25	35	7,113	57.3%	1.65	0.72
	Kwale	8,257	205,602	288,363	40.3%	657,112	25	35	7,313	88.6%	2.54	1.11
	Lamu	6,506	22,401	42,299	88.8%	96,390	3	7	5,517	84.8%	13.04	5.72
	Mombasa	210	247,073	341,148	38.1%	777,397	1177	1625				0.00
	Taita/Taveta	16,959	110,742	147,597	33.3%	336,339	7	9	5,842	34.4%	3.96	1.74
	Tana River	38,694	50,696	92,401	82.3%	210,560	1	2	8,550	22.1%	9.25	4.06
	SUB-TOTAL	83,040	944,082	1,342,794	42.2%	3,059,916	11	16	34,335	41.3%	2.56	1.12
EASTERN	Embu	2,714	178,912	263,173	47.1%	599,710	66	97	2,013	74.2%	0.76	0.34
	Isiolo	25,605	30,135	43,478	44.3%	99,076	1	2				0.00
	Kitui	29,388	342,953	464,283	35.4%	1,057,993	12	16	20,064	68.3%	4.32	1.90
	Machakos	14,178	707,214	1,022,522	44.6%	2,330,090	50	72	11,273	79.5%	1.10	0.48
	Marsabit	73,952	51,581	96,216	86.5%	219,254	1	1				0.00
	Meru	9,922	598,506	830,179	39.2%	1,891,785	60	84	5,317	53.6%	0.64	0.28
	SUB-TOTAL	155,759	1,907,301	2,719,851	42.6%	6,197,910	12	17	38,667	24.8%	1.42	0.62
NORTH EASTE	Garissa	43,931	64,521	128,867	99.7%	293,658	1	3				
	Mandera	26,470	95,006	105,609	11.2%	240,658	4	4				
	Wajir	56,501	86,230	139,319	61.6%	317,476	2	2				
	SUB-TOTAL	126,902	245,757	373,787 *	52.1%	851,774	2	3				
NYANZA	Kisii	2,196	675,041	869,512	28.8%	1,981,416	307	396	1,925	87.7%	0.22	0.10
	Kisumu	2,093	400,643	482,327	20.4%	1,099,111	191	230	1,597	76.3%	0.33	0.15
	Siaya	2,522	383,188	474,516	23.8%	1,081,312	152	188	2,059	81.6%	0.43	0.19
	South Nyanza	5,714	663,173	817,601	23.3%	1,863,123	116	143	4,499	78.7%	0.55	0.24
	SUB-TOTAL	12,525	2,122,045	2,643,956	24.6%	6,024,963	169	211	10,080	80.5%	0.38	0.17
RIFT VALLEY	Baringo	9,885	161,741	203,793	26.0%	464,397	16	21	7,185	72.7%	3.53	1.55
	Elgeyo Marak	2,279	159,265	148,868	-6.5%	339,236	70	65	1,454	63.8%	0.98	0.43
	Kajiado	19,605	85,903	149,005	73.5%	339,548	4	8	3,330	17.0%	2.23	0.98
	Kericho	3,931	479,135	633,348	32.2%	1,443,253	122	161	3,375	85.9%	0.53	0.23
	Laikipia	9,718	66,506	134,524	102.3%	306,549	7	14	8,087	83.2%	6.01	2.64
	Nakuru	5,769	290,853	522,709	79.7%	1,191,133	50	91	3,751	65.0%	0.72	0.31
	Nandi	2,745	209,068	299,319	43.2%	682,079	76	109	1,926	70.2%	0.64	0.28
	Narok	16,115	125,219	210,306	68.0%	479,239	8	13	11,873	73.7%	5.65	2.48
	Samburu	17,521	69,519	76,908	10.6%	175,255	4	4				0.00
	Trans Nzoia	2,079	124,361	259,503	108.7%	591,347	60	125	1,559	75.0%	0.60	0.26
	Turkana	61,768	165,225	142,702	-13.6%	325,185	3	2				0.00
	Uasin Gishu	3,378	191,036	300,766	57.4%	685,376	57	89	2,781	82.3%	0.92	0.41
	West Pokot	9,030	82,458	158,652	92.4%	361,531	9	17	4,855	53.4%	3.06	1.34
	SUB-TOTAL	163,883	2,210,289	3,240,402 *	46.6%	7,384,125	13	20	50,203	30.6%	1.55	0.68
WESTERN	Bungoma	3,077	345,226	503,935	46.0%	1,148,351	112	164	1,992	64.7%	0.40	0.17
	Busia	1,626	200,486	297,841	48.6%	678,711	123	183	1,349	83.0%	0.45	0.20
	Kakamega	3,495	782,586	1,030,887	31.7%	2,349,152	224	295	2,548	72.9%	0.25	0.11
	SUB-TOTAL	8,198	1,328,298	1,832,663 *	38.0%	4,176,214	162	224	5,889	71.9%	0.32	0.14
	TOTAL	564,162	10,942,705	15,327,064 *	40.1%	34,926,824	19	27	147,034	26.1%	0.96	0.42

SOURCE: Population Statistics: Republic of Kenya, Central Bureau of Statistics, Vol. II, Analytical Report, p. 1, Table 1.1
Agricultural Land Statistics: Farm Management Handbook of Kenya Vol. II, as reported in ISNAR.

1/ Assumes a 4.0% Population Growth Rate.
* Minor computational errors in the line. Original (incorrect) totals are used.

Table 4
Maize area, production and yields by province

	UNIT	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	MEAN	SHARE	GROWTH
AREA	000 Hectares																	AREA		
Rift Valley		169.9	120.8	151.4	164.9	207.1	200.9	268.2	303.3	261.5	252.9	321.4	345.4	350.1		366.0	360.0	256.3	27%	8.1%
Western		141.2	134.3	132.7	139.8	128.8	137.3	108.3	163.4	130.2	148.3	186.4	199.0	209.4		187.0	202.3	156.6	17%	3.3%
Nyanza		100.4	129.5	138.7	98.4	58.2	95.6	110.3	127.0	131.9	119.9	189.7	189.2	201.9		208.9	112.9	134.2	14%	5.4%
Central		93.6	98.5	119.2	130.5	117.4	98.1	86.4	99.6	94.3	97.8	102.7	102.6	108.6		192.7	75.7	107.8	11%	-0.4%
Eastern		194.1	182.0	219.7	223.6	230.2	194.2	218.9	242.7	214.9	290.3	294.2	319.5	318.5		293.4	193.1	242.0	26%	4.3%
Coast		40.2	42.9	24.5	22.8	22.0	52.9	60.9	66.0	41.9	28.8	41.7	63.1	40.0		60.2	55.3	44.2	5%	3.4%
TOTAL		739.4	708.0	786.2	780.0	763.7	779.0	853.0	1,002.0	874.7	938.0	1,136.1	1,218.8	1,228.5		1,308.2	999.2	941.0	100%	4.6%
PRODUCTION	000 tonnes																	PRODUCTION		
Rift Valley		336.7	305.5	328.5	376.7	577.8	799.9	733.4	808.8	785.8	642.4	699.1	993.5			448.5	982.1	587.9	38%	10.0%
Western		391.4	382.8	239.0	251.8	231.9	370.7	292.4	441.2	175.8	260.4	335.5	477.7			288.0	407.1	301.7	19%	7.0%
Nyanza		93.1	291.4	249.6	177.1	106.6	136.5	267.6	328.5	263.3	250.9	389.9	437.7			355.1	290.5	242.5	16%	9.0%
Central		126.3	205.0	253.5	179.9	221.4	227.5	233.5	233.3	206.8	171.0	188.4	282.5			72.7	204.3	187.1	12%	2.2%
Eastern		124.7	262.1	237.3	290.8	248.6	96.1	139.2	196.4	273.2	253.0	136.4	280.0			257.9	176.1	198.1	13%	1.0%
Coast		36.2	64.3	22.0	20.5	28.0	57.1	81.9	71.3	34.2	25.9	18.0	113.6			25.7	74.0	44.0	3%	2.8%
TOTAL		1,108.4	1,491.1	1,329.9	1,296.8	1,414.3	1,687.8	1,748.0	2,079.5	1,739.1	1,603.6	1,767.3	2,585.0			1,447.9	2,134.0	1,562.2	100%	5.2%
YIELDS	tonnes/ha																	YIELD		
Rift Valley		2.0	2.5	2.2	2.3	2.8	4.0	2.7	2.7	3.0	2.5	2.2	2.9			1.2	1.7	2.3		
Western		2.8	2.7	1.8	1.8	1.8	2.7	2.7	2.7	1.4	1.8	1.8	2.4			1.5	1.5	2.0		
Nyanza		0.9	2.3	1.8	1.8	1.8	1.4	2.4	2.6	2.0	2.1	2.1	2.3			1.7	1.2	1.8		
Central		1.3	2.1	2.1	1.4	1.9	2.3	2.7	2.3	2.2	1.7	1.8	2.8			0.4	0.4	1.7		
Eastern		0.6	1.4	1.1	1.3	1.1	0.5	0.6	0.8	1.3	0.9	0.5	0.9			0.9	0.9	0.8		
Coast		0.9	1.5	0.9	0.9	1.3	1.1	1.3	1.1	0.8	0.9	0.4	1.8			0.4	0.4	0.9		
TOTAL		1.5	2.1	1.7	1.7	1.9	2.2	2.0	2.1	2.0	1.7	1.6	2.1			1.1	1.1	1.6		

SOURCE: Ministry of Agriculture Spreadsheets.
Note: In 1983 no district agricultural reports were submitted to the Ministry.
The data given for 1985 is provisional and only for long rains.

Table 5
NCPB purchases of maize by province, 1970/71-1986-87 (in '000 90 kg bags)

Province	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Rift Valley	1,926	2,412	3,226	2,386	2,609	3,703	3,000	1,562	1,714	1,063	2,997	5,214	4,862	4,164		6,761	6,165
Western	835	642	1,113	1,401	1,674	1,923	1,909	918	570	314	897	1,369	1,066	833		1,480	1,033
Nyanza	20	172	401	140	234	395	673	168	47	36	349	605	566	509		570	555
Eastern	13	177	390	23	93	7	487	35	93	55	4	465	370	0		169	19
Central	5	132	214	142	378	144	240	31	24	1	5	84	104	22		255	284
Coast	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	3
Total	2,799	3,536	5,345	4,092	4,988	6,171	6,337	2,713	2,519	1,469	4,251	7,739	6,968	5,528	4,219	9,236	8,059
Total (in '000 Metric tons)	252	318	481	368	449	555	570	244	227	132	383	696	627	498	380	831	725

Source: 1970/71 - 1983/84 data from NCPB Statitics Division. 1985/86 - 1986/87 data from Coopers and Lybrand, NCPB Reorganisation Study, 1987.

Table 6
Shares of NCPB purchases of maize by province, 1970/71-1986/87

Province	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
Rift Valley	68.8%	68.2%	60.4%	58.3%	52.3%	60.0%	47.3%	57.6%	68.1%	72.4%	70.5%	67.4%	69.8%	75.3%
Western	29.8%	18.2%	20.8%	34.2%	33.6%	31.2%	30.1%	33.8%	22.6%	21.4%	21.1%	17.7%	15.3%	15.1%
Nyanza	0.7%	4.9%	7.5%	3.4%	4.7%	6.4%	10.6%	6.1%	1.9%	2.5%	8.2%	7.8%	8.1%	9.2%
Eastern	0.5%	5.0%	7.3%	0.6%	1.9%	0.1%	7.7%	1.3%	3.7%	3.7%	0.1%	6.0%	5.3%	0.0%
Central	0.2%	3.7%	4.0%	3.5%	7.6%	2.3%	3.8%	1.1%	3.7%	0.1%	0.1%	1.1%	1.5%	0.4%
Coast	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: 1970/71 - 1983/84 data from NCPB Statitics Division. 1985/86 - 1986/87 data from Coopers and Lybrand, NCPB Reorganiza

Table 7
Coffee area, production, and yield, 1981/82

PROVINCE	SMALLHOLDERS			ESTATES			TOTAL
	Area (1000ha)	Production (1000t)	Yield (kg/ha)	Area (1000ha)	Production (1000t)	Yield (kg/ha)	PERCENT OF OUTPUT
EASTERN	45	18.9	420	2.2	1.8	818	23.8%
CENTRAL	38.6	27.9	723	24.1	31	1286	67.8%
RIFT VALLEY	0.4	0.1	250	7.3	1.6	219	2.0%
NYANZA	8.6	4	465	-	-		4.6%
WESTERN	4.5	1.6	356	-	-		1.8%
COAST	0.4	0.1	250	-	-		0.1%
TOTAL	97.5	52.5	538	33.6	34.4	1024	100.0%

SOURCE: Coffee Board of Kenya/J. de Graaff, 1986.

Table 8
Tea area, production, and yield by province, 1973-82

ITEM	UNIT	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	MEAN	SHARE	Rate of Growth
CENTRAL													
Area	ha	15086	16052	16942	18028	19579	20465	21036	21783	22283	19026	42%	5.1%
Production (Made Tea)	Kg.	7024201	8059358	9496532	14705004	16653929	18869771	15214224	16187859	18164785	13819518	50%	11.8%
Yield	Kg./ha	466.2	502.1	560.5	815.7	850.6	922.1	723.2	743.1	815.2	711		
(Kiambu, Murang'a, Nyeri, Kirinyanga)													
EASTERN													
Area	ha	5009	5597	6308	7050	7439	7568	7754	7954	8112	6977	15%	5.8%
Production (Made Tea)	Kg.	2058834	2250306	2711529	3826925	4071662	5319557	4461072	3995793	4893553	3732203	14%	10.9%
Yield	Kg./ha	411.0	402.1	429.9	542.8	547.3	702.9	575.4	502.4	603.2	524		
(Embu, Meru)													
NYANZA													
Area	ha	6944	7566	8185	9202	9844	10329	11257	11928	12405	9740	21%	7.4%
Production (Made Tea)	Kg.	2826258	3065542	4012989	5234196	6863523	7375623	5540765	6309173	6508734	5304089	19%	10.8%
Yield	Kg./ha	407.0	405.2	490.3	568.8	697.2	714.1	492.2	528.9	524.7	536		
(Kisii, Sotik)													
RIFT VALLEY													
Area	ha	6119	6625	6831	7698	8235	8743	9501	9994	9855	8178	18%	6.5%
Production (Made Tea)	Kg.	2341688	2629797	3055189	4345238	5512701	6020267	4733610	5184526	5224213	4338581	16%	10.7%
Yield	Kg./ha	382.7	397.0	447.3	564.5	669.4	688.6	498.2	518.8	530.1	522		
(Kericho/Cheapir, Nandi/ Lessos, E/Maraloet/Charangani)													
WESTERN													
Area	ha	1246	1365	1474	1650	1764	1849	1872	1972	2038	1692	4%	6.1%
Production (Made Tea)	Kg.	267604	258000	304856	417069	484859	572935	604141	575687	556650	505225	2%	11.7%
Yield	Kg./ha	214.8	189.0	206.8	252.8	274.9	309.9	322.7	291.9	273.1	260		
(Kakamega)													
TOTAL													
Area	ha	34384	37205	39740	43628	46861	48954	51420	53631	54693	45613	100%	6.3%
Production (Made Tea)	Kg.	14518585	16263003	19581145	28519436	33584674	38158153	30554412	32250647	35347935	27641999	100%	11.3%
Yield	Kg./ha	422.2	437.1	492.7	653.7	716.7	779.5	594.2	601.3	646.3	668		

SOURCE: Compiled from KTDA Annual Reports.

