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LIVING AT THE MARGIN IN HILLS – People Building Sustainable Livelihoods Based on Renewable Natural Resources¹

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Abstract

Since 1995, the Hillside production system of DFID's Natural Resources Systems Programme (NRSP) has been developing and promoting improved hillside farming strategies relevant to the needs of marginal farmers. This work has addressed three main questions, (1) What is the knowledge-base of relevance to the livelihoods of marginal hillside farmers? (2) What are the best means for local professionals and rural communities to identify the most appropriate means of natural resources management and target them to poor households? (3) How can pilot research experiences be accelerated and scaled up to the wider community? The experience gained by NRSP demonstrates how poor people can build sustainable livelihoods based on the management of renewable natural resources on hillsides.

Hillside production systems are characterised by farming activities (crops, trees and livestock) on steep slopes where difficult terrain results in poor accessibility, limited infrastructure and markedly impoverished communities. Use of lands that are characteristically hillside has led to their degradation with soil erosion, declining soil fertility, and deforestation all contributing to low productivity. In addressing these land management problems, NRSP adopts an integrated systems approach towards the development and promotion of improved farming strategies that meet the needs of marginal farmers. Current projects are in Bolivia, Nepal, and Uganda. All projects, in varying ways, emphasise the factors that limit the adoption of available technologies.

One way to understand the complexity of livelihoods in hillside systems is to employ the Sustainable Rural Livelihoods (SRL) framework and conduct an analysis of how people develop their various capital assets. While financial, physical, and natural capital assets are extremely limited, social and human assets enable people to overcome the difficulties of their environment and secure their livelihoods. Social networks and reciprocal arrangements are especially important.

DFID and Hillside Research on Renewable Natural Resources

The Department for International Development (DFID) is the UK Government department responsible for promoting sustainable development and poverty reduction.

¹ Case examples are drawn from the DFID Natural Resources Systems Programme (NRSP) for Hillside Production Systems operating in Bolivia, Nepal and Uganda.

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DFID's mission statement includes addressing poverty reduction and sustainable development, especially in the poorest countries of sub-Saharan Africa and Asia (DFID 2004). Through DFID, the UK is committed to the internationally agreed Millennium Development Goals, to be achieved by 2015. In the context of natural resource (NR) systems, two MDGs are being supported: Goal 1 aims to eradicate extreme poverty and hunger and Goal 7 to ensure environmental sustainability. DFID contributes directly and indirectly to environmental sustainability through the integration of strategies for poverty eradication into efforts to combat NR problems such as desertification and drought. The UK commitment to development assistance is rising significantly, from approximately £3.4 billion in the financial year 2002/03 to £4.9 billion by 2005/06 in line with the UK Government's target to achieve a 0.4 percent of gross national income devoted to development assistance. One of the major pillars of this assistance is research. DFID's Renewable Natural Resources Research Strategy (RNRRS), covering the decade 1995-2005, focuses on the generation of new knowledge in natural and social sciences. It also emphasises the promotion and application of the use of this knowledge to improve the livelihoods of poor people in a sustainable way through better management of renewable NR systems. A key strategic requirement is that all research must be demand-led, with the needs of poor people clearly identified. As part of the RNRRS, the Natural Resources Systems Programme (NRSP) funds research with the goal of generating benefits for poor people by the application of new knowledge to NR systems.

NRSP is meeting this goal through delivering new knowledge that can enable poor people, who are largely dependent on the NR base, to improve their livelihoods. The central focus of knowledge generation is on changes in the management of the NR base that can enhance the livelihood assets of the poor over a relatively long timeframe. This will provide greater livelihood security and opportunities for advancement of poor individuals, households, or communities. Integrated management of natural resources is central to the research, where the "systems approach enables a better understanding of the actual situations of households in specified production systems in target countries" (DFID-NRSP 1999, p.4). Not only does the systems approach better define the NR base (landforms, soil, water, vegetation, and organic residues) but it also emphasises the integrated and dynamic nature of people's livelihood strategies and how these affect their decision-making and capacity to use and manage the NR base. Studies of the livelihoods of the poor and their interaction with other (less poor) sections of society are an important part of NRSP's research. They are a means of understanding what changes in the management of natural resources are feasible and how poor people's adoption of, or response to, these changes could assist them to secure and build their livelihoods.

