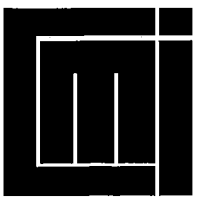
Land Reforms and Land Degradation in Tanzania:

Alternative Economic Approaches

Arild Angelsen and Odd-Helge Fjeldstad

WP 1995: 3



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Summary:

This paper uses as a point of departure the extensive soil erosion problems in the highland area of Western Tanzania. The first part of the paper focuses on the ongoing debate on land reforms in Tanzania, particularly the question of state, village or private land ownership. In the second part, a microeconomic model of farm decision-making is developed, where the focus is on two factors which are important to the magnitude of soil erosion: (i) existing intensity of production (overexploitation of land), and (ii) investments in soil conservation. We also develop a model to study migration to/from the highlands, and thereby the impact of different property regimes and other economic factors on soil erosion.

Sammendrag:

Dette notatet tar som utgangspunkt den omfattende jorderosjonen i høylandet i Vest-Tanzania. I notatets første del relateres dette til den pågående debatten om landreformer i Tanzania, spesielt spørsmålet om statlig, landsby eller private eiendomsrett. I andre delen utvikles en mikroøkonomisk modell for beslutninger i jordbruket, hvor fokus er på to faktorer som er viktige for omfanget av jorderosjon: (i) dyrkningsintensitet (overutnytting av jord), og (ii) investeringer som reduserer jorderosjon. Vi utvikler også en modell for å studere migrasjon til/fra høylandet, og derigjennom effekten av ulike eiendomsforhold og andre økonomiske variable på jorderosjon.

Indexing terms:

Agriculture
Soil erosion
Land tenure
Economic models
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Stikkord:

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Økonomiske modeller
Tanzania

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1 Introduction and overview[1]

The problem of land degradation in tropical agriculture is caused by the aggregate effect of numerous decisions by farming households. Farmers respond to the natural, cultural, social, political, legal, and economic environment that surrounds them. In this paper we emphasize the economic factors and argue that these are the major determinants of farmers' choices. In particular, we focus on two sets of economic variables; the property rights regime governing land use, and the relative prices.

A basic tenet in the economic theory of property rights is that farmers have greater incentives to invest in land improvements the greater his certainty that the land will belong to him or his descendants in the future. We raise the question of whether this implies that soil conservation presumes private property rights. We argue that individualized titling may not necessarily provide the answer. Instead we argue that reinstitutionalization of the customary tenure system may secure land rights of the individual farming household, and thus strengthen the farmers' incentives to invest in soil improving measures. A major challenge in this respect is to develop procedures and practices which make the allocation of village lands transparent and subject to public scrutiny.

We use the highlands zone of Western Tanzania as our frame of reference. Because of its high altitude (1440 to 1750 meters above sea level) and regular rainfall (annual precipitation varying from 800 to 1600 mm), the area has a high agricultural and forestry potential. The major staple crops are bananas, cassava, beans, and other food crops. All these products may also be sold as cash-crops. Coffee production has been introduced recently (see Mwalyosi, 1992; and Fjeldstad, 1993). People also keep livestock, mainly poultry, cattle, goats, and sheep.

A number of factors has contributed to overutilization of land resources in the area, resulting in deforestation, caused mainly by shifting cultivation, overgrazing, and wild fires. This has led to extensive removal of natural vegetation and subsequent soil erosion and decline in agricultural productivity. In the vicinity of villages the concentration of people has led to increased soil exhaustion, reduction of grazing land, overgrazing and deforestation, and to more intensive use of land for cropping.

Today, these problems are particularly evident by the existence of poor and unproductive soils in parts of the area, long distances covered in search of firewood, widespread red scars on the land, gully erosion and frequent famines. In addition, the watersheds have been highly disturbed and most of the formerly

[1] We would like to thank Sufian Hemed Bukurura, Espen Sjaastad, Ussif Rashid Sumaila, and Arne Wiig for several constructive comments to and suggestions for improvements of earlier drafts of this paper. The usual disclaimer applies. Earlier versions of this paper have been presented at the Joint CSAE/CMI Workshop on Land Reform, Oxford, March 1 - 3, 1995, and at the annual conference of the Norwegian Association for Development Research (NFU), Trondheim, June 6 - 8, 1995.

perennial swamps and streams are now dry for most of the year. This has created water shortages for both people and livestock, especially during the dry season. People are forced to travel long distances in search of domestic water and water for livestock breeding.

The adverse socio-economic and environmental effects characterizing the recent developments in the area may be summarized as:

- changes in the local ecology as a result of poor farming practices, livestock husbandry, forestry development and haphazard settlement;
- changes in the hydrology of the area have imposed sedimentation loads on the major river systems with adverse effects on the flows to the areas;
- competition and conflict in land resource use;
- overpopulation relative to the available resources leading to increased pressure on the remaining resources; and
- migration of people to townships in the region and to Dar es Salaam, contributing to increased urban pressure.

Similar problems as described above can also be observed in other areas in SubSaharan Africa (see e.g. Wachter, 1992; Place and Hazell, 1993; and Brekke *et al.*, 1995). Thus the experience from Western Tanzania may have a wider relevance, and can hopefully contribute to increased knowledge of the relationship between land degradation, and land rights and economic policies.

This paper consists of two parts. Part one (sections 2 and 3) focuses on land rights and land reforms in Tanzania, and relates these issues to theories of property rights. In section 2 we define the concept of property rights, and identify four broad categories of land rights regimes commonly used in the literature. The present land tenure system in Tanzania is reviewed, and the proposed land rights reforms by the Land Commission (1994) is discussed.

Section 3 proceed by asking which criteria should be used to assess the (proposed) land tenure regimes. We put forward and discuss four different criteria which are of particular relevance for the discussion of alternative land rights regimes and reforms in tropical agriculture: (i) Agricultural productivity and security of tenure; (ii) internalization of environmental costs; (iii) land distribution and equity; and (iv) transaction costs related to individualized titling to land.

The aim of part two (sections 4 and 5) is to discuss the potential role of various economic factors in explaining the degree of land degradation. The emphasis is on the effect of different property rights regimes as well as other economic factors (particularly relative prices) in determining how farmers use and manage land resources. This part provides a more formal discussion of some of the points made in part one (sections 2 and 3) related to the first and second criteria for assessment of property regimes.

Section 4 presents a microeconomic model of farm decision-making. The focus is on two variables which are important to the magnitude of soil erosion; (i) existing intensity of production (overexploitation of land), and (ii) investments in soil conservation. Section 5 discusses a more macro-oriented model, where the focus is on factors determining the overall population in a region, and thereby the pressure on land. We do not presently have sufficient data to test the relative importance of the various effects discussed in these models. The purpose is more to present possible effects (propositions) that should be considered in policy-formulation, and which also provide a set of hypothesis for empirical testing, and therefore could serve as a guide for more detailed empirical research.

2 Land rights in Tanzania

It is widely recognized that the property rights regime in place is a crucial factor in determining resource allocation in tropical agriculture (see, for example, Bromley, 1991). The property regime is a key factor in determining which costs and benefits are included in farmers' decision making, in particular to what extent long term effects are included. Furthermore, the property rights approach draws attention to the fact that subtle changes in the content of property rights can change the macro performance of an economic system and lead to economic growth or stagnation. Any redefinition of the structure of property rights by the state also has wealth effects involving both winners and losers. The latter issue is of particular importance in the Tanzanian economy which is dominated by agriculture.[2]

In this section we first define the concept of property rights and identify the land rights regimes most commonly used in the literature. Next, we describe the main characteristics of the Tanzanian land tenure system, and the land reforms proposed by the recent Land Commission (1994).

2.1 Property rights regimes

In simple terms, property rights are the rights individuals or groups of individuals have to enjoy the benefits from a given resource, in our case land resources.[3] Three types of property rights are generally distinguished between in the literature (Barzel, 1989; Eggertsson, 1990:34);

1. *Use rights:* the rights which define the potential uses of land that are legitimate for an individual, including the right to transform it physically through, for instance, different agricultural crops and growing techniques.

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[2] Agriculture accounts for more almost 50 percent of GDP in current prices, 1991-93 (Bank of Tanzania, 1993:14). It also accounts for nearly 70 percent of total export earnings (1992 and 1993), and provides employment for almost 90 percent of the labour force. See World Bank (1994) for a more detailed presentation of the agricultural sector in Tanzania.

[3] The term *land*, in its ground, soil, or earth-related sense has a variety of meanings. The most relevant definition for our purpose is that which sees land as a factor of production. The reader is referred to Wachter (1992: 6-7) for a listing of this and the other definitions.

2. *Income rights:* the right to earn income from the land and contract over the terms with other individuals.
3. *Transfer rights:* the right to transfer the asset to another party, that is, to alienate or sell the land.

A property institution consists of a set of *rights* and a set of duties or obligations (Angelsen, 1995b). Legal rights are never unlimited. For example, the kind of uses permitted by the law is often restricted (for instance, not growing opium), or the income from agricultural output may be taxed. Possible restrictions of these rights that shrink the set of alternative uses or capture part of the incomes from land use will lower the economic value of the land.

Property arrangements are social relationship among individuals, "they link not merely a person to an object, but rather a person to an object against other persons" (Bromley, 1989:202). The key element of this triadic relationship is the right of the owner to exclude others from the benefits related to the asset (use, income, and transfer rights). In short, property rights give a person the legal right to exclude others within the limits set by the law; to what extent these rights are protected is, inter alia, determined by the person's own enforcement of the rights (Angelsen, 1995b).

Property rights exist along a number of dimensions, thus any classification represents a simplification of a complex reality. It is most common to distinguish between four different property rights regimes (see, e.g., Bromley, 1991):

1. *State property*; the state holds the property rights.
2. *Common (or communal) property*; a group of individuals, for example a community, holds the rights.
3. *Private property*; an individual or an household holds the rights.
4. *Open access*; no property rights exists (either *de facto* or *de jure*).[4]

The main distinction is between situations *with* property rights (where the agent with the rights is either the state, the community, or an individual), and situations where *no one* has property rights, i.e. open access.

Whereas these four categories may clarify the discussion on property rights regimes, real life regimes are likely to be a combination of these four (Bromley, 1989; Ostrom, 1990; and Wachter, 1992). In describing actual property regimes a number of other dimensions must be added:

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[4] In addition to these four regimes, a global social planner's solution is often employed to define the socially optimal solution, and acts as a yardstick to measure the outcome under the other regimes. Parts of economic theory have traditionally not distinguished between state property and the social planner's solution, but little knowledge about tropical resource management is needed to realize the lack of realism in this assumption. *Homesteading* could also be considered a separate regime, which is particularly relevant in frontier areas: land clearing/preparation gives private property rights to cleared land. Under this regime land is transferred from an open access resource (regime 4) to a private property resource (regime 3). See, e.g., Angelsen (1994).

