

**THE CONTRIBUTION OF SOIL AND WATER CONSERVATION TO
SUSTAINABLE LIVELIHOODS IN SEMI-ARID AREAS OF
SUB-SAHARAN AFRICA**

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Abstract

This paper discusses the role of soil and water conservation (SWC) practices in sustainable livelihoods and presents preliminary findings from case studies conducted in Tanzania and Uganda. Ultimately the question addressed in this paper is: What factors and conditions lead to households choosing to invest in SWC? The conditions under which households choose to invest in building or maintaining SWC practices are described within the framework of local livelihood strategies, together with the policies and structures which influence these strategies.

In the Tanzania case study the majority of farm households practised SWC techniques, with those households most dependent on crop production for their livelihoods investing more in SWC. At the macro level, changes in the wider political environment of Tanzania have been critical – the post-Independence period has seen a major decline in the promotion and adoption of SWC. More recently, however, the liberalisation of the Tanzanian economy has improved access to markets and increased producer prices, stimulating investment in SWC at household level. In contrast, many households in the Uganda case study have diversified away from crop production in order to generate cash income and, as a result, SWC has been neglected. In Uganda those farmers with limited access to land and work oxen are seen to be more likely to invest in SWC, perhaps reflecting a greater need to invest in soil fertility maintenance where a lack of draught power limits the options for opening new land.

The findings presented suggest that there are important differences between and within communities with respect to the contribution that SWC makes to livelihoods. The decision to invest in SWC relates both to the assets available to households and the attractiveness of agricultural intensification as a livelihood strategy. This is also affected by wider policy and institutional issues that are beyond the immediate control of households.

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Acronyms

DFID	Department for International Development (UK)
NGO	Non governmental organisation
SSA	sub-Saharan Africa
SWC	soil and water conservation
SWMRP	Soil and Water Management Research Programme
TFAP	Tanzania Forestry Action Plan
WPLL	Western Pare lowlands (Tanzania)

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1 INTRODUCTION

This paper discusses the role of soil and water conservation (SWC) practices in sustainable livelihoods and presents the preliminary findings of a DFID-funded research project on natural resource degradation in semi-arid areas of sub-Saharan Africa. The aim of the research project is to investigate the potential to replicate successful adoption of SWC practices and to identify the key policy settings that promote SWC in a range of contexts. The project has examined the range of agro-ecological, socio-economic, institutional and policy factors that influence farmers' decisions to adopt SWC practices. Case studies have been carried out by NGOs and research institutions in six countries – Burkina Faso, Senegal, Ghana, Nigeria, Uganda and Tanzania. This paper reports on the findings of the case studies from East Africa, undertaken by the Soil and Water Management Research Group at Sokoine University of Agriculture in Tanzania and by Action Aid in Uganda.

Rethinking natural resource degradation

Reports frequently publish statistics illustrating the apparent decline of the land resource base utilised by farmers. However, recent research based on in-depth case studies has highlighted situations where population growth and agricultural intensification have been accompanied by improved rather than deteriorating environmental quality (Mortimore, 1993; Tiffen et al., 1994). Evidence is accumulating in support of a relationship – albeit complex – between population density and the prospects of successful environmental rehabilitation. In the case of Machakos in Kenya, for instance, it is clear that increasing population pressure created the demand for more productive and sustainable resource management, as well as providing the workforce to implement what in many cases were highly labour-intensive technologies (Tiffen et al., 1994). Other reports have suggested that local approaches to natural resource management are well suited to complex and dynamic environments (Reij et al., 1996).

Whilst it is now accepted that many examples of successful environmental management exist, what is less clear is whether they are representative of a wider

trend towards environmental recovery and household capacity to invest in sustainable resource management. Box 1 identifies some of the unanswered questions. We need to know much more about the conditions under which households choose to invest in building or maintaining SWC practices. This investment decision must be understood within the framework of the diverse and complex livelihood strategies adopted by the poor, together with the policies and structures which influence these strategies.

A livelihoods approach to soil and water conservation

The livelihoods approach places people at the centre of development and works to support people's efforts to achieve their own livelihood goals¹. At a practical level, the livelihoods approach can help us to address the questions raised in Box 1 by:

- considering the social, cultural and agro-ecological factors which underpin people's livelihood decisions;
- highlighting the vulnerability of livelihoods to trends, shocks and seasonality, and people's response to this vulnerability;
- focusing on the impact of different policy and

Box 1 Natural resource rehabilitation and SWC – the unanswered questions

Case studies rarely make clear the degree to which they are representative of the wider context beyond the settings in which their observations are made. We need to know much more about the conditions under which success occurs, and which of these conditions are necessary for replication.

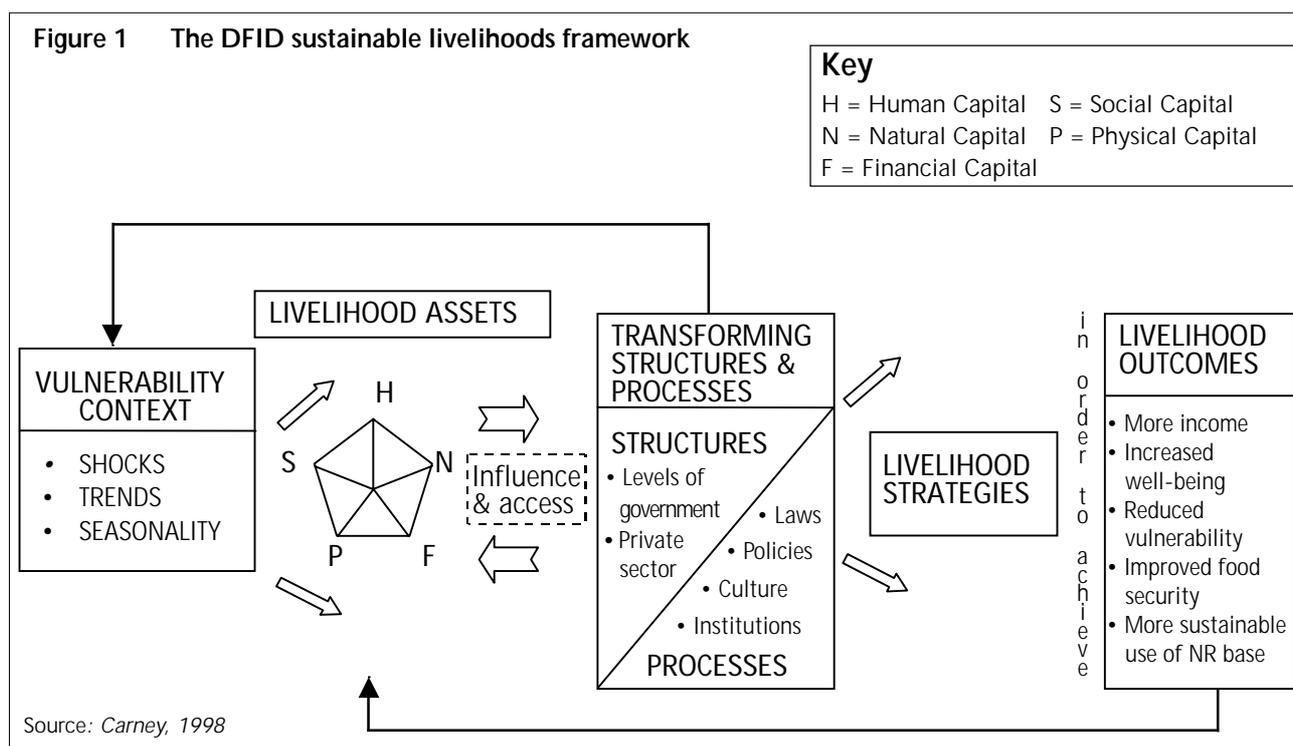
The relationship between vulnerability and SWC also remains unclear. It is often assumed that SWC is undertaken as a risk-reducing investment in the context of vulnerability, but case studies from Tanzania and Uganda both suggest investment is reduced as perceived vulnerability increases.

