
Lecture 2

The Economic Determinants of Poverty: Land Degradation Linkages

This second lecture examines the way in which poverty in many rural households across Africa, combined with the economic incentives they face, determines how households respond to land degradation. In order to address this topic, we focus on the poor rural African smallholder as the economic decision-making unit. In particular, we investigate the economic determinants of smallholders' decisions to degrade, as opposed to conserve, land and other resources.

The issue of economic determinants of poverty-land degradation linkages at the rural household level holds the key to understanding the aggregate trends in, and linkages between, rural poverty, land degradation and conversion explored in the first lecture. It is a critical issue not only for Africa but also for all developing rural areas of the world. For example, recent studies suggest that there are two overall aspects of poverty-environment linkages at the rural household level critical to the process of land degradation and resource conversion in developing countries (Barbier 1997).

First, poverty may not be a direct cause of environmental degradation, but instead may operate as a constraining factor on poorer rural households' ability to avoid land degradation or to invest in mitigating strategies. Empirical evidence suggests that poorer households in rural developing regions are more constrained by access to credit, inputs and research and extension services necessary for making investments in improved land and resource management. Poverty, imperfect capital markets and insecure land tenure may reinforce the tendency towards short-term time horizons in production decisions. This may bias land use decisions against long-term management strategies. Consequently, a rational strategy for poor rural households having limited access to capital and alternative economic

opportunities may be to extract short-term rents through resource conversion and land degradation. This is particularly the case where there are additional land resources available in frontier forest and other marginal areas to exploit relatively cheaply and if the cost of access remains low.

Second, poverty may severely constrain the ability of poor households to compete for resources, including high-quality and productive land. In periods of commodity booms and land speculation, wealthier households generally take advantage of their superior political and market power to ensure initial access to better quality resources in order to capture a larger share of the resource rents. Poorer households are either confined to marginal lands where resource rents are limited, or gain access to higher quality resources only after they are degraded and rents have been dissipated. This relationship between poverty, resource access and land degradation is perhaps less well documented for Africa but may be significant, particularly in areas characterized by poorly defined property rights and competition between rich and poor for scarce environmental assets.

This lecture will explore the role of these various poverty-environmental linkages in influencing land degradation by rural smallholders in Africa. We will focus mainly on poor farming households, and we will begin by examining the costs and benefits to these households of investing in improved land management and soil conservation.

Managing land degradation – the farmer's economic perspective

Poor rural households in Africa generally have only land and unskilled labour as their principal assets, and thus few human or capital endowments. They are also dependent on agricultural production as their main source of income. The importance of off-farm income often increases as the size of holdings declines (Barbier 1997). If land is the poor African farmer's main – and possibly only – productive capital asset, and if topsoil is an essential input to farming, it may therefore seem paradoxical that many poor rural households would engage in agricultural activities that result in soil erosion, fertility decline and, thus, land degradation. To understand this behaviour, we must explore more fully the reasons why some farmers may decide to invest in conserving their land, whereas others may not.

Soil is a semi-renewable resource. Although one could argue that

topsoil accretes, it does so at an extremely slow rate. In general, the rate at which topsoil is “degraded” or eroded through cultivation is generally faster than the rate at which it regenerates. Thus, soil good for agriculture is usually treated as a potentially depletable resource. It is generally assumed that most farming practices will result in rates of erosion that exceed the “natural” or “background” rate of soil erosion that would occur if no cultivation took place.

From an economic perspective, soil conservation implies “saving” soil for future use. Alternatively, a farmer may choose to work the soil harder today, at the expense of more erosion and less soil available for the future. This suggests that, as with other natural resources, conservation and depletion as applied to soil erosion have specific economic meaning. Conservation implies a redistribution of resource use rates into the future, whereas depletion, or soil erosion, implies a redistribution of resource use rates towards the present. This terminology proves to be extremely important in thinking about a farmer’s incentive to invest in soil conservation. In short, we must consider the costs and benefits that the farmer faces in deciding whether such conservation investments are worthwhile.

From the farmer’s perspective, there are essentially two components to the costs of trying to prevent soil erosion and land degradation:

- direct costs, to the farmer, of the effort (i.e., labour), materials, equipment, physical structures, etc. required to undertake soil conservation measures to halt erosion, and
- foregone output, or the loss of current output, that results from using “less” soil or land today.

