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STRATEGIES FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN THE EAST AFRICAN HIGHLANDS

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ABSTRACT

Low agricultural productivity, land degradation and poverty are severe interrelated problems in the East African highlands. While the proximate causes of such problems are relatively well known, the underlying causes are many and complex, and depend upon many site-specific factors that vary greatly across the diverse circumstances of the region. Thus, no "one-size-fits-all" policy, institutional or technology strategy is likely to suffice to generate sustainable development. While common elements of successful strategies do exist, such as security and macroeconomic stability, the appropriate portfolio of investments in physical, human, natural and social capital will likely be different in different circumstances.

In this paper, we argue that the appropriate strategy for sustainable development depends greatly upon the "pathways of development" that are feasible in a given location. Development pathways represent common patterns of change in economic livelihood strategies, such as continued semi-subsistence mixed crop-livestock production or commercialization of high-value perishable crops. We argue that such development pathways will be largely determined by three factors determining comparative advantage: agricultural potential, access to markets, and population density. Based on a typology of situations in the East African highlands using these variables, we develop hypotheses about the potential pathways of development in different situations, and the policy and institutional requisites to achieve sustainable development of such pathways. We also argue that the choice of development pathway largely conditions the opportunities for particular resource management technologies, and develop hypotheses about the technological strategies that may be feasible within particular development pathways.

We conclude the paper with hypotheses about the priorities for policy intervention to achieve sustainable development in the East African highlands. Among these, we suggest that the highest priority for road and irrigation development should be areas close to urban markets with high agricultural potential; that development of input and output markets and credit systems will be most critical in such areas; that increasing food security through increased food crop production or other means is likely to be a key to realizing the potential for more commercial production; that subsidies on the costs of transporting fertilizer to remote, high-potential, food deficit areas should be considered as a lower cost alternative to food aid; and that intensified and more private use of hillsides and grazing areas for sustainable uses such as tree planting may have potential to achieve more rapid and sustainable development of lower potential areas. We emphasize that these are only hypotheses, and that policy research is needed to assess their validity in different contexts of the East African highlands.

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STRATEGIES FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN THE EAST AFRICAN HIGHLANDS

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1. INTRODUCTION

In Sub-Saharan Africa, the nexus of population pressure, low and declining agricultural productivity, and unsustainable use of natural resources threatens a downward spiral of increasing poverty and land degradation unless effective strategies to reverse the spiral are identified and implemented (Cleaver and Schreiber 1994). These problems are particularly severe in the East African highlands. Average population density is more than 1 person per hectare in the highlands and well over 2 persons per hectare in many areas. Most farm households attempt to subsist on less than 1 hectare of land and incomes of much less than $1 per day. Cereal yields are well below yields attained in other parts of the world (averaging little more than 1 tonne per hectare for most cereals), while yield growth has been slow or in some cases, declining over the past several decades (Hoeckstra and Corbett 1995). Livestock productivity is also low compared to other parts of the world. For example, milk yields are less than 4 liters per day in the highlands (Winrock International 1992). These trends are all the more distressing because agricultural potential is quite high in much of the East African highlands, with sufficient rainfall and suitable soils to support much more intensive and profitable agriculture than currently exists.

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The problem of land degradation is particularly severe in the East African highlands. Mining of soil nutrients and high rates of soil erosion contribute to low and declining agricultural productivity and extreme poverty throughout much of this densely populated region. Estimated soil nutrient losses exceeded 80 kg of N, P_2O_5, and K_2O per cultivated hectare in 1983 in Ethiopia and Kenya, and were nearly 70 kg per hectare in Uganda (Stoorvogel and Smaling 1990). Similar large negative nutrient balances have been found at the district and farm scale in the highlands of Kenya (Smaling et al. 1997). FAO (1986) estimated that one-half of the arable lands in the Ethiopian highlands are moderately to severely eroded. Estimated soil erosion on cropland averages 42 tons per hectare per year in the Ethiopian highlands, though it is much higher on steeper slopes and for some crops (Hurni 1988). More than 6 million hectares of additional cropland and pasture in the Ethiopian highlands may become unusable (with less than 10 cm of soil depth left) between 1985 and 2010 if estimated erosion rates continue (Sutcliffe 1993). Although there is some controversy about the economic costs imposed by these problems (especially erosion), a conservative estimate of the annual costs of soil nutrient depletion alone is $100 million (Bojo and Cassells 1995). The gross discounted cumulative cost of erosion in Ethiopia has been estimated to be as high as $1.25 billion (Kappel 1996). Less information on erosion is available for other East African highland countries, although it is clear that the magnitude of the problem is substantial in these countries as well (Braun et al. 1997).

The proximate causes of these problems are well known (Bojo and Cassells 1995; Sanchez et al. 1997): increased cultivation on steep slopes, inadequate vegetative cover on croplands, deforestation, overgrazing, burning of crop residues and dung for fuel, low

use of inorganic fertilizers or integrated nutrient management, declining use of fallow, and limited adoption of soil and water conservation measures. Underlying these proximate causes are many more fundamental factors, including population growth, poverty, insecure land tenure, limited access to markets and credit, risks associated with the use of inputs and new technologies, and limited farmer knowledge of appropriate technologies in some cases. Government policies and institutions affect most of these causes. For example, market liberalization, credit policies, input supply policies and infrastructure investment have a large impact on opportunities to use inorganic fertilizers (Bumb and Banaante 1996). Land tenure policies may affect security of tenure, land fragmentation, and access to credit, and hence affect incentives and ability to invest in land improvements or to use inputs (Place and Hazell 1993). Education affects population growth and poverty. Education, research and extension policies can affect farmer knowledge about specific natural resource problems (e.g., types of nutrients required) and appropriate technologies to address such problems.

Given the complexity of factors influencing land degradation and the diversity of situations existing in the East African highlands, no single package of technologies will be able to address all of the problems. Similarly, no “one-size-fits-all” policy strategy will suffice to generate sustainable development, although there will be common elements to successful strategies in all cases, including macroeconomic stability, a competitive market environment, land tenure security, and investments in physical, human, natural and social capital. Much of what distinguishes different strategies will be differences in the portfolio of such investments that are needed in different circumstances.

The objectives of this paper are to begin to identify such strategies, to suggest what kinds of strategies are appropriate for different types of situations, and to consider the policy and institutional requisites for these strategies to be successful. The suggestions will be offered as hypotheses rather than as firm conclusions, since substantial empirical research is still needed to investigate the feasibility and desirability of the suggested strategies and supporting policy and institutional interventions.

In this paper, we argue that the nature of land degradation problems and appropriate means of addressing them will depend upon the broader development pathway that is pursued. For example, in areas where commercial crop production is occurring, the potential to address soil nutrient depletion using large inputs of inorganic fertilizer will be much greater than where production is likely to remain mainly subsistence-oriented. The latter situation will require lower use of external inputs, although opportunities for integrating small amounts of purchased inputs with local sources of inputs should not be overlooked.

We also argue that the policy and institutional strategy, particularly the appropriate mix of public and private investments, should be linked to the pathway of development. For example, areas where a commercialization pathway is viable may require development of input and output markets through private or public investment in transportation and marketing facilities, credit, etc. Appropriately targeted and sustained research and technical assistance will be important to all strategies, but especially where a low external input (and knowledge intensive) pathway is pursued.

The appropriate development pathway depends upon the factors that determine local comparative advantage. Three factors of particular importance in this regard are

agricultural potential, population density, and access to markets. Accordingly, we consider development pathways suitable to different circumstances along these three dimensions, and present examples from the highlands of Ethiopia, Kenya, and Uganda.

In the next two sections we present a brief overview of the agricultural context and the policy environment in each of these three countries. In section 4, we consider possible development pathways for different situations and in section 5, we consider the policy and institutional strategies to facilitate such pathways. In section 6, we offer tentative policy conclusions and directions for further research.

2. AGRICULTURE IN THE EAST AFRICAN HIGHLANDS

As mentioned above, there is considerable diversity in agricultural potential and the nature of agriculture across the East African highlands. Here we briefly consider the situation in Ethiopia, Kenya, and Uganda.

ETHIOPIA

The Ethiopian highlands account for nearly half of the highlands of Africa, and three-fourths of the highlands (over 1200 m.a.s.l.) of the three countries being considered (Braun et al 1997). The highlands range in annual average temperatures from 20-22°C in the lower elevations to 10-12°C in the higher elevations (3,000-3,400 m.a.s.l.). Annual rainfall ranges from about 600 mm in the northern highlands to over 2,000 mm in the southwestern highlands (Technical Committee for Agroforestry in Ethiopia 1990). Based upon climate, three agroecological zones have been identified: the drought-prone low-potential cereals (LPC) zone, mainly in the north (mainly 90-150 days growing period);

the high-potential cereals (HPC) zone, mainly in the central highlands (usually more than 180 days growing period); and the warmer and more humid high-potential perennials (HPP) zone in the southwest highlands.

The dominant soil types in the Ethiopian highlands are nitisols, vertisols, cambisols and luvisols (ibid.). Nitisols dominate in the HPP zone. These soils have very good agricultural potential, though their low phosphorus content and high capacity for P-fixation makes addition of phosphorus a necessity. Vertisols and luvisols are most common in the HPC zone. Vertisols have high nutrient retention and water holding capacity, but they are heavy and difficult to plow, and prone to waterlogging in the rainy season and cracking in the dry season. Cambisols and luvisols are most common in the LPC zone; these soils are generally of poorer quality. The soils in much of the northern and eastern highlands are very shallow, while soils are much deeper in the western and southern highlands (Hurni 1988; Braun et al. 1997). There are of course substantial variations within these zones.

More than four-fifths of the population of Ethiopia resides in the highlands, due to the cooler climate, greater rainfall, and lower incidence of pests and diseases affecting both humans and livestock. The highlands account for only 36 percent of the area of the country. The average population density in the highlands is nearly 100 persons per square km, including both urban and rural residents (ibid.). The infrastructure is very poor. With only 0.4 km of roads per 1,000 residents (World Report 1998), Ethiopia has among the lowest road densities in Africa (Ogbasellasie 1995; Ahmed and Donavan 1992), and most of the roads are in very poor condition. The railway line connecting Addis Ababa to the port in Djibouti is very old and in poor condition. Less than 200,000

hectares of land are potentially irrigable in the highlands, and the actual area irrigated is much less than this (Ogbasellasie 1995). Education levels are very low; the rate of adult literacy in the rural Ethiopia highlands (including Tigray, Amhara, and Oromiya, the main highland regions) was only 15 percent in 1994 (CSA 1995). Postal and telecommunications facilities are very limited, and electricity is virtually nonexistent in rural areas. On the positive side, there has been substantial investment in grain storage facilities in the past 20 years in response to the famines.

Agriculture in the Ethiopian highlands is dominated by very small scale mixed crop-livestock subsistence farms, usually operating less than 1 hectare (Ogbasellasie 1995). Due to population pressure and several land redistributions conducted since the fall of Emperor Haile Selassie in 1974, farms larger than a few hectares are rare, except for state farms established by the Derg regime. The most important food crops are teff, barley, wheat, sorghum, maize, and enset ("false banana"). The dominant cash crop, and most important export of Ethiopia, is coffee. Livestock, especially cattle and small ruminants, are very important in all parts of the highlands. Ethiopia has the largest livestock herd in Africa, and the vast majority of these are in the highlands (Winrock International 1992). Livestock are valued as a source of draft power, a store of wealth and source of status, for the meat and milk they provide, and for their contribution to soil fertility and household energy supply (dung) (ibid.).

Several major farming systems have been identified in the highlands, including the enset-coffee-cereals-livestock system and the forest coffee-enset-livestock system at middle altitudes (up to 2,500 m) in the HPP zone, the enset-barley-livestock system at high altitudes in the HPP zone, the mixed cereal-livestock system in the middle altitudes

of the HPC and LPC zones, and the barley-livestock system at higher altitudes in these zones. Use of fertilizer and improved seeds is very low in all of these systems, although these have been increasing rapidly in the past few years in the HPC zone as a result of a large extension program to promote intensified cereal production. As a result of population pressure, fallowing (for longer than the dry season) is rare. Farmyard manure and crop residues are traditional sources of soil nutrients, but are becoming increasingly scarce as shortages of fuelwood have necessitated the burning of dung and crop residues, especially at higher elevations in the low-potential zone. Although use of inorganic fertilizers has expanded rapidly in recent years as a result of a widespread extension effort, only about one-third of Ethiopian rural households used fertilizers in 1995, and the average level of use was only 11 kg per hectare, compared to 48 kg per hectare in Kenya and 97 kg per hectare worldwide (Mulat et al. 1997; FAO 1998). As a result of these factors, declining soil fertility is a problem in all systems, but especially in the LPC zone (Technical Committee for Agroforestry in Ethiopia).

Soil erosion is a severe problem in sloping areas, especially in the northern and central highlands where vegetative cover is very low and soils are already very shallow. Erosion is most severe on cultivated lands, averaging 42 tons per hectare per year on currently cultivated lands and 70 tons per hectare per year on formerly cultivated degraded lands (Hurni 1988). Erosion is likely much higher where teff is grown on sloping lands, because farmers plow several times to prepare a fine seed bed for this crop. Conservation measures have been widely promoted throughout the Ethiopian highlands (especially the northern highlands) through Food for Work projects and annual

compulsory work campaigns.[1] The emphasis has been on construction of physical structures such as terraces and bunds. Evidence of the productivity impacts of these structures is mixed. In more humid areas, they have not been found to increase crop yields significantly (in some cases reducing yields), because they reduce crop area, sometimes harbor pests, and other problems (Herweg 1992). In drier areas, such structures have been found to have much more beneficial impacts on productivity because they help to conserve soil moisture (Berhanu 1998).