The focus of many studies tends to be on indigenous innovation, with less to say on the role of government. In some cases, positive change is strongly driven by policy and institutional structures; in others it appears to depend heavily on endogenous social, cultural and agro-ecological conditions which are not easily influenced by external interventions.

The macro-level focus of many case studies has overlooked the need for household level data to show how rehabilitation processes have been individually experienced by families. For example, despite the positive environmental transition noted by Tiffen et al. (1994) in Machakos, it has been found that agricultural intensification has not been a homogenous experience in the area and that the effects of change have been unequal (Murton, 1997; Rocheleau, 1993 and 1995).

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institutional arrangements upon people and households, and upon the dimensions of poverty they define, rather than on the resources or institutions *per se*;

- stressing the importance of influencing these policies and institutional arrangements so they promote the agenda of the poor.

The livelihoods approach starts with an analysis of people’s livelihoods and how these have been changing over time. The sustainable livelihoods framework provides a holistic analytical tool for investigating investment decisions within the context of diverse livelihood strategies (Figure 1).

Livelihood assets

At the heart of the framework lies an analysis of the five different types of assets upon which individuals draw to build their livelihoods. These are:

- natural capital – land, water, vegetation, biodiversity, etc. and environmental services;
- social capital – social resources (networks, groups, trust, social relations, etc.);
- human capital – skills, knowledge, good health and ability to labour;
- physical capital – basic infrastructure (transport, shelter, communication, energy);
- financial capital – financial resources (savings, access to credit, bank loans, remittances, pensions, etc.).

Many studies have looked at the relationship between SWC and a household’s access to assets. Anderson and Thampapillai (1990), for example, report that the following factors are positively associated with the adoption of SWC:

- level of income (on- and off-farm);

- access to low cost credit;
- labour availability;
- low discount rates (i.e. long policy-planning horizons);
- high levels of education among farmers;
- access to sound technical advice;
- secure land tenure.

These factors are explored in more detail in the case studies presented below.

The vulnerability context

The types of capital assets available to rural people, and the way in which assets are combined and managed, depend heavily on the local context. In particular, they are determined strongly by the types of vulnerability faced by poor people, and people’s options for responding to vulnerability as it arises. In terms of the sustainable livelihoods concepts presented in Figure 1, the vulnerability faced by poor people includes that brought about by uncertainties in climate, politics, markets and potential conflict situations.

In semi-arid areas, climatic vulnerability is characterised by low mean annual rainfall, compounded by high variability in its spatio-temporal distribution. In addition, the past few decades have shown a definite trend for increasing aridity within the Sahelian region of sub-Saharan Africa (SSA). Hence, livelihood strategies in semi-arid areas are primarily geared towards coping with a high degree of uncertainty, minimising risk and meeting subsistence needs, rather than maximising production and profits (Scoones, 1996). This has implications for individual time preferences and investment decision-making amongst smallholder farmers.

Box 2 Key policy areas that act as incentives or disincentives to investment in SWC

- Setting commodity prices at their social value or shadow prices can help alleviate imbalances in resource allocation and pressures that lead to land degradation. Removing distortions that decrease the efficacy of agriculture and accelerate land degradation should be prioritised.
- Fiscal policies and taxes are often below the value of economic rent to encourage investment in large-scale agricultural/forestry enterprises. This can lead to land degradation and it is argued that for resources that border the categories of renewable and non-renewable, taxes should be based on economic and scarcity rent. Taxes that reflect true costs to society are more likely to encourage environmentally sustainable land use practices.
- Over-valued currencies can impede the adoption of SWC practices, especially if the agricultural output is intended for export markets.
- Decentralisation of decision-making and budgetary resources for soil conservation to the local level may act as an incentive for investment in SWC at an individual and societal level, although more research is required on this area.
- Reorientation from urban to rural spending, especially on education, has been positively linked to investment in SWC.
- Insecure land tenure can act as a constraint to smallholder investment in SWC measures by restricting planning horizons and access to institutional credit.
- Governments can focus national research and extension on SWC measures that are more demand-driven and focus on a 'basket of options' approach to interventions. Governments can also form links with other stakeholders, such as NGOs in order to facilitate more effective service delivery through a variety of dissemination pathways.

Source: Anderson and Thampapillai (1990); Lutz et al. (1989); Shiferaw and Holden (1996).

Transforming structures and processes

Rural people maintain their livelihoods by accessing and drawing down on capital assets. It is by building up their stock of capital assets that rural people are able to enhance their livelihoods. How and how far they can do this is determined by the types of policies, structures and institutions (transforming structures and processes) they face, and the modifications which can be made to these. Close understanding is therefore needed of:

- processes (policies, laws, rules and incentives);
- structures (organisations, from layers of government through to the private sector); and
- institutions (regularised patterns of behaviour structured by the rules and norms of society) which define individual livelihood options.

A wide range of policies and institutions may impact on decisions to invest in SWC. National environmental policies (which may include elements dealing directly with erosion and conservation issues); land tenure and planning policy; and forestry, agriculture and livestock policies (including agricultural subsidies) may have direct or indirect impacts. Policies relating to economic development, food aid, infrastructure and market development also have a significant influence on decision-making. Government policies can act as both incentives and disincentives to investment in SWC, as illustrated in Box 2.

In the past, SWC policies tended to focus on the use of subsidies as an incentive for farmers to adopt environmentally sound production practices and conservation measures (Anderson and Thampapillai, 1990). Such policies are grounded in the belief that SWC measures are inherently desirable and that the benefits of their adoption outweigh the costs of their implementation and maintenance. However, Lutz et al. (1989) show that frequently this is not the case and that the benefits from certain conservation techniques, especially those based on mechanical structures, do not justify their costs. Unless the off-site costs of soil degradation are high or the price signals that farmers receive are significantly distorted, it is argued that subsidies to enhance adoption of SWC techniques are economically inefficient.

Livelihood strategies

These are the range and combination of activities and choices that people make or undertake in order to achieve their livelihood goals. Three broad clusters of livelihood strategies have been identified, and these are commonly pursued in combination, either simultaneously or in sequence: (i) agricultural intensification/extensification; (ii) livelihood diversification; and (iii) migration (Scoones, 1998). The priority that people attach to each of these different strategies is a prime determinant of investment in SWC.

The adoption of SWC practices represents a decision by households to intensify their agricultural production – to improve output per unit area through capital investment or an increase in labour inputs. It is essential to recognise that SWC measures impose opportunity costs through their demands on labour, often at times of peak labour demand (Hailu and Runge-Metzger, 1993). It is often assumed that investing in SWC is automatically beneficial, without looking in detail at the costs and benefits, and particularly the on-farm versus off-farm costs of soil degradation. The inherent tension between resource conservation and resource exploitation is exemplified by SWC because the costs are felt more quickly than the benefits. Investments in SWC tend to generate returns in the long term, but do not necessarily result in higher yields or income in the short term.

Farmers' attitudes to risk will influence their willingness to invest in SWC, and an important question is how farmers cope with living in marginal, risk-prone environments such as semi-arid areas. The decision on whether to invest in SWC is mediated by the extent to which this increases or reduces the overall risks of a particular livelihood strategy – in this case agricultural production – relative to not doing so. The adoption of SWC practices can be regarded as a risk reduction strategy, whereby the overall resilience of the farming system may be enhanced and the impact of any stress (such as erratic and untimely rainfall) are less dramatic. However any investment in SWC may be more risky than other options open to households such as migration, as returns to any investment in land cannot be relied upon in semi-arid environments.

Table 1 Potential contribution of SWC to a sustainable livelihood

Outcome	Possible contribution of SWC
More income	Increase in water availability allows production of cash crops
Reduced vulnerability	Reduces risks associated with low and erratic rainfall
Improved food security	Improved soil and water management leads to higher yields
Increased well-being	Group approaches to SWC allow development of social and human capital
More sustainable use of the NR base	On-site and off-site benefits

Box 3 SWC and sustainable livelihoods

- How does investment in SWC contribute to sustainable livelihoods, in both the short and long term? What benefits does it bring (e.g. productivity versus risk reduction)?
- What are the alternative ways to achieve the same outcomes?
- What is the opportunity cost of investing in SWC?
- What is the relationship between different types of vulnerability and decisions to invest in SWC?
- What minimum levels of assets are necessary to support different types of investment in SWC?
- What policies clearly work to support investment in SWC? Which policies undermine investments?
- When do households choose to invest? How can they afford it? What is the trigger for beginning or stopping SWC activities? What is the cycle of investment?