Table 9
Cotton production by province, 1974-85 (1) (bales)

YEAR	WESTERN PROVINCE (2)	NYANZA PROVINCE (2)	EASTERN/ CENTRAL PROVINCE	COAST(3) PROVINCE	TOTAL
74/75	12,784	3,737	6,038	5,371	28,535
75/76	14,186	6,401	4,091	6,854	31,532
76/77	11,482	4,762	11,398	7,105	34,747
77/78	12,227	10,598	18,357	5,707	46,867
78/79	15,198	12,252	29,593	5,138	62,179
79/80	16,514	12,413	17,325	4,998	51,250
80/81	10,422	13,642	15,282	7,642	46,988
81/82	10,144	11,180	12,356	7,877	41,557
82/83	4,668	9,144	21,420	6,821	42,053
83/84 (4)	4,711	4,733	11,880	7,703	29,027
84/85 (5)	6,135	6,700	35,000	15,984	63,819
85/86	4,600 (6)	6,500	-	18,500	-

YEAR	WESTERN PROVINCE % OF TOTAL(2)	NYANZA PROVINCE % OF TOTAL(2)	EASTERN/ CENTRAL % OF TOTAL	COAST(3) PROVINCE % OF TOTAL	TOTAL	NYANZA/WESTERN PROVINCES % OF TOTAL
74/75	44.80	13.10	23.26	18.82	100	57.90
75/76	44.99	20.30	12.97	21.74	100	65.29
76/77	33.04	13.70	32.80	20.45	100	46.75
77/78	26.09	22.61	39.17	12.18	100	48.70
78/79	24.44	19.70	47.59	8.26	100	44.14
79/80	32.22	24.22	33.80	9.75	100	56.44
80/81	22.18	29.03	32.52	16.26	100	51.21
81/82	24.41	26.90	29.73	18.95	100	51.31
82/83	11.10	21.74	50.94	16.22	100	32.84
83/84 (4)	16.23	16.31	40.93	26.54	100	32.54
84/85 (5)	9.61	10.50	-	25.05	100	20.11

SOURCE: SUPERVISION REPORTS, JUNE 14,1984 AND 1986

NOTES: (1) BASED ON CLSMB ESTIMATES; A DEGREE OF OVERLAP OCCURS BETWEEN YEARS AND REGIONS.
(2) SOME RIFT VALLEY PRODUCTION INCLUDED IN WESTERN AND/OR NYANZE PARTICULARLY IN LATER YEARS.
(3) IRRIGATED AND RAINFED PRODUCTION COMBINED FOR YEARS BEFORE 1983/84.
(4) AT LEAST 20000 BALES POTENTIAL LOST TO DROUGHT.
(5) ESTIMATED VALUES; RIFT VALLEY PRODUCTION OF 35 INCLUDED IN WESTERN PROVINCE.
(6) AN ADDITIONAL 1000 BALES IS EXPECTED FROM THE RIFT VALLEY.
(5) ESTIMATED VALUES; RIFT VALLEY PRODUCTION OF 35 INCLUDED IN WESTERN PROVINCE.
(6) AN ADDITIONAL 1000 BALES IS EXPECTED FROM THE RIFT VALLEY.

Table 10
Geographical distribution of Zebu cattle, 1978-82 ('000 head)

PROVINCE	1978	1979	1980	1981	1982	MEAN HEAD
Rift Valley (% of Total)	3,735 44.1%	3,270 44.0%	3,187 38.8%	2,838 38.2%	3,290 3[illegible].7%	3,264 40.2%
Eastern (% of Total)	1,452 17.2%	1,224 16.5%	1,500 18.3%	1,309 16.7%	1,348 15.6%	1,367 16.8%
Nyanza (% of Total)	1,108 13.1%	334 4.5%	1,463 17.8%	1,464 18.7%	1,629 18.9%	1,199 14.8%
North Eastern (% of Total)	920 10.9%	826 11.1%	810 9.9%	806 10.3%	830 9.6%	838 10.3%
Coast (% of Total)	360 4.3%	1,074 14.5%	510 6.2%	707 9.0%	680 7.9%	666 8.2%
Western (% of Total)	722 8.5%	547 7.4%	653 7.9%	634 8.1%	704 8.2%	652 8.0%
Central (% of Total)	165 2.0%	151 2.0%	95 1.2%	88 1.1%	135 1.6%	127 1.6%
TOTAL	8,460	7,428	8,218	7,846	8,616	8,113

Table 11
Geographical distribution of grade cattle, 1977-82 ('000 head)

PROVINCE	1977	1978	1979	1980	1981	1982	MEAN HEAD
Rift Valley (% of Total	544 50.8%	557 49.5%	561 47.5%	654 46.5%	672 45.9%	811 42.7%	633 46.6%
Central (% of Total	415 38.7%	435 38.6%	461 39.1%	575 40.9%	595 40.6%	847 44.6%	555 40.8%
Eastern (% of Total	61 5.7%	77 6.8%	92 7.8%	81 5.8%	98 6.6%	115 6.1%	87 6.4%
Nyanza (% of Total	30 2.8%	33 2.9%	39 3.3%	41 2.9%	42 2.9%	47 2.5%	39 2.8%
Western (% of Total	11 1.0%	11 1.0%	13 1.1%	40 2.8%	41 2.8%	56 3.0%	29 2.1%
Coast (% of Total	11 1.0%	13 1.2%	14 1.2%	16 1.1%	19 1.3%	22 1.2%	16 1.2%
North Eastern (% of Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TOTAL	1,072	1,126	1,180	1,407	1,465	1,888	1,358

Source: Animal Production Division Annual Reports. Reported in Kenya Statistical Abstract, various years.

Table 12
Quantity and value of inputs purchased and used by smallholders, by type of output, by province, 1978 (in '000 ksh and '000 kg)

INPUT	COAST	% of Total	EASTERN	% of Total	CENTRAL	% of Total	RIFT VALLEY	% of Total	NYANZA	% of Total	WESTERN	% of Total	TOTAL
FERTILIZER													
Quantity	132.7	0.1%	18,378.2	20.6%	55,021.8	61.6%	8,190.9	9.2%	4,380.1	4.9%	3,220.1	3.6%	89,323.8
Value	278.4	0.3%	13,172.3	14.0%	55,298.0	58.6%	14,402.5	15.3%	6,919.1	7.3%	4,280.2	4.5%	94,348.5
Cultivated Area ('000 ha.) 1/	232.2	7.2%	690.4	21.5%	472.6	14.7%	792.6	24.6%	651.6	20.3%	376.7	11.7%	3,216.1
Kg. Fert. per Ha.	0.57		26.62		116.42		10.33		6.72		8.55		27.77
SPRAYS													
Quantity	0.1	0.0%	4,463.9	60.1%	2,621.7	35.3%	89.3	1.2%	224.7	3.0%	32.9	0.4%	7,432.5
Value	12.4	0.0%	5,600.8	22.3%	15,135.3	60.2%	629.2	2.5%	3,595.2	14.3%	150.9	0.6%	25,123.8
OTHER INPUT (Seeds)													
Quantity	0.0	0.0%	147.7	3.8%	2,945.7	75.1%	341.4	8.7%	7.2	0.2%	479.5	12.2%	3,921.5
Value	0.0	0.0%	717.8	2.9%	21,862.7	89.1%	1,808.3	7.4%	28.6	0.1%	119.7	0.5%	24,537.1
FEED													
Quantity	12.5	0.0%	1,291.7	6.2%	12,548.3	60.5%	6,441.8	31.1%	85.1	0.4%	365.4	1.8%	20,744.8
Value	4.6	0.0%	1,503.1	4.0%	19,233.9	50.7%	16,612.3	43.8%	58.5	0.2%	521.9	1.4%	37,934.3
MACHINERY CONTRACT													
Value	391.6		132.3		983.6		14,082.3		0.0		0.0		15,589.8
WAGES (incl. in kind)													
Quantity	2,249.7	2.5%	2,153.1	5.4%	23,165.2	58.3%	5,837.1	14.7%	5,917.3	14.9%	426.6	1.1%	39,749.0
Value	2,152.7	2.4%	14,385.9	10.5%	59,600.4	43.5%	22,801.8	16.6%	27,995.0	20.4%	10,103.9	7.4%	137,039.7
Avg. Wage 1/	0.96		6.68		2.57		3.91		4.73		23.7		3.4

SOURCE: Integrated Rural Surveys, 1976-1979. Ministry of Economic Planning and Development, Kenya. Table 10.3, p. 108
Note: 1/ Smallholder area for 1978. Integrated Rural Surveys, 1976-1979. Table 14.1, p.142.
2/ Calculated.

Table 13
Wage labor, earnings, and per capita income by province[1] (currency unit - '000 Kenya pounds, current)

PROVINCE	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	GROWTH RATE NOMINAL	GROWTH RATE REAL
NAIROBI																		
Number Employed	163,615	164,002	178,149	192,279	203,443	226,959	218,589	230,269	235,465	244,431	260,822	274,209	284,534	291,327	309,815	315,701	4.4%	4.4%
Earnings/Income	72504	73510	88180	97062	105150	123069	141426	166428	183161	203629	244134	287715	349609	382609	421134	464411	13.2%	1.2%
Per Capita/Employed	443	448	495	505	517	542	647	723	778	833	936	1049	1229	1313	1359	1471	8.8%	-3.2%
CENTRAL																		
Number Employed	93,800	98,738	112,991	116,269	122,263	133,235	123,992	133,588	143,687	137,912	145,801	149,555	152,557	153,451	155,608	156,655	3.2%	3.2%
Earnings/Income	13948	16859	20673	20989	23639	28282	31508	41811	47551	50814	59669	71311	81573	83517	95046	114757	13.9%	1.9%
Per Capita/Employed	149	171	183	181	193	212	254	313	331	369	409	477	535	544	611	733	10.7%	-1.3%
NYANZA																		
Number Employed	45,722	46,578	48,859	51,511	51,923	59,985	61,728	63,432	64,753	67,301	71,996	74,516	77,019	80,443	90,453	93,702	4.7%	4.7%
Earnings/Income	7773	10400	10644	11702	12776	18252	19154	23786	30668	36399	42340	47915	46394	52139	65495	72135	15.1%	3.1%
Per Capita/Employed	170	223	218	227	246	304	310	375	474	541	588	643	602	648	724	770	10.4%	-1.6%
WESTERN																		
Number Employed	18,761	19,837	20,929	22,142	24,495	34,758	36,745	36,184	44,598	42,465	46,019	49,466	52,322	53,294	56,624	61,915	8.3%	8.3%
Earnings/Income	3,921	4,395	4832	5665	7341	9679	11354	14363	18113	18748	21848	28809	35736	36793	44218	50290	17.7%	5.7%
Per Capita/Employed	209	222	231	256	300	278	309	397	406	441	475	582	683	690	781	812	9.4%	-2.6%
COAST																		
Number Employed	84,526	86,574	89,306	89,925	89,363	100,522	101,813	105,855	113,833	122,678	132,040	139,286	139,521	140,592	140,918	142,419	4.1%	4.1%
Earnings/Income	22,301	22,873	25,617	26,560	31,418	37,969	43,554	51,294	57,986	70,366	80,831	91,385	109,394	118,541	122,610	139,672	13.5%	1.5%
Per Capita/Employed	264	264	285	295	352	378	428	485	509	574	612	656	784	843	870	981	9.4%	-2.6%
RIFT VALLEY																		
Number Employed	178,949	184,312	191,694	195,885	214,646	208,178	209,847	216,925	225,798	221,133	234,375	232,648	230,221	226,143	241,356	242,517	1.9%	1.9%
Earnings/Income	22,725	26,157	27,470	31,548	35,451	38,838	44,827	55,342	62,715	68,366	74,028	90,518	108,970	116,659	136,228	149,545	12.9%	0.9%
Per Capita/Employed	127	142	143	161	165	187	214	255	278	309	316	389	473	516	564	617	11.1%	-0.9%
EASTERN																		
Number Employed	39,219	41,562	45,700	48,849	51,807	58,791	62,195	66,450	70,110	71,009	76,001	80,572	80,463	83,456	89,104	92,305	5.7%	5.7%
Earnings/Income	6,313	7,134	7,318	12,501	13,549	17,039	18,448	24,380	28,667	31,346	37,121	41,929	50,902	55,428	65,098	70,104	16.6%	4.6%
Per Capita/Employed	161	172	160	256	231	290	297	367	409	441	488	520	633	664	731	759	10.9%	-1.1%
NORTH-EASTERN																		
Number Employed	2,622	2,878	2,958	2,917	3,435	3,835	4,177	4,827	4,652	4,941	5,253	5,501	7,672	9,325	9,402	9,451	9.0%	9.0%
Earnings/Income	590	668	718	826	935	1,177	2,050	2,210	2,593	3,157	3,537	4,538	6,114	7,359	8,323	8,776	19.8%	7.8%
Per Capita/Employed	225	232	242	283	272	307	491	458	557	639	673	825	797	789	885	929	10.8%	-1.2%
TOTAL																		
Number Employed	627,214	644,481	691,186	719,777	761,375	826,263	819,086	857,530	902,896	911,561	972,307	1,005,753	1,024,309	1,038,031	1,093,278	1,114,655	3.9%	3.9%
Earnings/Income	150,074	161,998	185,420	206,854	231,169	274,305	312,320	379,614	431,434	482,824	563,509	664,121	788,692	853,044	958,222	1,069,689	13.8%	1.8%
Per Capita/Employed	239	251	268	287	304	332	381	443	478	530	580	660	770	822	876	960	9.9%	-2.1%
C.P.I. (1969=100) 2/	100.0	101.8	105.5	112.2	122.6	144.4	171.9	191.5	219.9	257.2	277.8	316.0	353.3	425.7	474.6	522.7	-	12.0%

SOURCES: 1/ Statistical Abstract, Central Bureau of Statistics, Republic of Kenya. Years 1978, 1982, and 1985.
2/ IFS (IMF) 1985 Yearbook.

NOTE: Earnings or Wages cover all cash payments, including basic salary, cost of living allowances, profit bonus, together with the value of rations and free board, and an estimate of the employer's contribution toward housing. Earnings as shown in this section are lower than the estimate of factor income going to employees because they exclude pensions, employers contributions to the National Security Fund or private provident funds and personal emoluments for the armed forces. Earnings in the rural non-agriculture sector are excluded.