KENYA

The Kenyan highlands stretch from the eastern slopes of Mt. Elgon southward through Nyanza province to the Tanzanian border and eastward through a narrow section of the rift valley and then expanding once more to cover the Aberdere range, Mount Kenya, and environs to the south and east. In total, the highlands cover approximately 18 percent of the land area. The highlands generally include the better agricultural areas and as a consequence population densities are high. It is estimated that 64 percent of Kenya's population resides in this relatively small area and many local areas have population densities in excess of 1,000 inhabitants per square kilometer (Braun et al. 1997). Most highland areas enjoy two rainy seasons, the long season from March to June and the short rainy season from October to December. Average annual rainfall is generally over 1,200 mm with much higher amounts reported in the higher elevations near Mount Kenya. The climate in the western highlands is warm year round with average temperatures of 21^{o}C. In the higher elevation central highlands, temperatures are somewhat cooler, with average high temperatures reaching as low as 18^{o}C in certain months of the year.

[1] Currently 20 days of compulsory work are required per year in Tigray.

Soils throughout the highlands are generally deep, well drained, clay-loams and are considered of medium to high agricultural potential. Nitisols dominate in the central highlands and are derived from volcanic rock. The central highlands are characterized by moderate to steep sloping land and thus there is a need for soil conservation measures to ensure continued productivity of soils. As discussed in more detail below, there are not widespread problems of soil infertility in the central highlands due to the commercial nature of agriculture and farmer reinvestment in land. In western Kenya, there is a major problem of nutrient depletion in the otherwise high-potential ferralsols, acrisols, and nitisols. For example, phosphorus has been found to be severely depleted (Olson P levels below 5 ppm) in widespread soil testing (ICRAF 1997). In addition, some of the soils are high phosphorus fixing, implying that much of the phosphorus in the soil is not available to plants (Sanchez et al. 1997). Nitrogen is another major limiting nutrient and potassium deficiencies are also reported. These are not inherent characteristics of the soils, but rather a result of many decades of continuous cropping and nutrient export with little nutrient input.

Throughout most of the highlands, land registration and consolidation exercises had taken place in the 1960s. In central Kenya, the results of this were single-parcel farms of between 3 and 8 hectares. In the sloping areas, these normally stretched from a ridge down a slope to a bottom valley area. After a generation or so of land subdivision, average farm sizes generally range from 1 to 4 hectares. Relative to other rural areas, this region generates high agricultural income and households are able to educate their children, many of whom take up jobs in the non-agricultural sector, partially easing the pressure for land subdivision. The updating of titles following transfers of land is

commonly practiced in this area relative to the western highlands (Place and Migot-Adholla 1998). In the western highlands, farms are more or less the same size, with the exception that in some of the most densely populated areas, farm sizes of below 1 hectare are common. In both areas, the most common form of land acquisition is through inheritance. Some purchasing of land takes place, but renting of land, though growing in significance, has not traditionally been important. In both areas, there is much off-farm activity as some family members will seek employment in the major cities.

Two important distinctions between the western and central highlands are the higher elevation and closer proximity to Nairobi (and the shipping port) of the central highlands. The higher elevation has permitted the productive cultivation of perennials such as coffee and tea, and the proximity to Nairobi has provided a ready market for cash activities such as dairy production. In the central highlands there is consequently a wide range of both cash and food crops grown. The major cash crops are tea (in the higher elevations), coffee, miraa (a stimulant), macademia nuts, fruit trees such as avocado, and vegetables. The major food crops are maize, beans, irish potatoes, bananas and an assortment of vegetables. In addition, livestock production, mainly for milk, is extremely important and in most areas over 80 percent of households own cattle (Minae et al. 1988). Consequently, sizeable land area is devoted to production of fodder, such as napier grass (Murithi 1998).

Farmers market coffee and tea through cooperatives, the local tea and coffee societies, and their widespread establishment has facilitated expansion of these commodities. The area under tea production has steadily increased to where Kenya is now the world's second largest exporter of tea. Coffee production remains an important

provider of foreign exchange but production levels have been more volatile. Dairy has been a major growth industry both during the monopoly period of the Kenya Cooperative Creameries (KCC) and since the liberalization of the sector in the early 1990s. Horticulture is also important in the central highlands. Flowers are restricted to larger farmers but smallholders are engaged in pyrethrum, tobacco, french beans, macadamia, and other fruits and vegetables.

One of the benefits of the cooperatives was to provide credit for inputs and sometimes other investments. This meant that as long as output prices were attractive, farmers normally had the interest and capacity to apply fertilizer inputs to their cash crops. For coffee, for instance, Kenyan farmers normally add nutrient inputs, as opposed to farmers in Uganda. The access to credit also had spillover effects into other crops and investments such as education. Thus, one of the features of the central highlands is the development of a highly diversified and intensified agricultural system. There remain poor households, but opportunities to improve livelihoods through agriculture abound.

The case of western Kenya is different. There are only isolated areas suitable for production of cash crops such as coffee or sugarcane. There is a sizeable regional demand from a large rural population and the presence of several small cities, but the distance to the largest cities and key tourist areas is relatively long and transport costs high. As a result, in comparison with the central highlands, the profitability of agriculture has traditionally been lower and farmers have in turn reinvested very little in agriculture. The general description is of low-input semi-subsistence farming systems. Maize and bean systems dominate, but in some areas bananas are common and in others sorghum and millet can be found. There is also some growing of cassava and sweet

potato. The higher valued crops in the system are the vegetables such as french bean, kale, cabbage, onion, pepper, and tomato. Tea is grown in some parts of the western highlands, though not as common as in the central highlands. Livestock (particularly crossbreeds) are also not as common as in the central highlands, and are normally confined to the wealthier households who utilize them for milk, manure, and sometimes ploughing. Yields of most crops are low and households normally must buy additional food to supplement production. In addition, acute demands for cash, for education fees for example, force households into selling food crops at low prices following harvest and buying them later at much higher prices. Western Kenya is a net importer of food.

UGANDA

The highlands of Uganda are mostly in the southwestern and western part of the country and in the east. The highlands (above 1,200 m.a.s.l) account for 27 percent of the land area of Uganda and 38 percent of the population (Braun et al. 1997). Population density averages 105 persons per sq km, including urban and rural areas. Population density is over 250 persons per sq km in parts of the southwestern and eastern highlands, which are the higher altitude areas. The climate is relatively humid and moderately warm, with annual average temperatures ranging from about 24°C at the lower elevations to 15°C at the higher elevations (over 3,000 m.a.s.l.). Annual rainfall ranges from about 1,000 mm to over 2,000 mm, and there are two growing seasons with over 180 growing period days in nearly all of the highlands.

The major soil types in the highlands include ferralsols in the Lake Victoria crescent and andosols, lithosols and nitisols in the southwest and east (Braun et al. 1997). Ferralsols are moderately deep and fertile, but with high acidity. Andosols are

moderately deep to deep and highly fertile. Nitisols are deep with moderate fertility but high acidity. The nitisols of the region are capable of supporting continuous cropping by renewing soil fertility through weathering (Hoekstra 1988).

Many rural areas of Uganda are relatively accessible by roads, and the density of roads and railroads—about 1.6 km per 1,000 persons (U.S. Library of Congress 1992), is relatively high compared to many other African and Asian countries (Ahmed and Donovan 1992). However, many of the roads are in poor condition. Rail service to port is unreliable, particularly through Kenya (World Bank 1996). In addition, the availability of vehicles and transport services within Uganda is limited and expensive, and fuel costs are high. Irrigation is little used in Uganda, despite the presence of sizeable wetland areas (Place and Otsuka 1997). There is limited capacity of storage and processing facilities, especially for perishable commodities (World Bank 1996).

Education has traditionally been given high priority in Uganda, though educational attainment is low compared to more developed parts of the world. Adult literacy was 57 percent in rural Uganda in 1992 (ibid.). There has been substantial expansion of the public school system since the late 1980s, although many problems limit the quality of education.

The major food crops produced in the highlands of Uganda include bananas and plantains, maize, sorghum, finger millet, cassava, sweet potatoes, and various pulses. Coffee is the most important cash crop, accounting for most of Uganda's export earnings. Cattle are important in parts of the highlands, but are found mainly on larger farms in lower elevations where population densities are lower. Small ruminants are more common at higher elevations (Hoekstra 1988).

A wide variety of farming systems exists. Intensive banana, coffee and maize production is common near Lake Victoria. Near Kampala, there is also increased uptake of horticulture crops such as vanilla, passion fruit, and pineapple. Banana, coffee, cattle, field beans, and maize are common in the western highlands. North of Jinja, fewer bananas are produced, and finger millet, cassava, and maize are common. Annual food crops dominate in the higher elevations of the southwest and include potatoes, a major export from the region. In the eastern highlands around Mt. Elgon, coffee-banana-cassava and banana-maize-coffee systems are common (Hoekstra 1988; Braun et al. 1997).

Most farms are less than 2 hectare in size in the Lake Victoria area and in the montane food crop systems in the southwest and east. Farms are somewhat larger in the cattle producing zones in the west, though still generally smaller than 15 hectare (Hoeckstra 1988). Most farms are semi-subsistence in orientation, producing most of the food supply for the household. Fallowing of one year or more is not practiced on smaller farms, and is declining where there are larger farms due to population pressure.

Declining soil fertility is a problem across much of the highlands, as a result of declining use of fallow, very low use of fertilizer, and limited use of manure. Low use of fertilizer may be due in some cases to low yield response to fertilizers, which has been found in many fertilizer trials (Braun et al. 1997). In some soils, accumulation of nitrogen occurs in the subsoil, and deep rooting crops or trees may be very useful to recycle nutrients into the topsoil (ibid.). However, low fertilizer use is also due to limited availability and high costs of fertilizer. Contributing to these problems are information

and marketing difficulties resulting from a weak extension service and high transport costs of fertilizers, which come through the port of Mombasa.

Soil erosion is a serious problem in the densely populated and steeply sloping highlands of the southwest and east (ibid.; Kamugisha 1993). Soil conservation measures were widely practiced prior to the early 1970s, promoted by educational programs and often enforced by local administrators. However, as a result of years of political turmoil, breakdown in former administrative structures, and population pressure, soil conservation is now much less common, and many of the older investments have been destroyed or seriously deteriorated (Zake 1992).

3. POLICIES AND INSTITUTIONS AFFECTING HIGHLAND DEVELOPMENT

Here we consider the effects of recent changes in the policy environment on development in the highlands, and the major policy and institutional constraints that still appear to inhibit development potential.

ETHIOPIA

Since the end of the civil war in 1991, the Ethiopian government has taken great strides towards liberalizing the economy and setting it on a path towards sustainable long term growth. The exchange rate has been devalued and has stabilized, and the foreign exchange market largely deregulated. Government spending and the money supply have been held under control, bringing inflation to under 5 percent (World Report 1998). Tax rates have been reduced and efforts undertaken to broaden the tax base. The banking

sector has been deregulated, and together with reduced inflation, this has allowed positive real interest rates on savings to help mobilize savings. Private banks are now allowed to compete with the Commercial Bank of Ethiopia, though the CBE still controls 90 percent of the market. Most price controls, trade restrictions, and restrictions on the labor market have been eliminated. Export taxes have been eliminated, except the coffee export tax, which is a major source of revenue to the Federal Government. Privatization of nearly half of the formerly state-owned enterprises has been completed (Ethiopian Herald, April 28, 1998), though most of the larger enterprises and state farms are still owned by the state. These changes have contributed to strong economic growth, averaging 6-7 percent per year over the past six years, and to elimination of the government deficit (World Report 1998).

A key element of the new policy strategy is to decentralize political power and administrative decisions from the Federal Government to the regions. Regional governments now raise some of their own revenue and execute their own plans and budgets, though a sizable fraction of their revenues still comes from the Federal Government. Within the regions, local municipalities (woredas) have their own elected councils and executive committees, responsible for developing their own plans and budgets as well as implementing the policies of the Federal and regional governments. Although woreda councils develop their own budget proposals, these must be approved by the regional government; thus a substantial degree of authority is maintained at the regional level. Below the woreda level are peasant associations, kebeles or tabias, which are composed of a few villages. These are the lowest administrative units in Ethiopia, and their local councils are supposed to develop their own plans, budget proposals, and

develop and enforce by-laws governing use of common resources, etc. According to some informants, this process of decentralization is furthest advanced in Tigray, where it has been built upon the philosophy and structures established by the Tigrayan People's Liberation Front during the civil war.

Although good progress has occurred, there still exist policy and institutional constraints to sustained development in the Ethiopian highlands. Chief among these are unresolved issues about land tenure, limited infrastructure development, limited competition in input supply markets, constrained access to rural credit, capacity limitations in the research and extension system, and lack of coordination between programs promoting increased agricultural production and programs promoting conservation objectives.