Livelihood outcomes

These are the end result of the different combinations of livelihood strategies that people choose to follow. It is difficult for an outsider to judge what constitutes a positive or negative outcome. The outcomes people aspire to will vary greatly at all levels – within households, within communities, within regions and so on. At a broad level, common livelihood outcomes might include: more income; increased well-being; reduced vulnerability; improved food security; and more sustainable use of the natural resource base.

A household’s decision to invest in SWC is based on anticipated benefits. Yet we know little about what contribution SWC makes to sustainable and secure livelihoods from a household’s perspective. What benefits does it bring in the short and long term? What indicators do people use to judge the performance of SWC practices? What contribution does SWC make to household food security? Table 1 provides a preliminary assessment of the potential contribution that SWC practices might make to livelihood outcomes.

Introduction to the case studies

Ultimately the question addressed in this paper is: What factors and conditions lead to households choosing to invest in SWC as one element of a sustainable livelihood strategy? For instance, what factors interact to convince farmers to choose to invest their labour in building and maintaining SWC structures rather than in off-farm employment opportunities? The factors affecting such decisions will vary considerably among different households according to their access to different types of assets (as described above) and according to the needs and priorities of individual households.

Looking at SWC from a livelihood perspective raises a number of interesting questions (Box 3). The following sections use evidence from case studies in Tanzania and Uganda to address these questions.

The case studies were based on the following methodology:

- Country literature reviews were produced by national researchers in both Tanzania and Uganda during the first phase of the project. These provided the main source of secondary data for the studies. In addition, local information was obtained through a review of national policy documents, district and local by-laws,

NGO reports and other literature about the study area. This was complemented by discussions with relevant district and local authorities.

- Qualitative and quantitative primary data were captured through a combination of focus group discussions and a questionnaire survey. Efforts were made to ensure adequate representation of women, men, the elderly and young farmers. Involvement in different livelihood activities (cropping, livestock management, petty trading and employment) was also taken into consideration.
- A feedback workshop was held with representatives of each village after the production of preliminary reports. This provided an opportunity to present the findings to farmers, verify findings through feedback and fill remaining information gaps.

2 TANZANIA

Background to the case study area

The two case study villages, Hedaru and Mgwazi, are located in Same District, in the semi-arid plains of the Western Pare lowlands (WPLL). Rainfall distribution is bimodal, with an average annual rainfall of approximately 400–600mm. The *vuli* rains (November to January) are lower and less reliable than the *masikaa* rains (March to May). Rainfall decreases and its variability increases towards the west (away from the Pare Mountains). Mean temperatures range from 16°C (July to August) to 32°C (January). Potential evaporation exceeds rainfall in five to ten months of the year (Hatibu et al., 1995).

The topography is characterised by scattered hills at the foot of the Pare Mountains, descending to undulating and rolling plains and flat, wide depressions. The highlands are the source of numerous springs and streams that drain into the permanent Pangani River. Many of these springs are perennial, but have low water yield and are used for domestic water and some supplementary irrigation.

The steeper slopes are highly susceptible to soil erosion and vulnerable to landslides. With poor vegetation cover along the steep and mid slope areas, uncontrolled run-off can concentrate in small channels or rills leading to the formation of gullies and seasonal streams. Part of this run-off is diverted

Table 2 Local soil classification, Tanzania

Local name	Texture	Cropping suitability
<i>mshangagaa</i>	sandy	none
<i>lumpu</i>	clay loam	all locally-grown crops, where water is adequate
<i>ishwere</i>	white clay	none
<i>sungutu</i>	sandy clay loam	all locally-grown crops
<i>ngamba</i>	heavy black clay (cracking)	maize, cotton and rice
<i>ivumba</i>	clayey (non-cracking)	sugarcane, cocoyams, bananas, sweet potatoes and legumes

into crop fields, while the rest drains into the Pangani River. The majority of the villagers have their fields in the plains where run-off collects and is easy to manage.

Farmers classify six different soil types, as shown in Table 2.

Forests are found on the upper slopes, although native species have been largely replaced by exotic hardwoods. Patches of trees, thickets, shrubs and grasses are found on the mid-slopes with grasses and scattered shrubs and trees (mainly *Acacia* spp.) on the plains.

The study area has good access to the urban markets of Dar es Salaam, Tanga, Moshi and Arusha. For this reason, perishable crops such as onions, tomatoes and cabbages are important cash crops in the area. Weekly market days in each village are major outlets, bringing together villagers and long distance traders.

In both villages, findings from focus group discussions show that households do not have enough income to support and sustain a reasonable standard of living. Farmers complained of food shortages due to both inadequate production and the lack of cash with which to purchase food from the market. Seasonal fluctuations lead to frequent food shortages with more occasional surpluses. There has also been a long-term general decline in incomes associated with the socialist policies of 1967–85. The policies created monopolies in the marketing of agricultural inputs and outputs which led to low production levels, especially of cash crops, and depressed rural incomes.

Seasonal crop failures are common and crop production alone does not fulfil the requirements for survival of the majority of rural households. As a result, rural households adopt a diverse range of livelihood strategies. The main sources of income include crop and livestock production and petty trading. Livestock are also an important source of household savings. Trading – which includes keeping stalls and small shops – is particularly important in Hedaru, which is developing into a major rural trading centre due to the presence of a weekly market, railway station and highway. Other sources of income include that from renting houses, fishing, bee-keeping, masonry, carpentry and remittances.

Farming systems and soil and water conservation techniques

There are four main farming systems in the area.

Maize–legume–vegetables: commonly practised on the upper slopes, although there is also substantial vegetable production in some valley bottoms. Vegetables (especially onions) are important cash crops.

Maize–legumes: practised on mid and gentle slope areas.

Maize–livestock: common in the lowland areas. Crop production is the major income-earning enterprise; livestock are extensively managed (grazed on land not designated for crop production, and on crop fields after harvest) and are kept mainly for savings or security purposes.

Livestock–fishing–rice: dominant in the low-lying areas and valley bottoms. Livestock rearing is the dominant economic enterprise, practised mainly by the Maasai ethnic group; fishing serves both consumption and income-generating purposes.

The adoption of SWC practices is essential in the maize–legume–vegetable system, which is practised on the steeper slopes with highly degraded soils. The majority of farmers use stone and contour bunds for vegetable production. In the valley bottoms, farmers make contour bunds or raised broad beds as a water table control measure. Rice is cultivated with conventional irrigation using water from the Pangani River. In both past and present, a total of eleven SWC techniques have been practised in the study area, as detailed in Box 4.

The following sections look at the ways in which a household's decision to practise SWC is influenced by household assets, the policy environment and livelihood strategies.

Access to assets

Land and resource tenure and security

The case study region is among the most highly populated districts in Tanzania (URT, 1988). In Mgwasi, there is evidence of land scarcity, while in Hedaru there is still some scope for opening new farms. All land is either public land or held by individuals under customary land rights². Customary land is acquired through inheritance, through allocation by the village government, or by purchase from others with customary land rights.

The study found that land ownership has some influence on adoption of SWC practices. Most farmers feel secure under the current land tenure system, and tenure is not a constraint in most cases. However a few farmers who rent land – mainly young people and new immigrants – regard insecure tenure as a constraint in the adoption of SWC practices.

Farm size and number of plots owned have a positive influence on the adoption of SWC practices. A large proportion of farmers with smaller farm sizes tend not to use SWC on any of their plots. These two factors are probably correlated, but the exact pattern

of causality is not clear. Where large farms are fragmented, economies of scale would be less apparent.

Access to labour

A long-term decline in farm incomes has led to a reduction in labour available for farm work, as labour is used for other activities to raise cash to purchase food. Since most SWC measures are labour intensive, it is assumed that they are often the first victims of farm labour shortages. However, using family size as a proxy for available family labour, and taking into account that family labour is often complemented by hired labour and through labour exchange, the study found no indication that differences in terms of labour availability were linked to the decision to invest in SWC. This finding may be explained by the long term nature of investment in SWC, implying that cross-sectional data are not the best approach to analysing this factor.