Table 14
Expenditure on main services by province, 1970-1984 (in thousand Kenya pounds, current)

PROVINCE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	• GROWTH RATES • NOMINAL	REAL
CENTRAL	591	732	1,688	1,079	1,319	1,191	1,569	2,119	3,574	4,076	4,038	6,043	6,949	6,143	18.7%	6.2%
WESTERN	184	283	435	260	399	568	438	524	712	862	922	1,562	1,416	2,996	17.4%	4.9%
EASTERN	397	805	708	589	861	758	1,054	1,117	1,561	1,759	2,341	3,849	3,034	3,386	16.1%	3.6%
NYANZA	352	320	990	313	441	640	741	799	1,106	1,322	1,623	1,504	1,987	2,036	14.4%	1.9%
RIFT VALLEY	852	1,207	1,472	1,213	1,540	1,712	1,964	1,886	2,435	2,696	2,675	3,818	4,906	3,924	11.7%	-0.8%
NORTH-EASTERN	71	117	249	82	111	106	6,600	7,145	143	195	238	275	472	502	11.6%	-0.9%
COAST	379	399	537	326	589	633	702	543	598	730	925	1,326	1,087	1,254	9.4%	-3.1%
AVERAGE	404	552	868	552	751	801	1,867	2,019	1,447	1,663	1,823	2,625	2,836	2,892	14.2%	1.7%
TOTAL	2,826	3,863	6,079	3,862	5,260	5,608	13,068	14,133	10,129	11,640	12,762	18,377	19,851	20,241	14.9%	2.4%
C.P.I. (1970=100)	100	104	110	121	142	169	188	216	253	273	311	348	419	467	-	12.5%

SOURCE: Statistical Abstract, 1978, 1982, and 1985 Editions. Central Bureau of Statistics, Kenya.
IFS, (IMF), 1985 Edition for C.P.I. Index.

NOTE: All figures listed as "provisional" except years 1970/1973.

Table 15
Percentage distribution of households by distance to water source in dry season by province

DISTANCE	COAST	EASTERN	CENTRAL	RIFT	NYANZA	WESTERN	AVERAGE
On Holding	28.4	27.3	67.5	62.1	41.3	65.5	50.7
0 - 1 Km	12.8	37.7	20.7	15.1	26.8	22.9	23.8
1 - 2 Km	29.7	15.2	10.3	9.6	19.9	9.1	14.2
2 - 4 Km	16.2	11.9	1.5	7.9	10.3	1.7	7.5
4 - 8 Km	8.3	6.9	0.0	4.3	1.7	0.8	3.1
Over 8 Km	4.6	1.0	0.0	1.0	0.0	0.0	0.7
Average Distance	2.7	1.8	0.9	2.1	1.4	1.0	1.7

SOURCE: Integrated Rural Surveys, 1976-79: Basic Report.

Table 16
Health services available by province, 1978-1984

PROVINCE	1978	1979	1980	1981	1982	1983	1984	MEAN
NAIROBI								
Hospitals	26	26	17	17	17	17	17	20
Health Centers	2	2	6	6	6	7	6	6
Dispensaries	113	112	61	62	62	71	66	61
Beds per 100,000 1/	479	566	566	720	565	534	508	571
COAST								
Hospitals	23	23	23	24	25	25	25	24
Health Centers	18	18	19	22	23	27	26	22
Dispensaries	129	137	133	133	133	133	142	135
Beds per 100,000	188	180	130	211	196	161	176	188
EASTERN								
Hospitals	27	27	27	27	28	31	31	28
Health Centers	20	29	25	27	33	71	39	35
Dispensaries	201	191	197	193	193	191	227	199
Beds per 100,000	127	128	128	138	128	118	125	127
NORTH EASTERN								
Hospitals	3	3	3	3	3	3	3	3
Health Centers	3	6	4	3	4	6	6	5
Dispensaries	16	16	16	16	17	21	21	18
Beds per 100,000	115	90	90	91	84	79	65	91
CENTRAL								
Hospitals	45	47	46	45	45	43	43	45
Health Centers	31	41	38	38	38	45	41	38
Dispensaries	158	154	175	180	180	207	193	178
Beds per 100,000	168	185	185	179	174	160	166	174
RIFT VALLEY								
Hospitals	50	52	51	52	51	50	50	51
Health Centers	66	65	72	66	68	79	82	77
Dispensaries	311	317	331	363	368	377	408	353
Beds per 100,000	160	147	147	147	138	132	141	145
NYANZA								
Hospitals	33	32	34	36	36	31	28	33
Health Centers	30	37	39	39	43	49	55	42
Dispensaries	144	112	138	142	144	161	150	142
Beds per 100,000	137	148	148	109	144	120	117	131
WESTERN								
Hospitals	16	16	15	15	15	16	16	16
Health Centers	31	35	37	39	39	34	34	38
Dispensaries	31	47	34	39	38	47	46	41
Beds per 100,000	127	140	140	130	135	125	122	131
TOTAL								
Hospitals	225	228	216	221	220	216	213	220
Health Centers	201	233	241	262	276	288	288	258
Dispensaries	1108	1086	1087	1130	1135	1213	1273	1147
Beds per 100,000	168	175	174	177	171	158	159	166

SOURCE: Ministry of Health, Health Information System.
NOTE: Statistical errors from original MOH quotations in Statistical Abstract, years 1979-1985

Table 17
Primary school enrollment by province, 1968-84

PROVINCE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
RIFT VALLEY	174,597	183,233	202,992	228,797	250,975	279,119	454,185	495,699	530,646	556,948	571,667
NORTH-EASTERN	2,389	3,301	3,432	4,668	5,048	6,377	7,200	6,965	7,507	9,234	9,487
NYANZA	221,138	206,462	234,012	248,990	269,764	291,128	562,511	602,695	550,580	554,450	518,346
WESTERN	145,932	169,930	201,787	200,708	234,900	245,847	401,475	431,259	446,185	447,281	415,894
COAST	71,642	76,805	83,983	87,445	96,102	103,107	149,778	156,927	160,156	163,225	170,664
EASTERN	242,059	269,652	289,867	315,454	339,582	370,555	515,624	545,877	543,222	572,635	601,851
CENTRAL	296,863	311,970	349,378	371,913	407,762	443,509	531,675	558,133	571,583	584,734	616,064
NAIROBI	55,060	60,944	61,238	67,523	71,786	76,375	83,430	83,400	84,738	86,342	91,540
TOTAL	1,209,680	1,282,297	1,427,589	1,525,498	1,675,919	1,816,017	2,705,878	2,881,155	2,894,617	2,974,849	2,994,894

								—— GROWTH RATES ——		
PROVINCE	1979	1980	1981	1982*	1983*	1984*	% SHARE	NOMINAL	POPULATION	ACTUAL 2/
RIFT VALLEY	706,262	781,847	826,481	859,425	931,468	959,224	18.8%	11.8%	4.7%	7.1%
NORTH-EASTERN	10,590	12,171	12,109	14,097	15,456	16,284	0.3%	11.1%	5.2%	5.9%
NYANZA	767,249	785,537	777,413	814,010	835,762	833,067	19.0%	9.9%	2.5%	7.4%
WESTERN	539,946	569,057	573,280	587,982	611,096	615,243	14.3%	9.3%	3.8%	5.5%
COAST	210,328	230,221	242,432	254,888	273,174	281,867	5.9%	9.2%	4.2%	5.0%
EASTERN	706,654	752,844	748,142	768,958	807,902	812,751	19.2%	8.1%	4.3%	3.8%
CENTRAL	663,015	696,968	699,039	715,236	741,258	750,373	19.5%	6.0%	4.0%	2.0%
NAIROBI	94,202	97,984	102,268	105,549	107,706	110,902	3.0%	4.2%	6.3%	-2.0%
TOTAL	3,698,246	3,926,629	3,981,162	4,120,145	4,323,822	4,380,232	100.0%	8.8%	4.0%	4.8%

SOURCE: Ministry of Education. Reported in Kenya Statistical Abstract, various issues.
NOTES 1/ Calculated from 1969 and 1979 Population Census.
2/ Actual growth here defined as rate of growth in enrollment above rate of growth in population.
*Provisional

Table 18
Secondary school enrollment by province, 1972-1984 (in thousands)

PROVINCE	1972	1973	1974	1975	1976	1977	1978	1979	1980
CENTRAL	37.1	41.7	51.4	55.6	66.7	78.2	87.4	94.6	105.8
COAST	14.4	15.4	17.4	16.4	16.5	19.0	19.6	20.7	23.1
EASTERN	23.5	24.7	35.4	38.5	45.1	54.5	63.2	67.9	71.1
NAIROBI	25.3	25.6	21.1	22.9	28.0	29.5	31.4	30.0	30.4
NO. EASTERN	0.3	0.4	0.4	0.5	0.6	0.7	0.7	1.0	1.5
NYANZA	22.3	23.0	28.8	31.8	46.1	50.5	62.4	65.8	70.9
RIFT VALLEY	20.4	22.3	21.4	29.2	34.5	40.8	46.7	53.4	58.8
WESTERN	18.6	21.7	20.2	31.9	42.8	47.1	50.3	51.0	54.3
TOTAL	161.9	174.8	195.8	226.8	280.4	320.3	361.7	384.4	415.9

						—— GROWTH RATES ——		
PROVINCE	1981	1982	1983	1984	% SHARE	NOMINAL 1/	POPULATION	ACTUAL 1/
CENTRAL	92.4	98.8	119.5	124.8	24.1%	9.8%	4.00%	5.8%
COAST	27.3	29.2	28.6	26.9	6.3%	6.2%	4.22%	2.0%
EASTERN	66.0	70.1	84.4	89.6	16.8%	10.8%	4.26%	6.5%
NAIROBI	32.2	34.4	38.5	31.7	8.7%	3.6%	6.25%	-2.7%
NO. EASTERN	1.3	1.4	1.5	1.3	0.3%	14.0%	5.21%	8.8%
NYANZA	77.6	83.0	86.9	80.8	16.7%	12.3%	2.46%	9.8%
RIFT VALLEY	60.1	64.3	68.6	80.8	13.7%	12.0%	4.66%	7.3%
WESTERN	53.1	56.8	65.7	75.0	13.5%	11.1%	3.80%	7.3%
TOTAL	409.9	438.4	493.7	510.9	100.0%	9.9%	4.01%	5.9%

SOURCE: Ministry of Education. Reported in Kenya Statistical Abstract, various issues.
NOTE: 1/ "Nominal" growth rate of secondary school enrollment calculated from Ministry figures; "Actual" growth rates is derived from "nominal" less rate of population growth.

Annex 5: Malawi

Table 1
Population density, land use, and per capita agricultural land by region, 1987 and 2000

REGION / Agr. Dev. Div. / District	POPULATION ('000) Total 1/ 1987	As % of Total	Rural 2/ 1987	% Rural 1987	Total 3/ 2000	LAND ('000 Hectares) Total 4/ 1985	Cultivated 1985 5/	Cultivable 1965 6/	% Cultivable	Forest Reserves 7/	Population Density 1987 pers/sq.km	PER CAPITA AGRICULTURAL LAND Total Pop. 1987	Rural Pop. 1987	Total Pop. 2000
NORTHERN	907.0	11%	840.0	93%	1,211.4	2,691	344	1,236	46%	180	34	1.36	1.47	1.02
Karonga ADD	243.9	3%	222.1	91%	334.5	646	44	269	42%		38	1.10	1.21	0.80
Chitipa	98.8	1%	92.4	95%	134.6	350		153	44%		28	1.58	1.66	1.14
Karonga	147.1	2%	129.6	88%	199.9	296		116	39%		50	0.79	0.90	0.58
Mzuzu ADD	663.1	8%	618.0	93%	876.9	2,045	300	967	47%		32	1.46	1.57	1.10
Nkhata Bay	136.0	2%	130.1	96%	197.7	409		114	28%		33	0.84	0.88	0.58
Rumphi	94.7	1%	87.8	93%	117.0	595		136	23%		16	1.44	1.55	1.16
Mzimba	432.4	5%	399.7	92%	562.2	1,041		717	69%		42	1.66	1.79	1.28
CENTRAL	3,116.2	39%	2,683.6	86%	5,007.3	3,559	1,110	2,250	63%	245	88	0.72	0.84	0.45
Kasungu ADD	1,013.9	13%	912.2	90%	1,607.9	1,593	478	985	62%		64	0.97	1.08	0.61
Kasungu	322.9	4%	286.9	89%	454.7	788		462	59%		41	1.43	1.61	1.02
Mchinji	248.2	3%	226.0	91%	370.5	336		200	60%		74	0.81	0.89	0.54
Ntchisi	120.7	2%	108.7	90%	204.8	166		126	76%		73	1.04	1.15	0.61
Dowa	322.1	4%	290.3	90%	577.9	304		198	65%		106	0.61	0.68	0.34
Lilongwe ADD	1,756.9	22%	1,475.4	84%	2,870.7	1,321	500	832	63%		133	0.47	0.56	0.29
Lilongwe	988.4	12%	780.7	79%	1,644.4	616		414	67%		160	0.42	0.53	0.25
Dedza	410.9	5%	370.6	90%	697.5	362		229	63%		113	0.56	0.62	0.33
Ntcheu	359.6	5%	326.6	91%	528.8	342		189	55%		105	0.53	0.58	0.36
Salima ADD	345.4	4%	297.2	86%	528.7	646	133	433	67%		54	1.25	1.46	0.82
Nkhotakota	157.1	2%	128.9	82%	220.3	426		248	58%		37	1.58	1.92	1.12
Salima 8/	188.3	2%	167.4	89%	308.4	220		185	84%		86	0.98	1.10	0.60
SOUTHERN	3,959.5	50%	3,468.4	88%	5,411.8 *	3,175	755	1,823	57%	291	125	0.46	0.53	0.34
Liwonde ADD	1,448.7	18%	1,360.3	94%	1,957.0	1,482	369	1,032	70%		98	0.71	0.76	0.53
Mangochi	495.9	6%	475.6	96%	593.7	627		404	64%		79	0.81	0.85	0.68
Machinga	514.6	6%	488.9	95%	671.1	596		488	82%		86	0.95	1.00	0.73
Zomba	438.2	5%	399.2	91%	692.2	258		140	54%		170	0.32	0.35	0.20
Blantyre ADD	1,989.7	25%	1,633.6	82%	2,859.6	1,024	289	450	44%		194	0.23	0.28	0.16
Chiradzulu	210.7	3%	205.2	97%	346.4	77		31	41%		275	0.15	0.15	0.09
Blantyre	587.9	7%	266.4	45%	802.0	201		81	40%		292	0.14	0.30	0.10
Mwanza	121.3	2%	114.4	94%	140.7	230		84	37%		53	0.69	0.74	0.60
Thyolo	431.5	5%	412.9	96%	632.1	172		47	27%		252	0.11	0.11	0.07
Mulanje	638.3	8%	618.7	97%	938.4	345		206	60%		185	0.32	0.33	0.22
Ngabu ADD	521.1	7%	486.1	93%	694.2	670	96	341	51%		78	0.65	0.70	0.49
Chikwawa	319.8	4%	300.4	94%	381.5	476		233	49%		67	0.73	0.77	0.61
Nsanje	201.3	3%	185.4	92%	312.7	194		109	56%		104	0.54	0.59	0.35
Total	7,982.7	100%	6,990.2	88%	11,630.5 *	9,425	2,208	5,309	56%	716	85	0.67	0.76	0.46

Sources: 1/ Malawi Population and Housing Census 1987: Preliminary Report. National Statistical Office: Zomba, 1988.