Under the new Ethiopian constitution, all land is the property of the state, and it may not be sold or mortgaged. The right of peasants and pastoralists of free access to land is guaranteed. The constitution also guarantees the right of individuals to improvements they make to land, including the right to bequeath, transfer, remove, or claim compensation for such improvements if the right of use expires. Although the constitution has resolved some issues, it seems to create other ambiguities and does not address some important issues. Given the scarcity of land, it is not clear how peasants' right of free access to land can be assured in practice, and what effect this may have on tenure security of those currently possessing land. Nor is it clear how much land peasants are entitled to. These issues have been left to the regional governments to resolve, and there have been important differences across the regions. In Tigray, a new land policy was established in 1997 stating that there will be no further redistributions of land except

where major infrastructure investments such as irrigation projects necessitates it. In Amhara, by contrast, a general redistribution was just completed in 1998, and no policy has been established regarding future redistributions. The Oromiya government is reportedly considering a redistribution. Given these circumstances, tenure insecurity may be more of a constraint to land improving investments in Amhara and Oromiya than in Tigray.

Another issue that is up to the regions to decide is the policy towards land leasing. Tigray's new land policy allows leasing for up to two years for traditional uses, and up to 10 years if the lessee makes significant investments. There is reportedly no restriction on lease terms in Amhara, while in Oromiya, peasants may only lease out half of their land for up to three years. Such restrictions may constrain efforts to reduce land fragmentation, limit farmers' ability to obtain sufficient income from farming, limit incentives to invest in land improvements, and constrain peasants' ability to take advantage of better economic opportunities outside of farming or in other locations. The prohibition on land mortgaging in the constitution of course reduces farmers' collateral and hence reduces their access to collateral-based credit, though alternatives such as peer group monitoring are possible and being used in Ethiopia.

Constraints on rural credit appear to limit use of purchased inputs and investments. According to officials from different parts of Ethiopia, the demand for rural credit greatly exceeds the supply. Part of the reason for this is undoubtedly the limited development and capacity of rural financial institutions. Due to their politicization by the Derg regime, many farmers reportedly prefer to avoid dealing with service cooperatives, and few organizations have stepped in to provide rural credit. In many areas, non-

government organizations, such as the Relief Society of Tigray (REST), are the main source of credit. Until 1998, maximum interest rates on loans by such institutions were regulated by the National Bank of Ethiopia, although these restrictions have been eliminated. Minimum interest rates on deposits are still regulated (6 percent), as are the maximum loan sizes by rural financial institutions (5,000 Birr). The loan size restrictions limit the usefulness of such institutions in financing investments and lead to small lending volume per borrower and per branch, causing administrative and other fixed costs to be high relative to the value of loans.

Absence of credit for marketing or other purposes also may constrain rural development, farmers' incomes and food security. Rural credit institutions currently require agricultural input loans to be repaid at harvest time, forcing farmers to sell when prices are low, rather than storing and selling when prices are higher and food is more scarce. There does not appear to be any government policy inhibiting such institutions from extending loans for a longer period (e.g., for one year rather than six months), which could help to facilitate storage and orderly marketing. Allowing credit specifically for marketing, storage facilities, and processing facilities could further promote the development of a competitive output marketing system. The absence of credit for consumption purposes, which serves as a form of insurance, also may inhibit productive development (as well as food security) by causing farmers to be highly risk averse when considering use of new technologies and inputs.

Credit constraints also inhibit investment in livestock. Few smallholder livestock producers receive formal credit in Ethiopia (Freeman et al. 1998a). Freeman et al. (1998b) have shown that a one percent increase in credit to purchase crossbred dairy

cows leads to a 0.6 percent increase in milk productivity on credit constrained farms and a 0.4 percent increase on non-constrained farms in Ethiopia. Such differences in the marginal productivity of working capital suggest that targeted livestock credit schemes to those most in need could have important efficiency as well as equity benefits.

Limited infrastructure development is another major constraint. Three-fourths of highland farm households lived more than a six-hour walk from an all-weather road in the early 1980s, and the situation may be little improved today (FAO 1986). This obviously restricts farmers' ability to participate in market transactions, and explains the predominance of subsistence farming in the Ethiopian highlands. Without improvements in market access, impacts from price liberalization, improved technologies, and improved availability of inputs and credit may be negligible for farmers in remote areas, because high transportation and marketing costs renders their production essentially non-tradable. The Ethiopian government and donors recognize the importance of the issue, and plans have recently been announced to invest 19 billion Birr (nearly $3 billion) in road improvements over the next five years (Ethiopian Herald, April 30, 1998). However, these funds are reportedly to be used mainly for improving the highway system, not the rural roads. An ambitious program to construct small-scale irrigation structures in drought prone areas with good irrigation potential is also underway, under the Sustainable Agriculture and Environmental Rehabilitation Program (SAERP) initiated by the U.N. Economic Commission for Africa. This program initially planned to construct 500 microdams irrigating about 100 hectare each in Tigray alone, although the plans have been scaled back as a result of capacity constraints and a more realistic assessment of the availability of suitable sites. While decisions have been made about the general

magnitude of such infrastructure investments, important decisions remain about how to target and implement them. In addition, better integration of different infrastructure programs may be needed. There appears to be little integration of the road construction and irrigation investment programs for example, even though these investments may be highly complementary.

The limited degree of competition in agricultural input markets also may be an important constraint to increased use of inputs. Presently, there are only three or four suppliers of agricultural inputs, with the dominant one, the Agricultural Input Supply Enterprise (AISE), owned by the government. There have been complaints by one of the private suppliers about favoritism shown by some regional governments towards the government supplier and its affiliates, though this is disputed by the regional governments (Mulat et al. 1997). Much of the problem may be that input markets have only recently been deregulated (the retail market was deregulated in 1997 and the wholesale market in 1998), and it will take some time for competition to flourish. There appears to be little involvement of traders or retailers in marketing agricultural inputs at present. Part of this may be due to uncertainty and unfamiliarity of these agents in marketing inputs, though transport costs and the need for credit to finance working capital are probably also important constraints.

Investments are also needed to increase the capacity of the research and extension system. Substantial progress has been made by the Ministry of Agriculture in implementing the Sasakawa-Global 2000 approach to extension (emphasizing use of fertilizers and improved seeds of cereal crops on 0.5 hectare demonstration plots), with impressive results. Between 1995 and 1998, demonstrations were conducted on about

600,000 plots, in most cases more than doubling crop yields (World Report 1998; Quinones et al. 1997). Extending this approach to a much larger number of farmers in the highlands will require substantial investment in training staff and farmers, and likely also some consideration of how to appropriately target and adapt these technologies (especially in moisture-stressed environments). The long-term success of these efforts will also require addressing the constraints to competitive input supply, credit, crop storage, marketing, processing and diversification discussed above, lest farmers become discouraged by unavailable inputs or rapidly falling output prices just as the program is bearing fruit. In many ways, technological success will create more challenges for policymakers than failure.

Another key issue is the need for greater integration of such productive technologies with efforts to conserve soil and water. Many of these efforts are conducted by separate programs with different objectives, resulting in poor coordination of the approaches (Hans Hurni, personal communication). This is unfortunate, since the complementarities between soil and water conservation and productivity enhancing measures can be substantial. For example, the returns to soil and water conservation structures will be much higher if they enable farmers to use fertilizer and improved seeds, by conserving soil moisture and reducing losses of such inputs through runoff. This complementarity of course also increases the returns to using fertilizer and seeds. To realize these potential benefits, greater integration of these approaches is needed in both research and extension packages.

KENYA

The Government of Kenya implemented a structural adjustment program beginning in 1986 and elements of this program are still being carried out such as the privatization of state enterprises. The reforms have targeted both macro-economic areas as well as sectoral areas, including agriculture. The government relaxed foreign exchange regulations and by 1995, the private sector could move currencies relatively freely. Tariff rates were reduced on many goods and the import/export sectors were freed up from excessive licensing restrictions. The shilling was allowed to be market determined (with the typical stabilization influence by the central bank) and interest rates were also freed to market forces. After the elections in 1992, the government ceased the printing of money to finance government shortfalls and was forced into meeting imbalances through borrowing. Following this, inflation has increasingly been under control, averaging at or below 10 percent since 1996. Real interest rates, on the other hand, increased dramatically as the government had to pay high interest rates in order to raise the significant amount of funds it required. Much of the government debt was held by commercial banks which tended to choke off domestic private lending. The high real interest rates attracted foreign funds and this helped to maintain a strong shilling over this time (1995-1999). The recent macro-economic indicators have generally been well received by the World Bank and IMF.

The government has had difficulty in funding its planned public expenditure program. Government revenues have almost annually been disappointing with much evasion of tax. When the IMF also withdrew its financing mechanism, the government has had to respond by reducing expenditures. This has meant that infrastructure revitalization and development has been slowed. The El Niño rains of 1997-98 further

damaged the poor infrastructure. Funds for agricultural research and extension have also been tight, and have relied to a large extent on donor support. The government has reduced costs by retrenchment in some ministries and in parastatals. The Kenya Revenue Authority has also recently been given more latitude to collect taxes and in 1998 tax collections actually exceeded target levels. The government has also introduced cost-sharing mechanisms in many sectors such as education and health.

In agriculture, important policy areas include inputs, credit, output, research and extension, land tenure, and land management. The agricultural input sector in Kenya has been one of the bright spots. Even prior to SAP, Kenya had abandoned subsidies for fertilizers and other inputs. Following liberalization, the government has slowly allowed competition in the sector to grow. The fertilizer sector, though already quite competitive relative to other countries in Africa, was decontrolled in 1990 and the number of importers and distributors has reached 23 by 1997 (Nyoro 1999). In response, the number of types of fertilizer on the market has increased four-fold. The seed sector also involves several major firms that compete with the Kenya Seed Company. The government has long had an interest in increasing the availability of credit to farmers. State supported credit is channeled through the Agricultural Finance Corporation (AFC), the Coffee Marketing Board, and the Kenya Tea Development Authority. The AFC though does not lend to smallholder farmers (a farmer must have at least 5 hectares of land). As in Ethiopia, lending to the livestock sector is constrained in Kenya. For example, Freeman et al. (1998b) found that a 1-percent increase in credit for purchasing crossbred dairy cows leads to 1.6 percent increase in milk productivity on credit constrained farms and 0.9 percent increase in productivity on non-constrained farms.

Private financial institutions rarely lend for agricultural purposes and when they do, only to large farmers with considerable collateral. Recent years have seen the launching of micro-finance projects, but only a few have targeted agriculture. Despite these mechnisms, it is estimated that only 10 percent of credit goes to agriculture while it contributes over 30 percent of GDP (Mwangi 1999).

There has been increased devolution of control and participation in the marketing of output by the state, but this has been a slow and rough process. Maize, the most important food crop has been largely freed from government regulation. Price supports and movement restrictions have disappeared. The National Cereal Produce Board (NCPB) still exists with the mandate to stockpile foodstuffs for national food security, but there is a thriving private sector that buys and sells maize throughout Kenya. Moreover, the NCPB itself has become a commercial enterprise and has reduced staff by 65 percent between 1993-98 (Mwangi 1999). The Kenyan government is still highly involved in the marketing of coffee, tea, sugar, and meat. Government parastatals are the sole buyer for tea and coffee, which are especially important in the highlands. Producer prices generally follow world prices and therefore Kenyan coffee farmers have not been spared the shocks of volatile world coffee prices. Production of coffee fluctuates widely in response to prices and as well to the speed of payment by the coffee board, which has often been slow in the past. The Kenya Tea Development Authority, on the other hand, has performed relatively well and tea area has continued to expand among smallholders in Kenya. For both coffee and tea, marketing outlets are well distributed through key growing areas in the highlands. The dairy sector had been tightly controlled by the Kenya government through the mid-1990s, when restrictions of selling milk to the

parastatal, Kenya Co-operative Creameries (KCC), were eased. KCC now buys a small share of total milk production and is in negotiation with a foreign firm to form a joint venture. The state still has strong influence on prices and incentives for some crops through their import policies, which in the case of maize, sugar, and wheat remain politically influenced.

Research, extension, and other agricultural information services in Kenya, while not up to the resource levels of Asian countries, compare favorably with other African countries. Agricultural research has a legacy of emphasizing cash crops for the larger farmers, but the Kenya Agricultural Research Institute has now decentralized into many locations to focus on the particular needs of smallholder farmers in those areas. Kenya has pursued the Training and Visit approach to extension and this has had poor results in some areas due to low extension worker to farmer ratios and limited transport resources. The government, however, is a supporter of new approaches and has facilitated the introduction of the catchment approach for soil conservation and the many innovative methods used by an array of NGOs.

Land tenure is largely secure for rural households and this is particularly the case in the highlands. Thus, farmers' willingness to invest is not hampered by uncertainty of land rights. The government has also spearheaded efforts to promote sustainable agriculture through the establishment of the permanent presidential commission on soil conservation and afforestation. In response, production and distribution of tree seed and seedlings was actively promoted and farmers throughout the highlands continue to plant trees for various purposes. The Ministry of Agriculture embarked on an ambitious soil conservation program in the late 1970s and the National Soil and Water Conservation

Program is recognized globally as one of the most successful conservation program, now reaching 100,000 farmers per year.

Kenya has long adopted a strategy to increase local level planning. Thus, sectoral plans are developed with inputs from district level plans. While this decentralization has been in place for some time, unlike in Uganda and Ethiopia, there has not been much movement towards actual devolution of power. The executive branch retains most political power and continues to make appointments at local administrative levels and it these appointments who provide most of the inputs into local planning. The state had, until 1996, also appointed the directors of the Kenya Farmers Association. The executive branch also develops strategic plans for the country. Recognizing the continued high rural population growth rates and continuing miniaturization of farms, the government has set a goal of becoming a semi-industrialized nation within the next few decades. There will be considerable obstacles in meeting this challenge, and widening the tax base to ease rates of taxation and interest will be among the first tasks. Public investments in transport, energy, and communication infrastructure will also be required. There will be keen competition for scarce funds from both the urban and rural sectors, most notably in social programs for education and health.