- How *secure* are the rights (claims)? The three first categories assume 100 percent security for the agent against third party intervention, whereas the open access case assumes no security. The security of, for example, private rights depends on the protection given to these rights by the state, and its enforcement ability.
- Property rights can be either formal (legal) or informal (customary or traditional) rights. One difference is that it may be more difficult to enforce informal rights than formal ones in a legal manner, and customary rights may also receive less respect from potential users outside the community. The existence of informal property rights makes enforcement difficult, particularly against claims from outsiders (outside the village). The result may be property rights insecurity and conflicts.
- Property rights are a bundle of rights, and the agent may not have all the three types of rights listed above. Typically, a farmer may have the *user rights* and the right to the income, but not the right to sell the land to outsiders. More generally, property rights will always be constrained, for example, certain land uses may be prohibited.
- The agent may not be well defined; for example, individual households may use land in a particular way after consultations with the leaders of the community.
- Land may have different regimes governing different uses; for example, agricultural use may resemble a private property regime, whereas collection of forest products from the same land is governed by communal management.
- Finally, another complication of the above categorization is the fact that property rights will never be fully delineated because of *transaction costs* (see section 3.4).

2.2 *The present land tenure system in Tanzania*[5]

The Tanzanian land tenure system could probably be interpreted as a combination of the state property regime, communal management and private property. This situation partly reflects the fact that since independence mainland Tanzania has not had an explicit policy on land tenure. In spite of such fundamental statements of policy as the Arusha Declaration in 1967, the land tenure system has essentially continued to be governed by the rules underlying principles of the Land Ordinance of 1923, and is almost unaltered in its essentials from colonialism (Land Commission, 1994:135).[6] The Tanzanian Constitution, for example, has no

[5] This section draws mainly on the *Report of the Presidential Commission of Inquiry into Land Matters,* which we will refer to as Land Commission (1994). The Commission submitted its report to the President on November 11, 1991.

[6] According to the 1923 Land Ordinance (i) all land is publicly owned and under the control of the state, (ii) land rights and titles are based on use, (iii) commoditization of and speculation in land are proscribed, and (iv) rights of occupancy, the only recognized tenure, are held in two ways: (i) under granted rights of occupancy, given subject to development conditions for up to 99 years, or (ii) deemed rights of occupancy or customary tenure, which, subject to use, are

provisions on land and land ownership, except for defining the territory of the country for purposes of securing the political sovereignty of the state. Even major policy programmes, such as the villagization of the 1973-76, paid little regard to issues of land tenure. One possible explanation is that the state also after independence wanted to maintain its ultimate control over land; another one could be an underestimation of the importance of property rights.

The present land tenure system in Tanzania, as in many other developing countries, is based on a system of dualism and hierarchy at the same time. The dualism is between the peasant/pastoral sector governed by customary land tenure under the deemed right of occupancy (usufructuary rights), and the plantation/urban sector governed by the statutory system, with property rights secured in the written national law. The structure is hierarchical in that the statutory system is considered superior, with far greater security of tenure, than the customary system. Progress in this hierarchy means movement away from the customary to the statutory. In practice, this movement actually involves expropriation of customary land, as has been the case throughout the colonial and post-colonial history (Land Commission, 1994:140).

Under many of the customary land tenure systems in Tanzania, the ultimate ownership to land (the transfer right) was vested in a corporate entity such as the tribe, the clan or the family. Use and income rights depended on membership of the group. In the current structure the radical title in all lands which are declared to be public land is vested in the President,

> *"and shall be held and administered for the use and common benefit, direct or indirect, of the natives of Tangyanika, and no title to the occupation and use of any such lands shall be valid without the consent of the President" (Land Commission, 1994:19).*

The President is empowered by the Land Ordinance to grant land by way of occupancy. In practice, the Ministry of Lands, Housing and Urban Development manages, administers, and allocates land. This means that the control and administration of peasant or village lands lay in the hands of the state. In effect, customary right holders in rural areas have been treated at best as "tenants-at-will", while those in urban areas are considered as "squatters". These groups use the land but have little security. On the other side, the holders of the granted rights of occupancy enjoy statutory security for the stated period so long as they use it according to prescribed conditions.

The villagization programme (1973-1976) involved a large-scale relocation of cultivators and pastoralists into villages.[7] The emphasize in this "operation

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held in perpetuity.

[7] The Tanzanian countryside is today organized in village communities. The latest tally shows some 8,367 registered villages. There may, however, be other traditional and newly established villages which have not been recorded or registered (Land Commission, 1994:146).

Tanzania"[8], as it was called, was on modes of production. Little regard was, however, paid to existing customary land tenure systems, and the "new" land tenure system in the new locations was not thought through (Land Commission, 1994:20). In some cases, land held under granted rights, but in practice abandoned or neglected by land holders, was allocated to villages without any formal procedures. This implied that the allocations of land within villages to individual farmers were unprotected by law.

Since the late 1980s some of the former land owners of abandoned farms and estates have started to claim their land held under customary tenure which had been alienated during villagization. To meet the problem of widespread confusion and dispute on land tenure in rural areas, the ruling party, Chama cha Mapinduzi (CCM) - the Revolutionary Party, in 1987 instructed the Government to complete demarcation and titling of villages under the legal regime of the Land Ordinance within five years. However, by mid-1991, only 22 percent of the some 8 400 registered villages had been surveyed. Only for 2 percent of the villages certificates had been registered (Skarstein and Havnevik, 1995:9).

The Land Commission (1994) argues that the whole procedure of preparing land certificates was beset with legal and practical problems. First, the existing deemed rights of villagers on village land were not made clear, thus causing double allocation and further confusion. Second, the right of occupancy of the village was granted to the Village Council, a body controlled by the state, and not the Village Assembly which was the only democratic village institution.

The government responded to the increasing problems related to land tenure to enact a new law (Act to regulate land tenure in established villages of 1992) which extinguished all rights of occupation of land based on customary law in established villages. This law, however, was challenged at the Court of Appeal which in January 1995 ruled the law unconstitutional and hence declared it non-valid (Birgegård, 1995).

The major problems with the present land tenure system can be summarized as follows (Land Commission, 1994:33):

- Procedures for allocating land are often disregarded or bent.
- Neither procedures nor practices of land allocation are transparent, open and subject to public scrutiny and challenge, thus facilitating abuse and malpractices.
- There is no clear law on the alienability of certain areas, such as conservation areas, leaving a wide discretion to civil servants and politicians, including the Ministers, concerned.

[8] "Operation Tanzania" is probably better known by the name "operation vijiji" (Land Commission, 1994:40).

- Villages lack firm control over the allocation of village land. Village land have thus become a pawn in the hands of powerful officers and organs of the central and local governments.
- There is a clear tendency towards alienation of large tracts of village lands to "outsiders".

2.3 Land reform recommendations

The principle underlying the Tanzanian corpus of customary law as well as the concept of rights of occupancy, is that land is for use and not simply a commodity at the disposal of the owner to do with it what he or she likes. The ultimate control over use and disposal of land lies in the community. The Land Commission maintains this principle in its recommendations. The other principle, which is also not new, is that security of land tenure depends on its use. With reference to the three types of property rights discussed in section 2.1, the Tanzanian system includes both the rights for individuals to use the land and the right to earn income from it.

The Land Commission (1994) recommends that the organizing principle for the land tenure structure to be a multiple land tenure system based on varied forms of land ownership and interests. It further recommends that all land in Tanzania be divided into *national lands* and *village lands*. *Village lands* are defined as all lands falling within the boundaries of villages, whether or not registered, while *national lands* are a residual category defined as all lands which are not village lands. Nonetheless, national lands constitute a significant portion of the land surface with respect to land use.

Village lands will, according to the Commission's recommendation, be vested in the respective Village Assemblies who hold land for the benefit of the villagers being members of the village in question. Where there are land traditionally used as commons, and extending over more than one village, for example pasturelands, then such adjoining village assemblies will have to enter into agreements for the use of the commons by the villagers of all the villages concerned. All adult members of the village are members of the Village Assembly. Thus, there is a close identity between the assembly and the rights-holders (Land Commission, 1994:146). The idea behind this is that the monopoly of the government over the control and management over land, should be done away with. At the same time, by maintaining the principle of the ultimate owner (or radical title), the Commission vests the ultimate control over land in the communities concerned, not in the state on behalf of and for the communities (Land Commission, 1994:141).

The ongoing economic and policy reforms in Tanzania implies a change towards a market exchange economic system. Thus, it may seem inconsistent with the government's macroeconomic policy when the Land Commission (1994) does not recommend individualized titling to land, and instead argues for a land tenure system where the ultimate control over and use of land lies in the community,

vested in the Village Assemblies. When the state or the local community, as in this case, imposes limits on exclusive rights, we may refer to these restrictions as attenuation of property rights. However, property rights to land in Tanzania are to some extent unattenuated since individuals have the rights to use and to earn income from the land, although restrictions on individual rights to trade in land exist.

This possible inconsistency may explain the fact that the Tanzanian president recently has appointed a new land commission which shall, particularly, focus on the possibilities of privatizing customary land, i.e., establishing individualized titling to land. This may also reflect external pressure from, for instance, the World Bank. The World Bank seems to regard title to property as necessary to encourage farmers to improve the land and maintain soil fertility (World Bank, 1989). Another explanation for the political drive towards legal private property rights may be the possibility for a change in the agricultural priorities, and the "signs of an awakening of Tanzania's long-rumored agricultural potential are to be sought not among smallholders but among larger commercial farms" (Putterman, 1995: 321).

To complete the uncertainty of the future land tenure, Havnevik and Skarstein (1995:30) report that the Government is about to enact a new Land Policy Law, which, in contrast to the Land Commission's recommendations and the World Bank policy, will continue to vest the radical title of land with the President.

3 Criteria for assessment of land rights reforms

Which criteria should be used to assess the (proposed) land rights regimes in Tanzania? In general, actual land rights regimes would be the result of a combination of a natural evolution (as argued by the evolutionary theory of land rights, see Platteau, 1995), and the land tenure policy of the country. The relative importance of these two sets of factors remains an issue of controversy. It is the land tenure policy which is the direct choice variable, and we need criteria to make policy assessments and recommendations. In this section, we put forward and discuss four different criteria (or objectives) which are of particular relevance for the discussion of alternative land rights regimes and reforms in the study area:

1. Economic efficiency, here specified as agricultural productivity.
2. Environmental conservation.
3. Distribution and equity.
4. Transaction costs.