2/ Rural population projected from 1977 Census data (by district) to 1985 at 2.4949% p.a.. Rate of growth derived from Malawi Population Census, 1977: Analytical Report, Vol. II. p. 115, Table 9.1 which gives urban population at 8.5% in 1977 and roughly 25% in 2000. See also M POP file. Data not yet available from the 1987 Population Census.

3/ Malawi Population Census 1977: Vol. II (N.S.O./Zomba) p. 168, Table A.9.43.

4/ Land data from Malawi Population Census 1977, Analytical Report, Vol. 1., Table 2.4

5/ Cultivated land calculated from 1984/85 M.O.A. Crop Estimates for total customary hectarage, plus area under tobacco estates in 1985, by ADD, from Deloitte Haskins and Sell, 1986, "Proposed Extension and Training Service for the Estate Sub-Sector," reported in IBRD Malawi Land Policy Study, April 1987, p.21 Table 3.2

6/ Cultivable land figures from 1965, Department of Agriculture estimates, published in Compendium of Agricultural Statistics, 1977. (NSO: Zomba), Table 1. (Conv. to Ha. at 2.47) Arable land estimates are generally more conservative than the figures given above; the by Office of President has cited 19% in "SAL IV: A Proposal..." for arable land, and the World Bank has alternately cited 38% cultivabe (1981 Development of the Agricultural Sector Report) and more recently 22% without forests, 62% with (Land Policy Study 1987, p.7). Elsewhere Mkandawiri and Phiri, "Land Policy Study" (Jan. 1987) cite the figure of 37% arable as a national average. We use the figures above as they represent official government data and are more dissaggregated, to the district level, this despite that they may be overinflated.

7/ Fully gazetted forest reserves. Office of the President and Cabinet, "Statement of Development Policies 1987-1996." p.38 Table 5.1

8/ The use of Agricultural Development Divisions (ADD's) as sub-heads for districts is useful because much of the available data, ie National Sample Survey 1980/81 data, is only given by ADD. However, in some cases, such as Salima District, it appears that district boundries are not strictly observed.

* Computional errors in the line. Original (incorrect) numbers are used.

Table 2
Area under major crops in smallholder sector, by agricultural development districts, 1980/81

CROP	MALAWI	KARONGA	MZUZU	NORTHERN REGION	KASUNGU	SALIMA	LILONGWE	CENTRAL REGION 1/	LIWONDE	BLANTYRE	NGABU	SOUTHERN REGION
All Crops	1,332.00	31.80	116.44	148.24	289.43	76.88	311.75	678.06	205.10	211.45	89.15	505.70
% of Total	100.0%	2.4%	8.7%	11.1%	21.7%	5.8%	23.4%	50.9%	15.4%	15.9%	6.7%	38.0%
Maize	768.02	11.51	64.20	75.71	180.08	45.17	183.65	408.90	137.78	121.12	24.51	283.41
% of Total	57.7%	0.9%	4.8%	5.7%	13.5%	3.4%	13.8%	30.7%	10.3%	9.1%	1.8%	21.3%
Hybrid	43.79	0.68	5.16	5.84	10.38	0.34	24.55	35.27	1.39	0.86	0.43	2.68
Composite	34.33	1.29	8.02	9.31	13.27	4.33	4.16	21.76	1.25	2.00	0.01	3.26
Local & Other	689.90	9.54	51.02	60.56	156.43	40.50	154.94	351.87	135.14	118.26	24.07	277.47
Mixtures	201.60	5.33	15.76	21.09	14.14	3.47	53.41	71.02	42.86	61.88	4.75	109.49
% of Total	15.1%	0.4%	1.2%	1.6%	1.1%	0.3%	4.0%	5.3%	3.2%	4.6%	0.4%	8.2%
Maize/Groundnuts	52.91	0.82	2.28	3.10	3.07	2.07	12.35	17.49	19.23	11.67	1.42	32.32
Maize/Pulses	103.75	2.92	11.81	14.73	10.92	0.14	34.91	45.97	10.18	32.52	0.35	43.05
Maize/Cassava	13.31	0.94	0.81	1.55	0.00	0.29	0.17	0.46	7.22	4.05	0.03	11.30
Maize/Other	31.63	0.65	1.06	1.71	0.15	0.97	5.98	7.10	6.23	13.64	2.95	22.82
Rice	22.85	7.65	0.65	8.30	0.05	4.54	0.00	4.59	6.70	2.15	1.11	9.96
% of Total	1.7%	0.6%	0.0%	0.6%	0.0%	0.3%	0.0%	0.3%	0.5%	0.2%	0.1%	0.7%
Groundnuts	135.53	0.30	10.90	11.20	64.58	3.78	49.21	117.57	3.96	1.92	0.88	6.76
% of Total	10.2%	0.0%	0.8%	0.8%	4.8%	0.3%	3.7%	8.8%	0.3%	0.1%	0.1%	0.5%
Roots 2/	50.50	3.07	12.19	15.26	5.65	8.30	3.65	17.60	5.28	12.29	0.07	17.64
% of Total	3.8%	0.2%	0.9%	1.1%	0.4%	0.6%	0.3%	1.3%	0.4%	0.9%	0.0%	1.3%
Pulses	6.80	0.47	0.63	1.10	2.28	0.34	2.21	4.83	0.14	0.65	0.08	0.87
% of Total	0.5%	0.0%	0.0%	0.1%	0.2%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	0.1%
Millet/Sorghum 3/	40.39	2.06	10.49	12.55	1.87	0.20	0.30	2.37	1.30	3.05	21.12	25.47
% of Total	3.0%	0.2%	0.8%	0.9%	0.1%	0.0%	0.0%	0.2%	0.1%	0.2%	1.6%	1.9%
Cotton	38.66	0.17	0.00	0.17	0.00	10.76	0.73	11.49	4.58	2.16	20.26	27.00
% of Total	2.9%	0.0%	0.0%	0.0%	0.0%	0.8%	0.1%	0.9%	0.3%	0.2%	1.5%	2.0%
Tobacco	39.14	0.00	0.66	0.66	19.89	0.12	16.79	36.80	0.74	0.94	0.00	1.68
% of Total	2.9%	0.0%	0.0%	0.0%	1.5%	0.0%	1.3%	2.8%	0.1%	0.1%	0.0%	0.1%
Dark Fired	29.53	0.00	0.00	0.00	11.78	0.03	16.47	28.28	0.39	0.86	0.00	1.25
Sun/Air	4.31	0.00	0.00	0.00	3.92	0.04	0.05	4.01	0.30	0.00	0.00	0.30
Flue-Cured	4.05	0.00	0.00	0.00	4.05	0.00	0.00	4.05	0.00	0.00	0.00	0.00
Other	1.25	0.00	0.66	0.66	0.14	0.05	0.27	0.46	0.05	0.08	0.00	0.13
Other Crops	126.20	6.84	24.27	31.11	10.69	9.04	7.96	27.69	8.48	21.28	37.64	67.40
% of Total	9.5%	0.5%	1.8%	2.3%	0.8%	0.7%	0.6%	2.1%	0.6%	1.6%	2.8%	5.1%

SOURCE: National Sample Survey of Agriculture 1980/81, Vol.II, Table 3.1

1/ The Central Region, as made up by the ADDs in it, is a little larger than the formal political Central Region because the Salima ADD includes part of the Mangochi District, which is part of the formal political Southern Region.
2/ Roots = Cassava + Potatoes + Other Roots.
3/ Millet and/or Sorghum hectarages.

NOTE: Percentages indicate percentage of total national crop hectarage under above crop.

Table 3
Maize (area in '000 ha; production in '000 mt; and yields in kg/ha)

REGION A.D.D.	1984 AREA	1984 PROD.	1984 YIELD	1985 AREA	1985 PROD.	1985 YIELD	1986 AREA	1986 PROD.	1986 YIELD	1987 AREA	1987 PROD.	1987 YIELD
NORTHERN	105.7	139.6	1.32	123.7	145.2	1.17	120.1	123.5	1.03	118.5	144.5	1.22
Karonga ADD	16.2	22.7	1.40	19.1	20.1	1.05	19.5	18.8	0.98	20.5	19.6	0.96
Mzuzu ADD	89.5	116.9	1.31	104.6	125.1	1.20	100.6	104.7	1.04	98	124.9	1.27
CENTRAL	597.6	816.4	1.37	619.3	769.3	1.24	585.9	695.8	1.19	618.7	822.6	1.33
Kasungu ADD	202.6	303.9	1.50	204.6	275.7	1.35	184.9	225.9	1.22	190.6	249.9	1.31
Lilongwe ADD	350.1	456.7	1.30	348.3	421.5	1.21	341.6	396.6	1.16	362.7	499.3	1.38
Salima ADD	44.9	55.8	1.24	66.4	72.1	1.09	59.4	73.3	1.23	65.4	73.4	1.12
SOUTHERN	441.6	399.0	0.90	450.7	380.1	0.84	476.4	382.4	0.80	477.9	456.9	0.96
Liwonde ADD	220.3	206.9	0.94	228.9	171.4	0.75	239	179.9	0.75	226.6	203.8	0.90
Blantyre ADD	200.8	171.9	0.86	200.6	187.5	0.93	212.1	186.8	0.88	224.5	226.4	1.01
Ngabu ADD	20.5	20.2	0.99	21.2	21.2	1.00	25.3	15.7	0.62	26.8	26.7	1.00
Total	1144.9	1355	1.18	1193.7	1294.6	1.08	1182.4	1201.7	1.02	1215.1	1424	1.17

Source: Ministry of Agriculture Crop Estimate Spreadsheets.

Table 4
ADMARC maize purchases and sales by region

Marketing Year	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88 (5/10/87)
Purchases																		
Northern	63.6%	62.1%	43.6%	39.1%	16.0%	15.6%	13.5%	15.6%	17.8%	18.4%	22.7%	25.9%	19.8%	18.9%	15.7%	25.0%	43.8%	43.8%
Central	6.8%	18.9%	27.5%	52.8%	66.8%	72.2%	69.2%	71.9%	63.3%	70.7%	68.8%	69.5%	58.1%	62.5%	51.2%	55.6%	49.0%	37.4%
Southern	29.6%	19.0%	28.8%	8.1%	17.2%	12.2%	17.3%	12.5%	18.9%	10.9%	8.5%	4.6%	22.1%	18.6%	33.1%	19.3%	7.2%	18.8%
Sales																		
Northern														11.1%	24.0%	8.6%	6.7%	
Central														20.2%	25.7%	14.5%	21.8%	
Southern														68.7%	50.2%	76.9%	71.5%	

Sources: 1970/71-79/80 data from C. Ranade, Fieldtrip (6/86) mimeographed sheetss.
1980/81 - 87/88 data from Deloitte, Haskins & Sells, ADMARC Organization and Management Review, 1987.

Table 5
ADMARC maize purchases and sales by region ('000 mt)

Marketing Year	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88 (5/10/87)
Purchases																		
Total	3.2	5.5	7.0	10.8	26.4	18.3	36.5	58.5	79.9	71.2	91.7	136.5	246.1	244.8	296.4	272.7	111.3	56.9
Northern	2.0	3.4	3.1	4.2	4.2	2.9	4.9	9.1	14.3	13.1	20.8	35.4	48.8	46.3	46.5	68.3	48.8	24.9
Central	0.2	1.0	1.9	5.7	17.6	13.2	25.2	42.0	50.6	50.3	63.1	94.8	142.9	152.9	151.8	151.7	54.5	21.3
Southern	0.9	1.1	2.0	0.9	4.5	2.2	6.3	7.3	15.1	7.8	7.8	6.3	54.4	45.6	98.1	52.7	8.0	10.7
Sales																		
Total														125.3	47.0	100.7	187.8	
Northern														13.9	11.3	8.7	12.6	
Central														25.3	12.1	14.6	40.9	
Southern														86.1	23.6	77.4	134.3	

Sources: 1970/71-79/80 data from C. Ranade, Fieldtrip (6/86) mimeographed sheetss.
1980/81 - 87/88 data from Deloitte, Haskins & Sells, ADMARC Organization and Management Review, 1987.

Table 6
Groundnuts (area in '000 ha; production in '000 mt; and yields in kg/ha)

REGION A.D.D.	1984 AREA	1984 PROD.	1984 YIELD	1985 AREA	1985 PROD.	1985 YIELD	1986 AREA	1986 PROD.	1986 YIELD	1987 AREA	1987 PROD.	1987 YIELD
NORTHERN	10.4	4.2	0.40	9.8	4.1	0.42	17.0	7.7	0.45	14.6	5.6	0.38
Karonga ADD	1.1	0.4	0.36	1.2	0.5	0.44	1.6	0.7	0.44	2.2	0.9	0.40
Mzuzu ADD	9.2	3.7	0.41	8.6	3.6	0.42	15.4	7.0	0.45	12.4	4.7	0.38
CENTRAL	99.5	48.5	0.49	136.8	75.8	0.55	163.8	68.8	0.42	131.5	58.6	0.45
Kasungu ADD	55.3	26.6	0.48	64.9	35.1	0.54	83.3	34.7	0.42	53.0	22.8	0.43
Lilongwe ADD	40.1	19.7	0.49	65.3	35.8	0.55	75.5	31.2	0.41	72.4	31.9	0.44
Salima ADD	3.1	2.2	0.72	6.6	4.9	0.74	5.0	2.9	0.59	6.1	4.1	0.67
SOUTHERN	27.2	9.5	0.35	29.6	8.3	0.28	29.2	11.5	0.39	30.1	12.3	0.41
Liwonde ADD	18.9	6.4	0.38	15.3	4.3	0.28	15.9	6.6	0.42	21.5	9.0	0.42
Blantyre ADD	9.8	2.9	0.30	13.7	3.8	0.28	12.4	4.7	0.38	7.7	2.9	0.37
Ngabu ADD	0.5	0.2	0.43	0.6	0.4	0.58	0.9	0.2	0.27	0.9	0.4	0.49
Total	136.0	62.2	0.46	176.3	88.2	0.50	209.9	88.0	0.42	176.2	76.7	0.44

Source: Ministry of Agriculture Crop Estimate Spreadsheets.