UGANDA

Since taking power in 1986, the National Resistance Movement of President Museveni has implemented one of the farthest reaching programs of structural adjustment in Africa (World Bank 1994). After a brief experiment with foreign exchange and price controls failed (inflation reached 380 percent by May 1987), the Museveni government changed course and became an enthusiastic supporter of stabilization and adjustment, in

some instances moving the process faster than even expected by the IMF and the World Bank (Nygaard et al. 1997). Foreign exchange markets have been completely liberalized since 1993. The money supply and public spending have been tightly controlled, domestic price controls have been eliminated, most quantitative trade restrictions have been eliminated, the banking sector deregulated, many state-owned firms privatized, and tariffs rationalized and reduced to some extent (ibid.; World Bank 1996). The government is now investing in improving the nation's badly deteriorated infrastructure, as well as increasing investment in health, education and the agriculture sector.

The government has also moved forward with political reforms. A new constitution was adopted in 1995, and the first direct presidential elections held in 1996. Although political parties are not allowed, policymaking in Uganda is open and participatory, contributing the government's ability to build popular support for implementing such difficult policy changes (Nygaard et al. 1997). The government is now pursuing a policy of decentralization, giving greater control over the civil service and local tax revenues to local councils at the district and sub-county levels.

These changes have brought some impressive results. Peace has been restored to most of the countryside, and the government is popular even in some stronghold areas of previous governments. Economic growth averaged more than 6 percent per year (in real terms) between 1987 and 1996 (ibid.). Inflation has been brought under control, and is now under 10 percent per year. The exchange rate has stabilized and substantial international reserves have been accumulated since the early 1990s. Domestic investment has increased. In 1996, the U.S. Agency for International Development

concluded that Uganda's accomplishments were "better than anticipated," creating "a fundamentally different environment for economic growth" (ibid.).

Despite these accomplishments, major challenges remain to be solved. Poverty is still severe in Uganda; two-thirds of the population live on less than $15 per month, the minimum considered necessary to meet minimum food requirements (Ministry of Planning and Economic Development (MPED 1997). Social and nutritional indicators in Uganda are among the lowest in the world (Nygaard et al. 1997). The AIDS epidemic has reached alarming proportions; an estimated 110,000 people died of AIDS in 1995, and the numbers are projected to increase for the next several years (ibid.).

The problem of poverty is particularly acute in the rural areas. The benefits of rural growth are not yet broadly shared in the countryside, where low-input semi-subsistence farming still dominates. Since 1987, per capita incomes in rural areas have increased less than 1 percent per year (Opio 1996), and food production per capita is still below the pre-1971 level (World Bank 1996). A combination of dry weather and crop disease pushed some rural communities to near famine conditions in 1997 (Nygaard et al. 1997).

There is substantial untapped potential in agriculture in Uganda. Yields on research stations are twice as high for beans and five times as high for maize as on farmers' fields (MPED 1996). Fewer than 30 percent of farmers use improved seed varieties and almost no farmers use fertilizer (ibid.). In part, this reflects low farmgate prices resulting from high transport costs and marketing margins: in 1993/94, farm prices averaged only 17 percent of retail prices for maize and 33 percent of retail prices for beans (ibid.).

In recognition of this potential, the Government of Uganda has decided to pursue a strategy of agricultural modernization as the linchpin of its strategy to eliminate poverty and ensure sustainable and rapid economic growth. The overall objective of the strategy is to transform smallholder agriculture from a subsistence to a commercial orientation, with greater total factor productivity, lower unit production and marketing costs, greater use of high yielding varieties and modern inputs, more diversified production of commodities with higher value and higher income elasticities of demand, and increased exports of traditional and non-traditional commodities (Government of Uganda 1998). Some of the key priorities of the modernization strategy include investing in infrastructure, increasing the role of the private sector in all commercial agricultural activities, decentralizing government functions, improving research-extension-farmer linkages, and implementing land reform.

With regard to infrastructure, the government has initiated a 10-year Road Sector Development Program, which will invest an estimated $1.5 billion on road improvement (ibid.). This will focus principally on the main roads, but also includes a component for rural feeder roads. In 1998/99, the government will spend Shs. 25 billion (about $18 million) for maintenance of feeder roads, more than double the previous level, and about Shs. 14 billion ($10 million) for rehabilitation of feeder roads. Despite these investments, the level of investment in rural roads is much less than that called for in the original version of the Modernization Plan (ibid.); consequently the state of rural roads is likely to remain poor for some time to come. Steps are also being taken to reduce taxes that affect transport costs; for example, the tax on petrol has been reduced by half (to Shs. 150 per litre) since 1997. The government has decided not to invest in construction of irrigation

infrastructure, although it will finance development of irrigation information and capacity building for smallholders in water harvesting methods.

Increasing the role of the private sector is a fundamental element of the modernization strategy. The government has clearly indicated that it will not be involved in the direct production or supply of agricultural inputs, in providing credit subsidies, or in processing or marketing outputs. Agricultural research for commercial crops, such as coffee, is to be financed increasingly by producers, and public extension services will not be provided to commercial farms. The government hopes that the private sector will develop largely on its own, facilitated by appropriate intervention to ensure peace, security and a stable macroeconomic environment; and to provide necessary regulations, infrastructure, and effective technology packages.

Another fundamental element of the strategy is the policy of decentralization. Together with increased reliance on the private sector, this is associated with a reduced role for the central government in agriculture. In line with this, the staff of the Ministry of Agriculture, Animal Industries and Fisheries (MAAIF) has been reduced from 1,400 to around 280. Local governments (districts and sub-counties) are now primarily responsible for planning and implementing agricultural programs and projects. Under the Local Governments Act of 1997, districts are now responsible for providing agricultural extension, land administration, and protection of forests and wetlands, while sub-county governments are responsible for provision of ancillary field services in agriculture, efforts to control soil erosion and protect local wetlands, and enforce other local regulations relating to natural resources and wildlife. Local governments are empowered to assess

and collect taxes and use revenues for their own purposes, with at least 65 percent of locally collected revenues to remain with the sub-counties.

This decentralization holds great promise of making government programs and expenditures more responsive to local priorities. This may mean, however, that agricultural activities receive less priority than might be desired by the central government, at least in the near term. For example, only three out of 32 districts whose 1997/98 budgets had been analyzed by MAAIF had allocated more than 3 percent of their budget to agriculture (ibid.). In addition, there is a great need for the central government to help develop the capacity of local governments to handle the many functions they now perform. The central government will also need to be involved in programs and projects having broader impacts across districts, such as development of highways and the communications network. These needs appear to be adequately anticipated by the government, although implementation will undoubtedly pose significant challenges.

Decentralization will play a major role in the process of improving research-extension-farmer linkages. With extension now the responsibility of the districts, extension priorities will be more in line with local priorities of farmers. The linkages between the district extension agencies and the National Agricultural Research Organization (NARO) have not been fully worked out yet. This is to be accomplished by establishing Zonal Agricultural Research and Outreach Centres (ZAROC), which will be involved in adaptive research and on-farm demonstrations. Despite the decentralization of extension services, extension will be funded mainly by the central government. The top priority in the agricultural budget plan for the next five years is extension services for smallholders, with expenditures for extension expected to more than double, while

research expenditures will grow much more slowly (ibid.). This is because extension has been neglected in Uganda, with spending on extension as a percentage of GDP lower than in other Sub-Saharan African countries.

Land reform is another major priority in the Modernization Plan. The Land Act of 1998 repeals earlier land laws; ensures security of tenure to owners of land held under customary tenure, freehold or leasehold; ensures security of tenure to long-term occupants of mailo land, and provides procedures for converting customary or mailo land to freehold or leasehold tenure. In the past, there have been conflicting claims to mailo land by occupants and owners, and the Land Act was intended to settle this issue. Long term (longer than 12 years) occupants of mailo land are provided a secure and inheritable use right, and rent is limited to be no greater than Shs. 1,000 per year (less than $1). This appears to be intended to encourage mailo owners to sell their interest in the land to the occupants, since the rents they receive are very minimal. In addition, the law provides for a Land Fund to be established, to help smallholders and land occupants to acquire and register land under secure tenure. Implementing this land reform will entail substantial costs to finance land purchases, register or title land, adjudicate disputes, resolve conflicts, etc. In the long term, the land reform may enhance tenure security and the development of land markets, though in the near term it may create difficulties as the procedures and problems are sorted out.

Other priorities for modernization include development of rural credit institutions, development of agricultural input and processing industries, improving access to export markets, fisheries and forestry development, and others (ibid). The Modernization Plan also incorporates government activities related to these priorities, although funded at

much lower levels than road development, extension, research, or land reform. Despite some expenditures on capacity strengthening in developing rural credit institutions, limited development of the rural financial system will likely remain a drag on agricultural development for the near future. Contributing to the problem is the very low rate of savings in Uganda (only 1 percent of GDP in 1994 (World Bank 1996)), which also limits the ability of the government to finance infrastructure and other investments without large foreign grants or borrowing. Mobilization of rural savings, as well as provision of credit services, will need to be a high priority of non-governmental organizations and the private sector if these problems are to be overcome.

4. STRATEGIES FOR SUSTAINABLE DEVELOPMENT

Over the past decade, a consensus has begun to emerge about many common features required for successful development strategies in Africa, most of them following standard neoclassical prescriptions (Delgado 1995; World Bank 1994; Cleaver and Schreiber 1994). General peace and security are needed to allow a climate favorable to production and investment. Macroeconomic policies that ensure a low and stable inflation rate are needed to reduce risks and allow development of the financial system. Foreign exchange and trade policies should be liberalized to avoid a bias against tradable goods. Competition should be allowed to develop in domestic markets to promote efficient allocation of scarce resources.

Although this consensus is very helpful in encouraging governments to stop doing things that have had negative impacts on development (such as foreign exchange and domestic price controls), it is less helpful in providing guidance to governments on what

they should do. A useful general principle to guide government action is to undertake those actions that yield high social net returns and that would not be done as well by some other means in the absence of government action. According to this principle, governments should intervene mainly to provide public goods (goods such as research or rural roads whose benefits are largely nonrival and nonexcludable, and hence not adequately provided by private markets); to address other market failures such as externalities (such as caused by environmental pollution or water use), missing markets (such as absence of credit and savings markets), and imperfect competition (such as monopoly power); or to address equity considerations such as problems of deep seated poverty.

To move from this general principle to specific actions, it is helpful to think of different pathways of development that may be appropriate in different circumstances. As mentioned in the introduction, the appropriate pathway of development depends upon current and potential comparative advantage. The returns to alternative policy and technology strategies in different locations will depend upon the potential comparative advantages. For example, investments in research and extension linked to adoption of improved cereal varieties and heavy use of inorganic fertilizer are likely to yield much higher returns where rainfall is relatively assured than in drought-prone areas where use of such inputs can be very risky. Highly labor intensive methods of soil and water conservation, such as building terraces or composting, are more likely to be adopted in more densely populated and less commercialized areas, where the opportunity cost of labor is low. Adoption of animal traction technologies is likely to yield higher returns in areas with heavy clay soils than in areas with light, erodible soils. Strategies relying on

heavy use of purchased inputs and credit are unlikely to be successful in remote areas where high transport and marketing costs make subsistence agriculture the dominant development pathway, even if they are able to cause substantial improvements in productivity. Similarly, commercial dairy production is likely to develop in peri-urban areas but not in remote areas.

Many factors combine to determine comparative advantage and the appropriate response to it. We will focus on three factors that we believe are critical: agricultural potential, access to markets, and population pressure. Agricultural potential is an abstraction of many factors—including rainfall, altitude, soil type and depth, topography, presence of pests and diseases, and others—that influence the absolute (as opposed to comparative) advantage of producing agricultural commodities in a particular place. There are of course variations in potential depending upon which commodities are being considered. Furthermore, agricultural potential is not a static concept but changes over time in response to changing natural conditions (such as climate change) as well as human-induced conditions (such as land degradation). For simplicity of exposition, however, we will sweep aside these important considerations and discuss agricultural potential as though it was a one dimensional and fixed concept. In reality, the multi-dimensional and dynamic nature of agricultural potential should be considered when developing more specific strategies of development than will be possible in this paper.

Access to markets is critical for determining the comparative advantage of a given location, given its agricultural potential. For example, a community with an absolute advantage in producing perishable vegetables (i.e., total factor productivity in vegetable production is higher there than anywhere else), may have little or no comparative

advantage (low profitability) in vegetable production if it is far from roads and urban markets. As with agricultural potential, market access is also a multi-dimensional and dynamic concept (distance to roads, condition of roads, distance to urban centers, degree of competition, access to transport facilities, etc.), but we will treat it as a single predetermined variable (though subject to change through investments in roads, for example).

Population pressure affects the labor intensity of agriculture by affecting the land/labor ratio, and may also induce innovations in technology, markets and institutions, or investments in infrastructure (Boserup 1965; Ruthenberg 1980; Hayami and Ruttan 1985; Binswanger and McIntire 1987). Population pressure thus affects the comparative advantage of labor intensive pathways of development, as well as returns to various types of investments. We take average population density as an indicator of population pressure, although one could argue that population density per unit of arable land would be a better indicator. Absence of comparable data on this latter indicator makes it difficult to use in practice, however. To some extent, differences in agricultural potential will account for differences in arable land per total area of land (i.e., the fraction of arable land is likely lower in areas with lower agricultural potential, controlling for population density).