One could argue that the environmental concern and the transaction costs should be part of an overall assessment of the economic efficiency (i.e., 2 and 4 to be included in 1). However, we have for clarity of exposition chosen to separate these, and limit the efficiency discussion to *on-farm* agricultural productivity.

3.1 Agricultural productivity and tenure security

From an economic efficiency point of view security of land rights is important for securing investments on the land, including investments in soil conservation or soil improving technologies. In the literature, usually three main arguments have been raised in favour of the granting of individualized titling of land (freehold title), under which complete usage rights and transferability are vested in the owner (Barrows and Roth, 1990; Wachter, 1992; and Pinckney and Kimuyo, 1994):

1. The farmer has greater incentive to invest in land improvements and include the long term effects of his current decisions, the greater his certainty that land will belong to him and his descendants in the future.
2. Titled land can be used as collateral to secure loans, thereby increasing the funds available for agricultural investments.
3. Assuming that the only value of land is its agricultural use, and assuming that no other impediments to increasing scale exist, more efficient farmers should be able to buy out their less efficient neighbours in a transaction that is beneficial both for farmers and society as a whole. Thus, productivity in the agricultural sector will rise over time as a result of these transactions.

The term "security of land" often refers to two aspects. First, it refers to security against loss of land. Second, it refers to security of investments in, and on, land. These two aspects are, of course, very much interrelated. In much of the economic literature, however, it is the second meaning of the term which is referred to. The security aspect is, in general, used as the main argument for private or individualized titling to land. However, if security of land rights are to be secured through traditional land tenure forms, this argument should be reconsidered. The key question would then be: Can the land tenure system recommended by the Land Commission (1994) provide sufficient security of land rights?

There is obviously an implicit security in the customary land rights system. However, the credibility of the system rests on the stability of the government and the credibility of its policy, and the legal protection given to traditional rights by the state. In particular, the credibility rests on the policy measures taken to secure village control over the allocation of village lands, and to eliminate the present tendency towards alienation of village lands to outsiders by powerful civil servants and politicians. One of the strongest arguments in favour of individualized property rights is that it makes land mortgageable and thereby increases the farmers' access to credit (see, e.g. World Bank, 1989). Secure rights will, according to this line of arguments, provide incentives for individuals to improve their land and "help rural credit markets to develop, because land is a good collateral" (World Bank, 1989:104). The use of land as collateral is dependent on the third class of property rights outlined in section 2.1, that is the transfer rights. However, the relevance of this argument on the accessibility of credit requires at least three assumptions to be fulfilled.[9] First, such credit must be available to a

[9] See, e.g., Land Commission (1994:119).

fairly substantial number of peasants. Second, there should be in place a developed financial infrastructure to advance credit to the agriculture sector. This in turn assumes an efficient and relatively independent judicial machinery to enforce ultimate foreclosures. Three, land-linked security must be the only (or the only one which is good) form available to organize rural credit. Empirical evidence from Tanzania, as well as from other SubSaharan African countries, have thrown considerable doubts on the validity of these assumptions. Other bottlenecks than lack of collateral seem to be more important for the provision of rural credit (Platteau, 1995). Place and Hazell (1993), in a statistical survey of regions in Ghana, Kenya and Rwanda, find that credit use was so infrequent in most regions that statistical analysis could not be used. In the three remaining regions, they find a positive, a negative, and no relationship, respectively, between land rights and credit use.

The demand for security of land in the villages in Tanzania is mainly confined to the security against loss of land, including the investments made. Villagers fear the loss of their lands, which is their main means of livelihood, through various means and mechanisms: Alienation of land to outsiders; government expropriation of village lands; urban expansion into village lands; etc., are examples of cases causing insecurity (see Land Commission, 1994:118). However, titling itself does not necessarily provide security against such risks of loss of land held by smallholders. The apparent insecurity of customary holders in Tanzania has been caused through a systematic administrative practice which has relegated customary rights to a secondary place, inferior to statutory land rights. Barring such practice, customary rights have the added advantage of legitimacy in, and supervision by, the immediate community, thus, enhancing their security. The security thus provided may then also be sufficient for such investments as may be generated within the peasant communities themselves. On the other hand, the security provided by the title, particularly to a land holder from outside the village community, has proved to be illusory in many cases. The very process of land alienation to an outsider in the face of the needs of villagers generates, according to Land Commission (1994:118), such hostility that it undermines the security promised by the registered title.

According to the arguments in favour of individualized land entitlement, the presumed added security gained by titling is supposed to induce more investment in land improvements directly, while the increased availability of land-secured credit should increase these investments indirectly. However, Barrows and Roth (1990), drawing on a variety of sources, illustrate that in Kenya security of tenure was not increased with titling. Further, there was little evidence of a correlation between titling and overall long-term investment. Finally, a "well-functioning" land market did not develop after titling since customary law was still determining sales and successions. Overall, it is hard to establish general empirical relationships between land titling, on the one hand, and agricultural productivity, input use, land investments, and credit use, on the other.

In a recent comparative study on land tenure reforms in Kenya and Tanzania, Pinckney and Kimuyo (1994:10) found that many farmers would never accept a land-secured loan if there were the least possibility of losing their land. Land for these people is worth more than its collateral value or the income from agricultural use. If profitable investments entail some risk, demand for land-secured loans may not materialize.

The sentiments against titling of land, may partly be explained by the fact that land is much more than simply a factor in economic production to a smallholder. Loss of agricultural land often means the loss of livelihood, and virtual marginalization and eventually destitution. It is not surprising, therefore, that when possible implications are understood, rural smallholders are very reluctant to use land as a collateral. Further, land continues to be the central force around which the rural people's spiritual and cultural life is organized. Tampering with land therefore means tampering with the social and psychological fabric of the society (Land Commission, 1994:119). Kinship ties remain strong and ethnic, local or regional feelings remain central considerations in social and political life. Land is thereby prevented from becoming a tradable commodity. People are often emotionally attached to "their" land which represents an important source of their identity. The "value" of land is embedded in the social structure and history of a particular community and has a significant symbolic component (Platteau, 1995:18). Thus, land represents far more than a mere input into an agricultural enterprise and it is impossible to abstract it from all the social, ritual, affective and political meanings associated with it.[10]

An immediate consequence of the central role of land as a source of identity and self-esteem is that original occupants are extremely keen to retain their land, even when they reside in towns, all the more so as loss of land implies discontinuance of rituals to ancestors. The reluctance to part with ancestral land is especially strong when it threatens to go to outsiders (Land Commission, 1994; Platteau, 1995).

3.2 Internalization of environmental costs

Environmental conservation could be considered as one kind of investments in the long term productivity of land. The discussion in section 3.1 on security of tenure is, therefore, very much interrelated with the discussion to what extent farmers will include the environmental consequences in their decisions. A major argument in the economic literature is that tenure security is essential if farmers are to incorporate long term *on-farm* environmental costs in their decisions. This is elaborated in a more formal way in section 4; thus we limit our discussion here.

[10] Such sentiments may seem to be universal. Lewis (1955:91), for example, writes that "there is probably no country in the world where land is bought and sold solely for its value as a factor of production, and no country where non-economic factors do not frustrate schemes which would otherwise increase output".

As shown formally in section 4, tenure is but one of many factors influencing farmers' decisions. Tenure security is no guarantee against environmental degradation to take place, for at least two reasons. First, even though farmers under tenure security will include *on-farm* environmental costs, an optimal strategy for the farmer may still be to degrade the land. This may be due to high discount rates and short time horizons, for example because of poverty, or other factors that make the farmers' decisions more short-term in character (see section 4). Cárcamo *et al.* (1995), in a study from Honduras show that even optimal farm plans, with secure tenure and a long time horizon, will produce unacceptable high rates of erosion.

Second, farmers will even under secure tenure have limited incentives to include *off-site* (or *off-farm*) environmental consequences into their decisions. Such effects are considered *external costs* (or externalities), i.e., they affect others than the decision-maker. This is a key issue in environmental economics to explain why environmental problems arise. Thus, tenure security is often necessary, but not sufficient to make farmers take into account the full range of environmental consequences of their decisions.

3.3 Land distribution and the equity-efficiency debate

Land Commission (1994: 120) argues that individualized titling of land may have unwanted distributional effects due to accumulation of land in fewer hands. This view is also in accordance with the first Tanzanian government's belief that the equity concerns were more important than the efficiency considerations, thus abolishing private land titles shortly after independence. However, in recent years, a number of authors have argued that casting the land tenure debate in Africa as one of equity versus efficiency is incorrect. Pinckney and Kimuyo (1994:16), for instance, argues that the evidence provided so far gives little credence to the equity concerns regarding land entitlement. The equity versus efficiency debate are challenged on three grounds:

1. Indigenous land rights were rarely communal in areas of permanent cultivation. Individual households were usually allocated plots of land that remained theirs to cultivate as long as they wished; in addition, land was inheritable. Thus, use rights and transfer rights to heirs were secure (Pinckney and Kimuyu, 1994:4).[11]
2. Indigenous land rights have not been static. Rather, as the advantages of individualized tenure have grown, tenure systems have evolved towards the granting of private rights (Cohen, 1980). Although in most cases the right to sell land outside the lineage group is still restricted, all other rights are frequently allocated to individuals.[12] Since security of tenure is not suspect

[11] See also section 2.1.

[12] The terms "lineage" refers here to a group of persons with a common ancestor who continue to live in close contact with each other.

under such arrangements, there would be no increased security under freehold title and thus no direct impact on investment.

3. It is possible that the village assembly could continue to control the allocation of land in their areas even after title deeds have been issued (or the government has nationalized all lands). Pinckney and Kimuyo (1994:5) refers to evidence that this has occurred in Tanzania, where rights granted or withheld by the legal system may not be *de facto* rights. If the granting of legal freehold tenure does not provide the owner with complete transferability rights, titled land will neither contribute to greater incentives to invest in land improvements nor improve the possibilities to use titled land as collateral to secure loans.