In comparison, the benefits that a farmer receives from soil conservation derive from soil’s potential income-yielding asset. The “stock” of soil available to a farmer is essentially an economic asset that can be exploited through cultivation to yield a stream of present and future income. Thus, to the farmer, the benefits of soil conservation are essentially the perceived gains in having more rather than less soil available currently and in the future. There are likely to be two types of such benefits of soil conservation:

- gains in current and future production, and thus income accruing to the farmer, from having more soil available today and in the future, and
- additional future resale or bequest value that accrues to the farmer from

having more soil and thus more potential land productivity at the time of the future bequest or sale.

The problem is that although there may be some immediate gains from investing in soil conservation, as we have already noted, the main benefits of “saving” topsoil accrue to the farmer in the future. In contrast, the direct and foregone output costs of conservation are incurred as soon as the farmer begins to undertake conservation. In addition, some conservation measures require ongoing and periodic maintenance. Hence, for many farmers, the economic decision to invest in land improvements and conservation depends ultimately on whether or not the future economic gains from conservation efforts are sufficient compensation for the upfront and maintenance costs of such investments. It will be shown that poverty among many rural African smallholders, combined with other important economic factors, can have an important influence on land management and conservation decisions.

Managing land degradation – poverty as a constraining factor

Many government and donor-funded soil conservation projects in Africa continue to treat land degradation as a “biophysical” rather than an “economic” problem. This partly explains the rather low rates of adoption of soil conservation methods, particularly among poor rural smallholders.

The conventional approach to soil conservation in Africa has been to encourage farmers to adopt a limited range of improved farming systems and crop production techniques and “packages” designed specifically for hilly and marginal lands. Often, generous subsidies are made available to farmers to spur adoption. Although improvements in farming systems on marginal lands and soil conservation techniques are extremely important, more fundamental economic considerations such as food security, land, labour and capital constraints, tenure problems and risk perceptions determine farmers’ willingness to adopt these innovations. Even the provision of subsidies may not necessarily assist adoption. In many cases, farmers revert to former practices once the subsidies end. Moreover, investments in improved farming systems and soil conservation projects are generally expensive, especially if subsidies are required, and this usually limits the scale and geographical coverage of such investments. If adoption rates are poor, then even the demonstration value of such investment

projects and programmes will be limited.

In recent years, the promotion of agroforestry projects in Africa and elsewhere has been viewed as the best way of encouraging poor rural households to change to higher valued farming systems while conserving topsoil and controlling degradation. Although this approach makes good sense, in practice a number of difficulties have been encountered (Barbier 1997). In many agroforestry projects, adoption rates by poor farmers have been low. Even where adoption has been successful, the farmers often adapt the system to suit their own requirements. The reasons for this are, once again, that there are significant constraints on farmers' willingness to adopt agroforestry systems. Systems such as alley cropping are highly labour-intensive, whereas some perennial and improved bush-fallow systems require large land holdings. Farmers without well-defined land rights do not have the incentive to invest in agroforestry systems. In many countries, tree harvesting laws and regulations also act as significant barriers to adoption.³

The riskiness of returns is a particular problem for agroforestry systems. Fluctuations in tree product yield and prices especially influence the profitability of perennial alley cropping or intercropping systems. Thus, some of the more profitable systems also tend to be the riskiest. In general, agroforestry systems preferred by poor rural smallholders offer short payback periods, and either immediate or intermittent benefits that allow farmers to self-finance their own investments.

To summarize, because many soil conservation projects in African do not take into account the factors determining farmers' land management decisions, they tend to fail after the intensive technical assistance, special incentives and subsidies provided by the projects are no longer available. Across Africa, the main reasons for failure in many of these programs are:

- that inappropriate emphasis has been placed on prevention of soil loss for its own sake, rather than on cost-benefit grounds, and
- that conservation schemes usually have been established in response to pressure from the extension services and because of the provision of incentives and subsidies rather than because farmers consider the conservation measures promoted to be desirable.

3. In the African context, "well-defined rights" can include secure traditional tenure systems, such as common property ownership and management regimes. If secure, such traditional systems can provide sufficient incentives for long-term land improvement investments. See, for example, the Machakos case study discussed in Lecture 3.

In contrast, successful programs have tended to promote conservation measures that are appropriate to the existing farming and cropping systems. Therefore, farmers have been willing to continue the conservation measures with little or no additional incentives. The above evidence on linkages between profitability and adoption of soil conservation measures suggests that conservation decisions of poor farming households must be examined from the perspective of the effect of such decisions on the overall profitability of the farming system. Recent conceptual models have attempted to analyse this behaviour of poor rural smallholders (Barbier 1990; Barrett 1991; Grepperud 1995). The results suggest that several key factors influence the decision of rural households to invest in improved land management.