These three factors interact with each other in complex ways. Population density tends to be higher where there is greater agricultural potential or greater market access, since people have moved to such areas in search of better opportunities. On the other hand, population pressure may have contributed to land degradation, reducing agricultural potential from what it once was. Market access tends to be better where there

is higher population density, since the per capita costs of building roads are lower and the benefits higher in such circumstances. Market access also tends to be better where agricultural potential is higher, since the returns to developing infrastructure are greater. Despite these interrelationships, there is still substantial independent variation of these factors in the East African highlands. Given such variations, and the fact that these factors change relatively slowly over time, it is useful to consider how different combinations of these factors influence possible development pathways.

We can classify the situations of the East African highlands into a maximum of eight types, considering "high" and "low" levels of each dimension. We recognize that there is an unavoidable element of arbitrariness in defining these terms. "High agricultural potential" refers to areas with more than 1,000 mm of annual rainfall, at medium altitude (less than 3,000 m elevation), and with soils suitable for agricultural production with minimum investment (excluding very thin soils, vertisols, highly acidic soils, and those which are high P-fixing). This includes most of the highlands of Uganda and Kenya, and most of the High-Potential Perennial and High-Potential Cereals zones of Ethiopia. "High market access" refers to areas relatively close to an urban center and with access to an all-weather road and transport facilities. Although relative to other parts of Africa, population density is high in all of the highlands, we consider "high" population density to mean greater than 175 persons per square kilometer. This includes most of the highlands of Kenya and southwestern Uganda, and some of the highlands of Ethiopia (Braun et al. 1997).

Examples of these categories are presented in Table 1. One of the possible categories—high agricultural potential-high market access-low population density—is

Table 1 Possible pathways of development in the East African Highlands

Agricultural potential	Market access	Population density: High	Population density: Low
HIGH	High	*Central Kenya, parts of Western Kenya, Eastern Uganda* - High input cereals - Perishable cash crops - Dairy, intensive livestock - Non-perishable cash crops - Rural nonfarm development	**???**
	Low	*Southwestern Uganda, parts of Western Kenya* - High input cereals - Non-perishable cash crops	*Southwestern Ethiopia* - High input cereals - Non-perishable cash crops - Livestock intensification; improved grazing areas
LOW	High	*Parts of Central Tigray* With irrigation investment: - High input cereals - Perishable cash crops - Dairy, intensive livestock Without irrigation investment: - Low input cereals - Rural nonfarm development	*Parts of Northern Ethiopia* With irrigation investment: - High input cereals - Perishable cash crops - Dairy, intensive livestock Without irrigation investment: - Low input cereals - Livestock intensification; improved grazing areas - Woodlots - Rural nonfarm devt.
	Low	*Parts of Northern Ethiopia?* - Low input cereals - Limited livestock intensification - Emigration	*Much of Northern Ethiopia* - Low input cereals - Livestock intensification; improved grazing areas

relatively uncommon, for obvious reasons. The opposite case—low agricultural potential-low market access-high population density—also is relatively uncommon, though examples may exist in parts of northern Ethiopia. There are parts of this region with low agricultural potential and population density but high market access, such as in central Tigray close to the major towns of Adwa and Axum. Areas with low agricultural potential, low market access, and low population density exist in much of the northern highlands of Ethiopia. Examples of areas with low-potential, high market access and low population density include parts of southern and eastern Tigray close to the major towns of Mekelle and Adigrat. Areas with high agricultural potential, high market access and high population density include central and much of western Kenya, parts of southern and western Ethiopia (especially non-vertisol areas close to Addis Ababa), and the highlands near Mt. Elgon in the east of Uganda. Areas with high agricultural potential, low market access and high population density include parts of the southern and western highlands of Ethiopia, western Kenya, and much of southwestern Uganda. Areas with high agricultural potential, low market access and low population density include much of the southern and western highlands of Ethiopia.

Possible pathways of development in these different situations are also presented in Table 1. Commercialization of perishable crops such as fruits and vegetables is profitable (and is occurring) mainly in areas of high-potential and high market access. Dairy production is also developing in the same regions, because of the high perishability of milk and the need for adequate feed supplies, which can be supplied in higher potential areas. Due to lower transport costs, feed markets can emerge in such areas, making it possible to intensify dairy production. As feed supplies become available, intensive beef

fattening and poultry and pig production (where pork consumption is not prevented by religious restrictions, as in Ethiopia) close to urban areas are also potentially profitable opportunities, regardless of the agricultural potential of the area (Jahnke 1982). High-value, but less perishable, crops such as coffee and tea are also being produced in some areas of high market access, though the profitability of some of these crops are less dependent on close proximity to the urban market than on proximity to processing facilities. Increased production of cereals and other food crops based on high use of improved seeds and fertilizer is being promoted throughout most of the highlands through extension programs, although the potential for this approach is of course greatest in the high-potential areas with good market access. Rural nonfarm development, strongly linked to agricultural production through development of input supply and agricultural processing industries and demand linkages for rural services, is also likely to contribute substantially to development in high-potential, high access areas.

Areas with high agricultural potential but low market access have more of a comparative advantage in producing high-value (relative to their volume) non-perishable commodities (such as coffee or tea) that can be transported over relatively long distances. Given the high costs and risks of depending on imported food into such areas, farmers are likely to continue producing most of their own food crops until improvements in roads and transportation services, as well as increased production of food crops in other regions, allow imported food to be more economical and less risky. At this stage of development, complementary linkages between crop and livestock production are important, with animals providing a source of draft power, manure and food protein, and crop residues an important source of feed (McIntire et al. 1992). Thus, intensified

livestock production may be beneficial as well, particularly in lower population density areas with more available land to provide fodder. There is good potential for adoption of purchased inputs, financed by sales of cash crops or livestock, as a way to improve local food supplies as well as income. This can result from use of inputs on both types of crops, and by freeing up land and labor from food crop production for cash crop production. However, where perennial cash crop production is not yet well established or not very profitable (but potential exists), the need for subsistence food production may undermine the ability to take advantage of such cash crop potential. For example, the Technical Committee for Agroforestry in Ethiopia (1990) reported that forest coffee production was declining in high-potential areas of Ethiopia as a result of population pressure and expanded food crop production. This is particularly likely to be a problem in higher population density areas, since the subsistence food constraint is likely to be a more binding constraint to cash crop production the more scarce land is (controlling for agricultural potential and distance to market).

In lower potential areas, such as the moisture-stressed highlands of northern Ethiopia, adoption of more input-intensive cereal production is still very limited, and likely to remain so except where irrigation investments are being made. Where irrigation investments are occurring and market access is good, commercial production of cereals and cash crops such as vegetables is also feasible (and is occurring, for example, near new microdams being constructed in northern Ethiopia). Increased production of cereals and fodder in irrigated areas may also enable intensive dairy production to begin in areas close to cities. Investments in irrigation are likely to yield lower returns in areas without good market access, unless irrigation is used for production of high-value (to weight)

crops. As in areas of high-potential but poor market access, sales of such high-value crops could help to finance purchase of agricultural inputs. Also as in that case, higher population pressure in poor market access areas is likely to make adoption of such high-value crops more difficult, due to the need to produce food locally.

In non-irrigated low-potential areas, the agricultural options are more limited. There may be potential to build upon the soil and water conservation investments being made in moisture-stressed areas, by promoting targeted and limited use of fertilizer and improved seeds to the parts of the fields where soil moisture is greatest. However, such a limited and adaptive approach is not presently being pursued. For this approach to be economically feasible, sources of income to finance input purchases are needed. Where population density is high, farms in such low-potential environments are unlikely to be able to produce sufficient surplus to finance purchase of inputs. Thus this will be most feasible closer to urban areas where off-farm sources of income are available, where rural industries such as mining are developing, or where seasonal migration (or remittances from permanent migrants) is common. In vertisol areas, as in many parts of central Ethiopia, increased food crop production depends upon investments to address the problems of drainage and waterlogging. While technologies have recently been developed to address these problems (such as the broad bed maker), adoption is not yet widespread (Gezehegn and Heidhues 1998). Factors inhibiting adoption of the broad bed maker include appear to include inadequate training in its appropriate use, limited availability of complementary inputs (especially seed and fertilizer), and low output/input price ratios resulting from removal of fertilizer subsidies and poor infrastructure (ibid.).

In low-potential areas with low population density, expansion of livestock production may offer development potential. Livestock convert low-value inputs into higher value products such as meat and hides, and are relatively easy to transport to market. Achieving this potential may require the strengthening of collective action institutions which would encourage investments in improvements of grazing lands, perhaps by planting and managing fodder grasses and trees. Tree planting activities in degraded lands may also provide opportunities for significant incomes and welfare improvement where market access is relatively good. In Eastern Tigray, for example, one village (Echmare, in the Gulomakeda woreda) started allowing private tree planting on degraded hillsides in 1992, through its own initiative. In contrast to the poor management of community woodlots in the region, private management has been very good (including watering the seedlings during the critical part of the dry season) and survival rates are reportedly as high as 90 percent. Additional areas of the degraded land have been allocated in almost every year since 1992, and households are now beginning to harvest the mature eucalyptus trees planted in the first years, which are worth 30 to 50 Birr ($5 to $8) per tree. Visual observations suggest that each household has at least 20 trees surviving in each plot allocated, or at least 100 trees in total; representing a substantial increase in household wealth in this village.[2]

The most difficult case for which to identify development pathways are areas with low agricultural potential, far from markets, high population density and without

[2] For purposes of comparison, an ox is reportedly worth about 900 Birr in this village. Thus the increment in wealth represented by a mature stand of 100 trees would be much greater than ownership of two oxen, which is a key indicator of wealth in the Ethiopian highlands.

irrigation or significant off-farm sources of income. In some cases, particularly close to forests (such as in parts of Eastern Tigray), bee-keeping is an economic activity. Small ruminants can be efficient users of available fodder resources, and can be transported long distances to market, though intensification of their use will be limited by availability of fodder or grazing materials. Tree planting on degraded lands, as mentioned above, and continued investment in soil and water conservation structures (particularly given relatively low opportunity costs of labor and the greater benefits of such technologies in drier areas) also may have significant potential to improve land productivity. Nevertheless, these seem unlikely to solve the long-term poverty problem facing such communities. Emigration is likely to be an important element of the strategy for survival and development in these areas.

5. POLICY AND INSTITUTIONAL REQUISITES

The policy and institutional requirements of sustainable development will depend upon which development pathways are pursued. Here we consider some of the critical constraints affecting the pathways discussed in the previous section, and the policy and institutional requisites to address these constraints. We also consider some of the implications of these pathways for sustainable land management.

HIGH EXTERNAL INPUT INTENSIFICATION OF FOOD CROP PRODUCTION

The first requirement of this pathway is the availability of food crop varieties that will respond well to fertilizer and other inputs in the conditions of the East African

highlands. The initial success of the Sasakawa-Global 2000 program in high-potential areas of Ethiopia (Quinones et al. 1997), and the high maize and bean yields demonstrated in research sites in Uganda (Nygaard et al. 1997), demonstrate the availability of such varieties, especially for maize.

To have the broadest and most sustainable economic impact, promotion of such technologies should account for local potentials and economic conditions as much as possible. As discussed previously, small farm sizes and uncertain rainfall (especially in moisture-stressed areas) can make allocation of half-hectare plots to new technologies a very risky strategy. This is less of a concern where rainfall is relatively assured or irrigation exists, but many farmers even in these circumstances still may prefer to adopt a more gradual or diversified approach, which may be precluded by a fixed package approach such as being promoted in Ethiopia. In addition, adaptive and participatory research is needed to develop more targeted recommendations for integrated nutrient management practices; taking into account available sources of organic matter, local sources of phosphate rock, and potential for leguminous crops or trees (Quinones et al. 1997; Sanchez et al. 1997). The priority for such research in the near term should be high-potential areas where this pathway is most feasible. For the longer term, continued basic research is needed to develop varieties that are suitable under lower potential conditions, such as in moisture-stressed environments or in acid soils.

Even without targeted nutrient management recommendations based on adaptive research, agricultural extension programs can improve the usefulness of their efforts by allowing a more flexible approach and learning from farmers. Although the fixed package of Sasakawa-Global 2000 has demonstrated some impressive results, even more

impressive results might be possible if farmers are given more opportunity to experiment with alternative mixes of inputs, and the results of such experiments are used to inform the development of more site-specific recommendations.

The availability of inputs (especially seeds and fertilizer) must also be assured. In some cases (e.g., in Ethiopia), inputs are sold by the extension program. While this is attractive as a way of demonstrating the benefits of using such inputs, this is something that can be as or more effectively provided by competitive input markets, at least to places with good market access. The longer-term goal should be to promote development of such markets. This is largely a matter of removing obstacles to such development, such as eliminating foreign exchange and import restrictions, deregulating prices, and avoiding interventions by local authorities in private marketing of inputs, as reportedly has occurred in parts of Ethiopia. Mulat et al. (1997) estimate that improvements in the competiveness of the input marketing system in Ethiopia resulting from such changes could reduce the average farm level price for fertilizer (relative to unsubsidized prices) by nearly 20 Birr per quintal (about 8 percent).[3] Other positive efforts that can help develop such competitive markets include investments in road construction and improvement and facilitation of the availability of credit to private wholesalers and retailers to finance purchase of storage and marketing facilities and working capital stocks.