Table 7
Customary tobacco by region, 1984/85 to 1987/88 (area in '000 ha; production in '000 mt; and yields in kg/ha)

REGION A.D.D.	1984 AREA	1984 PROD.	1984 YIELD	1985 AREA	1985 PROD.	1985 YIELD	1986 AREA	1986 PROD.	1986 YIELD	1987 AREA	1987 PROD.	1987 YIELD
NORTHERN Customary	0.9	0.3	0.32	0.4	0.2	0.37	0.5	0.3	0.52	0.0	0.3	6.49
Karonga ADD	0.0	0.0	0.48	0.0	0.0	0.50	0.0	0.1	1.47	0.0	0.1	1.55
Mzuzu ADD	0.9	0.3	0.32	0.4	0.2	0.36	0.5	0.2	0.44	0.5	0.2	0.46
CENTRAL Customary	41.7	18.1	0.43	34.0	14.6	0.43	30.9	12.8	0.41	22.5	8.2	0.36
Kasungu ADD	18.1	6.5	0.36	18.9	6.2	0.36	14.9	5.1	0.34	8.9	2.4	0.27
Lilongwe ADD	23.6	11.6	0.49	17.1	8.4	0.49	15.9	7.6	0.48	13.6	5.7	0.42
Salima ADD	0.0	0.0	0.00	0.0	0.0	0.00	0.1	0.0	0.50	0.0	0.0	0.40
SOUTHERN Customary	4.3	2.0	0.47	3.4	1.3	0.37	1.7	0.6	0.36	1.7	0.8	0.47
Liwonde ADD	2.4	1.0	0.42	1.9	0.6	0.31	1.1	0.4	0.32	1.2	0.5	0.45
Blantyre ADD	1.9	1.0	0.53	1.5	0.7	0.46	0.6	0.3	0.45	0.5	0.3	0.52
Ngabu ADD	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.00
Total Customary	46.9	20.4	0.43	37.9	16.0	0.42	33.2	13.7	0.41	24.3	9.3	0.38

Source: Ministry of Agriculture Crop Estimates Spreadsheets.

Table 8
Growth of tobacco estates, 1976-1985 (burley and flue-cured)

YEAR	FLUE-CURED	AREA	Avg. Size	BURLEY	AREA	Avg. Size	TOTAL	AREA	AVG. SIZE (HA.)
1976	425	15,318	36	284	8,662	31	710	23,980	34
1977	510	17,525	34	460	10,926	24	970	28,451	29
1978	529	18,941	36	383	13,784	36	1,215	32,725	27
1979	524	18,504	35	814	13,642	17	1,338	32,146	24
1980	440	14,716	33	1,068	15,804	15	1,508	30,520	20
1981	371	13,921	38	1,980	23,309	12	2,351	37,230	16
1982	355	13,745	39	4,032	39,389	10	4,387	53,134	12
1983	410	15,221	37	3,411	26,946	8	3,821	42,167	11
1984	499	16,196	32	3,498	31,503	9	3,997	48,419	12
1985	589	15,927	27	3,383	28,240	8	3,972	44,167	11
Growth Rate:	0.1%	-1.4%		32.0%	15.1%		21.3%	7.4%	

Source: Tobacco Control Commission.

Table 9
Total estate tobacco area, production, and yield by region (area in hectares; production in mt; yield in mt/ha)

HARVEST YEAR	NORTHERN AREA	NORTHERN PROD.	NORTHERN YIELD	CENTRAL AREA	CENTRAL PROD.	CENTRAL YIELD	SOUTHERN AREA	SOUTHERN PROD.	SOUTHERN YIELD	TOTAL PRODUCTION	TOTAL AREA
1968	0	0	0	3,283	3,365	1.03	2,039	2,411	1.18	5,776	5,322
1969	0	0	0	4,312	3,910	0.91	2,581	2,323	0.90	6,233	6,892
1970	10	2	0.19	5,992	6,423	1.07	3,582	3,926	1.10	10,350	9,584
1971	57	40	0.70	8,258	7,094	0.86	4,819	4,940	1.02	12,074	13,135
1972	154	117	0.76	8,304	8,095	0.97	5,197	5,891	1.13	14,102	13,655
1973	212	191	0.90	8,953	9,279	1.04	5,329	6,197	1.16	15,667	14,493
1974	344	306	0.89	10,137	9,454	0.93	5,827	6,097	1.05	15,658	16,308
1975	433	416	0.96	11,480	14,638	1.28	5,927	7,842	1.32	22,896	17,840
1976	972	795	0.82	14,374	14,509	1.01	6,353	7,465	1.17	22,770	21,700
1977	1,626	1,652	1.02	15,201	19,596	1.29	7,163	8,505	1.19	29,755	23,989
1978	2,665	2,227	0.84	17,276	20,426	1.18	8,172	8,773	1.07	31,426	28,113
1979	4,058	3,467	0.85	19,383	24,607	1.27	9,297	11,932	1.28	40,006	32,738
1980	3,947	4,105	1.04	19,053	26,550	1.39	9,536	12,331	1.29	42,986	32,537
1981	3,158	3,787	1.20	18,461	24,129	1.31	9,274	10,600	1.14	38,516	30,893
1982	4,371	4,890	1.12	22,986	32,148	1.40	9,873	13,173	1.33	50,211	37,230
1983	6,768	6,539	0.97	34,236	39,908	1.17	12,130	16,749	1.38	63,196	53,134
1984	5,275	5,951	1.13	26,389	33,801	1.28	10,503	15,139	1.44	54,891	42,167
1985	5,931	5,796	0.98	30,424	35,010	1.15	11,344	11,847	1.04	52,653	47,699

Source: Compiled from Tobacco Control Commission Circulars.

Table 10
Burley tobacco (area in hectares; production in mt; yield in mt/ha)

HARVEST YEAR	NORTHERN AREA	NORTHERN PROD.	NORTHERN YIELD	CENTRAL AREA	CENTRAL PROD.	CENTRAL YIELD	SOUTHERN AREA	SOUTHERN PROD.	SOUTHERN YIELD
1968	0	0	0.00	2,908	2,957	1.02	173	70	0.41
1969	0	0	0.00	3,874	3,408	0.88	204	56	0.27
1970	10	2	0.19	5,220	5,407	1.04	397	266	0.67
1971	57	40	0.70	6,617	5,248	0.79	655	377	0.58
1972	142	108	0.76	5,875	5,042	0.86	515	304	0.59
1973	186	172	0.92	5,852	5,148	0.88	566	356	0.63
1974	313	281	0.90	5,972	4,789	0.80	528	266	0.50
1975	382	373	0.98	6,194	7,231	1.17	574	393	0.68
1976	674	553	0.82	7,526	5,841	0.78	538	206	0.38
1977	920	831	0.90	6,940	8,706	1.25	805	633	0.79
1978	1,455	1,141	0.78	7,894	8,613	1.09	1,233	823	0.67
1979	2,202	1,686	0.77	9,438	11,322	1.20	2,150	1,872	0.87
1980	2,060	2,157	1.05	9,337	12,082	1.29	2,411	2,447	1.01
1981	2,334	2,655	1.14	10,614	13,451	1.27	3,048	2,696	0.88
1982	3,683	3,802	1.03	15,580	19,714	1.27	4,046	4,086	1.01
1983	6,072	5,434	0.89	26,709	28,783	1.08	6,608	7,320	1.11
1984	4,639	5,167	1.11	18,362	20,406	1.11	3,945	4,406	1.12
1985	5,179	4,923	0.95	22,094	21,928	0.99	4,230	3,521	0.83

Source: Compiled from Tobacco Control Commission Circulars.

Table 11
Flue-cured tobacco (area in hectares; production in mt; yield in mt/ha)

HARVEST YEAR	NORTHERN AREA	NORTHERN PROD.	NORTHERN YIELD	CENTRAL AREA	CENTRAL PROD.	CENTRAL YIELD	SOUTHERN AREA	SOUTHERN PROD.	SOUTHERN YIELD
1967				265	293	1.11	1,343	1,540	1.15
1968	0	0	0.00	375	409	1.09	1,866	2,341	1.25
1969	0	0	0.00	438	504	1.15	2,376	2,267	0.95
1970	0	0	0.00	772	1,016	1.32	3,185	3,660	1.15
1971	0	0	0.00	1,640	1,847	1.13	4,164	4,562	1.10
1972	12	9	0.73	2,429	3,053	1.26	4,681	5,587	1.19
1973	26	19	0.75	3,101	4,131	1.33	4,763	5,841	1.23
1974	31	25	0.81	4,165	4,665	1.12	5,298	5,831	1.10
1975	51	43	0.84	5,286	7,407	1.40	5,353	7,450	1.39
1976	298	243	0.81	6,845	8,668	1.27	5,816	7,259	1.25
1977		821	1.16	8,262	10,892	1.32	6,357	7,872	1.24
1978	1,[illegible]	1,086	0.90	9,382	11,814	1.26	6,940	7,949	1.15
1979	1,857	1,781	0.96	9,945	13,285	1.34	7,147	10,060	1.41
1980	1,888	1,948	1.03	9,716	14,468	1.49	7,125	9,884	1.39
1981	824	1,132	1.37	7,847	10,678	1.36	6,226	7,904	1.27
1982	688	1,088	1.58	7,406	12,434	1.68	5,827	9,087	1.56
1983	696	1,105	1.59	7,527	11,125	1.48	5,522	9,429	1.71
1984	638	784	1.23	8,027	13,395	1.67	6,558	10,733	1.64
1985	752	873	1.16	8,330	13,082	1.57	7,114	8,326	1.17

Source: Compiled from Tobacco Control Commission Circulars.

Table 12
Total area and percentage of area cropped by ploughing and ridging method by A.D.D. and region, 1980-81 (in thousand hectares: for customary farmers only)

PLOUGHING METHOD	TOTAL MALAWI	KARONGA	MZUZU	NORTHERN REGION	KASUNGU	SALIMA	LILONGWE	CENTRAL REGION 1/	LIWONDE	BLANTYRE	NGABU	SOUTHERN REGION
TOTAL AREA	1,332.00	31.80	118.40	148.20	289.43	76.88	311.75	678.06	205.10	211.45	89.15	505.70
% OF TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NOT PLOUGHED	1,136.20	17.11	73.91	91.02	252.67	65.35	286.19	604.21	186.85	187.34	67.31	441.50
% OF TOTAL	85.3%	53.8%	63.5%	61.4%	87.3%	85.0%	91.8%	89.1%	91.1%	88.6%	75.5%	87.3%
TILLED BY HAND	118.55	3.28	12.57	15.85	9.84	9.99	23.07	33.06	15.59	23.68	21.31	44.99
% OF TOTAL	8.9%	10.3%	10.8%	10.7%	3.4%	13.0%	7.4%	4.9%	7.6%	11.2%	23.9%	8.9%
PLOUGHED BY OXEN	71.93	11.38	29.91	41.30	22.58	1.54	2.18	3.72	2.46	0.42	0.27	0.69
% OF TOTAL	5.4%	35.8%	25.7%	27.9%	7.8%	2.0%	0.7%	0.5%	1.2%	0.2%	0.3%	0.1%
PLOUGHED BY TRACTOR	4.00	0.00	0.00	0.00	4.05	0.00	0.31	0.31	0.00	0.00	0.00	0.00
% OF TOTAL	0.3%				1.4%		0.1%	0.0%				
OTHER	0.00	0.03	0.00	0.03	0.29	0.00	0.00	0.00	0.00	0.00	0.27	0.27
% OF TOTAL	0.0%	0.1%			0.1%						0.3%	
RIDGING METHOD	**MALAWI**	**KARONGA**	**MZUZU**	**NORTHERN**	**KASUNGU**	**SALIMA**	**LILONGWE**	**CENTRAL**	**LIWONDE**	**BLANTYRE**	**NGABU**	**SOUTHERN**
TOTAL AREA	1,136.20	17.11	73.91	91.02	252.67	65.35	286.19	604.21	186.85	187.34	67.31	441.50
% OF TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NOT RIDGED THIS YEAR	202.24	6.04	16.26	22.30	45.73	9.87	29.76	85.36	21.49	11.80	51.83	85.12
% OF TOTAL	17.8%	35.3%	22.0%	24.5%	18.1%	15.1%	10.4%	14.1%	11.5%	6.3%	77.0%	19.3%
RIDGED BY HAND	841.92	10.56	29.12	39.68	165.50	53.06	251.84	470.41	164.05	174.04	15.01	353.10
% OF TOTAL	74.1%	61.7%	39.4%	43.6%	65.5%	81.2%	88.0%	77.9%	87.8%	92.9%	22.3%	80.0%
BY OXEN	81.81	0.43	2.85	3.27	36.13	2.42	3.15	41.70	0.93	0.37	0.00	1.31
% OF TOTAL	7.2%	2.5%	3.9%	3.6%	14.3%	3.7%	1.1%	6.9%	0.5%	0.2%	0.0%	0.3%
BY TRACTOR	3.41	0.00	0.07	0.07	3.54	0.00	0.00	3.54	0.00	0.00	0.00	0.00
% OF TOTAL	0.3%	0.0%	0.1%	0.1%	1.4%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%
OTHER	5.68	0.09	0.07	0.16	1.52	0.00	1.72	3.23	0.37	1.12	0.47	1.97
% OF TOTAL	0.5%	0.5%	0.1%	0.2%	0.6%	0.0%	0.6%	0.5%	0.2%	0.6%	0.7%	0.4%

SOURCE: National Sample Survey of Agriculture, 1980/81. Vol. I, p.15, Table 2.1 and 2.2.

Table 13
Fertilizer and seed use by region, 1980/81 (for customary farmers only)

ITEM	TOTAL MALAWI	KARONGA	MZUZU	NORTHERN REGION	KASUNGU	SALIMA	LILONGWE	CENTRAL REGION 1/	LIWONDE	BLANTYRE	NGABU	SOUTHERN REGION
TOTAL HOUSEHOLDS (in '000)	1,136	34	85	119	137	77	226	440	239	274	64	577
% OF TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
USING FERTILIZER	371	13	42	55	60	22	102	184	60	69	3	132
% OF TOTAL	32.7%	39.0%	49.7%	46.6%	44.0%	28.6%	45.2%	41.9%	25.0%	25.0%	5.4%	22.8%
BUYING SEEDS 1/	196	3	19	22	39	23	52	75	18	13	32	45
% OF TOTAL	17.3%	8.2%	22.7%	18.1%	28.5%	30.5%	22.8%	17.0%	7.4%	4.6%	50.6%	7.8%

SOURCE: National Sample Survey of Agriculture, 1980/81. Vol. I, pp. 27, Table 2.39 and p.28, Table 2.42
Note: 1/ From ADMARC.

Table 14
Average number of wage earners in agriculture, forestry and fishing sub-sector and statutory minimum daily wage rate, 1977-84 (in Tambala)

YEAR	NORTHERN REGION WAGE EARNERS	NORTHERN REGION MINIMUM WAGE 1/	NORTHERN REGION REAL MINIMUM WAGE 4/	CENTRAL REGION WAGE EARNERS	CENTRAL REGION MINIMUM WAGE 2/	CENTRAL REGION REAL MINIMUM WAGE 4/	SOUTHERN REGION WAGE EARNERS	SOUTHERN REGION MINIMUM WAGE 3/	SOUTHERN REGION REAL MINIMUM WAGE 4/	TOTAL WAGE EARNERS MALAWI	Consumer Price Index 4/ 1977 = 100
1977	13,984	35	35	52,328	35	35	88,384	40	40	154,696	100
1978	16,476	35	32	60,181	35	32	92,677	40	37	169,334	109
1979	17,754	35	29	66,963	35	29	97,578	40	33	182,295	121
1980	14,320	40	28	75,715	44	31	91,102	45	31	181,137	144
1981	12,417	60	37	59,670	70	44	85,108	70	44	157,195	161
1982	13,156	69	39	58,207	81	46	86,848	81	46	158,211	176
1983	14,993	69	34	62,157	81	40	120,058	81	40	197,208	200
1984	14,977	69	29	57,147	81	34	105,573	81	34	177,697	240

Source: "Reported Employment and Earnings Annual Report," (editions 1977-1984). National Statistical Office: Zomba, for wage earners.
Malawi Statistical Yearbook, 1983. National Statistical Office: Zomba. Oct., 1985, for minimum daily wage rate.