First, both the upfront investment cost for soil conservation as well as any additional “waiting cost” before future land productivity gains are realized are critical to the farmer’s land management decision. If conservation measures are prohibitively expensive for farm households, in terms of either cash outlays or labour allocation, then the costs of conservation today to farmers may not be worth future gains in productivity. As discussed above, the “waiting cost” associated with soil conservation may also be a disincentive, particularly for small and poor farmers and those without secure tenure. To the extent that farm households consider more crop income as desirable now rather than waiting for future productivity and income gains, they are less likely to invest in the control of soil erosion.

One important reason for this risk-averse behaviour is that poor rural smallholders in Africa often face important labour, land and cash constraints on their ability to invest in land improvements. Poor farm households may be able to overcome such constraints if they have access to credit, but usually such access is denied them because of their low level of investment collateral. Often the only asset available for collateral is their land, and this may not always be accepted as the basis for acquiring loans (Zeller *et al.* 1997). Throughout Africa, the ability of poor farmers to obtain credit for land improvements is limited either by restrictions on the availability of rural credit for this purpose, or because insecure property rights mean that poor farmers are not eligible for credit programmes.

In particular, legal land titles are significant in alleviating liquidity constraints that affect the purchase of inputs, as well as land improvements

generally. Yet, many smallholders do not have legally recognized titles to their land (Feder 1995). This may not necessarily be a problem in the case of secure traditional tenure systems, provided that the de facto ownership of the land by individual farmers is recognized and they are considered eligible for credit and other loans on this basis.

Even if formal credit is available in rural areas, poor smallholders usually are not eligible or they are unable to take advantage of it to finance inputs needed to improve land management and productivity (Feder 1985). Estimates suggest that only 5 per cent of farmers in Africa have access to cheaper formal credit, and about 5 per cent of all borrowers receive 80 per cent of all credit (Hoff *et al.* 1993). For example, in Malawi, although approximately 45 per cent of rural smallholders have holdings of less than 1 hectare (ha) and over 21 per cent are “core poor” households with less than 0.5 ha, only 17 per cent of medium-term credit is allocated to households with less than 2 ha of land (Barbier and Burgess 1992b). Many poor smallholders across Africa are forced to meet both consumption and input requirements by borrowing from more expensive informal credit sources (Zeller *et al.* 1997).

Existing credit policies and institutions in Africa are often biased against poor smallholders in obtaining access to credit for long-term investments in land improvements and conservation, and further increase the dependence of smallholder farmers on relatively more expensive informal lending sources. However, because of the limited income-earning potential from their smallholdings, many poor rural households find themselves in chronic debt to finance basic consumption and production needs. Imperfections in the rural capital market often limit households’ options for smoothing consumption from one period to the next, accumulating capital, and financing lump-sum investments, especially for land improvements (Zeller *et al.* 1997). In addition, household capacity to save or the control of assets determines access to credit and the cost of borrowing in formal capital markets. The lower the household’s wealth and risk-bearing ability, and conversely the greater its overall chronic indebtedness, the lower its access to formal credit and insurance services.

Informal lending along kinship and community lines may provide some substitute services, such as pooling the risks borne by individual farmers and insurance through reciprocal gift and loan exchange systems. For chronically indebted households, borrowing from friends, relatives and

within the local community is limited and can only satisfy a few specific credit needs. As a household's level of indebtedness rises, it is forced to borrow from other informal sources (money lenders, traders, merchants and processors) at higher interest rates, resulting in higher effective real interest rates of as much as 100 per cent per year (Binswanger and Sillers 1983; Zeller *et al.* 1997).

To conclude, many poor rural smallholders across Africa often find themselves caught in a vicious cycle of debt, poverty and land degradation. Although dependent on limited land holdings for agricultural income, these households engage in low-productivity farming practices that often exacerbate problems of fertility decline and land degradation. Not only are poor smallholders unable to finance investments in land improvements, given their low incomes, they are also often forced into debt just to finance essential inputs for their existing production systems. However, the more these households have to borrow, the more indebted they become, and the higher the amount of interest they have to pay.

Generating greater savings means increasing household income, but in the short run this means both working the land harder, which leads to more land degradation and lower agricultural productivity in the long run, and increasing purchases of inputs, which leads to higher household indebtedness over time. Moreover, this "vicious cycle" of poverty, environmental degradation and chronic indebtedness is not limited to a few isolated rural households and communities, but appears to be endemic to many. Often, vast pockets of poor smallholders are found in marginal agricultural areas in Africa.