In remote food deficit areas where substantial improvements in market access are not likely in the near future, consideration of the most effective means to address poverty and food security should include consideration of subsidizing the cost of transporting inputs to these areas (perhaps by continuing government provision to these areas). Since

[3] One quintal equals 100 kg.

1 ton of fertilizer can yield 3-7 tons of additional grain in higher potential areas (Mulat et al. 1997), it is much cheaper to subsidize the cost of transporting fertilizer than grain (through food aid) to such areas as a means of addressing food deficits. Subsidies are of course costly and difficult to maintain as a long-term strategy, but are a lower cost alternative to providing food aid to relatively high-potential, remote, food-deficit areas. There also can be difficulties in targeting subsidies, if farmers try to resell the fertilizer to other areas where fertilizer is not subsidized. This potential problem would be minimized, however, if the subsidy were only on transport costs. The longer term solution for such areas is to invest in improved infrastructure and transport services, but people still must be able to feed themselves in the near term.

Of course, exporting substantial quantities of grains from remote areas is not likely to be economical due to high transportation costs, and should not be promoted through subsidies. For example, it may require a two-day round trip for a farmer to take a quintal of grain by donkey to the nearest market from remote areas in Ethiopia. The opportunity cost of this trip (including the farmer's time and additional feed) could easily be 10 to 20 Birr, possibly approaching 10 percent of the value of the grain sold. Probably more important, farmers in remote areas may simply be unable to sell substantial amounts of grain, even if they produced a surplus, due to limited ownership of pack animals and carts. Thus, it is not a good idea to subsidize fertilizer imports to areas that are not facing food deficits, since the impact will be to produce a local surplus and depress local prices.

In areas with high-potential and good market access, subsidies for inputs should be avoided. Such areas are likely capable of producing and marketing sufficient surplus production to pay for inputs purchased without subsidies. The main constraints to

increased input use in such areas may be limited access to credit and limited information where extension systems have not functioned well, as in Uganda.

In moisture-stressed areas with otherwise suitable soil conditions (particularly areas close to roads and markets), high priority should be given to irrigation investments where irrigation potential exists. The drought prone areas of southern Tigray close to Mekelle are a good example of such a situation, and in fact this is where SAERT is focusing much of its investment in constructing microdams. In more remote areas with irrigation potential, priority should be given to investments in roads as well as irrigation, since marketing constraints may otherwise undermine the ability to reap the full benefit of irrigation investments.

In all areas where a high external input pathway is pursued, development of rural savings and credit institutions is critical to the long-run sustainability of the effort. As discussed earlier, rural credit institutions are poorly developed in most of the highlands, and practically non-existent in Uganda. Efforts to develop such institutions should focus on areas where there is good potential for a high input strategy. The greatest immediate need is of course for short-term credit simply to finance the input purchases. However, where surplus production and trade is possible, marketing credit to allow farmers to store and market grain during the dry season is also very important. Related to that, credit to finance investment in grain storage and facilities is needed where inadequate capacity exists. Adequate regulation of private grain warehouses, for example through licensing and bonding, is also needed to assure quality and reliability of the grain stored. Given such regulation, private warehouse receipts could serve as reliable collateral for marketing or other kinds of loans. In areas with sufficiently large production and good

market access to support grain milling, credit or equity to finance such investments will also be needed. The development of equity markets in the highland countries may be helpful in this regard, as is maintaining a policy environment favorable to domestic and foreign investment in industry.

The high external input pathway may facilitate more sustainable land management. Investments in soil and water conservation will be more attractive to private farmers since the value of land and the need to minimize losses of valuable inputs through erosion and runoff will be increased. In addition to direct benefits where such intensification occurs, indirect benefits in other areas can also result, as increased supplies of biomass reduce pressure on forests and grazing areas, and increased incomes provide alternatives to expansion of production onto marginal lands.

The impacts of this strategy on restoring soil fertility are not assured however. Soil fertility can be restored through increased use of fertilizer together with greater production of organic material. However, a net increase in soil mining may occur even with greater use of fertilizer, as a result of increased losses through erosion, leaching and quantities harvested. For example, recent estimates from western Kenya show greater nutrient mining on farms where there was more commercial orientation in food crop production, suggesting that the profitability of using fertilizers in food crops may be insufficient to prevent such depletion (de Jager et al. 1998). Further research is needed on this issue.

In summary, to fully realize the potential benefits of a high external input strategy of increasing food production, adequate attention must be paid to factors affecting the feasibility and profitability of input use, including infrastructure, extension, input

availability, credit, and marketing facilities. In some cases where persistent food deficits exist, subsidies on the costs of transporting inputs should be considered as a lower cost alternative to food aid, until these other constraints can be overcome (IFPRI 1995).

LOW EXTERNAL INPUT INTENSIFICATION OF FOOD CROP PRODUCTION

In lower potential areas without irrigation, the return to using external inputs, particularly fertilizer, is likely to be much more limited. The strategy for intensifying food crop production therefore must rely on a low (not zero) external input approach. In moisture stressed areas, a critical need is to conserve and use the available soil moisture as efficiently as possible, in combination with integrated use of limited amounts of inorganic fertilizer with organic nutrient sources.

In northern Ethiopia, where the moisture stress problem is severe, soil and water conservation structures such as stone bunds and terraces are very common, and there may be good potential to increase production through better management of water and nutrients where these structures exist. For example, it might be possible to significantly increase production with limited risk by targeting use of fertilizer and manure in the vicinity of conservation structures, where soil moisture is greater. However, the fixed package approach of the current extension program has not encouraged such site-specific experimentation. In addition, little adaptive research has been conducted to explore the potential of such integrated approaches to conservation and productivity improvement.

Research is also needed to better understand the potential for improving soil productivity through integrated use of organic and inorganic fertilizers in different settings (Palm et al. 1997). Organic sources vary greatly in terms of their biomass productivity and nutrient content, their interactions with soil moisture and inorganic

sources of nutrients, and their impacts on productivity; and these issues are not yet well understood in Sub-Saharan Africa (ibid.). For example, application of organic materials may reduce nutrient availability to crops by immobilizing nitrogen, especially if the ratio of carbon to nitrogen in the organic materials is high. Organic materials can also increase pest problems. On the other hand, they may increase nutrient availability by reducing phosphorus fixation, and improve soil physical properties and water holding capacity. It is also important to recognize that many organic "sources" of nutrients (such as crop residues or manure produced from grazing crop residues) only recycle nutrients within the farming system, and do not add to the stock of nutrients in the system. As important as such recycling is to help slow the rate of nutrient depletion, it cannot restore soil fertility. Biological nitrogen fixation by leguminous plants, uptake by trees of nutrients that are unavailable to crops, and transfer of biomass from outside the farm do increase the stock of nutrients available to the farming system, and can be very important components of a low external input strategy. However, these strategies cannot adequately restore phosphorus where it is depleted (Sanchez et al. 1997). Thus, some use of inorganic fertilizer is an essential component of strategies to restore soil fertility and increase agricultural productivity, especially where phosphorus depletion is a major problem.

A critical constraint on increased use of organic material in low-potential areas is the shortage of such material and high demand to use it for other purposes (particularly in high population density areas) such as burning of dung and grazing of crop residues. It is thus difficult to address the soil fertility problem in such areas without addressing the larger problem of a shortage of biomass. One way to address this issue is to make better

use of degraded lands and communal grazing areas to produce biomass. As the experience in the village of Echmare in Eastern Tigray discussed earlier indicates, there is substantial potential to increase production of trees on degraded lands, helping to relieve local shortages of wood for fuel and construction materials, as well as generating substantial income and wealth. The key to success seems to be to provide the right set of incentives. The community approach to planting woodlots has yielded limited benefits in Ethiopia, whereas allowing individuals to receive private benefits from tree planting (with secure tenure) shows promise of achieving impressive results. The regional governments of Tigray and Amhara have been sufficiently impressed by the potential of the private approach that they have made private allocation of wastelands for tree planting a part of their land policies.

The impact of these new policies remain to be seen, but if they do result in a substantial increase in tree planting and harvesting from wastelands, more manure and crop residues can be recycled into crop production as fuelwood becomes more available. As the general biomass shortage is reduced, the need for the most rapidly growing species (generally eucalyptus) will decline, and other kinds of trees, such as fruit trees, legumes, and fodder producing trees may become more attractive to plant. This will increase opportunities for improving soil fertility and intensifying livestock production, as well as generating income directly from tree products.

Improved management of pasture and grazing areas also could yield substantial benefits. For example, area enclosures are being used to allow regeneration of natural grasses and trees in many parts of the Ethiopian highlands. These are showing good results in terms of regeneration, but there are common complaints from farmers that they

are not benefiting from the biomass being produced (where cut and carry or controlled grazing systems have not been established). In addition, enclosures tend to increase pressure on other unprotected areas, so the net impact on resource degradation is not necessarily positive. To help ensure that positive benefits are achieved and felt by farmers, more intensive management of grazing areas, such as planting and managing improved grasses and trees, is needed. This could be approached by allocating such lands for private grazing use or through better collective management of enclosures.[4]

Because of economies of scale in protecting grazing areas and risk spreading advantages of using them collectively, privatization of such lands may not be optimal (Baland and Platteau 1996). However, attaining the benefits of collective management requires effective institutions at the local level. Such institutions do not necessarily arise spontaneously, even when the net benefits of effective collective action are large (ibid.). Government or other external intervention can help to catalyze the development of such institutions, though this requires a cautious approach that respects local autonomy and concerns. Heavy-handed intervention from external agents can undermine the development of such institutions, causing increased dependency on the regulatory role of such external agents, and possibly increased conflicts in the community. Research is needed to better understand the conditions under which effective institutions for managing grazing lands arise and become sustainable in the East African highlands, and how governments and NGOs can help to promote rather than undermine this development. Where this does occur, intensified livestock production, improved soil

[4] More productive pasture areas are often allocated to private individuals in Ethiopia.

fertility management, and increased incomes will also likely occur.

Organic sources of crop nutrients can also be generated on cropland. Many practices have been developed for this purpose, such as hedgerow intercropping, improved fallows, green manures, composting, and planting of fodder or multi-purpose trees (Cooper et al. 1996). High population density and remoteness from markets favors more labor intensive practices (such as hedgerow intercropping or composting) since opportunity costs of labor are lower in such circumstances (ibid; Ehui et al. 1990). However, the potential of such approaches is limited by the scarcity of water in the low-potential highlands. High population density and small farm sizes will limit more extensive practices, such as improved fallows and planting trees. In land scarce settings, planting of trees may be most feasible in particular niches, such as in the homestead plot, on bunds and on plot boundaries. However, planting on boundaries and bunds can create problems by competing with crops for water and light on the owner's as well as neighbors' fields (ibid.).[5] There are also possibilities of temporal niches, such as improved fallows during the short rainy season.

Despite these possibilities, the potential for increasing flows of organic nutrients into food crop production from such sources is probably lower than the potential offered by better management of grazing lands and wastelands, at least in lower population density settings as in much of northern Ethiopia. In very high population density, low-potential (non-irrigated) areas, the options for increased organic matter production are

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[5] These problems are particularly acute for eucalyptus, which has led the governments of some regions in Ethiopia to ban planting of eucalyptus in farmland. The competition between eucalyptus and crops is one reason farmers may prefer to plant eucalyptus in sole stands and near homesteads, rather than along field boundaries.

probably relatively limited. In such cases, development of woodlots, even on farmland, may be a better option for sustainable land use and reducing poverty (particularly where market access is relatively good and farmers have access to off-farm sources of income). The ban on planting eucalyptus trees in farmland adopted by some regions in Ethiopia may eliminate this as a feasible option, since eucalyptus is by far the preferred tree because of its ability to grow rapidly, produce valuable products, and regenerate even in very dry conditions.[6] Furthermore, discussions with farmers suggest that many believe that the ban is on planting any kinds of trees, and not just eucalyptus. In any case, it is not clear why policies relating to planting trees in farmland could not be set by local communities rather than regional or national governments, since the impacts are localized.

Tenure insecurity on farmland may also undermine investments in tree planting, manuring, soil and water conservation structures, and other land improvements. In the East African highlands, this issue appears to be of greatest concern in Ethiopia where land redistributions are still a threat (excluding Tigray). Problems of insecurity may be greatest for women, who are normally producers of food crops, but who are often not allowed to make decisions on long-term land investments, such as tree planting. Restrictions on long-term leasing, as in the Oromiya region may also reduce such investments where leasing is common. Land fragmentation, as is common throughout much of the highlands, is likely a major constraint to investment in manuring, mulching,

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[6] It is not clear how well this ban is being enforced. One can readily observe eucalyptus trees planted in farmlands in various parts of northern Ethiopia. Nevertheless, the policy may be limiting tree planting by increasing the risks of doing so.

or other approaches requiring transport of bulky materials to distant fields. Fragmentation may also prevent investments in land improvements such as planting fruit trees or constructing soil bunds, since these may be subject to theft or damage by neighbors if not easily supervised. For example, Olson (1995) reports cases of farmers in the Kabale district of southwestern Uganda surreptitiously undermining terraces on plots of their upstream neighbors, thus "harvesting" some of the fertile soil that had accumulated in the terrace. Restrictions on land sales and leasing, as exist in Ethiopia, contribute to the land fragmentation problem. However, the example from Uganda, where such restrictions do not exist, suggests that reform of land policies would not necessarily solve it.

Livestock grazing practices also can have a significant impact on the feasibility of some kinds of land improving investments. For example, free grazing on farmland after the harvest is common in much of the Ethiopian highlands. This likely limits the ability of farmers to invest in planting many kinds of biological measures to control erosion and restore soil fertility, since such measures may be destroyed by grazing or trampling. Thus, improvements in management of farmlands may depend upon changes in the grazing system and improvements in the management of grazing areas.