Reliance on local communities may also offer other important advantages such as social security to its members. Even though social differentiation should not be underestimated, Tanzanian village communities tend to provide some social security to their members, and to provide a more equal opportunity for everybody to participate in new opportunities. Thus, considerations of equity and social security may often dominate considerations of economic efficiency. In a generally insecure economic environment, this should probably be regarded as a positive contribution (Posner, 1980; Runge, 1986; Bardhan, 1993; Platteau, 1995).

The issue of land distribution will become more pressing as land scarcity increases. According to Putterman (1995: 312) only 13 percent of potentially arable land is currently cultivated, the share obviously being much higher in densely populated regions. Higher land scarcity implies that some will get more land than other, the issue being by which criterion land should be allocated: Economic (market) power, or local or national political power, cf. Table 1.

	Formal ownership (transfer rights)	**Main type of power determining land allocation**
Present system	President	National political power
Land Commission	Village assemblies	Local political power
Full private property	Individuals	Market (economic) power

Table 1. Different types of power determining land allocation.

3.4 Transaction costs and the case of individualized titling to land

Property rights will never be fully delineated because of transaction costs (Angelsen, 1995b). Transaction costs can be defined as "the costs that arise when individuals exchange ownership rights to economic assets and enforce their exclusive rights" (Eggertsson, 1990:14), or "the costs associated with the transfer, capture, and protection of rights" (Barzel, 1989:2). Thus, one may distinguish between transaction costs related to three different activities:[13]

[13] Cf. Eggertsson (1990:15).

1. *Information*: costs associated with the search for information about price, quality and (sometimes) quantity of economic goods.
2. *Contracts:* costs related to bargaining, monitoring and enforcement of contracts.
3. *Enforcement of property rights:* costs incurred by the rightholder's efforts to protect the rights.

Unlike conventional neo-classical economic analysis which regard such rights as absolute, the inclusion of *transaction costs* in the analysis of property rights implies that "rights are never complete, because people will never find it worthwhile to gain the entire potential of "their" assets (Barzel, 1989:2). According to Barzel (1989), the security of rights people have over an asset is a function of three factors: the rightholder's protection efforts, other people's capture attempts, and the government's protection.

The existence of markets for productive assets, including land, is one of the most important feature of a market exchange system based on private property. The market price of a productive asset signals the opportunity cost of using the resource in production, also taking into account potential future uses. Relative to other arrangements, the market provides this critical information at low cost. The market value of a means of production is derived from the demand for goods and services by final users, but its value depends also on the distribution of wealth and the structure of private property rights (Eggertsson, 1990:37).

The value of exclusive (individualized) property rights depends, *ceteris paribus*, on the cost of enforcing those rights, that is, the cost of excluding others, which ultimately depends on coercion (Eggertsson, 1990:35). The enforcement of exclusive rights is usually undertaken by both the individual owners and the state. Enforcement by the state increases the value of privately owned assets and constitutes one of the cornerstones of market exchange. However, the credibility of state enforcement depends also on the stability of the regime and the credibility of its policy. In areas where the state does not help to enforce contracts, but rather prohibits possession and trade in lands, high transaction costs usually limit or even prevent exchange.

Contrary to informal practices at village level which economize on information costs, the introduction of formal land titling procedures is costly. Enforcement of property rights involves excluding others from the use of scarce resources. Exclusive or individualized ownership calls for costly measurement and delineation of lands and enforcement of ownership rights. Such transaction costs may be significant in a country like Tanzania, where the physical and administrative infrastructure, in general, are of poor quality. Thus, these costs may, at present, be a major obstacle to individualized titling to land in Tanzania.

3.5 The evolutionary theory of land rights and land reforms in Tanzania

The Tanzanian Land Commission recommends that the ultimate control over use and disposal of village lands should be vested in the communities concerned. This implies, a strengthening of local capacities for management, information and dispute settlement, rather than imposing from above the mechanisms of a formal state legal system (see Atwood, 1990:667).

These recommendations seem to be in accordance with Platteau's (1995) evolutionary theory of land rights. Platteau (p. 37) argues that since experience shows that direct state intervention in land matters often has been a major source of farmers' insecurity in many African countries, and since village systems frequently are able to evolve to meet new needs, indigenous land tenure systems still have a dominant role to play. Further, he argues that it is only when informal institutions and practices are no more reliable methods of adjudicating land rights and ensuring land tenure security that the government should consider undertaking a formal registration procedure. Thus, what is needed is a gradualist and pragmatic approach that "reinstitutionalizes indigenous land tenure, promotes the adaptability of its existing arrangements, avoids a regimented tenure model, and relies as much as possible on informal procedures at local level" (p. 37). The land tenure system in Tanzania, as in other countries, has developed through an evolutionary process. By institutionalizing the customary land tenure system individual user rights may be secured, and thus the peasants' incentives to invest in soil preserving and soil improving measures. However, a need for land titling and registration may arise in a situation with growing uncertainties about the application and effectiveness of the indigenous land tenure systems. This may, according to Wachter (1992:92), take place when "there are uncertainties about which are the legitimate authorities with power to control land use and land transactions, and where land values and pressures on land are rising".

Although tempting to romanticize the strengths of the traditional system, we should be aware of possible pitfalls and failings. In the discussion above we have pointed to some major problems with the existing traditional system, for instance, land-grabbing by higher-placed officials and politicians, alienation of village lands to domestic and foreign investors and tourist companies. In a situation with increasing scarcity of land, a market based system of land allocation may contribute to increased transparency. However, the transaction costs of implementing and enforcing a system of individualized titling to land, are probably major obstacles presently against the introduction of a market based land allocation system in Tanzania.

The above discussion leads us to the following tentative conclusions on land tenure reforms:

- There is no clear-cut relationship between land titles, and farm productivity, input and credit use, and land investments.

- Full tenure security is no guarantee against land degradation, but may be a necessary condition for reducing environmental problems related to traditional agriculture.
- Indigenous or customary land tenure systems evolve naturally in response to local demand, in particular to the need for more individualized use and income rights as land becomes more valuable.
- Large scale national land titling programmes do not seem to serve their purpose and justify their costs. Land titles should, however, be offered as an option to the farmers at reasonable costs.
- The fear of a more unequal land distribution when moving towards a system of private property rights may seem exaggerated.
- When land becomes scarce, a more unequal land distribution will often evolve. Then, a main issue may be to decide on which type of power to determine the land allocation: economic or political.

4 An economic analysis of farmers' decision-making

The aim of sections 4 and 5 is to discuss - based on economic theory - the role of various factors in explaining the degree of land degradation (soil erosion) in the highland areas of Western Tanzania. The emphasis is on the effects of various property rights regimes as well as other economic factors (particularly relative prices) in determining how farmers of the area use and manage land resources. The objectives are first, to provide a more formal discussion of some of the points made in earlier sections related to different criteria for assessment of property regimes, second, to put the discussion of property rights in a wider perspective, and, third, to show the relevance of other economic factors.

We do not presently have sufficient data to test the relative importance of the various effects discussed. The purpose is more to present possible effects that should be considered in policy-formulation, and which also provides a set of hypothesis for empirical testing. Therefore, this approach may serve as a guide for more detailed empirical research in the area.

We will also keep the formalization of the models at a relatively simple level, and try to extract as much as possible from these in terms of economic mechanisms at work and policy lessons. We believe that the reason for policy failures is not as much a question of a lack of complex theories, but rather lack of understanding and violations of simple economic principles.

Two sources of agricultural land degradation can be distinguished (Wachter, 1990: 77). First, there is land degradation stemming from the overexploitation of land resources. Second, land degradation can stem from the underinvestment in land. The theoretical discussion will in part be divided along these lines. In this section we present a simple two-period model of individual farmers' decision-making (a micro approach), relating soil erosion to the present intensity of production (overexploitation) and investments in soil conservation. This will identify a

number of factors which influence farmers' exploitation of and investments in land. In the following section 5 we focus on migration, and factors which determine the total population in a region (a macro approach). High population pressure may result in overexploitation of land (the first source of land degradation).

4.1 A two-period model

This section presents a simple, two-period model of farmers' decision-making. The aim is to use the results derived from the model to undertake a structured discussion of the causes of soil degradation. Soil erosion is one type of land degradation that has received some attention in the literature (McConnell, 1983; Wade and Heady, 1978; Ciriacy-Wantrup, 1968; etc.).[14] The key focus in the literature is on the intertemporal choice: How to balance the short term production gain of soil mining against its long term productivity loss? How much to invest now in soil conservation to increase future productivity? Most models use the mathematical technique of optimal control, which gives the optimal path over time for the key variables (like soil depth). For the present purposes we will present the simpler two-period model of farmers' decision-making.[15] In spite of its simplicity compared to optimal control models, the two-period model produces most of the insight derived from the former models. One should note that period 2 in the model is to be interpreted as the future, and because of the unrealistic assumption of no value of soil at the end of period 2 (salvage value), the focus is on period 1 decisions.

A few more words on the underlying assumptions and limitations of the model are in order:

- We assume that the objective is income maximizing, with all prices exogenously given in the model (small, open economy assumption).[16] This is sufficient in order to present and discuss the structure of intertemporal choice. An alternative formulation would be that farmers maximize household utility, given the available family labour (Chayanov, 1966), or that farmers minimize their labour efforts subject to a subsistence constraint. The assumption used here is crucial for some of the policy effects, as discussed below and in more details in Angelsen (1994; 1995a).

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[14] Burt (1981) presents a formal intertemporal model of soil use. As early as in 1968, Ciriacy-Wantrup analysed soil as a renewable resource with a threshold level below which resource use becomes irreversible. Bunce (1974) gives an economic analysis of soil conservation in a static framework. McConnell (1983) focuses on the intertemporal path of soil use including the conditions under which private and social optima diverge. The paper also gives insight about effective instruments of erosion control. Barrett (1991) argues that pricing reforms will *not* affect soil conservation in developing countries dramatically.

[15] See, for example, McInerey (1976) and Carlson *et al.* (1993), for an exposition of this type of modelling of natural resources.

[16] We discuss below the possibility that the prices may be *expected* values, which does not violate this assumption; the important point is that these still are exogenous in the model.