Recent literature suggests that fertility decisions of smallholders are very much conditioned by the poverty profile of the household as well as its access to resources (Dasgupta 1993; Dasgupta and Mäler 1991; Filmer and Pritchett 1996). In other words, population growth is not exogenous but endogenous, and thus land degradation may over time affect the fertility rates of poor rural households. This in turn implies that, although rapid population growth will by itself create greater pressure on fragile land, the potential feedback effects between population, land degradation and rural poverty may be the more interesting – and possibly intractable – aspect of the problem.

Managing land degradation – the role of policy

Market, policy and institutional failures (such as insecure tenure or ownership of the land), distorted market prices for inputs and outputs, imperfect competition, incomplete markets and so forth – all can all affect the farmer's perception of the costs and benefits of controlling soil erosion. As noted, imperfect land and capital markets may play a significant role in affecting the farmer's decision to control soil erosion. The most reliable indicator that a farm household has on the effects of soil erosion on future land productivity is through land prices. However, in many African countries, rural land markets are imperfect or distorted. Consequently, the costs of soil erosion in terms of foregone future crop productivity and income may not be reflected adequately or even bear any relation to the price of land in local markets.

Similarly, the lack of effective rural credit markets may distort the farm household's decision as to whether it is worthwhile investing in protecting the soil because of its future productivity and income potential, as opposed to exploiting it for immediate gain today. In other words, the opportunity cost of conserving the soil may be extremely high. If the farmer has to borrow in the short term to invest in conservation, then distorted or non-existent local capital markets may make the direct costs of conservation prohibitively expensive.

Agricultural policies can affect production decisions such that sub-optimal land management practices are unintentionally encouraged, resulting in unnecessary land degradation. Other economic policies can also have profound effects on land use. Virtually any policy that distorts market prices of agricultural inputs and outputs can alter incentives for soil conservation. The impact of specific policies on farmer decision-making and land degradation is often ambiguous. Impacts on households vary, to the extent that policies affect certain farming communities and rural areas more than others.

Nevertheless, recent evidence suggests that there are a number of important ways in which agricultural policies can influence land degradation by poor rural smallholders (Barbier and Burgess 1992a; Barbier 1997).

- Higher aggregate crop prices and lower agricultural input costs increase the profitability of crop production. This may encourage an aggregate

expansion of agricultural production onto marginal or more erodible land if the cost of access and conversion of non-agricultural land is low.

- The impact of agricultural pricing on relative returns to agricultural production can affect long-run decisions to invest in sustainable land management and conservation.
- Changes in the relative prices of crops (and crop inputs) can influence the substitution of more environmentally benign cropping and farm production systems for systems that are more environmentally damaging.
- The variability of input and produce prices can affect farmers' choice of crops and cultivation practices, as well as decisions to invest in sustainable land management, through influence on the risks associated with alternative agricultural investments and production systems.

In the next lecture, we will explore in more detail the impacts of agricultural policies on the livelihoods of the rural poor and their land use decisions through specific case studies from across Africa. Now, however, we will turn briefly to some examples from Malawi to illustrate further the main point emphasized in this lecture, namely that poor rural smallholders in Africa often face important labour, land and cash constraints on their ability to invest in land improvements.

Poverty-environment linkages – the case of Malawi⁴

Although 4.3 million hectares (ha) of land are classified as arable in Malawi, probably only about 2.4 million ha are suitable for agriculture. With a large and growing rural population, this means that there is very little land available for the predominantly smallholder agricultural economy. This has resulted in both extensive rural poverty and serious land degradation problems. As indicated in the previous lecture, the current and future income losses arising from soil erosion may amount to over 20 per cent of Malawi's agricultural gross domestic product (GDP).

Approximately 1.6 million smallholder families in Malawi cultivate up to 1.8 million ha under customary tenure. The average farm size is about 1.17 ha. About 55 per cent of the holdings are less than 1.0 ha, 31 per cent are between 1 and 2 ha, and only 14 per cent are above 2 ha. The principal crop is the staple maize, grown on 75 per cent of the cropped area, with

4. The material presented in this case study is drawn from Barbier and Burgess (1992b).

other important crops being groundnuts, fire-cured tobacco, cassava, cotton, rice and various pulses, roots and tubers.