Other issues such as fertilizer and input credit supply are less important where a low external input strategy is pursued than where a high input strategy is pursued, since such areas will have lower demand for these inputs. Nevertheless, these areas should not be neglected in this regard since the small amounts of inputs and credit they use may be highly important. Other kinds of credit, particularly credit for productive nonagricultural purposes (such as petty trading) and for consumption purposes may be highly important

in addressing problems of poverty and food insecurity. Development of road infrastructure, storage facilities and the output marketing system will be less important to such areas as suppliers of food, but critical to them as net importers of food.

INTENSIFICATION OF LIVESTOCK PRODUCTION

The most widespread technical constraint to intensified livestock production in Sub-Saharan Africa is the availability of feed (McIntire et al. 1992; Winrock International 1992). In the densely populated highlands, the prospects for relaxing this constraint through increased forage production in farmlands is limited (except where high-value dairy production exists), given the scarcity of land and food (McIntire et al. 1992). Except in less densely populated parts of the highlands, the potential for increased fodder production in communal grazing areas and wastelands is also limited, as discussed above. Imported feed and feed concentrates are likely to be of limited use, except in very commercialized systems such as dairy production in Kenya. Thus, the prospects for livestock intensification (especially in mixed crop-livestock systems common in Ethiopia) may depend substantially upon the success of intensification of cereal production, which can greatly increase the quantity and quality of crop residues available as a feed source, as well as freeing up land to be used for increased forage production. This implies that the policy and institutional requisites of cereal crop intensification discussed above are also critical to livestock intensification.

Other important constraints to intensified livestock production in the East African highlands include animal diseases, limited stock of improved breeds, limited availability of veterinary services and other inputs, poor infrastructure, and limited market and institutional development (Winrock International 1992). While it is desirable to address

all of these constraints wherever they are binding, priority should be given in the near term to places where there is substantial commercial potential and where the feed constraint is not binding. For example, improved dairy breeds are not likely to be used where adequate feed cannot be assured or only limited commercial potential exists, given their cost and greater demand for feed. Returns to investment in veterinary services, infrastructure and marketing facilities will be much greater where commercial potential exists and feed is adequate than elsewhere. Thus, such efforts should be targeted in the near term to areas close to urban markets, particularly where dairy potential exists, since the returns to this activity are relatively high (McIntire et al. 1992; Jahnke 1982).

Significant opportunities for export of live animals exist in East Africa, especially in Kenya and Ethiopia. Traditionally animals are exported from these countries to satisfy demand for live animals (especially small ruminants) in the Middle East. Therefore policies to further facilitate export markets of live animals will be appropriate. Development of the export markets will require significant investments in infrastructure (e.g., ports and roads) as well as investment in research to improve feed availability and the elimination of animal diseases. Further expansion of export markets for live animals will diversify the source of export earning which are largely dependent on traditional cash crops such coffee and tea.

Development of dairy cooperatives may be a critical component of a strategy to develop dairy production in areas of high market access. Because of the bulky, highly perishable, and easily contaminated nature of fluid milk, the transaction costs and risks involved in marketing milk are very high (Staal et al. 1997). Dairy cooperatives help to reduce risks and transactions costs facing individual producers by pooling risk, reducing

unit costs due to economies of scale in collection and transport, making inputs available, and enhancing their bargaining power. They reduce costs faced by processors by reducing milk acquisition costs and assuring the quality and reliability of the supply. In addition, dairy cooperatives may contribute to the development of social capital; for example, by investing in education and health facilities.

Dairy cooperatives have played a potent role in dairy development in Kenya. The government of Kenya has promoted dairy development for many years through the Kenya Cooperative Creameries (KCC), which acts as a stable market outlet for smallholder dairy producers and private cooperatives. This undoubtedly contributed to the success of dairy development in Kenya, but has had problems in recent years as poor financial performance of KCC (due in part to policies of pan territorial and pan seasonal pricing) caused delays in payments to private cooperatives and producers (ibid.). The Kenyan government liberalized the dairy industry in 1992, eliminating KCC's monopoly on processed milk sales (but not on raw milk sales) in urban areas.[7] This liberalization, together with KCC's difficulties, led to more rapid development of private dairy marketing cooperatives (ibid.). Despite the liberalization, policy distortions continue to inhibit the competitiveness of the dairy sector in Kenya, particularly the monopoly power of the KCC (Staal and Shapiro 1994). Lack of credit to finance transport and processing equipment, and excessive government regulation of private cooperatives may also be important constraints (Staal et al. 1997).[8] Further market liberalization and provision of

[7] Although the restriction on selling raw milk in urban markets was not officially eliminated by the 1992 liberalization, many private producers and cooperatives began selling raw milk directly to consumers after that (Staal et al. 1997).

[8] For example, all expenditures by cooperatives of over KSH 5,000 (less than $100) must be approved by the District Cooperative Officer, and approval of the Ministry

credit for the private marketing sector could help the cooperatives to develop even further.

Dairy cooperatives are much less common in Ethiopia. Almost all milk is marketed through informal channels in the Addis Ababa milkshed; only 12 percent is sold to the parastatal Dairy Development Enterprise (DDE) (ibid.). As a result, substantial differences in prices received by different producers and paid by different buyers exist. Large producers receive higher prices than smaller producers, urban producers higher than peri-urban, and all producers are willing to accept lower prices if selling to larger and more reliable customers (ibid.). Controlling for these differences, farmers with more capital are able to obtain higher prices than poorer ones. These findings suggest that development of cooperatives could help promote smallholder dairy development in Ethiopia, by helping to reduce transactions costs and achieving economies of scale. The Smallholder Dairy Development Project, funded by FINNIDA, has begun to promote development of milk groups for processing and marketing in peri-urban areas of Ethiopia.[9] Preliminary results from a recent survey of such groups suggest that there are substantial variations in their performance and viability, influenced by many factors (Nicholson et al. 1998). One factor that appears to be particularly important is economies of scale; the largest group studied obtained the highest prices for dairy products and was the most profitable (ibid.). Thus, changes in farmer attitudes towards participation in cooperatives are likely to be an important determinant of their success in

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of Cooperative Development is required to appoint and dismiss key cooperative management positions (ibid.).

[9] Perhaps because of the negative impression farmers have of cooperatives from the politicization of service cooperatives under the Derg, dairy cooperatives are called "milk groups" in Ethiopia.

Ethiopia. As in Kenya, removal of bureaucratic obstacles to cooperative development and availability of credit could help facilitate cooperative development.[10] Availability of crossbred cattle also must be assured. Government provision of information about market opportunities and prices and capacity building in cooperative management could also be very helpful.

Development of other intensive commercial livestock enterprises such as beef fattening and poultry and pork production is constrained mainly by the need for low-cost feed, though religion also plays a strong role with regard to pork consumption. Where domestic feed supplies are limited, avoiding restrictions on imported feed concentrates could help such enterprises to develop. Once demand for such concentrates becomes sufficiently developed, and domestic production of cereals increases sufficiently, local production of feed concentrates may become profitable. Ensuring a policy environment attractive to foreign and domestic investors could be an important element in facilitating such development.

Development of such commercial intensive livestock industries would greatly increase the availability of manure. Given the high cost of transporting manure, the direct impacts on soil fertility would be limited mainly to areas close to the urban markets where these industries develop. However, the increase in supply of such organic material might be used to develop domestic industries supplying more concentrated fertilizer or fuel, which could have a significant impact even in areas further from the urban market.

[10] For example, government agencies in Ethiopia are reputed to have claimed ownership of dairy processing equipment purchased by groups of producers under dairy development projects (ibid.).

An attractive policy environment could also help facilitate investment in this type of venture.

In more remote areas, focusing on increased fodder production (through increased cereal production, forage crops and/or fodder trees) may be the greatest opportunity in the near term. Given improved fodder production, there will be opportunities to promote increased productivity in small ruminant production, particularly in lower population density settings, together with improved grazing land management. Public measures to control or eliminate animal diseases are justified in remote areas as well as commercial areas for both efficiency reasons (due to the public goods nature of the investment) and to address rural poverty and food insecurity.

COMMERCIAL PRODUCTION OF PERISHABLE CASH CROPS

Where there is very good access to markets and irrigation or sufficiently reliable rainfall, intensive commercial production of perishable fruits and vegetables can be very profitable. As with intensified livestock production, the ability to pursue this strategy may depend upon the success of increased productivity of cereal production, though for a slightly different reason. Risk averse farmers with very little land are usually reluctant to gamble on new and highly risky crops, however potentially profitable, unless their food security is assured (von Braun et al. 1991). Such assurance need not depend only on local food production though. For example, small farmers in western Kenya are adopting vegetable crops and importing maize from Uganda. Open trade policies thus can be very helpful in allowing such commercialization to occur. Nonfarm income can also provide sufficient food security to allow commercialization to occur (ibid.). But in cases such as in much of central Ethiopia and parts of Uganda, where a potential comparative

advantage in cereal production exists, realizing that potential can be an important first step towards enabling farmers to diversify into higher value products. Thus the requisites of high-external input intensification of cereals also most likely help to promote intensive production of perishable cash crops in such cases. At the same time, income earned from such cash crop production can help farmers intensify food crop production, by enabling them to purchase more inputs. Thus increased cash crop production and increased food crop production may be mutually reinforcing strategies.

One important constraint may be lack of knowledge about such products, especially their market potential. Technical assistance, emphasizing market opportunities for different crops as well as crop management, can be very important. With fresh horticultural products, local markets can quickly become saturated, causing dramatic price declines.[11] It is critical for farmers to be aware of the potentials and problems of alternative crops, so that they can diversify their production. Information on prices in local markets, announced over radio, could also be helpful.

Such technical assistance need not come only from government extension agents however. In other parts of the world, farmers often obtain advice from other farmers, input suppliers or traders. As the input marketing system develops, local suppliers will become more knowledgeable and able to provide advice to farmers. Providing training to suppliers as well as farmers could help this process. For some things, however, technical assistance probably must be provided (or at least financed) by governments, due to incentives facing private suppliers. For example, integrated pest management and

[11] On a field trip to a microdam site near Axum in Tigray, farmers recounted how the price of tomatoes fell from 8 Birr/kg to 2.50 Birr/kg and the price for peppers fell from 6 Birr/kg to 3 Birr/kg after the previous harvest.

organic farming methods may not be adequately promoted (relative to their potential benefit) by private input suppliers, since these methods may reduce their sales of agrochemicals. Training is also needed on proper use and disposal of pesticides, which are likely to be much more widely used where horticultural development is occurring. Taxes on pesticides, so that their private cost reflects their social cost accounting for negative externalities, would help to promote safer and more efficient use of pesticides, while generating revenue for governments.

Another important role for the state in promoting horticultural crop development is to open up international trade in seeds. The role for research on new varieties may be more limited than for cereals or other major crops, due to the wide variety and relatively small amounts produced of any particular horticultural crop.

Where irrigation is used in production of cash crops, conflicts may arise over access to water and management of irrigation systems. Well functioning institutions are needed to allocate use rights and enforce responsibilities. As with institutions to manage grazing lands (discussed above), such effective institutions may not arise spontaneously, but may be catalyzed by appropriate interventions by external agents (Baland and Platteau 1996). On the other hand, external intervention may undermine the effectiveness of local management and increase the potential for conflict (ibid.). Thus a careful approach to promoting development of such institutions is warranted, taking full account of local conditions and concerns before investing in irrigation schemes or identifying the strategy to address issues of rights and responsibilities. For example, one microdam was recently completed by SAERT in Tigray, even though the former users of land flooded by the new reservoir have not yet been allocated any land in the command area. Such a

situation could cause serious difficulties to the households who have lost land and lead to conflicts that undermine confidence in the overall effort, which otherwise appears to be achieving impressive results. In other cases in Tigray, local community councils have been very involved in such decisions from the outset, and land in the command area has been allocated to all affected households; resulting in broad support for the effort.

Available input supply and credit to finance input purchases are of course important for producers of horticultural crops, as they are for high input production of cereals. Given the high expected returns to such inputs, linking future credit to repayment of past loans can provide a strong incentive to repay. However, since such crops are highly risky (particularly price risk), lenders may be reluctant to lend as much as farmers desire where collateral is limited, as in Ethiopia where land cannot be mortgaged. Where land can be mortgaged, farmers may be reluctant to borrow due to the risk involved, even if the expected profits are high. Alternative institutional arrangements, such as sharecropping and contract farming, can be used as a means of reducing risks and obtaining access to short term capital.

Tenure insecurity, restrictions on leasing, and land fragmentation may limit commercialization of perishable cash crops for the same reasons cited earlier in discussing factors affecting investments in land improvement. These factors are particularly important with respect to planting fruit trees, which of course require long-term tenure security, and protection against theft or being cut for fuelwood. Where such security is lacking, investments in fruit trees are likely to be limited to plots near the homestead.

Where there is potential for developing processing and/or export, the availability of cold storage, processing and transport facilities may be critical constraints. The availability of electricity is one factor that may constrain the development of such facilities. Where electricity is not available, storage facilities and processors may use diesel generators, although the costs may be high, especially where fuel taxes are high. Commercial credit or equity capital also will be needed. Provision of infrastructure and lines of credit for such purposes and maintaining a policy environment that facilitates private investment are thus likely to be very important to achieve this potential. Development of processing can also promote contract farming or cooperatives, since processors will seek to assure themselves a reliable supply.