One of the 'production systems' of NRSP is the Hillsides Production System (HSPS), to which historically NRSP has devoted about 15 percent of its budget. Hillsides and mountains tend to accommodate many of the poorest people. Land quality is poor, people are isolated, and literacy rates are amongst the lowest. In a study of NRSP's portfolio of production systems and target countries, HSPSs in Nepal, Bolivia and

Uganda recorded the lowest road density, the least literacy, and an average Gross Domestic Product of US\$1556 per annum (Taylor et al. 2003). These are clear indicators that hillsides should receive priority attention to meet the MDGs.

HSPS has changed substantially since 1995. Initially there was a strong technical focus on developing new technologies on the assumption that development is limited on hillsides by lack of **knowledge** of appropriate techniques. That assumption was challenged as DFID increasingly turned its focus towards issues of poverty, livelihoods and **access** to knowledge. The current goal, purpose and output of HSPS are given in Table 3.1 and HSPS now adopts a more holistic systems approach, especially at Output level, with a specified focus on 'farming strategies' and the 'needs of marginal farmers'. Activities concentrate on the **application of technologies** and ways to **extend research benefits** to greater numbers of poor people. The three principal sets of activities are grouped around themes, namely:

- a) Livelihoods of marginal hillside farmers;
- b) Identification and matching of technologies to poor households;
- c) Applying, extending and scaling-up results.

The first set of activities examines the means to achieve sustainable soil and land resource management in hillsides environments. It involves an understanding of the livelihoods base of marginal hillside farmers, including society, economy, and environment. The second concentrates on the analytical tools necessary for assessing soil and land resource management issues and targeting these to farming strategies that are relevant to hillside communities. The third set of activities holds the greatest challenge and is the current focus: how to benefit poor people well beyond the immediate target areas of the research projects. HSPS is doing this through assessing the possible ways to scale up, undertaking pilot examples of integrated soil and land resource enhancement, and funding uptake promotion through symposia, workshops, and new initiatives. NRSP-HSPS commissioned a review of scaling-up strategies for research in NR management (Gündel et al. 2001), which is intended to guide future projects in building wider impact and greater application to large numbers of poor people.

The Symposium of February 2003 held in Nepal on 'Renewable Natural Resources Management for the Hindu-Kush Himalayas' also forms part of this last set of activities, enabling the wider community of scientists in the region to consider the lessons learnt by nearly a decade of research on the natural resources of hillsides.

The objective of this paper is twofold. First, it is to describe some of the key livelihood characteristics of people living on hillsides in order to ascertain the characteristics that have led to their building of sustainable land use. Secondly, it is to provide researched examples of livelihood strategies that are enduring, have the ability to cope with external pressures, and demonstrate lessons that may be valuable more widely for sustainable development. Other chapters in this book present the progress made on specific activities of NRSP-HSPS work.

Table 3.1: DFID's Natural Resources Systems Programme – the Hillside Production System Logical Framework

Narrative Summary	Objectively Verifiable Indicators (OVI)	Means of Verification (MOV)	Important Assumptions
Goal			
Livelihoods of poor people improved through sustainably enhanced production and productivity of RNR systems	Measure of change in capabilities, assets and activities		
Purposes			
Benefits for poor people in target countries generated by applications of new knowledge to natural resources management in hillside production systems	By 2005 evidence of application of research products to benefit target communities by achieving one or more of: <ul style="list-style-type: none"> - Sustainable production increase - Less variable production - Productivity increase - Improved employment (numbers, income, quality) - Improved access by poor people to RNR outputs 	DFID commissioned reviews Monitoring against relevant baseline data collated by the programme Reports of in-country institutions National statistics	Enabling environment (policies, institutions, markets, incentives) for widespread adoption of new strategies and practices exists Climatic conditions are favourable
Output			
Improved hillside farming strategies relevant to the needs of marginal farmers developed and promoted	<ul style="list-style-type: none"> • By 2000, knowledge base for soil and water conservation, and maintenance and improvement of soil fertility relevant to marginal hillside farmers developed in at least two target areas • By 2004 new approaches to enabling local professionals and rural communities, including the poorest individuals and households, in remote hillside environments to adapt relevant NR management knowledge to their circumstances and apply this knowledge developed and promoted • By 2005 this new knowledge incorporated into the development strategies of target institutions of at least two hillside target countries 	Reviews by programme manager Reports of research team and collaborating /target institutions Dissemination products Local national and international statistical data Data collected and collated by programme manager	Target beneficiaries adopt and promote systems and approaches Enabling environment exists Budgets and programmes of target institutions are sufficient and well managed

Society, Economy and Environment of Hillsides

People living on hillsides and mountain slopes are literally dwelling 'at the margin' of society, of the national economy and of the wider biophysical environment. NRSP-HSPS in its earliest set of activities sought to characterise society, economy and environment in terms of the livelihoods of people who dwell on hillsides. The following brief account of marginal hillside farming situations is based on a synthesis of NRSP-HSPS research and other studies, such as those undertaken for the UN International Year of Mountains in 2002.