Notes: 1/ For Mzuzu.
2/ For Lilongwe.
3/ For Blantyre.
4/ Consumer Price Index from IFS (IMF) Yearbook 1987, p.676.

Table 15
Total household income by source and region, 1980/81 (in thousand Kwacha: customary farmers only)

ITEM	TOTAL MALAWI	KARONGA	MZUZU	NORTHERN REGION	KASUNGU	SALIMA	LILONGWE	CENTRAL REGION 1/	LIWONDE	BLANTYRE	NGABU	SOUTHERN REGION
TOTAL INCOME/ ALL SOURCES	157,439	4,814	11,702	16,516	29,174	9,408	26,410	64,992	32,433	34,375	9,124	75,932
% OF TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
FOOD CROPS	36,408	1,470	2,717	4,187	8,477	1,183	9,006	18,668	5,690	7,019	845	13,555
% OF TOTAL	23.1%	30.5%	23.2%	25.4%	29.1%	12.6%	34.1%	28.7%	17.5%	20.4%	9.3%	17.9%
CASH CROPS	16,910	268	550	815	7,723	1,688	2,528	11,940	909	1,032	2,213	4,155
% OF TOTAL	10.7%	5.5%	4.7%	4.9%	26.5%	17.9%	9.6%	18.4%	2.8%	3.0%	24.3%	5.5%
LIVESTOCK	13,139	1,036	1,269	2,305	3,849	595	2,612	7,056	1,035	2,170	572	3,778
% OF TOTAL	8.3%	21.5%	10.8%	14.0%	13.2%	6.3%	9.9%	10.9%	3.2%	6.3%	6.3%	5.0%
BUSINESS	43,780	927	3,469	4,397	4,271	3,469	6,132	13,873	12,385	10,202	2,925	25,511
% OF TOTAL	27.8%	19.3%	29.6%	26.6%	14.6%	36.9%	23.2%	21.3%	38.2%	29.7%	32.1%	33.6%
LABOR	24,536	313	1,467	1,780	2,919	1,375	3,002	7,296	6,817	7,140	1,503	15,459
% OF TOTAL	15.6%	6.5%	12.5%	10.8%	10.0%	14.6%	11.4%	11.2%	21.0%	20.8%	16.5%	20.4%
TRANSFERS/OTHER	22,687	803	2,229	3,032	1,935	1,096	3,130	6,181	5,597	6,812	1,066	13,474
% OF TOTAL	14.4%	16.7%	19.0%	18.4%	6.6%	11.6%	11.9%	9.5%	17.3%	19.8%	11.7%	17.7%

SOURCE: National Sample Survey of Agriculture, 1980/81. Vol. I, pp. 27, Table 2.39 and p.28, Table 2.42

Table 16
Total household income per household by source and region, 1980/81 (in Kwacha: customary farmers only)

ITEM	TOTAL MALAWI	KARONGA	MZUZU	NORTHERN REGION	KASUNGU	SALIMA	LILONGWE	CENTRAL REGION 1/	LIWONDE	BLANTYRE	NGABU	SOUTHERN REGION
TOTAL HOUSEHOLDS (in '000)	1,136	34	85	119	137	77	226	440	239	274	64	577
% OF TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
PER HOUSEHOLD: TOTAL INCOME	139	142	138	139	213	123	117	452	136	125	143	404
% OF TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
FOOD CROPS	32	43	32	35	62	15	40	42	24	26	13	23
% OF TOTAL	23.1%	30.5%	23.2%	25.4%	29.1%	12.6%	34.1%	9.4%	17.5%	20.4%	9.3%	5.8%
CASH CROPS	15	8	6	7	56	22	11	27	4	4	35	7
% OF TOTAL	10.7%	5.5%	4.7%	4.9%	26.5%	17.9%	9.6%	6.0%	2.8%	3.0%	24.3%	1.8%
LIVESTOCK	12	31	15	19	28	8	12	16	4	8	9	7
% OF TOTAL	8.3%	21.5%	10.8%	14.0%	13.2%	6.3%	9.9%	3.5%	3.7%	6.3%	6.3%	1.6%
BUSINESS	33	27	41	37	31	45	27	32	52	37	46	44
% OF TOTAL	27.8%	19.3%	29.6%	26.6%	14.6%	36.9%	23.2%	7.0%	38.2%	29.7%	32.1%	10.9%
LABOR	22	9	17	15	21	18	13	17	29	26	24	27
% OF TOTAL	15.6%	6.5%	12.5%	10.8%	10.0%	14.6%	11.4%	3.7%	21.0%	20.8%	16.5%	6.6%
TRANSFERS/OTHER	20	24	26	26	14	14	14	14	23	25	17	23
% OF TOTAL	14.4%	16.7%	19.0%	18.4%	6.6%	11.6%	11.9%	3.1%	17.3%	19.8%	11.7%	5.8%

SOURCE: National Sample Survey of Agriculture, 1980/81. Vol. I, pp. 27, Table 2.39 and p.28, Table 2.42

Table 17
Average share of marketed production, by region (selected years)

REGION / District	Export Crops 5/	Production Share	Food Crops	Production Share
NORTHERN	By Region			
Chitipa, Karonga, Khata Bay, Rumphi, Mzimba	E. Tobacco	10%	Maize	14%
CENTRAL				
Kasungu, Nkhotakota, Ntchisi, Dowa, Salima, Lilongwe, Mchinji, Dedza, Ntcheu	E. Tobacco S. Tobacco Groundnuts Cotton	63% 93% 97% 28%	Maize	73%
SOUTHERN	By Region			
Mangochi, Machinga, Zomba, Chiradzulu, Blantyre, Mwanza, Thyolo, Mulanje, Chikwawa, Nsanje	E. Tobacco Cotton	27% 67%	Maize	13%

Source:

Estate Tobacco ("E. Tobacco") data from Tobacco Control Commission circulars. Shares based on four-year (1979-1981, 1983) mean of burley and flue-cured tobacco sales. All other export and food crop data from M.O.A./Christiansen, and refers to share of ADMARC purchases by region (by A.D.D.) for year 1985/1986.

Annex 6: Nigeria

Table 1
Population density and per capita arable land, 1985 and 2000 (in ha/person)

REGION/STATE	POPULATION 1963 ('000)	POPULATION 1985 ('000)	POPULATION 2000 1/ ('000)	TOTAL LAND ('000 ha)	ARABLE LAND 2/ ('000 ha)	POPULATION DENSITY	PER CAPITA ARABLE LAND IN 1985	PER CAPITA ARABLE LAND IN 2000	MEAN ANNUAL RAINFALL	SOIL TYPES
NORTHERN STATES (Semi-Arid Tropics)	19,540	34,105	49,359	38,970	29,350	88	0.86	0.59	500-1000 mm.	Ferruginous Tropical Soils 3/
Bauchi	2,393	4,176	6,048	6,550	4,930	64	1.18	0.82	Crops:	
Borno	2,950	5,149	7,457	11,910	8,970	43	1.74	1.20	coarse cereals	
Kaduna	4,033	7,039	10,195	6,940	5,230	101	0.74	0.51	legumes	
Kano	5,698	9,945	14,367	4,370	3,290	228	0.33	0.23	cotton	
Sokoto	4,467	7,796	11,292	9,200	6,930	85	0.89	0.61		
MIDDLE BELT STATES (Guinea Savannah)	9,810	17,122	24,796	32,270	24,310	53	1.42	0.98	1000-1500 mm.	Ferruginous Tropical Soils
Benue	2,389	4,169	6,038	4,550	3,430	92	0.82	0.57	Crops:	
Gongola	2,564	4,475	6,480	9,450	7,120	47	1.59	1.10	cereals	
Kwara	1,687	2,945	4,265	6,010	4,530	49	1.54	1.06	root crops	
Niger	1,176	2,052	2,972	6,730	5,070	30	2.47	1.71	rice	
Plateau	1,994	3,481	5,041	5,530	4,160	63	1.20	0.83		
SOUTHERN STATES (Tropical Rainforest)	25,234	44,898	66,065	19,001	14,320	236	0.32	0.22	1500-4000 mm.	Ferralitic and Hydromorphic Soils 4/
Anambra	3,540	6,178	8,947	1,710	1,290	361	0.21	0.14	Crops:	
Bendel	2,422	4,228	6,123	3,890	2,930	109	0.69	0.48	tropical tree	
Cross River	3,423	5,974	8,652	2,720	2,050	220	0.34	0.24	crops	
Imo	3,615	6,309	9,136	1,150	870	549	0.14	0.10	root crops	
Lagos	1,204	2,956	5,323	351	260	842	0.09	0.05		
Ogun	1,526	2,663	3,857	1,720	1,300	155	0.49	0.34		
Ondo	2,686	4,689	6,791	2,000	1,510	234	0.32	0.22		
Oyo	5,126	8,947	12,158	3,690	2,700	242	0.31	0.23		
Rivers	1,692	2,954	4,278	1,770	1,330	167	0.45	0.31		
TOTAL NIGERIA	54,583	96,125	140,220	90,241	67,980	107	0.71	0.48		

Source: Population Data:
Nigeria, National Population Commission: "Problems and Prospects in Integrated Rural Development," 1980, Lagos.

Land Data:
P.E.T. Allen, "Land Use in Nigeria," 1981

Notes: 1/ Population growth projected at 2.5% for all states except Lagos, which was projected at 4.0%.
2/ Obtained by taking 75.3% of land area of each state (cited in "Impact of National Agricultural Research," Federal Ministry of Science and Technology, September 1985).
3/ Defined as having "limited capacity for storing nutrients and are subject to leaching."
4/ Ferralitic soils defined as "intensely leached and highly vulnerable to erosion."
Hydromorphic soils are those that are waterlogged.

Table 2
Productivity potential of soils

FAO Soil Classes	Soil Types	Area		Location/States
High Productivity				
1.	—	—	—	—
Good Productivity				
2.	Hydromorphic/ Alluvial Soils	50,400	5.5%	Floodplains, Fadamas, Lake Chad
Medium Productivity				
3.	Ferruginous Soils	289,200	31.7%	Ogun, Oyo, Kwara, Bauchi and Borno; found less extensively in Sokoto, Kaduna, Niger, Benue, and Plateau.
Low Productivity				
4.	Vertisols; Lithosols; Regosols;	423,600	46.4%	Southwestern Nigeria; Benue, Plateau, Kwara, Borno, and Kano.
5.	Brown/Reddish Brown; Ferralitic Soils.	148,800	16.3%	Sokoto, Kano, Gongola; Ogun, Oyo, and Ondo.
TOTAL		912,000	100.0%	

Table 3
Fertilizer consumption by region, 1984 (in mt and as percent of total)

REGION/STATE	POPULATION DENSITY pers/sq.km	MT of Product	Percent of Total
NORTHERN STATES (Semi-Arid Tropics)	114	377,407	65.0%
Bauchi	157	62,114	10.7%
Borno	231	44,220	7.6%
Kaduna	99	113,220	19.5%
Kano	44	83,834	14.4%
Sokoto	118	74,019	12.7%
MIDDLE BELT STATES (Guinea Savannah)	188	132,423	22.8%
Benue	109	5,340	0.9%
Gongola	211	23,898	4.1%
Kwara	204	31,708	5.5%
Abuja	328	17,520	3.0%
Plateau	159	53,959	9.3%
SOUTHERN STATES (Tropical Rainforest)	42	70,772	12.2%
Anambra	28	18,478	3.2%
Bendel	92	7,152	1.2%
Cross River	46	3,933	0.7%
Imo	18	16,617	2.9%
Lagos	12	750	0.1%
Ogun	65	2,541	0.4%
Ondo	43	5,637	1.0%
Oyo	41	14,029	2.4%
Rivers	60	1,637	0.3%
TOTAL NIGERIA	94	580,602	100.0%

Source: Lele, Oyejide, Bindlish and Bumb, 1989.

Table 4
Capital expenditures in the agricultural sector by states

STATES	SECOND PLAN 1970-74 (Actual)			THIRD PLAN 1975/76 - 1979/80 (Actual)			FOURTH PLAN 1981-85 (Actual)		
	M.N	% of Total	N/ha	M.N	% of Total	N/ha	M.N	% of Total	N/ha
NORTHERN	56	18.1	1.91	240	13.1	8.18	1472	18.1	50.15
Bauchi	3	15.8	0.61	22	7.4	4.46	251	19.6	50.91
Borno	6	17.7	0.67	37	10.7	4.12	180	11.4	20.07
Kaduna	8	8.3	1.53	66	18.3	12.62	307	19.2	58.70
Kano	31	26.7	9.42	74	16.3	22.49	407	18.5	123.71
Sokoto	8	18.6	1.15	41	11.1	5.92	327	22.3	47.19
MIDDLE BELT	25	13.8	1.03	188	11.5	7.73	697	12.3	28.67
Benue	4	12.9	1.17	60	16.6	17.49	228	19.1	66.47
Gongola	5	18.5	.70	37	12.1	5.20	121	9.3	16.99
Kwara	5	9.3	1.10	26	5.8	5.74	97	8.8	21.41
Niger	6	18.8	1.18	31	12.9	6.11	109	10.9	21.50
Plateau	5	13.5	1.2	34	12.0	8.17	142	12.9	34.13
SOUTHERN	73	14.2	5.10	368	10.1	25.70	1258	9.0	87.85
Anambra	7	18.9	5.43	27	9.4	20.93	138	9.2	106.98
Bendel	10	10.1	3.41	39	7.4	13.31	159	7.6	54.27
Cross River	11	15.5	5.37	52	15.3	25.37	144	11.1	70.24
Imo	5	20.0	5.75	40	10.3	45.98	210	14.0	241.38
Lagos	10	11.6	38.46	19	3.9	73.08	125	6.4	480.77
Ogun	5	19.2	3.85	36	11.5	27.69	100	10.0	76.92
Ondo	6	19.4	3.97	62	15.1	41.06	169	12.1	111.92
Oyo	11	19.6	3.96	43	12.2	15.47	100	6.3	35.97
Rivers	8	9.4	6.02	50	9.5	37.59	113	7.1	84.96

Source : Nigeria, Second, Third and Fourth National Development Plans.