Rapid population growth of 3%–4% per annum in Malawi has meant that approximately 30,000 new families must be absorbed each year. Given that less than 30 per cent of smallholders have access to fertilizer and the adoption rate for high-yielding maize varieties is less than 10 per cent, average yields are very low – about 900 kg/ha for maize. The combination of population pressure on scarce land and low yields has led to depressed farm incomes, declining per capita smallholder food production and widespread household food insecurity. For example, in the late 1980s, average annual income of a smallholder household was only US\$173, over 90 per cent of which came from on-farm activities. Over 55 per cent of households produced insufficient food for their needs.

An important distinction in the smallholder sub-sector is between households cultivating less than 1.0 ha – the minimum required for attaining sufficient household calorie requirements from their land – and those with larger holdings. Approximately 715,000 households fall into the former category, of which over 338,000 are “core poor” households with less than 0.5 ha. Consequently, the majority of smallholders are food-deficit and low-income households who spend almost half of their cash income on food and depend heavily on off-farm labour employment. It is only households having relatively larger holdings that are self-sufficient in food production.

As discussed previously, access to capital can assist poor rural smallholders in overcoming labour, land and cash constraints by allowing them to invest in improved land management.⁵ For example, access to capital and credit can affect smallholder conservation directly by providing sufficient funds for conservation efforts, and indirectly by improving yields, raising incomes, and increasing the value of the land. This may increase interest in long-term gains over immediate returns, as well as

5. However, access to capital and credit will result in increased conservation efforts only if the returns on such investments are competitive with alternative options. As pointed out by Reardon and Vosti (1997), investments in off-farm activity can compete with investments in land conservation, especially for poor households where there is a scarcity of cash that can be invested or available labour beyond subsistence levels. On the other hand, the authors also point out that there can be a positive feedback effect from nonfarm investments to conservation. Cash from these activities can be used to finance soil conservation investments and the use of fertility-enhancing inputs, as well as reduce the general dependency of the household on the land.

reduce the risk and insecurity associated with land management investments.

Unfortunately, the low availability and high costs of suitable credit and other capital funds for poor rural smallholders across Malawi appear to be limiting conservation efforts. Only about 20 per cent of smallholders in Malawi have access to short-term or seasonal credit – mainly for fertilizers – and produce a marketable surplus. These are generally farmers with holdings over 1.0 ha. In addition, only 17 per cent of medium-term credit is allocated to households with less than 2 ha of land. Medium or seasonal credit is available specifically for direct conservation investments, either to individual smallholders or through community groups. The indirect impacts of such short- and medium-term credit constraints on conservation by smallholders may be particularly important since labour and land are often the only assets held by most farmers in Malawi.

The proportion of total person-days on smallholder plots supplied by hired labour is relatively low: about 5 per cent for all smallholders and only 1.6 per cent for the core poor. Since approximately 85 per cent of gross margins on crops such as maize is attributed to the labour input, and only about 15 per cent to land, doubling the land available to the poor – even if feasible – would at most increase their income by about 13 per cent. This suggests that low labour productivity and poor yields are central to the poverty problem. However, low yields and low productivity of land and labour are directly related to the low intensity of agricultural production. The result is chronic food insecurity among households and increased pressure to meet immediate food requirements, at the expense of improved long-term land management.

Labour is by far the most important input into conservation. About 95 per cent of the total labour available to smallholders is from the farm household. The opportunity cost of this source of labour is a key determinant of its use in conservation. Given the generally low productivity and underemployment of unskilled labour throughout Malawi, it could be presumed that this opportunity cost is very low. However, there are other factors that also affect the use of labour for soil conservation. For example, although the availability of farm labour may be limited only in certain seasons and localities – e.g., during the peak period of planting and weeding during the growing season, and in areas where many off-farm employment opportunities exist – it may significantly affect soil

conservation.

The peak period of labour demand also coincides with times when household stocks of food and cash are lowest or non-existent for the poorest households. Households dependent on wage income may have little choice but to sell their own labour and forego timely planting and weeding on their own fields. At this time, labour for conservation may have a high opportunity cost, particularly for the poor households with income and credit constraints. On the other hand, conservation measures that do not conflict with peak periods of labour demand should be less affected by these constraints.