Box 4 SWC technologies practised in the Tanzania case study area

1. Live barriers – introduced during the colonial period and abandoned immediately after Independence (1961) due to the politicisation of SWC issues, the weakening of support institutions and drought.
2. Supplementary irrigation systems – these have existed since pre-colonial times (prior to 1900) and make the cultivation of maize possible.
3. Deep tillage – introduced during the period following the Arusha Declaration (1968) as a result of publicly-funded tractor hire schemes.
4. Bunded basins – for the purpose of holding water for rice cultivation.
5. Tree planting – introduced during the colonial period (1906–61), expanded during the post-Arusha (1968–85) and liberalisation periods (1985 to date) due to ongoing campaigns and programmes and the establishment of tree nurseries.
6. Stone bunds – part of the supplementary irrigation system, expanded during the liberalisation period; associated with increased vegetable production.
7. Cut-off drains or contour bunds – introduced during the colonial period and abandoned immediately after Independence due to the politicisation of SWC issues and the weakening of support institutions.
8. Terraces – introduced during the colonial period but widely abandoned.
9. Trash lines – did not survive after the Arusha Declaration period; currently not widely used because they are considered to harbour vermin and other crop pests.
10. Forest and bush protection – clan forests are still protected, but smaller patches of trees ('microforests') in household fields have died out. The introduction of 'reserved forests' resulted in the removal of any sense of local ownership. Modern religious teachings also prohibited followers from performing traditional rituals associated with protected forests; microforests disappeared during the liberalisation period due to reduced enforcement of by-laws.
11. Traditional land use planning (including allocation of grazing land, protection of watersheds and hilltops from cultivation and grazing) – traditionally enforced by local chiefs and peer pressure, but disappeared during the liberalisation period due to reduced enforcement of by-laws.

Access to information and technology

Most of the people in the villages in the WPLL have their roots in the highlands and since the beginning of the 20th century have migrated to the lowlands in search of better agricultural resources, employment and market access (Hatibu et al., 1995). This migration pattern continues with people still settling in Hedaru village. SWC practices were essential to cultivation in the highlands, but investment in SWC was perceived to be less important in the lowlands where people now farm. Farmers did not perceive soil erosion to be a problem in 51 per cent of plots. This may be because assessments were based on relative comparisons. All those who perceived high erosion problems in their plots were also practising SWC and, somewhat surprisingly, 33 per cent of farmers who did not perceive any erosion problem in their plots were also practising SWC.

Lack of knowledge was regarded as a key constraint to the adoption of SWC practices; 57 per cent of surveyed farmers who had not invested in SWC attributed this to a lack of knowledge. A similar picture emerged from the focus group discussions, where both lack of access to knowledge, due to ineffective extension services, as well as the provision of complementary inputs (such as fertilisers, tools and seeds) were cited as reasons for non-adoption. The issue of SWC rarely features in extension messages. These findings are consistent with those of other studies conducted in the WPLL.

Access to financial capital

Availability of non-farm income is an indicator of access to financial capital and has a positive influence on investment in SWC. Financial capital is mainly used to pay for additional labour when investing in SWC. In some cases, it is needed to pay for cement for water diversion structures.

Transforming structures and processes

Five major socio-economic development periods were identified through historical analysis, each having an important influence on the adoption of SWC practices:

1. Pre-colonial (before 1900) – traditional land management enforced by chiefs, whose territories were coherent with watershed boundaries.
2. Colonial (1906–61) – weakening of traditional institutions and consequent reduction in authority; migration to lowlands.
3. Post-Independence (1961–67) – abolition of chiefdoms and reduction in successful enforcement of SWC practices. Opposition to enforced conservation was part of the campaigning platform of the Independence movement, so government policies immediately after Independence did little to promote SWC.
4. Post-Arusha Declaration (1968–85) – villagisation and the associated concentration of population led to the opening of unsuitable land for cultivation, as well as overgrazing and deforestation.

5. Liberalisation (1985 to date) – in relation to agriculture, liberalisation policies have included removal of: controls on markets and prices for agricultural inputs and outputs; restrictions on exports and retention of income; controls on importing inputs; control of exchange rates; and controls on investments and financial services. Improved output prices, especially for vegetables, have encouraged agricultural investment.

Weakening of support institutions

The abolition of chiefdoms in the early post-Independence period created a vacuum in leadership and created new administrative structures, whose boundaries did not follow watershed boundaries and led to uncoordinated watershed management. In focus group discussions, farmers identified strict customs and regulations and their uncompromising enforcement as the most important factor in promoting SWC. Villagers reported that the replacement of customs by by-laws in the colonial period had made little difference. The major difference was in the level of enforcement of the present system – corrupt officials fail to enforce SWC regulations.

Under the current village administration system, all adults in the village are members of the village assembly, at the apex of village government. The executive arm of the village government is the village council, whose secretary is a local government employee. The village council normally has five standing committees:

- finance and planning;
- production and marketing;
- construction and transport;
- education, culture and social welfare;
- defence and security.

These committees are responsible for decision-making on a day-to-day basis. For example, the finance and planning committee is responsible for land allocation and water rights, while the defence and security committee is responsible for reconciling disputes and enforcement of by-laws. Villagers argued that the powers given to ward and village executive officers have weakened village administration and that enforcement of by-laws at the village level is lax.

Decentralisation has led to major coordination problems because regional and district offices of line ministries continue to be supervised by their respective ministries. Democratically elected local governments have been replaced by appointed local authorities. Villagers associate the lack of accountability of local authorities with corruption, reinforced by the primacy of political correctness over technical performance as a criterion for promotion. Corrupt and ineffective government institutions have led to the disappearance of those SWC practices dependent on the enforcement of by-laws.

Natural resources policies

In terms of agricultural policy, the 1972 directive – which promoted the adoption of modern farming systems – recognised soil erosion as a major problem, and attention was focused on rehabilitating areas which were degraded. No attention was paid to the causes of erosion or how to protect cultivated lands. The 1974 directive emphasised small-scale traditional irrigation schemes following the 1973/4 drought. The government provided materials, machinery and technicians to assist with the improvement of *ndivas* (small water reservoirs) in the study area. The 1975 directive led to unplanned clearing of land for cultivation, especially near urban areas. The 1983 agriculture policy specified that SWC technologies should be incorporated into land use plans and village master plans (for example tree planting, protection of water sources and ridge cultivation or cut-off drains on cultivated slopes). A similar approach was adopted in the 1986 livestock policy, although it was less specific on the approach to SWC.

Three types of instrument have been used to implement SWC strategy at the local level.

- Enforcement through by-laws – the District Authority has made several by-laws relating to the prevention of soil erosion and the promotion of water conservation. To simplify enforcement, these are focused on preserved or restricted areas, in which tree-felling, cultivation and animal husbandry are restricted or prohibited. Villagers are concerned that these by-laws are not being strictly enforced, thereby undermining SWC.
- Donor-funded projects – there have been very few donor-funded projects designed to promote SWC under the agriculture and livestock policy. Most have been designed under the forestry sector.
- Promotion through extension – few improvements have been made in the delivery of public services and the extension service is still extremely weak. Many changes are being implemented and staff morale is low. Until the end of 1998, the Soil Conservation and Land Use Planning Section was separate from the Agriculture Extension Programme and had negligible resources. SWC rarely features in agricultural extension messages, as it is seen as the responsibility of another department.

Forest policy has also had an important influence on SWC. Forest policy specifies that central government is responsible for controlling:

- catchments, watersheds and other land that cannot, even with proper SWC practices, be used for agriculture or pasture without risk of soil deterioration or interference with water supplies;
- forested areas, the preservation of which is necessary to ensure the protection of the land against flood or erosion, or to regulate the water supplies and flow of streams, or to maintain the climatic conditions suitable for agriculture.