Through their inaccessibility to the rest of society and their vulnerability to catastrophic environmental processes, hillsides provide a precarious future for local people. Risk and uncertainty characterise day-to-day living (Thompson et al. 1986) and there has been a long history of debate about the changing Hindu Kush-Himalaya environment especially (Blaikie and Muldavin 2004). The problems of the poor are generally more acute on hillsides. Because communities are poor, their strategies for coping have to be more complex and diverse in order to withstand a dynamic and unpredictable environment (Chambers 1997). They have to be involved in a large number of activities in order to survive and have to exploit fully their precarious biophysical environment. Especially vulnerable are the landless, the land-scarce, women, the elderly, and dependent children (Ellis-Jones 1999). They demand little attention and get even less from policy-makers and professionals. Their votes are sought for elections, but the services promised rarely materialise because pressing matters in the towns and affluent rural areas intervene. Conflict, political destabilisation, and policy confusion are especially prevalent in mountain areas (Blaikie and Sadeque 2000). Similarly, many of the world hot spots of land degradation are in poor areas that coincide with steep slopes (Scherr and Yadav 1996). Rates of degradation and environmental change are at a maximum in the steep terrain of hillsides (Messerli and Ives 1997), and change can be both incremental (soil erosion) and catastrophic (landslides).

Yet at the same time, societies who live in these challenging environments provide us with important lessons and empirical examples of how to survive, how to adapt and to adopt innovative ideas and technologies, and how to live sustainably in an uncertain world. However, this is a far different view of these societies than that which has pertained even up until very recently. As Ives (1999) describes:

"The Nepali hill farmer was assumed to be responsible for massive deforestation, increased landsliding, soil erosion, and horrendous downstream effects through Gangetic India and Bangladesh, all the way to the Bay of Bengal..... the subsistent farmers were perceived as ignorant ... and reckless." (p.175)

Many of the elements of this assumption, subsequently known as the 'Myth of Himalayan Environmental Degradation', have come under scrutiny since the late 1980s. Although the 'myth' has been influential in the environmental policy process (Turner et al. 1995), most research, including that by NRSP-HSPS, has shown that environmental

problems are not as intractable as first presented. Evidence has accumulated (e.g. Gilmour 1988) that the extreme statements were more the result of the prejudice of the observers than a real assessment of the state of hillslope environments. Hill people have typically been used as scapegoats for other problems such as land expropriation, corruption, and political intrigue, and for the failure of professionals adequately to understand the complexities and dynamics of mountain environments and societies (Forsyth 1998).

Notwithstanding predictions of disaster and collapse of hillsides society because of environmental degradation (e.g. UNEP 1984), most land use is remarkably enduring. For example, Sherpa village landscapes in the Mount Everest region have many planted trees and sacred forests, a product of centuries of evolution from original Tibetan beliefs of the spiritual power of trees. These are not only conservative of the landscape, but also critical to the preservation of the oldest and largest individual juniper, fir, birch and rhododendron trees in the region (Stevens 1993). Likewise, terrace systems in Nepal (Figure 3.1) have been maintained and have continued to produce for hundreds

of years, even though stable and unstable political and social forces have come and gone (Wu and Thornes 1995). The people who have guarded such trees, structures, and practices are a repository of technical expertise from which the development community could derive vital answers to fundamental global concerns, such as how to conserve biodiversity, protect against soil erosion, and fashion a sustainable livelihood out of low-quality natural resources. Socially, hillsides provide the home for societies that have been able to preserve spiritual and cultural values which have been lost elsewhere. These values act to protect the environment (Bernbaum 1999). Traditional practice and ways of life based on these values can serve as models for lowland dwellers. In particular, the preservation of biodiversity is enhanced through sacred

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Figure 3.1: Terrace systems below Annapurna – an enduring feature of the Himalayan mid hills of Nepal.

rights, religious observance, and spiritual worship, manifested by planting of trees, use of living fences, and keeping sacred groves or forests to bury the dead. Ethnic diversity is also important, maintaining a diversity of agricultural systems, conserving agrobiodiversity, and evolving complex landscapes that are linked to food security and livelihoods. In Xinjiang, the largest of the 27 provinces of China, Wenjiang and Yuhong (1999) suggest that the ethnic mix of about 47 different cultures is largely responsible for environmental protection. The climate is harsh, dry, and difficult. Most of these ethnic groups live in mountainous and steep areas, coincident with some biodiversity – over 3500 species of plants recorded and 608 species of fauna, including many on the national rarity list and many whose wild genotypes are cultivated and managed in situ. They question whether reserved areas could have achieved such protection.