Smallholder cropping patterns and land use systems also vary considerably throughout Malawi, and differ significantly in their use of labour. The differences in the labour requirements of various cropping systems across regions have an impact on farmers' attitudes about and adoption of specific conservation measures, such as contour ridging, alley cropping and bunding. When the implementation of conservation measures conflicts with periods of labour shortages, farmers may be less receptive to implementing them because of the high opportunity costs involved. Labour costs are particularly high for labour-intensive crops such as tobacco and cotton. Maize, especially local maize, rotated with groundnuts and beans, has the lowest labour costs per ha. Conservation recommendations that are advocated uniformly nationwide, such as "early planting," ridging on contours, and *leucaena*-maize alley cropping, may not succeed in some regions because of labour shortages, opportunity costs and high cost of hired labour.

Table 2.1 shows that, across Malawi, female-headed households make up 42 per cent of the "core-poor" households. They typically cultivate very small plots of land (<0.5 ha) and are often marginalized onto the less fertile soils and steeper slopes (>12 per cent). They find it difficult to finance agricultural inputs such as fertilizer, to rotate annual crops, to use "green manure" crops or to undertake soil conservation. As a result, poorer female-headed households generally face declining soil fertility and lower crop yields, further exacerbating their poverty and increasing their dependence upon the land.

Female-headed households confront a multitude of constraints that hinder economic opportunities and improved land management. For example, both female- and male-headed households may be unable to adopt

Table 2.1. Female-headed households and poverty, Malawi

A. Smallholder poverty profile	Core poor		Other poor		Non-poor
Sex of head of household (HH) (% female)	42		34		16
Number of labour days/year/HH	532		606		762
Average landholding ha/HH	0.39		0.73		1.76
% HH using fertilizer	9		16		35

B. Fertilizer use by household¹	Male HH		Female HH	
	No.	%	No.	%
Total number of households	556	63.0	327	37.0
Fertilizer farmers	208	37.4	90	27.5
Non-fertilizer farmers	348	62.6	237	72.5

C. Smallholder credit disbursement	1983/84	1987/88	1989/90
Seasonal loans ('000 MK)	11,460	26,871	57,075
No. of beneficiaries ('000)	180	243	315
Women as % of beneficiaries	15.0	29.8	29.9

Notes: ¹ Based on a survey of 883 households in Blantyre Agricultural Division.
MK = Malawi Kwatcha.

Source: Barbier and Burgess (1992b).

new maize varieties, as these require relatively intensive fertilizer inputs as compared to traditional maize. However, female-headed households often have extremely low income and cannot obtain sufficient financing from their own sources or obtain credit to purchase hybrid maize and fertilizer. The average female-headed household cultivates maize on 90 per cent of its land and rarely grows any cash crops, whereas the average male-headed household grows maize on 81 per cent of its land with the remainder mostly under a cash crop such as tobacco. Out of a total of 327 female-headed households surveyed in Blantyre Agricultural Division, only 90 households (27.5 per cent) used fertilizers on their land. In comparison, over 37 per cent of the male-headed households surveyed used fertilizers (see table 2.1B). Across Malawi, only around 30 per cent of seasonal loans for fertilizers and new maize varieties were made to women (see table 2.1C).

Large labour demands on women within the household – such as child

Table 2.2. Adoption of soil conservation by household type, Ntcheu rural development project, Malawi

Activity	Target (No. of HH)	Achievement (No. of HH)	Success rate (%)
Farm plans	M: 8	3	37.5
	F: 2	0	0.0
Contour ridging	M: 600	232	38.7
	F: 300	42	14.0
Composting	M: 1,500	1,051	70.1
	F: 1,000	156	15.6
Manuring	M: 4,500	3,347	74.4
	F: 2,500	1,002	40.1
Alley cropping	M: 170	30	17.6
	F: 80	14	17.5
Buffer strips	M: 8	3	37.5
	F: 2	0	0.0
Raised boundaries/ paths	M: 200	321	160.5
	F: 100	199	199.0
Gully reclamation	M: 80	104	130.0
	F: 20	20	100.0
Farmer training	M: 500	157	31.4
	F: 220	245	111.4

Notes: M = Male-headed households. F = Female-headed households.

Source: Barbier and Burgess (1992b).

bearing and rearing, firewood and water collection, cooking, land preparation, planting and weeding – further limit their ability to construct ridges along contours, build bunds, maintain buffer strips, plant trees and undertake other conservation measures. Off-farm employment opportunities for women to supplement farm income may also be constrained by gender discriminations in the labour market. For example, male labour is usually preferred to female labour for wage employment on tobacco estates.