Forestry policy has also relied on controlled early burning for soil improvement. Wrongly applied,

however, this leaves the ground bare just before the rains and leads to high erosion rates. The most important by-laws under the forestry policy are concerned with control of forest harvesting as well as tree planting. Certain tree species are also protected.

The forestry sector has actively promoted projects and programmes in support of the above policy, especially with respect to land conservation. In the late 1960s, one of the successes of the Village Afforestation Programme was in raising awareness of the importance of trees. During the post-Arusha period (1968–85), the promotion of SWC was mainly based on projects with a bias towards forestry. However, tree planting was promoted inappropriately in grazing and cultivated areas, and most of the tree species were selected for their rapid growth rather than other tangible economic benefits, such as fruit or timber. Planting of trees by individuals is now given more emphasis and supply of seedlings has been decentralised from government nurseries to village, school, group and private nurseries.

The Tanzania Forestry Action Plan (TFAP) has eight key programmes including one on sustainable land husbandry. Within the study area, the three main TFAP activities are:

- village-based participatory land use planning;
- neighbourhood land management;
- village afforestation.

Forestry extension workers are charged with training farmers in nursery management and tree husbandry.

Since Independence, land policy has been based on the premise that undeveloped land has no value. SWC works do not count as development and therefore would not be compensated in the event of land acquisition by the President. However, farmers in the study area feel secure under the current tenure system, and do not consider the acquisition policy to have effected their SWC efforts. Except for those few farmers who rent their land, the current tenure system is not seen as a constraint, but rather an incentive to invest in SWC.

Water policy does not give much attention to water conservation. Customary agreements governing the sharing of spring and stream water for supplementary irrigation between highlands and lowlands are still observed in the area. Water collection procedures and the protection of water sources are also still observed. The local government has assisted with the improvement of *ndiva* and irrigation canals. In Hedaru, the Soil and Water Management Research Programme (SWMRP) has assisted with diversion of streams and gully flow into crop fields. No extension support has been received in relation to water activities, although the Same District Agricultural Improvement Programme Trust Fund and SWMRP have conducted several seminars on rainwater harvesting.

Most of the policies discussed above have been recently revised, but it is evident that the impact of the revised policies has not yet been felt in the study area.

SWC as a component of livelihood strategies – who invests?

The majority of farmers practice one or two methods of SWC. The main reasons given for adoption and non-adoption are shown in Table 3. The survey clearly indicated that households that are more dependent on crop production for their livelihoods invest more in SWC. However, access to financial capital (indicated by the availability of off-farm income) was also seen to play a role. A demonstrable benefit was an important determining factor for investment in SWC. Farmers invested more in SWC when:

- they needed more cash income to pay taxes and to purchase services;
- competitive markets for selling crops were available and they could obtain good prices for their produce.

Most villagers identified their role in SWC as providing labour. Farmers saw their responsibility as:

- taking care of the individual farm and providing labour for SWC;
- cooperating with others;
- adopting improved farming practices.

They did not show willingness to invest cash or materials in SWC and regarded the provision of inputs and construction materials as the government's responsibility³.

The study found that duration in farming relates to the use of SWC methods. The very young and old farmers are more likely to invest in SWC. This may be linked to the general decline in SWC investment in the post-Arusha period, due to the opposition to enforced conservation measures. Those of medium age are most likely to have started farming during this period.

The study found that female-headed households tend to have less family labour and participate less in labour exchange. They are also less likely to invest in SWC⁴. A recent study in the WPLL found that all sampled farmers identified as non-users of rainwater harvesting techniques were females or from female-headed households (BACAS, 1997). Another study conducted in North Pare and West Usambara Mountains showed that female-headed households tend to have limited access to information and land ownership (Semgalawe, 1998). They are less likely to perceive soil erosion as a problem and are less likely to invest in SWC.

Table 3 Reasons for adoption and non-adoption of SWC methods, Tanzania

Non-adoption	Adoption
lack of SWC knowledge (57%*)	reduction of water and soil loss (70%)
no erosion problem (31%)	improvement of crop harvest (13%)
restriction by neighbours and livestock (9%)	increasing sources of wood and timber (4%)
had not started growing onions (3%)	prevention of wind and attraction of rainfall (3%)
	other reasons (10%)

* percentages of respondents

Conclusion

SWC plays an important role in the farming system of the villages in the WPLL. Both macro- and micro-level factors have had an important influence on the extent to which households practise SWC.

At a macro level

Changes in the wider political environment have been critical in determining the level of investment in SWC in Tanzania. The post-Independence period saw a major decline in the promotion and adoption of SWC that continues to be felt today, with households headed by middle-aged farmers less likely to adopt SWC. More recently, the liberalisation of the economy has improved access to markets and increased producer prices. This has proved to be an important stimulant for investment in SWC – perhaps most vividly demonstrated by the adoption of onion cultivation as a cash crop with a parallel investment in SWC practices.

Strict customs and regulations and their uncompromising enforcement were regarded as the most important factor in promoting SWC in the past. The replacement of customs by by-laws in the colonial period made little difference – the most important factor is the level of enforcement at the local level. Villagers argued that the powers given to ward and village executive officers in recent times have weakened village administration and that enforcement of by-laws at the village level is lax.

At a micro level

There are important differences among households in the adoption of SWC which are related to differences in access to assets (i.e. the ability to practice SWC) and the fit of SWC with livelihood strategies (i.e. the motivation to adopt).

In terms of assets:

- farmers who rent rather than own land are less likely to invest in SWC;
- farmers with smaller farm sizes tend not to use SWC on any of their plots;
- access to knowledge was regarded as a key constraint to the adoption of SWC practice; duration in farming may be associated with knowledge and awareness;
- availability of non-farm income has a positive influence on investment in SWC;
- the study found that female-headed households tend to have less family labour and participate less in labour exchange; they are also less likely to invest in SWC.

Somewhat surprisingly, the study did not find evidence that labour availability was a constraint on investment in SWC, possibly because of the snapshot nature of cross-sectional data.

In terms of the fit of SWC with livelihood strategies:

- households that are more dependent on crop production for their livelihoods invest more in SWC;

- farmers invest more in SWC when they need more cash income to pay taxes and to purchase services, and when markets are available and competitive.

3 UGANDA

Background to the case study region

The five case study villages, Atete, Acuna, Moru, Otuko and Orisai are all found in the northern part of Katakwi District in one of the driest parts of the Teso region of north-eastern Uganda. Households are vulnerable to the erratic climatic conditions, which can lead to both droughts and flooding. Severe droughts occurred in 1928 and 1945 (the latter accompanied by a locust invasion). Severe floods occurred in 1946 and 1961. Total annual rainfall is approximately 1,200mm. Rainfall is bimodal with the long rains occurring from March to early June and the short rains in October and November. The short rains are followed by the more severe dry spell, during which fields are prepared. Annual temperatures range from 20°C to 30°C. According to farmers, the weather patterns have become more erratic in recent years.

The landscape is gently undulating, alternating between broad valley floors and rounded interflues. The parent materials of the soils found on the backslopes and the summits are derived from granite and gneisses, while soils on the footslopes and valley bottoms are developed from parent materials that are colluvial or alluvial in nature. Several prominent residual granite outcrops (*kopjes*) are scattered on the summit and backslopes. The main soil types identified by farmers are:

- *akao*: swampy soils susceptible to flooding;
- *apuuton*: sandy soils with high water absorption capacity and easily drained; and
- *eitela*: gravel, inappropriate for agriculture.

Agriculture is concentrated on the well-drained soils on the summits and backslopes. Here, soils are coarser, acid in nature and of low fertility. Soil moisture deficits are severe, limiting cultivation to drought resistant crops such as sorghum, millet and cowpeas. On the footslopes and in the narrow valley floors, seasonally waterlogged soils offer greater agricultural potential but are rarely exploited. The poorly-drained soils of swampy valley bottoms are generally not used for cropping.

The different types of vegetation evident in the area include:

- small-scale farms – the predominant cover;
- tropical high forest – in the Ominya forest reserve;
- bushland and thickets – summits and steeper slopes with well drained soils are dominated by savannah woodland and tree savannah.

Much of the natural vegetation has been removed to allow for the expansion of cropping.