Economically, hillside communities are amongst the poorest. Some opportunities for productive enterprises exist in some Andean communities, for example, but generally they are few and far between. Yet, natural resource management practices that maintain adequate depths of topsoil on steep slopes are frequent and justified locally for their economic potential. *Gliricidia sepium* contour hedgerows, typically planted by many farmers in the Hill Country of Sri Lanka, work by accumulating large amounts of sediment behind these living barriers of vegetation (Stocking and Clark 1999). They are relatively low cost, demanding an initial investment in labour and planting materials, as well as continuing maintenance and pruning of the plants – see Figure 3.2. However, the benefits for most land users lie in the multiple productive uses of both the hedgerow and the retained soil. The *Gliricidia* provides poles for sale, firewood, or the training of



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Figure 3.2: *Gliricidia sepium* hedgerows in the hill country of Sri Lanka – a locally adapted technology to create hillside terraces and greater production opportunities

climbing beans. It also provides mulch and nutrient supply to the fields from the leaf litter. The hedgerow lines give a safe entry to fields, especially important on these exceptionally steep slopes. The accumulated soil not only gives greater fertility for the usual crops, but also provides planting spaces and soil depth for speciality and demanding crops. A study of the cost-benefit of the various soil conservation techniques shows that many practices have good financial viability for the small-farm household, provided that the complex and diverse aspects of the technologies are included in the analysis (Stocking 2001).

Biophysically, hillsides are vulnerable to soil erosion, land degradation, and their impacts such as loss in soil and plant productivity. In particular, accelerated soil loss and rapid depletion of soil fertility characterise steep slopes, making farming not only immediately risky but also potentially unsustainable without controlling interventions. Nevertheless, land users have inherited a wide array of techniques to manage these difficult circumstances, including bench terraces, sediment harvesting, and green cover and mulch crops. Ancient terraces and other land use systems that survive to this day are proof that these techniques are indeed sustainable. Much can be learned about the social, economic, and environmental conditions for the successful implementation of biophysical controls against land degradation on steep slopes. Development practitioners have a wealth of examples of sustainable rural livelihoods on mountainsides, a few of which will be cited in this paper. These broad aspects of living on hillsides can best be analysed in terms of livelihood capital assets and exemplified by some of the many examples of 'good practice' that are found world-wide on steep slopes.

Livelihood Characteristics of Hillside Communities and Environments

Hillside communities and environments present many challenges to development practitioners. The challenges are part of daily life for these communities and many have come to an accommodation with their situation, pointing to possible ways forward in solving problems elsewhere in the rural sector. The need to build upon farmers' practice and knowledge in hillsides has been ably demonstrated by Fujisaka (1989). A synthesis of the literature brings out the following attributes that lead both to problems on the one hand and to possible solutions on the other:

Inaccessibility

Hillsides are inaccessible and difficult to reach. This leads to physical isolation, poor communications, and weak infrastructure. Inaccessibility means lack of access to knowledge and ideas that lowlanders take for granted. It is also means poor markets, roads, credit facilities, services, and professional assistance. Chambers (1997, p. 80) identifies isolation and remoteness as one of the main features of the relationship between rural people and professionals, but instead of it being attributed to the peasantry, he features it as the characteristic of planners, economists, and professionals: "[they] are cocooned in comfortable (centrally heated, air conditioned) offices, with their exposure to the world of ordinary people largely limited to commuting, shopping, bars, tourism..... Their physical isolation is compounded by an

illusion of instant contact through fax, e-mail, statistics and other proxies for people.” If this is the gulf of understanding with poor people generally, how much more so is it with hillside dwellers?

However, this isolation may also mean the generation of local coping strategies. For example, in Tanzania *ngoro* is a local name for the pitting conservation system of the Matengo tribe in Mbinga District. *Ngoro* has been in use for over 200 years (Allan 1965; Malley et al. 2004). The system is an indigenous and ingenious means of soil, water, and nutrient conservation for land cultivation on steep slopes (Figure 3.3). Similarly, in Nepal one of the NRSP-HSPS projects has identified the inherent skills behind farmers’ practices in the middle hills, including local soil names, measures to stem soil and nutrient losses, and management practices on bari land terraces (Desbiez et al. 2004).