Extension advice on how to deal with the problems posed by soil erosion reaches mainly male farmers with large holdings who are credit

club members. Extension messages tend to be very general and are not customized to the needs and requirements of women, particularly the labour and other economic constraints they face. Table 2.2 shows the relatively poor adoption of on-farm soil conservation measures by female as opposed to male farmers. Extension services in Malawi have tended to be highly successful in achieving or exceeding targets for community-based soil conservation projects, such as raising of common boundaries and communal paths, gully reclamation and group farmer training. However, the actual implementation of on-farm conservation techniques by individual households is generally less successful, and the particular constraints faced by female-headed households appear to have strong influence on the lack of adoption of these techniques.

Recent interest in Malawi has focused on the development of agroforestry systems to control land degradation. Table 2.3 gives estimates of the comparative returns of an *Acacia albida*-maize intercropped system and a maize-*leucaena* alley cropping system. The net variable returns and gross margins of the *Acacia albida*-maize system exceed those of a monocropped maize stand without fertilizer (presumably local variety) and compare favourably with those of fertilized hybrid maize. However, the assumption is that *Acacia albida* already exists on the stand and is conserved. Only a small proportion of farmers in Malawi, and mainly in the Northern Region, would be fortunate enough to have trees growing naturally on their plots. Most farmers would have to plant the trees and maintain and protect the seedlings, which would increase the labour costs significantly. They would also have to wait 3 to 5 years until the trees yielded sufficient litter for fertilizing their maize crop.

Table 2.3 also indicates that the net variable returns and gross margins of the *leucaena*-maize system exceed those of maize, with or without fertilizer. However, the high labour inputs for planting, pruning, weeding and protecting the *leucaena* may be prohibitive for some farmers, particularly as these activities would normally be carried out at the peak period of labour demand. In addition, *leucaena* is highly susceptible to termite attack, livestock browsing and damage from monkeys. It is also unsuitable for many highland areas in Malawi.

In sum, all conservation recommendations need to be carefully examined in terms of their implications for labour utilization and costs for the targeted beneficiaries. Even the relatively straightforward

Table 2.3. Comparative returns on smallholder forestry, Ntcheu rural development project, Malawi
(Malawi Kwacha (MK) per hectare (ha))

A. Comparison of maize with and without <i>Acacia albida</i> intercropping (MK/ha)¹			
	With	Without	Fertilized (without)
Maize yield (kg/ha)	1,473.90	688.00	3,000.00
Price (MK/kg)	0.24	0.24	0.24
Gross return	353.74	165.12	720.00
Seed	16.25	16.25	16.25
Fertilizer	0.00	0.00	114.00
Labour	121.80	121.80	153.12
Transport ²	2.82	0.57	43.32
Total variable cost	140.87	138.62	326.69
Net variable return	212.86	26.50	393.31
Gross margin	334.66	148.30	546.43
Benefit/Cost ratio ³	1.64	0.76	

B. Comparison of maize with and without <i>Leucaena</i> alley cropping (MK/ha)⁴			
	With	Without	Fertilized (without)
Maize yield (kg/ha)	3,082.00	997.00	3,000.00
Price (MK/kg)	0.24	0.24	0.24
Gross return	739.68	239.28	720.00
Seed	16.25	16.25	16.25
Fertilizer	0.00	0.00	114.00
Labour	316.68	121.80	153.12
Transport ²	39.49	0.57	43.32
Total variable cost	332.93	138.62	326.69
Net variable return	406.75	26.50	393.31
Gross margin	723.43	148.30	546.43
Benefit/Cost ratio ³	2.12	0.76	

Notes: ¹ *Acacia albida* trees were assumed to be conserved in fields, not planted. Maize yield samples were taken from a 7x7-m plot under tree canopy, and compared to a similar plot away from canopy.

² Transport costs calculated from Ministry of Agriculture data.

³ Costs and benefits discounted over a ten-year period at 15 per cent discount rate.

⁴ Maize yield estimates were based on samples from 10x10-m plots undertaking maize-*leucaena* alley cropping; however, actual *Leucaena* are susceptible to termite attack, livestock browsing and monkey damage.

Source: Barbier and Burgess (1992b); originally adapted from Selenje *et al.* (1989).

recommendation of aligning ridges on contours, which is expected to be a dry season activity when labour demand is slack, can face unexpected problems. For example, in many farming areas, ridging is done too late – not until the first rains have set in. One reason is that the dry season is considered a time for traditional social activities, such as weddings, dances and other rituals, as well as being important for some off-farm sources of employment. Dry season ridging is also a more demanding task. During the dry season, it may take up to two weeks for one man to ridge a hectare, whereas when the first rains soften the soil, it may take only 4 or 5 days. The high opportunity cost of such labour inputs is prohibitive for many poor smallholders, especially female-headed households.