The population density (in Toroma sub-county) averages 87 people per square kilometre. This is expected to rise with the recent establishment of district

headquarters in Katakwi. The majority of people resident in the area are from the Iteso ethnic group, although there are seasonal influxes of Karamojong who bring their cattle in search of dry-season grazing and water resources. The main environmental concerns are bush-burning, over-grazing leading to soil erosion (especially during the seasonal influx of Karamojong herders), brick-making and charcoal-burning.

Soil erosion is only a problem in a few areas. Farmers indicated that 93 per cent of cultivated fields are located on flat land, except in Moru village where 60 per cent of the land is on a gentle slope and erosion is perceived to be a problem. Of the 10 per cent of farmers who saw soil erosion as the main concern, only 30 per cent practise SWC. Flooding is a major constraint to agricultural production – 61 per cent of respondents regard flooding as the major environmental hazard, of whom 70 per cent invested in SWC. Drought was regarded as the major environmental hazard by 28 per cent of the sample population, of whom 64 per cent invested in SWC. The main sources of water are lakes, pools, swamps, valley dams, tanks, hand-augured wells and boreholes.

While the study area is relatively close to a major highway, transport infrastructure remains poor. The marketing system is based on village markets where small surpluses of food crops, livestock and cash crops are sold, and on weekly markets at strategic points in each parish which bring traders from further afield. Most households have diversified away from crop production in order to generate cash income for the purchase of food. The main sources of income identified by respondents were:

- sale of staple crops (57% of households);
- sale of livestock products (38% of households);
- sale of cash crops (18% of households);
- business and petty trading (16% of households);
- remittances (10% of households);
- others (12% of households).

'Other' sources of income include hiring out labour, owning eating places, bee-keeping, fishing, employment, carpentry and brewing local beer. About 43 per cent of households had access to non-farm income, and of these, four per cent indicated that non-farm activities were their main source of income.

The main livelihood problems identified in focus group discussions were:

- shortage of food;
- limited market for surplus produce;
- shortage of income;
- old age and poor health;
- poor enforcement of local by-laws;
- lack of secure land tenure and high labour demands for women;
- seasonal influx of Karamojong herders, leading to over-grazing.

Farming systems and soil and water conservation practices

Four farming systems are found in the study area.

Root crop–cereal–legume: the most common system in the area. Major SWC practices are crop rotation, grass bands, deep ploughing and contour ploughing.

Cereal–legumes: cultivation mainly for domestic consumption.

Cereal–cotton: cotton used to be an important cash crop in the Teso system prior to the collapse of the cotton marketing system.

Livestock–fishing–rice: livestock keeping used to be an important component of the Teso system prior to cattle rustling in the 1980s.

In contrast to the Tanzania case study, not all farmers practice SWC in the Uganda case study area. The following sections look at the influence of capital assets, the policy environment and livelihood strategies on a household's decision to adopt SWC practices. The main SWC practices found in the area are described in Box 5.

Capital assets

Land and resource tenure and security

Land is communally owned under the guardianship of the clans. The clans allocate land use rights to individual households belonging to the clan. Use rights are inherited by male offspring. The land available to each household has decreased over time as it has been divided among

Box 5 SWC practices in the Uganda case study area

- Demarcation of land into land for cultivation, grazing land (mainly around swamps and along river banks, because this facilitated watering of animals) and residential areas – this practice existed in the pre-colonial period (prior to 1898) and continues to the present day. It was formalised by the *Cattle Grazing Act* during the colonial period (1898–62), and also promoted during the post-colonial period (after 1962).
- Semi-nomadic shifting agriculture – in the pre-colonial period, the clan head had authority to insist that people shift from one area to another once soil had become depleted. This practice was discontinued in the colonial period, as colonial authorities promoted more settled forms of agriculture.
- Protection of hilltops and forests for rituals – practised during the colonial period.
- Mulching – practised during the pre-colonial period and promoted during the colonial period, along with manuring.
- Intercropping – primarily the result of the inability to clear new land for cultivation (because the technology of draught power was not available), with the additional benefits of reducing risk, increasing yields per hectare and cutting down on labour demand for weeding. Practised from the pre-colonial period to the present day.
- Fallowing – practised from the pre-colonial period and promoted in the colonial period. In practice to the present day, although cattle rustling in recent decades has reduced the availability of draught power to re-open old fallows.
- Use of legumes – practised from the pre-colonial period to the present day.
- Rotations – introduced and promoted during the colonial period.
- Grass strips – introduced in the colonial period.
- Contour ploughing and ditches – introduced during the colonial period.

male offspring. Also due to the lack of draught power following cattle rustling, many farmers have been unable to open new land and have resorted to over-cultivation of existing plots. Access to land by female-headed households is tenuous – women may use land with the permission of the male right-holder and the clan. Land around swamps is reserved for communal grazing and watering of animals, although this system is beginning to break down with the growing importance of rice as a cash crop.

About 75 per cent of respondents owned land, while the rest borrowed or rented land within or outside the study area. Farmers may own substantial areas of land, but this is often fragmented – 46 per cent of respondents have one or two plots, and 28 per cent have three or four plots. Farmers with larger numbers of plots are less likely to adopt SWC practices in all or any of their plots. If the number of plots is correlated to the total availability of land, those with limited access to land are likely to invest in SWC (Table 4).

Table 4 shows that those with 4–7 or 8–14 hectares of land are most likely to adopt SWC practices in all their plots, and are least likely to adopt SWC in none of their plots. Those with less than four hectares are less likely to invest in SWC in all of their plots, but are still more likely to invest than those with more than 15 hectares.

Access to labour

Farm labour is taken to mean family members of active age plus hired labour. The average family size⁵ is eight. Just over 40 per cent of those under 12 years and of those between 12 and 18 years are available for farm work on a full-time basis reflecting the high school drop-out rate. Just over 35 per cent of those between 18 and 50 years are available, as are about 25 per cent of those older than 50 years. Those between 18 and 50 years are less likely than those aged below 18 to be available for full-time farm work because they engage in other, more profitable, off-farm activities in order to generate income. The reasons given for the low relative profitability of agriculture were:

- drought (making agriculture unreliable);
- pests and disease attack;
- lack of seeds for agriculture;
- weeds which damage crops (in particular *striga*).

Family labour is complemented by either hired labour

or labour exchange arrangements. Across the five study villages, 54 per cent of respondents hired labour and 60 per cent of respondents participated in labour-sharing arrangements. Hired labour is available cheaply but is difficult to acquire because of low household incomes.

Of those who do not practice SWC, 13 per cent claimed that labour was one of the main reasons (with 15 per cent non-respondents). Of those who practice SWC, 31 per cent claim that lack of labour was a constraint to increased investment (with 67 per cent non-respondents). These figures suggest that lack of labour is not the main reason for not investing in SWC. It is a more significant constraint to increased investment for those who choose to adopt SWC practices.

Access to indigenous knowledge, information and technology

Analysis of the relationship between age and knowledge shows that those under 45 years are more likely to claim knowledge of SWC activities. On the assumption that indigenous knowledge is associated with older generations, this suggests that either indigenous knowledge has not been passed on or that it is not considered relevant for locally-appropriate SWC activities.

Analysis of the relationship between education and investment in SWC shows that those with education up to primary or 'O'-level are most likely to practise SWC. Those with either no education or education beyond 'O'-level are less likely to invest in SWC. This suggests that some education is an important prerequisite. Those with higher levels of education may be less inclined to invest in SWC if their livelihoods are less dependent on crop production.

Those who have been involved in farming for less than five years are more likely than those who have been involved in farming for more than five years to practice SWC on all their plots, and less likely to practice SWC on none of their plots. This runs counter to the hypothesis that farmers who have been involved in farming for more time are more likely to invest because of greater experience and/or better access to indigenous and non-indigenous knowledge. On the assumption that recent farmers are younger, possible explanations are that they are less risk-averse (especially since they have started farming following the worst of the cattle rustling and civil conflict), that there is a correlation between duration in farming and farm size, and/or that recent education has highlighted the importance of SWC.