There is good potential for sustainable land management where horticultural production is occurring, but there are also risks. Such high-value, labor-intensive production may reduce pressure on land by providing farmers' sufficient income on a smaller area of land. It can contribute to agro-biodiversity and help to reduce pest problems if used in rotations with primary staple crops (Pingali and Rosegrant 1995). Horticultural production can encourage investment in soil conservation by increasing returns to such investments. For example, Tiffen et al. (1994) found a strong association between adoption of horticultural crops and construction of bench terraces in the Machakos district of Kenya. The cash income generated by horticultural production also provides incentive and ability to purchase fertilizers, which may restore soil fertility. This effect is not assured, however, since multiple cropping of horticultural crops can rapidly deplete soil nutrients even when increased fertilizers are applied. Education and extension efforts can help to address such problems, though farmers may simply find it

too risky or costly to apply sufficient amounts of fertilizer to avoid this problem. Other potential problems include contamination of soil and water and human health risks caused by agrochemicals, and increased conflicts over water. Applied research and extension related to integrated pest management, integrated nutrient management, and water management are critical to minimize such risks and attain the greatest possible benefits from this development strategy.

HIGH-VALUE NON-PERISHABLE PERENNIAL CROPS

Given the time lags required to receive the benefits of investment, expansion of production of high-value perennial crops such as coffee and tea where land is scarce depends upon first assuring food security. Since areas with a comparative advantage in such non-perishable crops will tend to be further from markets than dairy or horticultural areas, relying on imported food is likely to be more costly than local production. Increased food production therefore must be high priority for such areas, with the goal being elimination of local food deficits and freeing up of scarce land for the production of higher value crops. The policy and institutional requisites thus include those discussed earlier to achieve high input intensification of cereal production, including consideration of subsidies on the transport cost of fertilizer in the near term until food deficits are eliminated and income from perennial crop production is growing.

Many of the requirements for other commercial strategies mentioned earlier are also important for high-value perennials. Investment in roads, land tenure security, and land transactions (to reduce fragmentation) are critical. Research and extension to promote use of improved varieties and improved management is needed. Some of this can be (and is) financed by fees on commercial producers; however, there may still be a

need for public sector research and extension to reach small producers using low technology methods, such as producers of forest coffee in Ethiopia. Promotion of private nurseries (for example, through availability of credit) can be helpful. Credit to finance inputs and purchase of tree seedlings can also be helpful. Development of processing facilities and assuring adequate capacity utilization of such facilities is important, especially for tea (von Braun et al. 1991). The need to assure a sufficient quantity and reliability of supply to make such facilities profitable contributed to the attractiveness of large plantations established by colonial settlers in Kenya. Development of alternative institutional arrangements more appropriate to smallholder production, such as cooperatives or contract farming, can help to achieve the same goals. Large processing facilities are less necessary for coffee than tea if coffee is sold in unwashed form, but the value-added in the local economy is reduced. To be able to tap this potential, substantial investments in coffee washing facilities are now occurring in coffee producing areas of Ethiopia (Ethiopian Herald, May 7, 1998). Maintaining a policy environment conducive to development of cooperatives and such investments in processing are key to attaining the potential of this strategy.

The benefits of development of high-value perennial crops for the sustainability of land use can be substantial. As with annual horticultural crops, the income generated can help reduce pressure to continue producing or expanding onto marginal lands and allow greater use of inorganic fertilizers, while the increase in land values encourages investments in land improvements.[12] In contrast to annual cash crops, high-value

[12] For example, coffee has played a key role along with horticultural crops in promoting more profitable and sustainable land use in the Machakos district of Kenya (Tiffen et al. 1994).

perennials are a less erosive land use. Where coffee is grown in shaded conditions, there is good potential to plant other kinds of trees for soil fertility management, fodder and/or fruit production, increasing the benefits for land management and farm incomes. There is evidence from western Kenya that soil fertility depletion is lower where perennial cash crops such as coffee and tea are grown than where annual food crops are grown for commercial purposes (De Jager et al. 1998). As with horticultural crops, however, there are risks posed by increased use of agrochemicals in the production of such crops. Thus, extension and training will play an important role in promoting appropriate practices of integrated soil nutrient management and integrated pest management.

RURAL NONFARM DEVELOPMENT

In areas close to roads and markets, rural nonfarm activities are usually an important source of employment and income (Delgado et al. 1994; von Braun et al. 1991). Where commercial agricultural production is expanding, as in central and parts of western Kenya, linkages to agricultural input supply, processing, and trading are particularly important. For example, off-farm income exceeds half of total income for farmers in western Kenya (the proportion is higher for lower income farmers), and much of this comes from small enterprises engaged in such agriculturally related activities (Crowley et al. 1996). Thus many of the requisites for this strategy are the same as those discussed above for the commercial agricultural development strategies.[13]

[13] Other kinds of rural nonfarm development may be related to development in mining, manufacturing (e.g., textiles and leather goods), and construction (related to development in other sectors). These types of development have some of their own requirements, which will not be discussed in detail here.

Beyond development of commercial agriculture, the key requirements for this strategy include development of infrastructure (especially roads and electricity) and transportation facilities, education and vocational training, availability of credit and savings to help finance small startup enterprises and equity capital for medium and larger enterprises (access to credit usually not a problem for larger enterprises). It is important to maintain an environment conducive to investment; for example, by reducing delays in licensing procedures, facilitating purchase or long-term leasing of land and buildings by enterprises in urban and peri-urban areas, reducing taxes and broadening the tax base. Restrictions on labor mobility caused by restrictions on land sales or leasing in rural areas (as in Ethiopia) can also be an important constraint inhibiting migration of workers to areas where employment demand is high. However, shortages of skilled workers resulting from low education and inadequate training facilities is probably a more critical constraint. High priority should be given to improved education in all areas, and to establishing training facilities where potential for nonfarm development exists.

The impacts of nonfarm development for sustainable land management are less direct than the effects of the agricultural development strategies, but may be larger and more profound in the long run. Nonfarm income enables households to save and to overcome capital market imperfections that may cause households to discount the future heavily and limit their ability to invest in commercial crop production, inputs or land improvements (Crowley et al. 1996; Reardon et al. 1996; Pender and Kerr 1998; Clay et al. 1995). Such development can provide farmers an alternative to continuing depletion of soil, forests and other resources (Pinstrup-Andersen and Pandya Lorch 1995). On the other hand, nonfarm development may reduce farmers' incentive to invest in land

improvement, by increasing the opportunity cost of their time (Pender and Kerr 1998; Clay et al. 1995). It is thus important to promote less labor intensive strategies of land management—such as planting trees rather than annual crops—in areas where nonfarm employment opportunities are increasing the value of labor. Land policies that limit farmers' ability to plant trees—such as the periodic land redistributions, restrictions on land sales and leasing (limiting ability to reduce fragmentation) and the ban on planting eucalyptus trees in farmland that exist in parts of Ethiopia—may thus have a particularly onerous impact where rapid nonfarm development is occurring.

EMIGRATION

Related to nonfarm development is the strategy of emigration, both seasonal and permanent. Areas with low agricultural potential and low market access are likely to be particularly large sources of outmigration, though emigration from all areas of the rural highlands is likely given the high population density and small farm sizes. The feasibility of this strategy depends largely upon nonfarm development; thus the requisites of the strategy include the requisites of nonfarm development. There is also potential for seasonal rural-rural migration within the highlands from low-potential areas to higher potential or irrigated areas during the dry season, and in some cases there may be potential for permanent rural-rural migration to reduce disparities in across locations (though generally high population density throughout the highlands makes this difficult).

The need for education and training for people in areas of outmigration should be emphasized. Land tenure is also a key issue affecting migration. People without secure tenure are unlikely to risk losing their land by taking jobs in the city. The scope for permanent rural-rural migration is also affected by host area tenure policies affecting

opportunities for land purchasing or leasing. This will be less important with regard to seasonal migration, although availability of land to establish housing for seasonal immigrants is important. Education policies also can affect possibilities for inter-regional migration: for example, different languages are now being taught in different regions of Ethiopia, which will likely increase barriers to inter-regional migration.

6. CONCLUSIONS AND HYPOTHESES

In this paper we have argued that the policy and institutional requirements for sustainable development depend upon the pathway of development that is pursued, and that the appropriate development pathways depend upon the factors determining potential comparative advantage—especially agricultural potential, access to markets and population pressure. Several generic development pathways have been identified, including high external input intensification of food production, low external input intensification of food production, livestock intensification, commercial production of perishable (mainly horticultural) crops, commercial production of high-value non-perishable (mainly perennial) crops, rural nonfarm development, and emigration. We have argued that success of the commercial agricultural development pathways is largely conditional upon increased food crop production, particularly in areas with poor market access with potential for high-value perennial crop production. Opportunities for intensified commercial production of crop and livestock products are very good in much of the highlands, where agricultural potential is high. The opportunities for agricultural development in low-potential areas are more limited, although there appears to be good potential to increase the overall productivity of land use through better management of

grazing lands and wastelands, particularly in lower population density areas where substantial areas of such lands are still present. In higher population density, low-potential areas with good market access, there may be good potential for investments in irrigation or rural nonfarm development (though rural nonfarm development may need to depend upon linkages to sectors such as manufacturing or mining where agricultural potential is low). In high population density, low-potential areas with poor market access, emigration is bound to be a major element of people's livelihood strategies.

Although many policy prescriptions are valid in general, consideration of the key constraints likely to be binding in the different situations discussed suggests a number of hypotheses about where public policy and investment priorities should be placed:

1. The highest priority for road development should be areas relatively close to urban markets where there is high agricultural potential or high irrigation potential. The highest priority for irrigation development is also in these areas; particularly dryer areas, although supplemental irrigation in higher rainfall areas can also be very valuable. Such development could enable intensive production of food crops, high-value perishable cash crops, and dairy products. Where irrigation investment is occurring, adequate attention must be given to institutional issues, such as how water will be allocated and how losers will be compensated, prior to physical construction.
2. Where such commercial potential exists, food security is a key to allowing farmers to exploit the opportunities available. Where farmers have substantial off-farm income, they may be willing and able to specialize in

cash crop production. However, where such opportunities are more limited (or more limited for income farmers), the risks associated with cash crop production may require increases in food productivity to enable greater cash crop production. Increased cash crop production may also help promote increased food crop production (by enabling purchase of inputs), so that both food and cash crop production may increase for some time before greater specialization occurs. Similar complementary growth of food crop and dairy production may occur in the early phases of development. Research and extension programs should recognize and exploit such complementarities.

3. Assuring adequate provision of inputs and credit, and development of the marketing system are critical to all commercial strategies. Development of processing facilities and marketing institutions (such as cooperatives and contract farming), facilitated by a supportive policy environment, are needed. Research and extension programs will need to take a broader focus, emphasizing market opportunities for new commodities, management of animal health, integrated pest management, and integrated soil nutrient management.

4. Second priority for road development should be high-potential areas further from markets, especially where population density is high. There is good potential for intensified production of high-value perennial crops in these areas if roads are adequate. However, achieving this potential first requires assuring food security, which is likely to be most economical

by increasing productivity in food crop production. For the near term, subsidies on the cost of transporting fertilizer and other inputs to such areas (if they are food deficit areas) should be considered as a lower cost alternative to food aid. As food deficits are eliminated and increased income from perennial crops generated, such subsidies should be eliminated. More generally, there is a need to increase the availability and ensure competitive prices of agricultural inputs. A high priority for such areas is also elimination of land redistributions and avoidance of restrictions on land sales or long term leasing, so that the problems of land tenure insecurity and land fragmentation can be reduced.

5. For low-potential areas without good potential for irrigation (especially with lower population density), priority should be placed on promoting increased productivity of all land, including grazing lands and wastelands. Cautious efforts are needed by governments and NGOs to catalyze development of local institutions in order to intensify management of grazing lands. Contingent upon intensified grazing land management, some intensification of livestock production is possible. Increased production of small ruminants may be a particularly profitable strategy. Allocation of wastelands and sloping lands for private tree planting has potential to substantially reduce the biomass shortage in some areas, as well as increasing household wealth and incomes, though the potential for income generation is greater closer to markets. In the near term, food aid may be needed in such areas, though priority should be given to

developing alternative sources of income as well as increasing land productivity.

6. For low-potential areas with good market access, good opportunities for rural nonfarm development may exist, though these may depend upon non-agricultural activities, such as manufacturing and mining, given low agricultural potential. Priority should be on investment in infrastructure (especially electricity), availability of credit to finance startup enterprises, and education and training of the labor force.

7. For low-potential areas with poor market access (especially with high population density), emigration should be facilitated. High priority should be placed on education and training. Allowing land sales or long-term leases could also help to facilitate emigration and less intensive use of the land.

It is important to emphasize that these are only hypotheses, based upon theoretical considerations and a very limited amount of empirical evidence. Furthermore, there is certainly substantial variation within the broad types of situations discussed, and across households having access to different resource endowments. Addressing problems of poverty, low agricultural productivity and resource degradation will therefore require strategies that address the needs of the poor as well as the more well-endowed. Nevertheless, identifying the broad strategies of development that are feasible can help to identify and recommend targeted strategies for specific situations. Making recommendations about specific strategies will require more detailed information about the costs and benefits of alternative strategies in different situations, the priorities and

concerns of key stakeholders, and other factors that will determine the likely success or failure of such recommendations. Policy research is needed to address these issues. We hope that this paper will help to provide impetus and guidance to such research.

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