Table 5
Federal allocations and independent revenues of the states, 1981-85

	Federal Allocations		Independent Revenues		Total Revenues
		Percent of			
	Nm.	Total	Nm.	Total	Nm.
Northern States	7,628	92.0	663	8.0	8,291
Bauchi	1,302	93.9	84	6.1	1,386
Borno	1,550	94.7	87	5.3	1,637
Kaduna	1,624	90.7	166	9.3	1,790
Kano	1,357	86.9	204	13.1	1,561
Sokoto	1,795	93.6	122	6.4	1,917
Middle Belt States	6,121	93.2	444	6.8	6,565
Benue	1,247	93.9	81	6.1	1,328
Gongola	1,408	94.2	87	5.8	1,495
Kwara	1,176	94.0	75	6.0	1,251
Niger	1,076	93.7	72	6.3	1,148
Plateau	1,214	90.4	129	9.6	1,343
Southern States	13,287	81.7	2,982	18.3	1,269
Anambara	1,385	82.8	287	17.2	1,672
Bendel	2,075	89.7	238	10.3	2,313
Gross River	1,423	91.2	137	8.8	1,560
Imo	1,550	84.3	288	15.7	1,838
Lagos	948	42.6	1,278	57.4	2,226
Ogun	1,006	87.4	145	12.6	1,151
Ondo	1,239	86.2	198	13.8	1,437
Oyo	1,738	89.8	197	10.2	1,935
Rivers	1,923	90.0	214	10.0	2,137

Source: Nigeria, Fourth National Development Plan.

Table 6
Primary and secondary education, 1978

	PRIMARY SCHOOLS			SECONDARY SCHOOLS		
	Number of Schools	Enrollment '000 Students	% of Total Population	Number of Schools	Enrollment '000 Students	% of Total Population
NORTHERN STATES	14,172	3,204	11.1	272	103	0.4
Bauchi	2,477	399	11.3	48	13	0.4
Borno	2,428	693	15.9	59	14	0.3
Kaduna	2,857	845	14.2	74	35	.6
Kano	3,032	843	10.0	33	20	0.2
Sokoto	3,378	424	6.4	58	21	0.3
MIDDLE BELT STATES	9,205	2,786	19.3	434	164	1.1
Benue	2,786	866	24.6	183	45	1.3
Gongola	2,224	473	12.5	44	20	0.5
Kwara	1,414	588	23.7	105	61	2.5
Niger	1,133	320	18.5	27	11	0.6
Plateau	1,648	539	18.4	75	27	0.9
SOUTHERN STATES	14,092	6,759	17.9	2,200	1,332	3.5
Anambra	1,926	962	18.5	370	146	2.8
Bendel	1,690	836	23.4	267	185	5.2
Cross River	1,693	851	16.9	210	105	2.1
Imo	1,946	1,025	19.3	350	251	4.7
Lagos	712	465	20.6	125	154	6.8
Ogun	1,226	350	15.6	151	73	3.3
Ondo	1,500	478	12.1	252	139	3.5
Oyo	2,475	1,282	17.0	378	204	2.7
Rivers	924	510	20.5	97	75	3.0
ALL NIGERIA	37,469	12,749	15.8	2,906	1,599	2.0

Source: Nigeria, Fourth National Development Plan.

Table 7
Hospital facilities, 1979/80

	NUMBER OF HOSPITAL BEDS	POPULATION PER BED
NORTHERN STATES	11,174	2,577
Bauchi	1,111	3,173
Borno	1,455	2,988
Kaduna	4,178	1,422
Kano	2,944	2,852
Sokoto	1,486	4,429
MIDDLE BELT STATES	9,683	1,493
Benue	1,640	2,146
Gongola	2,148	1,759
Kwara	2,391	1,040
Niger	1,381	1,254
Plateau	2,123	1,384
SOUTHERN STATES	48,809	772
Anambra	7,140	730
Bendel	6,626	539
Cross River	5,429	929
Imo	5,546	960
Lagos	5,244	432
Ogun	2,978	755
Ondo	6,874	576
Oyo	6,265	1,206
Rivers	2,707	921
ALL NIGERIA	69,666	1,161

Source:
Nigeria, Fourth National Development Plan.

Table 8
Rural and urban water supply, 1978

	PERCENT OF RURAL POPULATION SERVED	PERCENT OF URBAN POPULATION SERVED
NORHERN STATES	19	67
Borno	0	70
Kaduna	13	31
Sokoto	39	100
MIDDLE BELT STATES	27	69
Benue	88	80
Gongola	2	31
Kwara	13	85
Plateau	0	83
SOUTHERN STATES	25	79
Anambra	64	37
Cross River	8	85
Imo	20	100
Lagos	4	94
Ogun	14	100
Oyo	N/A	79a/
Rivers	35	66
AVERAGE OF ABOVE STATES	24	73

a/ Refers to percent of total population served (i.e., urban and rural).
Source: Nigeria, Fourth National Development Plan.

Table 9
Indicators of child under-nutrition

	Percent of Children below 2 Standard Deviations of Weight-to-Height Indicator		
	Urban	Rural	Total
North	25.4	20.9	24.3
Bauchi	21.9	23.9	22.3
Borno	25.9	15.4	24.3
Kaduna	20.6	15.0	19.1
Kano	32.1	22.2	29.0
Sonoto	25.6	23.8	25.1
Middle Belt	26.1	18.0	23.9
Benue	23.0	16.2	21.5
Gangola	28.2	28.1	28.2
Kwale	36.3	10.2	29.3
Niger	19.4	15.7	17.7
Plateau	21.6	20.6	21.3
South	12.6	18.7	14.4
Anambara	14.9	20.2	16.8
Bendel	11.9	23.5	14.4
Cross River	9.3	8.0	8.6
Imo	10.1	18.5	12.5
Lagos	3.4	19.4	6.2
Ogun	13.4	13.2	13.3
Ondo	12.7	15.3	13.8
Oyo	5.5	34.1	11.5
Rivers	26.4	23.9	25.7
All Nigeria	20.9	19.1	20.4

Source of Basic Data: F.O.S., "The Health of Nigerians 1983/84: Health and Nutrition Status Survey (A module of the National Integrated Survey of Householders (NISH) April 1983- March 1984)," Lagos, September 1985.

Annex 7: MADIA Tables

Table 1
Computation of per capita land availability using FAO and government data

		EAST AFRICA			WEST AFRICA		
ITEM	YEAR	KENYA	MALAWI	TANZANIA	CAMEROON	NIGERIA	SENEGAL
LAND (in '000 ha.)							
Total Land Area							
National	1985	56,416	9,428	88,366	46,540	90,241	19,672
FAO Yearbook 1/	1984	56,925	9,408	88,604	46,944	91,077	19,200
Area Under Cultivation							
National		2,577	3,639	4,465	6,830	12,542	2,612
(as % of total)		5%	39%	5%	15%	14%	13%
FAO Yearbook 14/	1984	2,335	2,345	5,190	6,965	31,035	5,225
(as % of total)		4%	25%	6%	15%	34%	27%
FAO Atlas 15/	1980	4,400	2,500	9,200	7,700	32,300	5,200
(as % of total)		8%	27%	10%	16%	35%	27%
"Arable" Land							
FAO (Unadjusted) 16/	1985	1,850	2,320	4,130	5,910	28,500	5,220
(as % of total)		3%	25%	5%	13%	31%	27%
FAO (Adjusted) 17/	1984	6,075	6,085	42,785	32,165	46,235	5,942
(as % of total)		11%	65%	48%	69%	51%	31%
FAO Atlas (Potentially Cultivable) 18/	1980	6,700	4,100	36,600	31,500	47,900	9,700
(as % of total)		12%	44%	41%	67%	53%	51%
National Arable Estimate	1985	14,703	5,280	49,100	34,905	67,951	10,481
(as % of total)		26%	56%	56%	75%	75%	53%
POPULATION (in '000)							
Initial (Census of 1980's)		10,942	4,040	12,313	na	55,670	na
Present Total							
National (Census of 1970's)		15,327	5,547	17,036	7,761	na	5,069
National (Current Estimate)	1985	20,200	7,200	21,383	10,130	96,125	6,478
FAO 4/	1985	20,600	6,944	22,499	9,873	95,198	6,444
IBRD 5/	1985	20,000	7,000	22,000	10,000	100,000	7,000
Present Rural							
National		16,598	6,276	18,389	6,469	67,288	4,340
(as % of total)		82%	87%	86%	64%	70%	67%
FAO 7/	1985	16,242	5,440	18,574	6,036	63,484	5,121
(as % of total)		79%	78%	83%	61%	67%	79%
IBRD 8/	1985	16,000	6,160	18,920	5,800	70,000	4,480
(as % of total)		80%	88%	86%	58%	70%	64%
Projected Total	2000						
National		37,505	11,783	34,066	16,682	140,220	10,093
IBRD 10/		36,000	11,000	37,000	17,000	163,000	10,000
Projected Rural	2000						
National		26,103	8,837	25,073	8,341	77,121	5,955
(as % of total)		70%	75%	74%	50%	55%	59%
PER CAPITA LAND AVAILABILITY							
Total Land Per Capita Availability National Data	1965	5.16	2.33	7.18	ERR	1.62	ERR
	1985	2.79	1.31	4.13	4.59	0.94	3.04
	2000	1.50	0.80	2.59	2.79	0.64	1.95
Arable Land Per Capita Availability National Data	1965	1.34	1.31	3.99	ERR	1.22	ERR
	1985	0.73	0.73	2.30	3.45	0.71	1.62
	2000	0.39	0.45	1.44	2.09	0.48	1.04
Arable Land Per Capita Availability National Data (Rural Population)	1985	0.89	0.84	2.67	5.40	1.01	2.41
	2000	0.56	0.60	1.96	4.18	0.88	1.76
Arable Land Per Capita Availability FAO Atlas (land)/IBRD (Pop.) Data	1985	0.33	0.59	1.63	3.19	0.50	1.51
	2000	0.19	0.37	0.99	1.85	0.29	0.97
Arable Land Per Capita Availability FAO Yearbook Definition	1985	0.09	0.33	0.18	0.60	0.30	0.81

Sources: See Tables 2 and 3.

Table 2
Population projections, and urban/rural growth, 1985-2000

Kenya

Year	-- Population in Thousands -- Total	Urban	Rural	% Urban
1985	22,200	4,094	18,106	18.4%
1986	22,990	4,383	18,606	19.1%
1987	23,808	4,693	19,115	19.7%
1988	24,655	5,025	19,630	20.4%
1989	25,532	5,380	20,152	21.1%
1990	26,440	5,760	20,680	21.8%
1991	27,381	6,167	21,214	22.5%
1992	28,355	6,603	21,752	23.3%
1993	29,364	7,069	22,294	24.1%
1994	30,408	7,569	22,839	24.9%
1995	31,490	8,104	23,386	25.7%
1996	32,611	8,677	23,934	26.6%
1997	33,771	9,290	24,481	27.5%
1998	34,972	9,946	25,026	28.4%
1999	36,217	10,649	25,568	29.4%
2000	37,505	11,402	26,103	30.4%

		Calculate Growth Rates 1985-2000	1979-2000	1979-1985
Pop. Growth Rate:	3.56%	3.56%	4.35%	6.37%
Urbanization Rate:	3.39%		3.39%	
Urban Growth Rate:	7.07%			
Rural Growth Rate:	2.47%			

Sources: Growth Rate calculated from 1985 and 1987 Economic Survey figures given in Table 2, for 1985 and 2000; Urbanization Rate calculated from 1979 Census figure and 2000 figure (30.4%) given in 1985 Economic Survey.

Malawi

Year	-- Population in Thousands -- Total	Urban	Rural	% Urban
1985	7,200	893	6,307	12.4%
1986	7,440	967	6,473	13.0%
1987	7,689	1,047	6,642	13.6%
1988	7,945	1,134	6,811	14.3%
1989	8,211	1,228	6,982	15.0%
1990	8,485	1,330	7,155	15.7%
1991	8,768	1,441	7,327	16.4%
1992	9,061	1,560	7,501	17.2%
1993	9,363	1,690	7,674	18.0%
1994	9,676	1,830	7,846	18.9%
1995	9,999	1,982	8,017	19.8%
1996	10,333	2,146	8,186	20.8%
1997	10,678	2,325	8,353	21.8%
1998	11,034	2,518	8,516	22.8%
1999	11,402	2,726	8,676	23.9%
2000	11,783	2,953	8,830	25.1%

		Calculate Growth Rates 1985-2000	1977-2000	1979-1985
Pop. Growth Rate:	3.34%	3.34%	3.33%	3.21%
Urbanization Rate:	4.80%		4.80%	
Urban Growth Rate:	8.30%			
Rural Growth Rate:	2.27%			

Sources: Growth Rate calculated from 1977 Census figures, Vol. II. Urbanization Rate calculated from 1977 Census figures of 8.5% in 1977 and 25% in 2000.

Tanzania

Year	-- Population in Thousands -- Total	Urban	Rural	% Urban
1985	21,383	2,994	18,389	14.0%
1986	22,067	3,223	18,844	14.6%
1987	22,773	3,470	19,303	15.2%
1988	23,502	3,736	19,766	15.9%
1989	24,254	4,023	20,232	16.6%
1990	25,030	4,331	20,699	17.3%
1991	25,831	4,663	21,168	18.1%
1992	26,658	5,020	21,637	18.8%
1993	27,511	5,405	22,106	19.6%
1994	28,391	5,820	22,572	20.5%
1995	29,300	6,266	23,034	21.4%
1996	30,237	6,746	23,491	22.3%
1997	31,205	7,263	23,942	23.3%
1998	32,204	7,820	24,383	24.3%
1999	33,234	8,420	24,814	25.3%
2000	34,298	9,065	25,232	26.4%

		Calculate Growth Rates 1985-2000	1977-2000	1985-1985
Pop. Growth Rate:	3.20%	3.34%	3.33%	3.31%
Urbanization Rate:	4.33%			4.33%
Urban Growth Rate:	7.67%			
Rural Growth Rate:	2.13%			

Sources: Pop. Growth Rate from The Demography of Tanzania, p. 231. Urbanization Rate calculated from WDR figures of 6% in 1965 and 14% in 1985.

Cameroon

Year	-- Population in Thousands -- Total	Urban	Rural	% Urban
1985	10,130	3,559	6,571	35.1%
1986	10,457	3,761	6,696	36.0%
1987	10,795	3,975	6,820	36.8%
1988	11,144	4,201	6,943	37.7%
1989	11,504	4,440	7,064	38.6%
1990	11,875	4,693	7,183	39.5%
1991	12,259	4,960	7,299	40.5%
1992	12,655	5,242	7,413	41.4%
1993	13,063	5,540	7,524	42.4%
1994	13,485	5,855	7,631	43.4%
1995	13,921	6,188	7,733	44.5%
1996	14,371	6,540	7,831	45.5%
1997	14,835	6,912	7,923	46.6%
1998	15,314	7,305	8,009	47.7%
1999	15,809	7,720	8,088	48.8%
2000	16,319	8,160	8,160	50.0%

		Calculate Growth Rates 1985-2000	1976-2000	1976-1984	1981-91
Pop. Growth Rate:	3.23%	3.23%		2.52%	
Urbanization Rate:	2.38%	2.38%	2.37%	2.34%	1.39%
Urban Growth Rate:	5.59%				
Rural Growth Rate:	1.45%				

Sources: Population Growth Rate from Sixth Plan (1986-1991), p. 5. Urbanization Rate calculated from 1985 figure (Sixth Plan; p. 3) and World Bank estimates for 2000 (Country Economic Memorandum, 1987; p. 18).