The data also show a positive correlation between access to farm tools (such as ox-plough, hand hoe, *panga*, shovel, rake, axe, etc.) and investment in SWC. However, those who do not own oxen are more likely to adopt SWC practices. This may reflect the greater need to invest in soil fertility maintenance where lack of draught power limits options for opening new land.

Table 4 Farm size and adoption of SWC

Farm size (ha)	SWC adopted in all plots (%)	SWC adopted in some plots (%)	SWC adopted in no plots (%)
< 4	57	29	14
4–7	86	10.5	3.5
8–14	80	20	0
> 15	25	12.5	62.5

Access to financial capital

Lack of money is an important barrier for 55 per cent of non-adopters, probably preventing them from hiring labour and purchasing tools/materials required.

Transforming structures and processes

Uganda has seen four major political periods, each with specific policies of social and economic development:

- pre-colonial period (prior to 1898);
- colonial period (1898–1962);
- post-Independence (1962–86);
- National Resistance Movement period (1986 to date).

As part of the drive to increase cash crop production, the colonial government forced people to switch from a nomadic system of shifting agriculture to a system based on settled farming.

The government introduced paid agricultural labour, which provided incentives to shift from pastoralism towards crop production. Paid labour, promotion of cash crops such as cotton, and benefits to progressive farmers all provided incentives for investment in SWC during the colonial period. This was also supported with research on the maintenance of soil productivity and SWC.

Colonial legislation to promote SWC distinguished between African land and non-African land. On African land, responsibility for SWC was delegated to local authorities (a system which continues today). However, traditional leaders, chiefs and clan leaders were co-opted by the colonial government to enforce by-laws and collect taxes, which eroded the relationship between these traditional institutions and the people. All local authorities adopted a more or less standard set of by-laws, as follows:

- potatoes were to be planted on soil ridges across the slope;
- no annual crops were to be grown within 9ft (2.7m) of any perennial or seasonal watercourse or any maintained road;
- all paths, cattle tracts, ditches and access roads should be protected against erosion by run-off channels and soak-away stakes; and
- all house compounds except those in the growing area and compounds around buildings should be covered with mulch where possible.

These by-laws still form the basis of current by-laws in the case study area.

The effectiveness of by-laws and legislation was characterised by a number of limitations:

- implementation of the by-laws was entrusted to ill-equipped local authorities, many of whom lacked technical expertise;
- for African land, the laws did not emanate from any soil management policy which could also have provided for training, research and extension;
- the main focus of attention was limited to non-African land.

Most colonial policies relating to SWC were regarded as oppressive and discriminatory, and so were discarded at Independence in 1962. Lack of leadership by local authorities after Independence, especially in the 1970s, led to serious setbacks in SWC.

Current institutional and policy environment

Local government in Uganda is based on a local council system, with the local council executive at the apex of village government. District and local councils are mandated to develop specific by-laws on natural resource management, subject to approval by the National Environmental Management Authority. Guidelines to local administrations on certain aspects of land use policy are available, but not strictly adhered to, as by-laws need to respond to local circumstances. Katakwi District Local Council has passed several by-laws on land use, grazing, water conservation and prevention of soil erosion. To simplify enforcement, by-laws tend to be based on restrictions. Responsibility for enforcing these by-laws has been delegated to lower-level local councils, such as Toroma sub-county. Farmers identified several water-related by-laws which they are observing in the study area. The important ones are that protection of water resources shall be done by every member of the community whenever required by the village authorities; and no unnecessary grazing or watering of animals shall be allowed in non-designated areas.

Enforcement levels are low due to the lack of motivation of local council chairpersons.

There has been revived interest in SWC in both the Department of Agriculture and the Department for Environmental Protection. This has led to the establishment of a soil conservation unit within the Agricultural Engineering Section and a proposal to designate an officer specifically charged with soil conservation in each district. Local administrations are supposed to recruit people to work as field assistants on SWC, trained by the Department of Agriculture and paid by the local administration. Extension on SWC is carried out within the same framework as the agricultural sector as a whole. The extension system has recently been restructured and it is hoped that SWC activities will form a major component of the new structure. As yet, little has been achieved in the study area. According to farmer focus groups, there has been a complete breakdown in the link between agricultural extensionists and farmers

In 1989, the government drafted a national soils policy to provide a framework for action to prevent and/or reduce degradation of soils and related resources and promote sustainable soil management. The policy places high priority on the need for updating soil surveys, mapping and implementation of national land use planning.

The current land tenure system involves a combination of customary tenure, private land, freehold and leasehold. The main form of land ownership in Toroma is customary tenure. Households in the study area did not view land tenure as a major constraint to SWC, except for those who rent land and for those who have no access to land.

National sectoral policies were approved in 1994/5 though have not yet had a significant influence on SWC activities at the local level. One of the guiding principles of the agricultural and livestock policy is that policy and planning should incorporate the environmental costs of soil degradation in economic analysis of agricultural development programmes and projects. Strategies include offering land users incentives for SWC and good husbandry practices where appropriate and practicable.

The water policy now places strong emphasis on managing water resources at the lowest appropriate level or community level, and on strengthening capacity for local community management. Water-related projects implemented in the area have focused on improving access to clean water and sanitation. Forestry interventions in Katakwi have focused on the promotion of tree nurseries.

SWC as a strategy – who invests?

The main reasons given for investing or not investing in SWC are shown in Table 5.

The major socio-economic factors found to influence the adoption of SWC practices were:

- type of land use – SWC practices adopted almost exclusively in cultivated areas;
- tradition;
- farmers' perception of the severity of land and soil degradation – villages with land shortages and consequent soil depletion were characterised by extensive adoption of SWC practices;
- learning from the example of fellow farmers;
- presence of external assistance, such as NGOs;
- high crop values – a general increase in crop prices has led to a shift from livestock keeping into crop production and increased investment by existing crop producers. SWC practices are more likely to be adopted in plots where high value crops (such as cotton, sesame, cassava, groundnuts and potatoes) are cultivated;
- availability of labour and cash;
- incentives – direct incentives such as farm tools, or

indirect incentives such as recognition. SWC adopted under such incentives may not be sustained once incentives are withdrawn.

In terms of the fit of SWC with livelihood strategies, many households have diversified away from crop production in order to generate cash income for the purchase of food. As a result, SWC has been neglected. Alternative investment opportunities identified included:

- expansion of farming activity;
- business;
- house construction;
- purchase of oxen and other livestock;
- school fees;
- purchase of household property;
- seeds for cultivation.

Households have invested in SWC where high value crops (such as cotton, sesame, cassava, groundnuts and potatoes) are cultivated. Just over half of the respondents (55 per cent) said that they themselves must take some responsibility for SWC. Slightly more (68 per cent) said that they had received assistance for their SWC efforts, mainly from NGOs and fellow farmers, but also from friends.

Conclusion

SWC plays a less important role in the farming system of the Ugandan case study due mainly to the fact that farmers perceive that soil erosion is not a serious problem. Both macro- and micro-level factors have had an important influence on the extent to which households practise SWC.

At a macro level

Until recently, SWC has received relatively little attention from national level institutions. Since 1994, a number of relevant national sectoral policies have been revised, and there have been indications of increased interest in SWC. However, it is still too early to evaluate the impact of these changes on the ground.

Changes in the wider political environment have affected investment in SWC through changes in the capacity and perceived authority of local institutions. Since the colonial period, responsibility for promoting SWC has been delegated to local leaders and administrations. The decentralisation policy adopted in 1994 has reinforced this approach. However, SWC is not necessarily high on the agendas of local administrations, and they have limited capacity and expertise to promote SWC. Support from agricultural extension staff is limited by retrenchment, low motivation and a shortage of resources.

At a micro level

In terms of the fit of SWC with livelihood strategies, many households have diversified away from crop production in order to generate cash income for the

Reasons for investing in SWC	Constraints to investing in SWC
improves soil fertility	lack of knowledge
higher yields	lack of tools and implements
reduces pest prevalence	lack of oxen
reduces risk of crop failure	lack of labour
increases food available at home	

purchase of food and in some cases this has led to a decline in investment in SWC. There are signs of a relationship between agricultural intensification and investment in SWC. Those farmers with limited access to land are more likely to invest in SWC. And those who do not own oxen are more likely to adopt SWC practices. This may reflect the greater need to invest in soil fertility maintenance where lack of draught power limits options for opening new land. Overall there is relatively little investment in SWC in the case study area. Where households do practise SWC it is generally in response to high crop values (practices are more likely to be adopted in plots where high value crops such as cotton, sesame, cassava, groundnuts and potatoes are cultivated); and direct incentives (such as the provision of farm implement or indirect incentives such as recognition).