- The model includes some stochastic elements: a probability of loosing the land, and expected values of future prices. The treatment of risk is, however, the simplest possible, as we assume that farmers are risk neutral, allowing us to apply the expected values directly. Introducing risk aversion would add realism and include some new arguments, but complicate the model considerably.[17]
- We only discuss *on-site* (on-farm) effects of soil erosion. *Off-site* effects may be even more important, but are simpler from an analytical viewpoint; the individual farmer would not under any property regime have incentives to include *off-site* effects in his decision-making. *Off-site* or *off-farm effects* relate to the traditional externality argument in environmental economics.
- Tenure security (the probability of *not* loosing the land between the first and second period) is an exogenous variable in the model, which is another simplification. In practice, it may depend on decisions made by the farmer regarding intensity of production and other property rights enforcement activities (including obtaining title deeds, if possible). There is a mutual link between property rights security and intensification and investments in land. A model endogenizing tenure security is found in Angelsen (1995b), but for the present discussion it is sufficient to keep tenure security exogenous.
- The model does not discuss the crop choice, which may have significant effects on erosion rates. Cárcamo *et al.* (1994) in a study from upland Honduras, argues that this is among the most important decisions made by the farmers. Analytically it is very simple to include crop choice in the analysis; one just compares the income (net present value) from different crops or crop mixes, and choose the one which gives the highest.

We focus on a representative farmer. The production function in period t is given by;

$$(1) \qquad y_t = a_t f(z_t, x_t); \quad f_i' > 0;\ f_{ii}'' < 0;\ f_{zz}'' f_{xx}'' - (f_{zx}'')^2 > 0;\ f_{zx}'' \gtrless 0;\ i = z, x;\ t = 1, 2$$

y_t is yield (output per ha) in period t; a_t is a coefficient for the technological level in year t (if $a_2 > a_1$, we have neutral technical progress); z_t is a vector of inputs used in period t, or simpler a fixed combination of inputs; x_t is the soil stock (for example as measured by soil depth) in period t.[18] The production function is concave: production is increasing with soil depth and with other inputs, but at a decreasing rate.

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[17] See, for example, Ardila and Innes (1993) for a more realistic discussion of soil erosion and risk.

[18] What is commonly referred to as soil erosion could be distinguished into two different, but related, processes: Loss of topsoil and nutrient depletion. We assume that the land productivity is dependent on the total stock of nutrients - *NS* (which could be further decomposed into nitrogen, phosphor, etc.). The interesting variable *NS* can then be written as a product of nutrient content (*NC*) and the soil stock (*SS*): *NS* = *NC* * *SS*, where *NC* by definition is *NU/SS*. At our level of abstraction, we have not distinguished clearly between these two process, although the model follows most models in the literature and focuses on soil depth or soil stock.

The key link between the two periods is the soil stock. The relationship is modelled as follows;

(2) $$x_2 = x_1 + k - g(z_1, s)$$

$$g'_z > 0;\ g''_{zz} < 0; g'_s < 0; g''_{ss} < 0; g''_{zs} < 0;\ g''_{zz}g''_{ss} - (g''_{zs})^2 > 0$$

k is the natural soil regeneration, i.e., an exogenous addition to the soil base from period 1 to period 2.[19] From the stock in period 1 one also has to deduct the soil loss due to agricultural production; $g(z_1,x)$. This loss is assumed to be positively related to the intensity of production in period 1, as given by the amount of inputs applied (z_1), and negatively to investments in soil conservation (s).[20]

The farmers' decision problem is to maximize the income over the two periods, that is the net present value (NPV), taking into account the soil dynamics in equation (2). The NPV is given by;

(3) $$NPV = (p_1 y_1 - w_1 z_1) - qs + \delta\lambda(p_2 y_2 - w_2 z_2)$$

p_t is the output price in period t; w_t the input price (or a vector of input prices) in period t; q is the price of soil conservation measures. The discount factor is $\delta = \frac{1}{1+r} < 1$, where r is the discount rate. λ is the probability that the farmer will keep the land also in period 2. $(1-\lambda)$ is the risk (probability) of loosing the land, reflecting the tenure security.

The parameters ($\delta\lambda$) before period 2 income are both less than 1. This implies that the income in period 2 is given less weight in the decision problem for two reasons; (i) discounting and (ii) the risk of loosing land. This is central in our discussion, and will be elaborated below.

The NPV is maximized with respect to three decision variables; z_1, z_2, and s. The expression to be maximized is given by inserting equations (1) and (2) into (3);

(4) $$NPV = p_1 a_1 f(z_1, x_1) - w_1 z_1 - qs + \delta\lambda\{p_2 a_2 f[z_2, x_1 + k - g(z_1, s)] - w_2 z_2\}$$

The exogenous variables in the model are a_1, a_2 p_1, p_2, w_1, w_2, q, δ, λ, and x_1, but as usual only relative prices matter (not their absolute levels). Given an interior solution, the necessary conditions for maximum of (4) are given by the first order conditions (FOC);

(5) $$\frac{\partial NPV}{\partial z_1} = p_1 a_1 f'_z - w_1 - \delta\lambda p_2 a_2 f'_x g'_z = 0$$

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[19] Alternatively, k could have been a function of the soil stock, but this would not have added much to the model.

[20] This may not always be the case, for example can higher intensity in terms of more inputs imply that the soil is covered with vegetation for a longer period of the year, and thereby reduces the exposition of bare land.

(6) $\frac{\partial NPV}{\partial s} = -q - \delta\lambda p_2 a_2 f'_x g'_s = 0$

(7) $\frac{\partial NPV}{\partial z_2} = \delta\lambda(p_2 a_2 f'_z - w_2) = 0$

The interpretation of these conditions are as follows. (5) describes the optimal choice of input in period 1. First, there is a yield gain in period 1. This must be balanced against the cost of purchasing inputs (w_1). In addition, there is a loss in terms of reduced productivity in period 2, as captured by the last term in (5).

(6) gives the optimal investments in soil conservation. The cost are given by q, whereas the second term gives the discounted expected income from the productivity gain in period 2 from the marginal investment. Finally, (7) is the period 2 version of (5), except that there is no third period in the model and the effects on erosion of z_2 is therefore neglected. This follow from our limitation of the model to two periods; thus our focus is here on z_1 and s, and on (5) and (6).

In both (5) and (6) the term $\delta\lambda$ appears, reflecting the weight given to productivity changes in period 2 in the decisions made in period 1 on the intensity of production and soil conservation investments. The higher this term is, the more weight is given to the future over the present.

The optimality conditions in (5) and (6) are illustrated graphically in Figures 1 and 2 below.

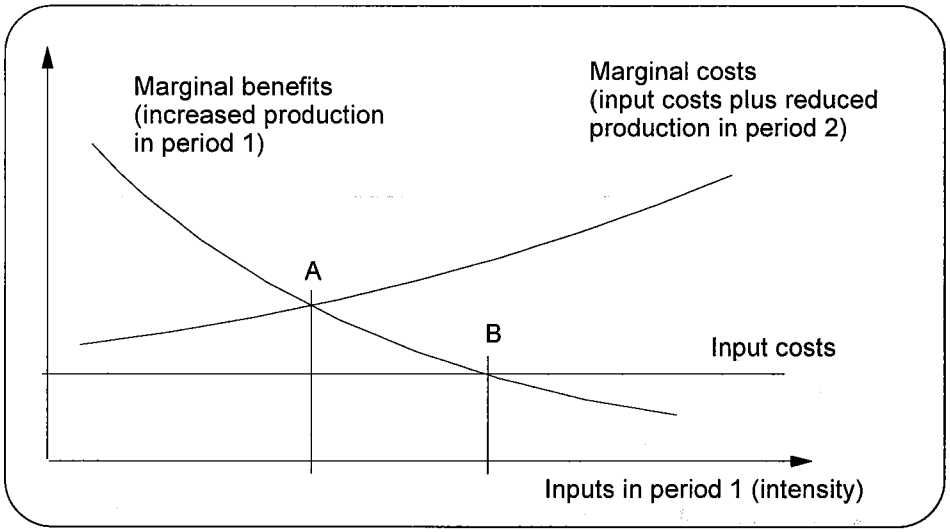

Figure 1. Intensity of production in period 1 (z_1).

Two different solutions are illustrated in Figure 1. The general case is given in point *A*, where some weight is given to the productivity loss in period 2 due to soil erosion. Point *B* is the extreme case when this loss is completely neglected, either because of an infinitely high discount rate, or because the farmer considers the chances for future production on the land to be nil because of the tenure insecurity.

Figure 2 similarly illustrates equation (6). Under assumptions as in case *B* of Figure 1, there will be no investments in soil conservation.

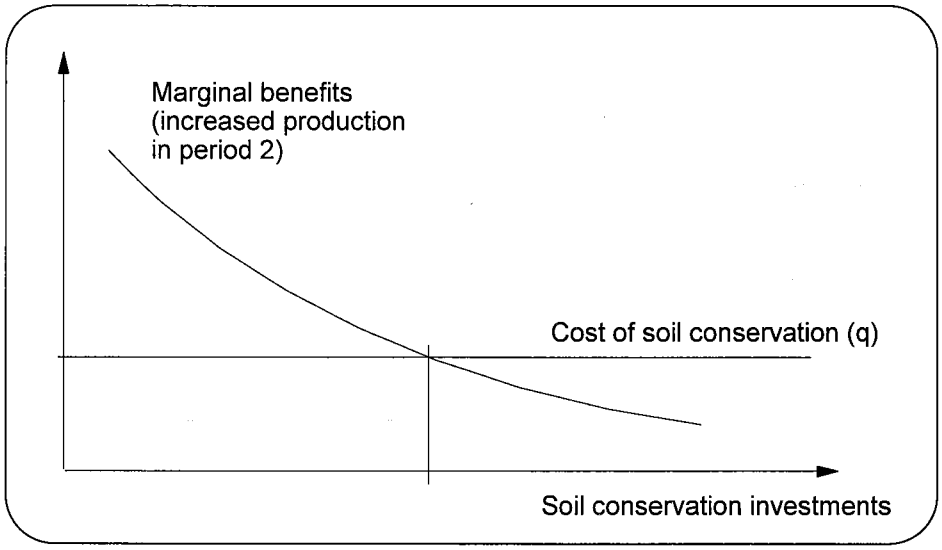

Figure 2. Investments in soil erosion (s).

> *Proposition 1: The magnitude of soil erosion (a function of present intensity of production and soil conservation investments) is determined by an intertemporal choice between the present costs and the future benefits of higher agricultural productivity. Generally, factors which lowers the present costs and/or increase the future benefits in the farmers decision problem will promote soil conservation.*

4.2 What determines the magnitude of soil erosion?

This section gives a more detailed discussion of the various factors that affect farmers' choices, in particular related to the magnitude of soil erosion. We do not show formally the effect of changes in various exogenous parameters[21], but the results should follow intuitively by considering the equations (5) - (7) and Figures 1 and 2.