Population projections, and urban/rural growth, 1985-2000

Nigeria

Year	-- Population in Thousands -- Total	Urban	Rural	% Urban
1985	96,125	28,838	67,288	30.0%
1986	98,575	30,383	68,192	30.8%
1987	101,088	32,011	69,077	31.7%
1988	103,665	33,726	69,938	32.5%
1989	106,307	35,534	70,773	33.4%
1990	109,017	37,438	71,579	34.3%
1991	111,796	39,444	72,352	35.3%
1992	114,646	41,558	73,088	36.2%
1993	117,568	43,785	73,783	37.2%
1994	120,565	46,131	74,433	38.3%
1995	123,639	48,603	75,035	39.3%
1996	126,790	51,208	75,582	40.4%
1997	130,022	53,952	76,069	41.5%
1998	133,336	56,843	76,492	42.6%
1999	136,735	59,890	76,845	43.8%
2000	140,220	63,099	77,121	45.0%

		Calculate Growth Rates 1985-2000	1965-1985	1972-1982
Pop. Growth Rate:	3.00%	3.00%		
Urbanization Rate:	1.45%		1.45%	3.82%
Urban Growth Rate:	4.49%			
Rural Growth Rate:	2.12%			

Sources:

Population Growth Rate derived from National Population Commission figures for 1985 and 2000, cited in Lele et al., "Nigeria's Economic Development..." April 1988 draft. Urbanization rate derived from WDR 1987 estimate of 30% for 1985, and Nigeria: Basic Economic Report," Aug. 1981 for 2000 figure of 45%.

Senegal

Year	-- Population in Thousands -- Total	Urban	Rural	% Urban
1985	6,478	2,164	4,314	33.4%
1986	6,672	2,261	4,412	33.9%
1987	6,873	2,362	4,510	34.4%
1988	7,079	2,469	4,610	34.9%
1989	7,291	2,579	4,712	35.4%
1990	7,510	2,695	4,815	35.9%
1991	7,735	2,816	4,919	36.4%
1992	7,967	2,943	5,024	36.9%
1993	8,206	3,075	5,131	37.5%
1994	8,453	3,213	5,239	38.0%
1995	8,706	3,358	5,348	38.6%
1996	8,967	3,509	5,459	39.1%
1997	9,236	3,666	5,570	39.7%
1998	9,514	3,831	5,683	40.3%
1999	9,799	4,003	5,796	40.9%
2000	10,093	4,183	5,910	41.4%

		Calculate Growth Rates 1985-2000	1976-2000	1976-1984
Pop. Growth Rate:	2.55%	2.55%		
Urbanization Rate:	2.74%	2.74%		
Urban Growth Rate:	5.36%			
Rural Growth Rate:	0.91%			

Sources:

Population Growth Rate from WDR 1987. Urbanization rate derived from WDR 1987 estimate of 27% in 1965 and 36% for 1985. Note that projecting the Government's rate (1972-1982) would yield 58% urban by the year 2000.

Table 3
Population pressure and deforestation, 1974-1984 (as percentage of total forest area)

Country	Per Capita Arable Land (Ha/Person) Rural	Total	TROPICAL FOREST STUDY 1/ In '000 Hectares	As a % of Total	FAO PRODUCTION YEARBOOK 2/ In '000 Hectares	As a % of Total
Malawi	0.53	0.48	1,200	24%	450	9%
Nigeria	1.01	0.71	2,850	16%	2,700	15%
Senegal	1.02	0.70	500	8%	308	5%
Kenya	0.88	0.73	190	5%	270	7%
Cameroon	5.23	3.34	800	3%	983	4%
Tanzania	2.59	2.30	100	0%	1,083	2%

Sources: 1/ Forest Resources of Tropical Africa, Part I. Table 6d, P. 88. Includes closed broadleaved, coniferous and bamboo forests.
2/ FAO Production Yearbook, Vol. 39.

Notes

1. The six countries selected for analysis (Kenya, Malawi, and Tanzania in East Africa, and Cameroon, Nigeria, and Senegal in West Africa) collectively account for 40 percent of the population of Sub-Saharan Africa and 50 percent of its GNP. They cover almost all the ecological zones in Africa, ranging from the Sahelian and Guinea Savannah zones in the North to the equatorial rain forest in the South, and including the volcanic, humid, and semi-humid highlands of East and West Africa. Taken together, the six grow almost all the major crops of Africa, including tea, coffee, cocoa, tobacco, cotton, groundnuts, cashews, sisal, sugar, maize, sorghum, millet, and rice. They include two oil-exporting and four oil-importing countries, two land-surplus and four land-short countries. Despite their diverse physical characteristics, and although they have followed different policy paths and achieved different outcomes, the six countries have enough in common to permit fruitful comparison. MADIA is a REPAC-(Research Approval Committee) funded research project approved in June of 1984. The MADIA study has the active support of seven donor agencies from Denmark, France, the Federal Republic of Germany, Sweden, the United Kingdom, the United States, and the Commission of the European Communities.

2. Ruthenberg (1983, p.15) defines the R-value (or "intensity of rotation") as

$$R = \frac{Y_t \cdot 100}{Y_f + Y_t}$$

where: Y_t = years cultivated
Y_f = years fallow

Thus, if a plot were cultivated for 3 years continuously and then left fallow for the next 7 years, the R-value would equal 30. Similarly, annual cropping without fallow would have an R-value of 100, and growing more than one crop per year each year would have an R-value above 100.

3. The production of flue-cured tobacco is considered harmful to the environment insofar as the treatment process consumes a fair amount of wood and contributes to pressure on wood resources. However, the effects are occurring through the expansion of estates, bypassing smallholders from potential sales. For a more thorough critique of tobacco production on the environment, see Boehnert, 1988.

4. While recognizing the fundamental importance of irrigation, however, the MADIA study documents the extent to which the possibilities for small-scale irrigation, whether developed by farmers by using traditional means or the more modern tubewells and valley bottom development schemes, are unexploited relative to the complex and capital-intensive large-scale irrigation. Not only have governments shown frequent preference for such irrigation but donors have provided large support for it. Examples include the Bura irrigation scheme in Kenya (at the cost of $25,000 per hectare), the River Basin Development Authorities in Nigeria (at the cost of between $35,000 and $100,000 per hectare), the SAED irrigation schemes in the Fleuve (the cost of which is unknown but estimated by FAO at $50,000 per hectare), and the SEMRY projects in Northern Cameroon ($13,000 per hectare). Each exemplifies inappropriate technocratic approaches that donors supported because of historical political involvement without regard to the development of the appropriate capacity for their management. Important exceptions to this are the World Bank's support for tubewells and surface irrigation on Kebrija in Northern Nigeria and the valley bottom development in Cameroon.

5. Initially, Ruthenberg argues, land is at low productivity but in equilibrium. To increase the land's current productivity is to risk jeopardizing its future productivity. He observes, "the basic principle of farming is to change the natural system into one which produces more of the goods desired by man. The man-made system is an artificial construction which requires continuous economic inputs obtained from the environment to maintain its output level. Farming thus implies the abolition of an unproductive 'steady state' in favor of a man-created, more productive but unstable 'state,' and much of the farm input (tillage, fertilizers, weeding, etc.) is nothing but an effort to prevent the new state from declining towards an unproductive low-level steady state" (Ruthenberg 1980, p. 9). Increasing the intensity of cultivation increases the relative instability in the ecosystem. The danger of instability is that if sufficient inputs are not maintained (or invested) over time the plot will return not merely to its former low-productivity state, but to a state of lower potential, as is evidenced by "desertification" of marginal lands.

6. There are many cases where population growth, rather than increasing capital accumulation, has depressed savings and diverted investment away from production to consumption. See for instance Ruttan 1984.

7. For a more detailed discussion of the role of ethnicity on the making of agricultural policy, see Lele and Hanak, eds., *The Politics of Agricultural Policy*, forthcoming.

8. Note that in Nigeria a large work on land potential has been completed for the North-Central plains. See Ministry of Overseas Development 1979.

9. A good source of further reading on interactions between ecology and development economics can be found in H. Daly (1989).

10. Figure of 19 percent cited in "SAL IV: Adjustment with Growth and Development," Malawi Government (Office of the President/Ministry of Finance) Special Studies Document 1986/2 (January, 1987), p.vii.; figure of 56 percent arable is cited in *Malawi Population Census 1977: Analytical Report, Vol. I*. National Statistical Office (Zomba: 1984), p.3.

11. See for instance the "sources of growth" analysis in Jammeh and Lele 1988.

12. In Cameroon, regional demographic surveys were undertaken from 1960-65, but the first full national census was in 1976. Likewise in Senegal, the first complete national census in 1976 was predated only by an administrative census in 1960 and a demographic survey in 1961 (Domschke and Goyer 1986).

13. An intermediary step in the "normal" trajectory of intensification includes significant rural-to-urban migration as the productivity of labor decreases. Boserup writes that

> ...people in rural areas, instead of voluntarily accepting the harder toil of a more intensive agriculture, will seek to obtain more remunerative and less arduous work in non-agricultural occupations. (Boserup 1965, p. 118.)

14. We were fortunate to receive a significant contribution to this section from G.M. Higgins, who helped to draft the FAO/UNFPA/IIASA study. We are grateful for his reviewing this section and making helpful suggestions on the original manuscript.

15. Higgins, G.M./UNFPA/IIASA 1982. Three levels of input use are assumed in the FAO/IIASA analysis to calculate the kilocalorie production frontier:

a) *low level* assumes only land and labor, and no soil conservation;

b) *intermediate level* assumes improved hand tools and/or draft implements, some fertilizer and pesticide application, moderate soil conservation, and a cultivation mix of improved and traditional crops; and

c) *high level* assumes "complete mechanization, full use of genetic material," necessary farm chemicals, soil conservation measures, and cultivation of "only the most calorie (protein) productive crops on all potentially cultivable rainfed lands."

16. Several assumptions implicit in the FAO/IIASA analysis are masked by giving results in terms of sustainable populations. For every potential population that can be sustained (at given levels of input use), decisions have been made regarding optimal land use with respect to crops, consumer preferences, minimum calorie requirements, and response coefficients. These variables are used to calculate a production possibility frontier in kilocalories, based on agroclimatic and soil constraints. The assumptions remain largely hidden as the study lists only the end result: sustainable population figures.

17. In a recently published Ph.D. dissertation, Boehnert (1988) notes that "the increasing population is pressing more and more people into the arid and semi-arid areas. With them they bring their traditional farming practice, used in wetter and cooler areas with a different soil structure. For example, deep ploughing with heavy farm equipment and the custom of keeping the soil cultivated and open most of the year."

18. Crops can be high value in terms of relative price, but may not yield higher returns if yields are low. Cassava is considered a low value crop, but returns are higher than cocoa in Nigeria because of its high yields and the lower yields of aging cocoa trees that are nearing the end of the 20-year productive cycle.

19. One exception is the volcanic soils, found in highlands such as in Kenya and Western Cameroon, which are deep and remain highly productive year after year.

20. The importance of wood as a source of fuel is nicely illustrated by the fact that the cuisine of the Sahelian and Sudanian zones consists mainly of simmered stews, sauces, and grain porridges, whose preparation requires slow cooking and a great deal of wood using the traditional "three-stone" stove (Gorse and Steeds 1985, p. 29).

21. The critical position of Nigeria and Malawi is confirmed by other available evidence. The FAO Production Yearbook also has data on area under forest/woodlands that suggest a positive relationship between diminishing area under forests and woodlands and population densities. The area under forests decreased by 15 percent, for instance, in Nigeria during the 1974-84 period. In Malawi and Kenya, also characterized by high population pressures, forest area is listed as decreasing by 7 and 9 percent, respectively (see table A.3, annex). The figures are slightly less for Senegal (5 percent), Cameroon (4 percent), and Tanzania (2 percent).

22. A recent article in Kenya's *Weekly Review* presents the government position on the new Nyayo tea zones as "an outstanding example of President Daniel Arap Moi's commitment to environmental conservation. Inaugurated by the president himself in 1984, it was billed as one of the most effective means of protecting and conserving Kenya's forests against wanton destruction through illegal human settlements. Tea is planted in a thin strip of land adjacent to gazetted forests. The tea bushes provide ample soil cover curtailing soil erosion which normally sets in after trees are felled for saw milling and for other purposes. As trees are kept short by constant picking, it was expected that the tea zones would act as buffer zones and trespassers into forests are easily sighted from considerable distances" (*Weekly Review*, 1989).

23. It is now well established that symbiotic root microorganisms (*Rhizobium*, *Frankia*, and mycorrhizal fungi) can effectively contribute to tree productivity in marginal climatic and edaphic conditions. Since significant advances have been made recently in the manipulation of the microorganisms, it is not possible to contemplate their use in the field.... A number of trees have the potential for fixing atmospheric nitrogen through their symbiotic associations with *Rhizobium* (leguminous trees) or *Frankia* (nitrogen-fixing nonleguminous plants, now dubbed actinorrhizal plants). Promoting the nitrogen fixation capacity of these trees through inoculation with the proper symbiotic microorganisms or through selection of the plant host is an elegant approach to making the forest ecosystem self-sufficient in nitrogen (Gorse and Steeds 1985, p. 54).

24. See for instance *Forest Resources Crisis in the Third World*, Proceedings from the Conference, September 6-8, 1986. Sahabat Alam Malaysia (Penang: 1987). For a more optimistic scenario, see Anderson 1987.

25. Although in absolute terms the Rift Valley province contains more high potential land (911,500 hectares) than either the Central, Western, or Nyanza provinces, the relevant proportion of high potential to total land is much lower—only 6 percent as compared to about 25 percent in the Central province. The lower proportion of high potential land, the large tracts of medium and low potential land, and the inclusion of nomadic peoples in the equation—such as the Turkana and the Masai (who constitute just under 10 percent of the Rift Valley population)—may help explain the appearance of a more abundant supply of arable land in the Rift Valley whereas its high potential districts are equally densely populated.

26. The land survey was published in 1965, and subsequently republished in 1985 (Stobbs and Jeffers 1985). These figures are also cited by the government in 1977 *Compendium of Agricultural Statistics*. Arable land estimates are generally more conservative than the figures given above; the Office of the President, for example, has cited the figure of 19 percent arable in "SAL IV: A Proposal..." while the World Bank has alternately cited 38 percent cultivable ("1981 Development of the Agricultural Sector Report") and more recently 22 percent without forests, 62 percent with (Land Policy Study 1987, p.7). Elsewhere Mkandawiri and Phiri, "Land Policy Study" (1987) cite the figure of 37 percent arable as a national average. We use the first set of figures as they represent official government data and are more disaggregated (to the district level), although they may be high.

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