For many farmers, SWC practices impose a high demand on labour and other resources. There is also a positive correlation between access to farm tools and investment in SWC. Access to labour is an important factor. Those aged between 18 and 50 years are less likely than those aged below 18 to be available for full-time farm work because they engage in other more profitable off-farm activities in order to generate income.

Access to knowledge featured strongly in discussions. Analysis of the relationship between education and investment in SWC shows that that some education is an important prerequisite for investment. However, those with higher levels of education may be less inclined to invest in SWC if their livelihoods are less dependent on crop production. Those who have been involved in farming for less than five years are more likely to practice SWC than those with more experience.

4 CONCLUSION

In Tanzania, SWC plays an important role in the farming systems of the case study villages and there are signs of increasing investment in SWC practices. In contrast, soil fertility management is the main form of SWC adopted in the farming systems in the Ugandan case study. In the Ugandan case study, there is some evidence of declining investment at the village level as households switch away from agriculture-based livelihood strategies. Investment by certain types of household may be increasing nevertheless. Different climatic and geophysical contexts play a major role in this divergence, but a closer look at the livelihoods in the two countries helps to explain the difference in trends.

Vulnerability context

In both Tanzania and Uganda, variability in rainfall distribution constitutes a major element of the vulnerability context. In Uganda, average annual rainfall is much higher, but farmers report increasing variability

in recent years with serious fluctuations in rainfall causing both drought and flooding. Uncertainty over yields was given as one of the reasons for not investing in SWC in Uganda.

Cattle rustling and conflicts with neighbouring tribes have had a significant impact on the livelihoods of the villagers in the Ugandan case study. This has resulted in the loss of assets – notably draught power as well as farm tools and implements – which are key to the farming system and SWC. This has had a serious negative impact on household capacity to invest in agriculture.

In both Tanzania and Uganda, current farming systems may not be well-adapted to the specific agro-ecological context. In Tanzania, the population of the case study sites have traditionally farmed in the highlands and have only migrated to the lower slopes and plains during the course of the 20th century. In Uganda, traditional livelihood strategies in the region were based on semi-nomadic pastoralism and shifting cultivation. Settled agriculture was encouraged during the colonial period and swidden farming systems developed, but these have been overturned by conflict and cattle rustling in recent decades.

Access to assets

Secure access to land is often cited as a key factor necessary for investment in SWC. In both Tanzania and Uganda, the majority of households feel relatively secure with the current land tenure system, which in both cases is based on traditional customary systems. Female-headed households in both case studies have less secure access to land and this is associated with lower investment in SWC, particularly in Tanzania.

The relationship between farm size and SWC differ between the two case studies. In Tanzania, households with smaller farm sizes tend not to use SWC on any of their plots. However in Uganda, the opposite is the case – households with more limited access to land are more likely to invest in SWC. Those who do not own oxen are also more likely to adopt SWC practices. This may reflect the greater need to invest in soil fertility maintenance where lack of draught power limits options for opening up new land. There is also a positive correlation between access to other farm tools and investment in SWC in both cases.

Access to labour is notoriously difficult to measure, and the Tanzanian authors highlight the weakness of the link between long term investments in SWC and labour availability measured through cross-sectional data. In both case study regions, labour exchange systems still function and are an important means of securing labour. Labour is also available to hire but, as the Ugandan authors point out, access to hired labour

is limited where incomes are low. The study found that female-headed households tend to have less family labour and participate less in labour exchange. They are also less likely to invest in SWC.

Case studies in both Tanzania and Uganda highlighted 'lack of knowledge' as being a major constraint to investment in SWC. This may reflect a perception that traditional techniques are inappropriate to current farming systems, that traditional knowledge has been lost (either through migration or because traditional institutions have been undermined), or that this knowledge exists but is undervalued. Analysis of the relationship between education and investment in SWC in Uganda shows that some education is an important prerequisite for SWC investment.

Livelihood strategies

Households in the case study areas adopt a range of activities to achieve their livelihood goals. There is evidence that households are both intensifying agricultural production and diversifying into other off-farm income-earning activities in order to survive. Migration is a less important strategy in the two areas.

SWC forms one component of an agricultural intensification strategy in both countries. In Tanzania, households that are most dependent on crop production for their livelihoods invest more in SWC. In both countries, households are more likely to invest in SWC on land growing high value cash crops.

The impact of the diversification of livelihood strategies on decisions to invest in SWC is not clear. On the one hand, the Tanzania case study suggests that off-farm income is an important source of investment funds (this is similar to the findings of Tiffen et al. (1994) in the Machakos study). However the Ugandan evidence suggests that many households have diversified away from crop production in order to generate cash income for the purchase of food, and in some cases this has led to a decline in investment in SWC.

Institutions and policies

In both Tanzania and Uganda, policies and institutions have been in constant flux during the 20th century, and in the post-Independence period in particular.

The Tanzania case study emphasised the importance of rigorous enforcement of by-laws in promoting SWC and showed how the weakening of support institutions (both chiefdom and village administration) have eroded investment in SWC. Post-Independence saw a major decline in the promotion and adoption of SWC that continues to be felt today, with households headed by middle-aged farmers less likely to adopt SWC. In Tanzania, economic liberalisation since the mid-1980s has increased agricultural producer prices, and is

highlighted by farmers as providing a better investment environment for SWC.

In Uganda, recent regional political and economic instability has undermined farming systems and disrupted investment in SWC. Within the framework of decentralisation and building on historical approaches, district and local councils have been charged with strengthening by-laws for SWC. However, most district and local councils lack the capacity and/or motivation to fulfil this mandate. Recent sectoral policy reviews and increased interest in SWC at the national level have not yet produced substantive changes at the ground level.

Outcomes

Households in the case studies invest in SWC primarily to improve yields, usually of cash crops. It therefore seems to represent one component of a strategy to increase incomes in contrast to improving food production and sufficiency. Neither case study was able to elicit information on how investment in SWC fits into risk management strategies or whether it reflects trade-offs between short and long term benefits.

The relationship between the vulnerability context and investment in SWC needs further clarification. On the one hand SWC is often promoted as a means to reduce household vulnerability associated with erratic rainfall, but the Uganda case study in particular, suggests that increasing variability of rainfall – resulting in both drought and floods – has discouraged the adoption of SWC practices.

SWC and livelihoods in Tanzania and Uganda

These findings will be compared with those emerging from the other case studies from Burkina Faso, Ghana, Nigeria and Senegal at a workshop to be held early in 2000. These preliminary findings suggest that there are important differences between and within communities with respect to the contribution that SWC makes to livelihoods. The decision to invest in SWC relates both to the assets available to households (the ability to invest) and the attractiveness of agricultural intensification (with SWC as one component of this) as a livelihood strategy. This is affected by wider policy and institutional issues beyond the immediate control of households. Those working on SWC issues need to think carefully about whether a lack of investment in SWC is due to key constraints or lack of availability of assets (such as knowledge, tools, labour, etc.); whether this is due to the fact that households are choosing more attractive and possibly less risky strategies; and how these decisions are influenced by the policy and institutional environment.

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ENDNOTES

- ¹ See Carney (1998) and DFID (1999) for more details.
- ² Land under sisal is held under Right of Occupancy, which is granted by the presidency for a prescribed length of time.
- ³ One interpretation is that farmers do invest cash and materials in SWC but were reluctant to give this impression to researchers associated with an NGO.
- ⁴ There may be important differences among female-headed households. Women rarely own land but do have rights to the land of deceased husbands, so households headed by widowed women will have better access to land than unmarried women.
- ⁵ Family size is defined as those residing in the household on a day-to-day basis including children and the aged.

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