Tenure (in)security

A crucial aspect of property regimes is the security it gives farmers: Can (s)he expect to keep on farming the land? What are the chances of loosing it? Rather than being a fixed probability for different regimes (e.g., private rights give 100 percent security), it should be thought of as a continuum of probabilities. Thus it is difficult to give a general ranking of the various regimes, with the exception of open access where the security (by definition) is zero. One should further note that the security is a *subjective* variable; the key is how the farmers *perceive* the security.

[21] This could be done be total differentiation of (5) - (7), and solving with respect to the endogenous variables.

The effect of increased security is straightforward in the model. It implies that farmers put more emphasis on the second period because the chances are greater that they are able to continue farming. Graphically this implies that the curves which give the marginal cost curve in Figure 1 and the marginal benefit curve in Figure 2 will move upwards. Period 1 inputs (z_1) will decrease, whereas soil conservation investments (s) will increase.

Proposition 2: Increased security of tenure implies that farmers put more emphasis on the future consequences of their present decisions. Thus, one gets less intensive farming and increased investments in soil conservation, which both reduce soil erosion.

Discount rate

We see from equations (5) and (6) that the discount factor enters the model in exactly the same way as the probability of keeping the land (tenure security). A higher discount rate (lower discount factor; δ) has the same effect as higher tenure insecurity; the effect is more soil erosion.[22] Note that also the discount rate is a subjective factor, as λ is. *If* the farmers had access to credit in a perfect credit market, the market rate of interest would be the relevant discount rate. This is, however, rarely the case in low income developing countries.

One important factor influencing the subjective discount rate is the level of poverty. The poorer a society is the more the daily struggle for survival dominates the decision-making, and pre-empts any long term planning (World Commission, 1987; Jagannathan, 1989; Perrings, 1989).

Proposition 3: Higher discount rate (lower discount factor) has the same effect as lower tenure security; it increases soil erosion. Poverty is a contributing factor to high discount rates and myopic decision-making.

Output prices and technical change

From (5) - (7) we see that changes in the output price (p_t) and technical change (a_t) has exactly the same effect in the model; both increase the value of production for a given set of inputs and soil stock. When the output price in period 1 increases whereas the future one remains unchanged, the effect on the present intensity of production is seen from Figure 1. The marginal value of productivity in period 1 is boosted (the marginal benefit curve moves upward), and the result is increased intensity of production.[23] The intuition is straightforward: Production in period 1 has become relatively more profitable, implying more intensive agriculture which leads to more soil erosion.

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[22] The phenomenon that increased risk of loosing a resource has exactly the same effect as higher discount rate is well recognized in the resource economics literature, and is referred to as *risk discounting* (see for example Clark, 1990).

[23] The other curve may also change due to indirect effects via changes in soil stock in period 2. We do not discuss this effect here, as it would not dominate the direct effect, and therefore not change the results.

The effect on soil conservation investments is less clear. Higher p_1 leads to lower soil stock in period 2, as just argued, which may affect the marginal return on soil conservation investments. A plausible assumption is that lower soil stock may increase the marginal return on such investments, implying that s will increase.[24] The increase in soil conservation investments is, however, not sufficient to compensate for the increase in intensity, and the net effect will still be more soil erosion.

A higher output price in period 2 will result in less intensive practices. Period 2 farming has become relatively more profitable, thus the erosion cost of present farming has increased. Moreover, soil conservation investments will be more profitable and therefore increase. Both effects imply less soil erosion.

Note that future output prices are farmers' *expected* prices. Changes in *expectations about future prices* is therefore sufficient to induce changes in *present* farming practices. Expectations about a decline in output prices will therefore induce the rational farmers to increase present farming intensity and lower soil conservation investments, and thereby increase land degradation. One may hypothesize that, for example, a general economic recession in a country may increase pessimism and lower expectations about future output prices, and thereby lead to increased environmental problems.

> *Proposition 4: Higher present output prices will lead to more soil erosion, whereas higher (expected) future output prices will change farming practices in favour of reduced soil erosion.*

The above conclusion is sensitive to our assumption that farmers maximize their (discounted) income, and that all prices are exogenously given. An alternative model is the subsistence approach, where farmers minimize their labour efforts subject to a subsistence constraint ("full belly" model). The effect of an increase in the output price will be completely different under this assumption. A higher output price implies that the household can obtain the same (subsistence) income by producing less intensive, which reduces the problem of soil erosion.[25]

If the conclusion is so critically dependent on the assumptions made, which model gives the most realistic description of the farmers' adaptation and responses? Definite tests of the subsistence versus the income-maximizing hypothesis are difficult to formulate, and are rarely undertaken in empirical work (López, 1992). It is commonly argued that the subsistence model may be the most appropriate for traditional societies, whereas the model with exogenous prices (open economy model) gives a better description of a modernized society (e.g., Stryker, 1976). However, if one also considers *migration*, the assumption used in our model would clearly give a more realistic description. A key variable in decisions concerning migration is the difference in expected income between the old and new location, as discussed in section 5.

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[24] Mathematically, this is to say that $g''_{zs} < 0$.

[25] See Angelsen (1994) for a more detailed discussion.

The two assumptions also reflect differences in time perspective; the income-maximizing model is more relevant for the long term adaptation. One reason is migration, another is the fact that a subsistence requirement is not static and change (normally increase) over time. Smallholders are often subject to strong social pressures to indulge in new expenditures.

Input prices (wage)

The effect of an increase in the price of inputs in period 1 (e.g., a wage increase in the case of labour) is readily seen from Figure 1; the marginal costs curve shifts upward, implying reduced inputs, and therefore less erosion. The discussion is parallel to the case when period 1 output price increases; present farming is less profitable, and therefore less intensive practices are applied. Similarly, the effect on soil conservation investments depends on how the marginal profitability of such investments changes with the soil stock. We may reasonably assume (as done above) that increased w_1 reduces the investments, but the net effect is still less erosion.

In addition to land, labour is the most important input in traditional agriculture. It is therefore of particular interest to see what determines the wage level, or the opportunity costs of labour (which may be wage labour, self employment, etc.). High population growth would generally lead to a lower wage level (at least in the short run). The effect in our model will be increased soil erosion, which then provides a theoretical foundation for the conventional argument of the link between population growth and environmental degradation. It also suggests that providing attractive alternative (off-farm) employment, which increases the opportunity costs of farming labour (w_1 in our model), is important in reducing soil erosion.

> *Proposition 5: A lower wage rate (opportunity costs of labour) in period 1, for example, due to high population growth or reduced availability of attractive off-farm labour, will result in more intensive farming and increased soil erosion.*

Costs of soil conservation

A final exogenous parameter in our model is the costs of soil conservation investments (q). Higher costs will, obviously, lead to reduced investments, and therefore contribute to increased erosion. It may indirectly also have an effect on inputs in period 1; following our assumptions above these will be reduced, but the net effect is still to increase soil erosion.

The costs of soil conservation investments would include information costs. This opens up for government policies and programmes that reduce the costs of soil conservation to have a constructive role to play, for example, through information and extension services. More directly the government can influence the costs through, for example, subsidising inputs used for soil conservation.

Proposition 6: Lower costs of soil conservation investments, for example, through information and extension programmes, will increase such investments and thereby reduce soil erosion.

5 Upland land degradation, property regimes and migration

5.1 A simple migration model

Whereas we in the previous section study decisions at the farm level, we now move to the macro level and study some general equilibrium effects. This section presents a simple model to study the effects on migration of various changes in economic variables, policies and land rights regimes, which may have implications for the extent of soil erosion in our study area. We start out by considering a stylized economy described by the following characteristics. There are two areas (regions); the uplands (u) and the lowlands (l). We assume that land in each region (L_i) is fixed; i = regions u and l.

The total population (N) in the two regions is fixed, and is allocated between the two regions through unrestricted migration. This may not correspond with the Tanzanian reality, where there are restrictions on migration and where one may start farming. However, in a long term perspective, the income differentials between regions will influence migration. Even in the presence of some constraints on migration, market forces will be at work.

We consider only agricultural activities, and one homogenous output (Y_i) in each region. The farm gate prices (p_i) excluding taxes, are exogenously given, that is the price is not influenced by the production in the two regions (e.g., sold at a larger national or world market). The prices take into account costs of transportation to markets.

Formally, the economy is described by these equations;[26]

$$(8) \qquad Y_i = \tilde{f}_i(N_i, \bar{L}_i) = f_i(N_i);\ f_i' > 0,\ f_{ii}'' < 0; \quad i = u, l$$

$$(9) \qquad N = N_u + N_l$$

The first equation is the production functions in the two sectors, where the fixed land (L_i) can be included in the functional form, thus production (Y_i) is a (strictly) concave function of the only variable input, population in the region (N_i). The second equation simply states that total population is fixed, and allocated between the two regions.

It is commonly assumed that the negative environmental effects of agricultural production, for example, soil erosion and loss of biodiversity, are higher in the uplands. Soil erosion may be higher due to more erodable soil in the steeper terrain. Loss of biodiversity may be higher due to the simple fact that more virgin

[26] This presentation is partly inspired by Sinn (1988), but is also based on the reasoning of standard textbooks in environmental and development economics.

habitats are left in the uplands, and these are reduced when population increases. Thus, soil erosion (E) is assumed to be positively related to the population size in the uplands, as captured in equation (10) below. For simplicity, we assume that there are no environmental problems in the lowlands; the essence of this formulation being that environmental problems are more severe in the uplands. The soil erosion discussed in this model could be both *on-farm* and *off-farm.*

$$(10) \quad E = e(N_u);\ e' > 0$$

To close our model we need to state how labour is allocated between the uplands and the lowlands. The socially optimal allocation, where one includes both the production benefits and the environmental costs, is found when the net social benefits or welfare, $(p_u Y_u + p_l Y_l - E)$, is maximized. The necessary condition for maximum is;

$$(11) \quad p_u f'_u - e' = p_l f'_l$$

The net marginal loss of the last migrant leaving the uplands, after taking into account the reduced erosion that follows, should equal the production gain in the lowlands from this migrant. The model now consists of five equations, with Y_i, N_i and E as the five endogenous variables in the model, and L_i, p_i, N, and the technology contained in the form of the production functions as exogenous parameters.

The optimal allocation of population between the two regions is illustrated in Figure 3 below. The length of the "box" is the total population. The optimal solution is at A, where the marginal social benefits are the same in both regions.