Poverty, entitlement loss and environmental degradation

In the first lecture, we noted that over half of the poorest rural groups in Africa subsist on resource-poor and marginal land. Therefore, it is the welfare of the poorest that is at greatest risk from continued land degradation. The inability of poor rural households to compete with richer households for access to better resources, including high-quality and productive land, is an important reason why so many of them are concentrated in marginal areas. Wealthier households generally take advantage of their superior political and market power to secure exclusive access to better quality resources and, as a result, poorer households find themselves confined to marginal land areas and poor quality resources prone to degradation.

Kates (1990) argues that throughout the developing world the poor often suffer from three major processes of environmental entitlement loss:

1. The poor are displaced from traditional entitlement to common resources when development activities or appropriation of the resources by richer claimants take place.
2. The remaining entitlements are divided and reduced through the sharing of resources with children or sales of parts thereof to cope with extreme losses (crop failure, illness, death), social obligations (marriages, celebrations) or subsistence.
3. The resources of the poor are degraded through excessive use and failure to restore or to improve their productivity and regeneration. This process is made worse by the restriction of the poor to environments unable to

sustain requisite levels of resource use.

As a result of these processes, the economic livelihoods of the poor become even more vulnerable to risks posed by land degradation. The ability and willingness to manage resources on a sustainable basis may become even more constrained. The initial catalyst behind the loss in environmental entitlement is the inability of poorer households to compete with the rich for higher quality land and resources, but this is often overlooked.

The displacement of poorer rural groups from their traditional farming and grazing lands is documented in Africa. The problem is becoming increasingly prevalent in the river floodplain zones of the semi-arid regions of Africa, where different economic groups compete for water and land resources (Adams 1991). Often, public investment schemes and policies end up supporting the appropriation of water for one group of land users at the expense of more vulnerable, and often poorer, land users.

Irrigation development in semi-arid areas of Africa is usually through the introduction of large-scale commercial agricultural schemes. These conflict with the more traditional farming and pastoral systems that regulate access to existing land and water supplies. Frequently, appraisal of the environmental impacts of such large-scale irrigation schemes has shown that the investments should be modified or abandoned in some cases. (Adams 1991).

For example, upstream irrigation development on the Hadejia and Jama'are rivers and their tributaries, in semi-arid regions of Northern Nigeria, threatens traditional floodplain agriculture and pastoralism downstream. The assumption behind investment in the irrigation projects is that the net benefits of the upstream irrigation developments far exceed the net benefits of the floodplain system. The latter benefits are routinely ignored in project analysis. However, a recent analysis of the net benefits of the Hadejia-Jama'are floodplain shows that they are considerable, particularly in comparison with the Kano River Irrigation Project (Barbier, Adams and Kimmage 1993). The results suggest that the opportunity cost of diverting water to upstream developments in terms of foregone floodplain benefits could be high. Therefore, these opportunity costs must be considered carefully in any analysis of water diversion. However, what often cannot be calculated are the long-term economic costs of displacing poor farmers and pastoralists from their traditional sources of water and

land, and forcing them to move to more fragile environments prone to degradation.

Conclusion

In this lecture, we have explored the role of poverty as a constraint to the ability and willingness of poor African households to invest in improved land management. We also have discussed how poor households become confined to marginal lands and vulnerable to the risks posed by land degradation. In some cases, this stemmed initially from the inability of poor households to compete with the rich for access to higher quality resources, including land.

The poverty-environment linkages that drive land degradation in Africa appear fairly intractable. However, they are not necessarily insurmountable. The reason we observe a “cumulative causation” link between land degradation and conversion in Africa is critically related to the role of poverty in influencing the economic incentives and behaviour of many poor rural households. The way markets and institutions operate determine economic incentives that face even poor rural households. Markets and institutions are in turn affected by public policies and investments. Therefore, if we are to discover ways to overcome land degradation problems faced by the rural poor in Africa, the analysis of the market, institutional and policy failures that have fostered such problems is an important starting point. In particular, we need to improve our understanding of why certain policy reforms and investments have succeeded where others have not.

In the third, and final, lecture we will examine a few case studies that could provide some policy guidance on how to tackle problems due to rural poverty-land degradation linkages facing African countries.

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