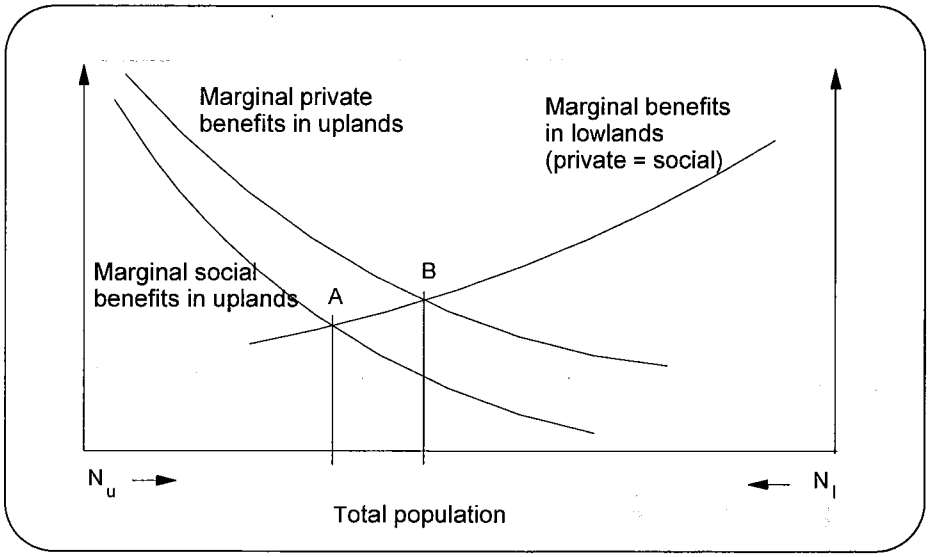

Figure 3. The long-term allocation of the population between the lowlands and the uplands.

5.2 *The free market solution*

We now compare the socially optimal solution with the free market solution. The individual migrant would only consider the income (s)he gets at his/her present place of residence with the expected income at the new place. The environmental costs are spread out on the many, and therefore not included in the individual decision-making. The individual farmer only considers the costs and benefits (s)he is facing directly.

Further, farmers would look at the net price after deducting a possible output tax ($t_i \geq 0$), which could be an export tax[27] or a sales tax for goods at a local market (although the latter would be more difficult to enforce);

$$(12) \quad (p_u - t_u)f'_u = (p_l - t_l)f'_l = w$$

The underlying assumption is that new migrants to an area receive an income equal to their marginal productivity, which is in line with the tradition following the Harris-Todaro (1970) expected income migration model. This would be the case if, for example, they are hired as wage labour and the labour market is reasonably competitive. Alternatively, one could assume that even though land in each region is fixed, all land is not under cultivation, and newcomers have to settle on the marginal land (in terms of soil quality, slope, location, etc.). This may be the assumption closest to the Tanzanian reality, where (as already noted) only 13 percent of the potentially arable land is currently under cultivation (the remaining 87 percent may, however, include fallow land in a shifting cultivation system, which should be considered agricultural land).

The solution to this model is also illustrated in Figure 3 above. The market solution is at point *B*, which would give a too high population in the uplands where the environmental problems are largest.

> *Proposition 7: The free migration solution will cause too high population in the uplands, and excessive environmental problems, compared to the socially optimal solution. (Potential) migrants will not consider the environmental costs of their decisions.*

This lesson is fundamental in environmental economics; the more than 70 years old wisdom of Pigou. Yet, its implications are not always fully appreciated in analysis and policy making related to environmental problems. One important corollary to this way of reasoning is that the problem is not ignorant, uninformed and uneducated farmers, but the underlying incentives. Thus, programmes to address the erosion problem through information, training, and (other) extension services may be expected to have limited effects, unless the underlying incentive structures are changed.

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[27] Export taxes on agricultural produce were removed in the mid 1980s in Tanzania (Tax Commission, 1991).

Now we consider the effect of higher net farm gate price for agricultural produce in the uplands, for example, due to improved rural roads that lower transportation costs (p_u up) or reduced output taxes (t_u down). The curves for the marginal benefits in uplands will shift upward in Figure 3 by a factor equal to the price increase. It will be attractive to move from the lowlands to the uplands until a new migration equilibrium is restored, with an even higher population in the uplands. A similar shift may be caused by technological progress in the uplands, e.g., improvements in the genetic plant material and improved production technologies, resulting in higher upland population.

Proposition 8: The extent of soil erosion is determined by the relative profitability of upland agriculture. Higher farm gate prices in the uplands, for example, because of technical progress or lower transportation (marketing) costs due to improvements in infrastructure, will increase the problems. In the same way, well intended measures to "help the uplands" which increase the income (or welfare more generally) in the uplands may increase environmental problems.

Proposition 9: An important policy measure to reduce upland soil erosion would be to increase the profitability of lowland farming. Thus, the key to the upland problem lies in the lowlands.

For example Mwalyosi (1992) suggests improvements in transport and communication infrastructure to increase agricultural production in the highland zone. It may help in achieving the short term income objectives. The effect may, however, also be increased land degradation due to increased population pressure. Moreover, through migration the long term effects on income is also uncertain, as migration tend to reduce income differences between regions.

In drawing Figure 3, we have assumed that the tax paid by the marginal migrant is lower than the marginal erosion costs: $t_u f'_u < e'$. We note that if we set the output tax such that $t_u f'_u = e'$ in equilibrium and $t_l = 0$, then the socially optimal solution will be achieved. This means that the farmers on the margin must pay a tax equal to the marginal erosion costs. Thus, in considering migration from the uplands to the lowlands (or the other direction), potential migrants include a reduced tax payment in their decision making which is equal to the reduction in erosion. In this way the tax system makes the farmers behave *as if* they included the environmental costs. The environmental externalities are internalized in farmers decision making. Graphically, this is obtained by moving the upper curve downwards (by increasing the tax) until point *B* coincides with point *A*.

Proposition 10: A tax on output from uplands can be used to correct the market solution, that is to achieve the socially optimal level of upland population and erosion through market mechanisms.[28]

[28] This conclusion that an output tax would correct the environmental externality is crucially dependent on our assumption of only one input in the production function. With more than one input, e.g., land, labour and fertilizers, an optimal policy would not be an output tax, but rather a direct tax on the externality. If the externality is related to the area of land used, a land tax

Modifying the model, a general population increase can be illustrated graphically by extending the "box" in Figure 3. This will lead to an increase in both the upland and lowland populations. The distribution of the increase between the two regions depends on the production technology in the two regions (the elasticity of marginal productivity). Note that in this model the effects of a population increase do *not* depend on whether the increase occurs in the lowlands or the uplands; through migration the long term equilibrium will be the same.

The simple framework presented above could be extended in several directions, as done in the following sections. One way to add realism to the above model is to include inter-sectoral transfer costs (costs of moving, etc.). Thus for an individual or a family to move, a positive income differential between the two regions must exist in order to compensate for these costs. We may therefore have an equilibrium situation with income differential, which would be less than the transfer costs. Introducing such costs would not change any of the main mechanisms in the model.[29]

The existence of risk and risk aversion is another factor which may cause the expected income to be different between the two regions in a long term equilibrium. One could realistically assume that both production and market (price) risks are higher in upland agriculture. To compensate for the higher income variations, the expected income must be higher in the uplands in equilibrium.

> *Proposition 11: Reduced risk in upland agriculture, for example, through price stabilization measures, will increase lowland-to-upland migration or reduce upland-to-lowland migration, and thereby escalate the soil erosion problem.*

5.3 The importance of different property regimes

The development of (private) property rights is in general linked positively to the intensity of production (see discussion in Angelsen, 1995b). Thus, the uplands tend to have less secure and well established property rights than the lowlands. In this section we relax the assumption that new migrants receive an income according to their marginal productivity. Instead we move to the other extreme, and assume that total upland production is shared equally among its population (including newcomers). This is a situation of open access.[30] Typically this could be

would be the solution; if related to chemical fertilizer use, a fertilizer tax would be the optimal policy. Land taxes would, however, entail higher administrative costs, and would be more difficult to enforce (see for example Skinner, 1993). Thus, in a second-best world, output taxes *may* still be the optimal instrument.

[29] It would, however, modify the above conclusion that the outcome does not depend on where the population growth takes place. If, as an example, we are in a situation where the equilibrium income is higher in the uplands than in the lowlands, a *small* population increase in the uplands would not lead to any migration. It would lower the upland income, but not sufficient to cause any migration.

[30] This situation is commonly referred to as a common property regime (CPR), but CPR would normally include some restrictions on access, which is not the case in our model. However, it

the case if the dominating agricultural practice in the uplands (highlands zone) is cattle holding, as pastoral land is often open access (or common property), whereas crop production dominates in the lowlands. The migration equilibrium condition now becomes;

$$(13) \quad \frac{(p_u - t_u)f_u(N_u)}{N_u} = (p_l - t_l)f_l' = w$$

Farmers in the uplands receive an income equal to the value of the *average* productivity, while lowland farmers get an income according to their marginal productivity. This is illustrated in Figure 4 below.

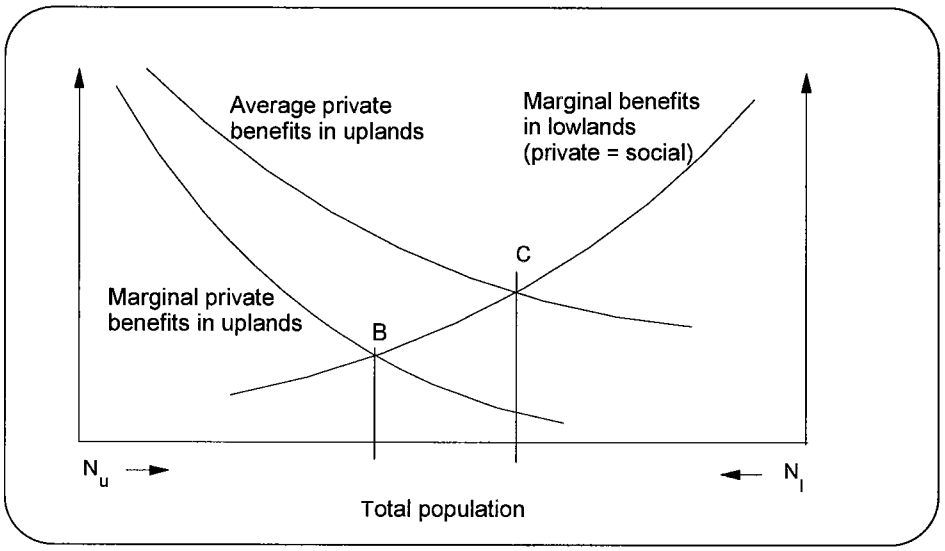

Figure 4. Migration equilibrium in a situation with open access in the uplands.

The new equilibrium is given in point *C*, and should be compared to the previous equilibrium in *B*. Because of decreasing marginal productivity as the population increases in the region, the average productivity curve would be below the marginal productivity curve. Thus, the new equilibrium implies more people in the uplands, and therefore an intensification of the soil erosion problems.

(Potential) migrants from the uplands will receive *more* than their contribution to increased production (the income is higher than the value of marginal productivity). All potential land rent is dissipated. Thus we have another kind of negative external effects, as potential migrants by not leaving the uplands lower the income to the population in the uplands. They do not take into account that they influence other farmers' income. The result is overpopulation in the uplands, relative to the available land resources, due to the lack of property rights regime in the uplands.

The loss in production and income is equal to the triangle (below the BC line) in Figure 4. Upland farmers in the BC segment of the figure would have had a higher

resembles the equal sharing characteristics of many CPRs.

productivity in the lowlands; graphically this is shown by the fact that the marginal productivity curve for the uplands is below the marginal productivity curve for the lowlands. Note that this production loss comes in addition to the loss due to environmental externalities in the uplands, as discussed above.

Proposition 12: A property rights regime in the uplands based on equal sharing of the production output will lead to even higher population and, by extension, more land degradation in the uplands. In addition to the social loss in the first model due to environmental externalities, there is a production loss since upland income does not reflect farmers marginal productivity.

The other policy lessons from section 5.1 would also be valid here.

5.4 The role of off-farm employment and rural-urban migration

We now extend the analysis to include off-farm employment in particularly urban areas (townships or densely populated areas). Large scale rural-urban migration is an important feature of most developing countries, including Tanzania. For simplicity, we have only one agricultural sector (the uplands). Potential migrants base their decisions on the difference between their present income and the *expected* income (wage) in the cities (w^e). The latter is given by bw^t, where b is the probability of getting a job, and w^t is the (average) wage level in town. For simplicity, it is assumed that the income is zero when unemployed. Moreover, b and w^t are given in the model. Note that people often move to towns in search for employment, that is without having any particular job arranged for before leaving. Thus, the *ex ante* decision is based on *expected* income, but migrants will end up *ex post* with either higher (become employed) or lower (remain unemployed) income.

We may identify at least two different market solutions in this model;[31]

(14) $(p_u - t_u)f'_u = bw^t$ upland income based on *marginal* productivity (D in Figure 5)

(15) $\frac{(p_u - t_u)f_u(N_u)}{N_u} = bw^t$ upland income based on *average* productivity (E in Figure 5)

The two possible equilibrium situations are illustrated in Figure 5 below. In the first case, when upland income is determined according to marginal productivity, the upland population is given according to (14) at point D. In the second case, where the income is based on average productivity, the upland income for a given upland population is higher (the curve is above the marginal productivity curve in the figure), thus the equilibrium level of upland population will also be higher (point E).

[31] These solutions assume that migrants are risk neutral, i.e., we can use expected values. If we included risk aversion, migrants would demand the higher expected income in town to compensate for the higher income risk.

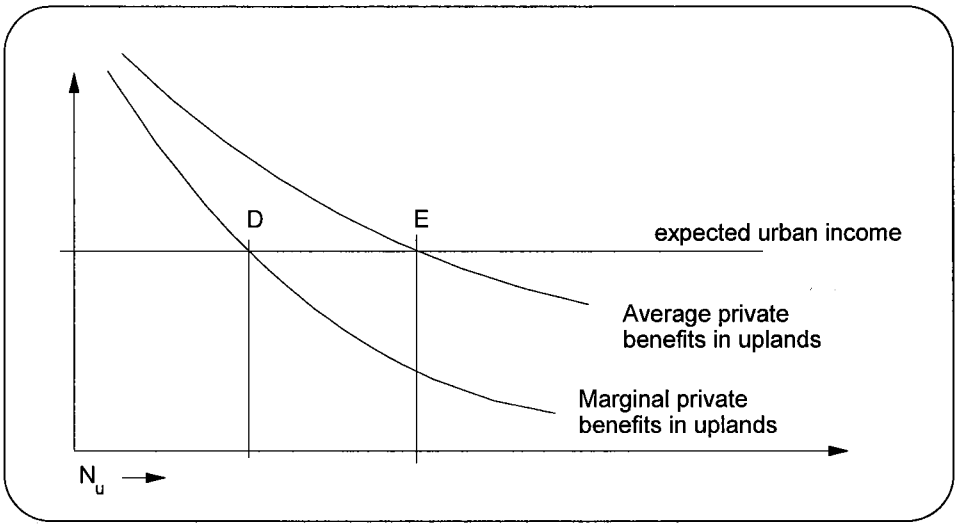

Figure 5. Rural-urban migration.

> *Proposition 13: The expected urban income is a crucial variable in this approach, and the main factor in determining upland population and thereby the extent of soil erosion and land degradation. Better off-farm working opportunities, that is, higher urban wage and/or reduced unemployment in the urban sector, is a key to reducing environmental problems in the uplands.*
>
> *Proposition 14: A property rights regime which gives farmers an income equal to their average productivity will, also in this model, result in too high population and environmental problems in the uplands.*

We have not included the socially optimal solutions in the figure. If the only externality considered is upland land degradation, then the optimal point would obviously be to the left of point *D*. This could be corrected by, for example, introducing an output tax on agricultural produce in the uplands, i.e., by moving the marginal productivity curve downwards in the figure. A more complete economic analysis should, however, also include the urban congestion problems (which is a major source of urban environmental problems). Moreover, unemployment represents a waste of resources which should be taken into account in the overall analysis.

We should also note that there is a trade-off between upland environmental and urban congestion (environmental) problems. This trade-off would, of course, not be fixed, and a challenge would be to reduce it by, for example, introducing incentives for better farming practices in the uplands, and public sewage projects in the cities. Still, even though the trade-off can be reduced, it is hard to eliminate it all together.

A possible extension of the above migration model is to include leisure in the migrants objective functions, and use the family rather than the individual as the

decision unit. This would, as shown by Stark (1983), lead to more rural urban migration, and reduce upland population in the model.

6 Conclusion: The challenge of sustainable intensification of Tanzanian agriculture

The challenge of achieving a more efficient and long term use of land resources in Tanzania (and other SubSaharan countries) is parallel to the twin problems in the debate on sustainable development: How to increase the income to the farmers, while conserving the land quality (i.e., the long term income opportunities)? This is the challenge of *sustainable intensification* of tropical agriculture.

Agricultural intensification, however, often implies that farmers must accept to temporarily reduce their current consumption levels (and/or reduce their amount of leisure) in order to enhance the productivity of their land and to maintain their income-earning capacity in the future. If this challenge is not met, incomes will continue to decrease and current consumption will be increasingly financed from dissaving, which will eventually lead to inadvertent loss of assets, including land (Platteau, 1995).

The model presented in section 4 suggests that increased income without environmental degradation may be achieved by a combination of agricultural intensification *and* investments in soil conservation. A number of policy measures can be used to promote this development. Investments in soil conservation can be boosted through increased tenure security, reduction of poverty which lowers farmers' discount rate, economic stability which lead to expectations about high output prices in the future, and lower costs of soil conservation measures. Intensification which increases present income will similarly be stimulated by higher output prices, technological improvements, and reductions in input prices. Note that because of the conflict between soil conservation and intensification, only an emphasis on the latter could harm the long term income prospects through increased erosion. A policy package which include *both* objectives is called for. An important aspect not discussed in the model is the crop choice, which may have significant effects on the erosion rates.

The models in sections 4 and 5 also show that the property rights regime is only one but several factors which influence farmers' decisions and land management. Establishing tenure security is clearly an important incentive for farmers to include long-term considerations into their farming practices, and to undertake investments in soil conservation and other assets which increase the future productivity of land. This may not, however, be sufficient to make peasants take full account of the environmental consequences of their actions. Relative prices between different agricultural inputs, between different outputs, between inputs and outputs, and between different regions in the country are equally important.

We have further argued that whereas tenure security is important, it is not an argument for a particular property rights regime. The farmers' security against

loosing the land may be high or low within any of the three most important categories of property regime; private, communal and state property (section 2.1). Furthermore, the security of tenure would be a subjective variable, thus depending on factors such as the local customs, the (perceived) protection given in national laws and courts, political and economic stability, etc.

Related to the discussion of the desirability of various land rights regimes, there seems to be some confusion on the terminology used. The Tanzanian property rights system could be described as one where the user and income rights are assigned to the individual peasants, whereas the right to transfer the land is kept with the community (sections 2.1 and 2.2). Is it correct to label a system where two (probably the most important) of three categories of rights are *de facto* with individual peasants as a *communal property rights regime,* or is it more proper to call it a *private property regime?* Paradoxically, it seems that communal management is successful when the system is able to secure individual user rights.

There seems to be strong empirical evidence for an evolution of more individualized property rights as land becomes more scarce, either within a system of so-called communal management, or through the development of legal individual rights with formal titles (see Angelsen, 1995b). The proposed land reforms by the Land Commission (1994) may facilitate such a development, and therefore not interfere with what many would argue is a "natural" development of more individualized land rights. If the right to transfer and allocate land remains with the community, the argument of increased inequality going in tandem with private property rights could be avoided. However, Pinckney and Kimuyu (1994), based on the Kenyan experience, and others, argue that the fear for increased inequality is exaggerated. We agree with Pinckney and Kimuyu (1994:25), who conclude that the government, while being ready to intervene to assist in the development of land tenure systems, should focus its scarce resources on real constraints on agricultural productivity, such as inadequate production technology, and market inefficiencies. The key question for the government to ask is, "What actions are needed to give peasants the incentives to make long-term productivity and land improving investments?"

Given that land is becoming a more scarce resource, the conflicts and allocation problems become harder. A system where the *de jure* rights are with the community means that the allocation of land is determined in a political and bureaucratic system, not in a market system as with formal private property. Political power is substituted for economic power. There are pros and cons of both ways of allocating land. It is naïve to only look at the positive sides of one system and the negative ones of the other. A pragmatic approach is needed. We should, however, not underestimate the potential problems connected with the customary system proposed by the Land Commission (1994). By allowing decisions on land allocation to be subjugated to bureaucratic and political controls through the village assemblies, possible problems of misuse and malpractice may thrive. Thus, a major challenge will be to develop procedures and practices which make the allocation of village lands transparent and subject to public scrutiny.

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