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Figure 3.3: Construction and maintenance of *ngoro* ridges, south-west Tanzania. An example of sustainable soil management practices developed and practised locally

Poverty

The quality, abundance, and accessibility of natural resources such as soil, water, and growing season are constraining issues in hillsides and mountain areas. Forests may, where ecologically possible, provide a buffer for poverty. However, such opportunities are getting rarer as forests are increasingly exploited. Hillsides communities, therefore, are often amongst the poorest and most dispossessed. It is difficult from official statistics to isolate the degree of poverty that prevails in hillside environments. However, poverty is linked to inequality (UNDP 1992), and inequalities promote environmental deterioration and contribute to conflicts. Messerli and Ives (1997) report that of 48 wars and conflicts in 1995, 26 took place in or directly affected mountainous regions.

Anecdotal evidence and news reports suggest that the situation is even starker today: Kashmiri separatist movements in India and Pakistan; Maoist insurgents in Nepal; and Taleban mountain retreats in Eastern Afghanistan.

However, out of poverty can come tested and verified indigenous technologies. These are practices that rely on the immediate natural resource base, rather than bought-in external inputs. For example, in Embu-Meru districts around Mount Kenya the poorest social groups also practice some of the most effective and low-cost soil conservation practices. Typically, these are trashlines made up of weeds, scraped together into contour ridges. Not only do these practices conserve soil, they also provide an extremely low-cost way of retaining water and nutrients. Studies of trashlines have shown their economic benefit, in contrast to the cost of many imported techniques (Kiome and Stocking 1995). Effective environmental protection and secure livelihoods have arisen out of necessity

Landlessness

Hillsides areas typically have large areas of open access or common land, or land that is nominally under state control as forest or reserve. NRSP has investigated the links in Nepal between social structure, livelihoods and common pool forest resources, for example (Seeley 2003). While in some benign political regimes in the Andes *de facto* access is not a problem, elsewhere it can be uncertain. Gaining title to land is difficult, if not impossible. Large parts of the Mahaweli Ganga catchment in the Hill Country of Sri Lanka has been kept as state forest land, although trees are only evident in plantations. When the Victoria Dam and several other reservoirs were constructed in the 1970s, some 40,000 small farmers were displaced. The more powerful and influential of these farmers gained places on the new Mahaweli irrigation schemes, though these had their risks and problems being out on the dry plains below the well-watered and fertile valleys. But the rising water displaced the majority of the poor, including those who rented or sharecropped land.

The only feasible place to go for many of these mainly landless people was to the upper catchment steep slopes, to earn a living illegally farming tobacco, vegetables, and, where possible, rice. These farmers were accused at the time of ruining the slopes and causing erosion and sedimentation into the reservoirs, and of damage to the electric turbines producing power for Colombo. Certainly, there was much erosion from the tobacco fields because of the poor cover. However, subsequent surveys revealed that none of this sediment reached the reservoirs; it was all trapped further down the slope where the farmers started to construct sediment traps and to make new fields. The legal status of some of these new farms has been settled and some have turned their enforced illegality into a viable production unit. Others still have to farm surreptitiously. In the majority of cases, these steep hillside fields are well conserved, stable, and viable. To an extent, this is an unplanned 'good news' story, but it can be replicated in many other places, where difficult economic and social situations, in this case landlessness, have turned out to be the forcing factor for good land management.

Fragility

This gives rise to vulnerability to catastrophic events, such as landslides, hailstorms, and loss of infrastructural assets. Fragility is related to sensitivity and resilience, and in both aspects, hillsides are exceptionally vulnerable. They are sensitive in the sense that only small ‘shocks’ or perturbations may have an exceptionally large effect, such as landslides or rockfalls. They lack resilience in the sense that these same shocks are far more common in their occurrence and hillside slopes will usually always suffer some consequence. Hillside farmers in Nepal use local terms for ‘strength’ and ‘power’ of their soils, which encapsulate notions of degree of fragility (Joshi et al. 2004). Unpredictable and severe disruption to livelihoods is endemic in mountain communities, because of the steep slopes and sudden storms, often of hail, which cause great damage to crops, houses, livestock, and communications. Landslides are an especial problem in hilly areas of south and Southeast Asia where terrace systems predominate – see Figure 3.4.



Figure 3.4: Landslides cut through old terrace systems near Landruk, mid-hills of Nepal

Some communities, however, manage this fragility with long-term benefit. In the steep valleys leading up from the north coast of Jamaica near Moore Town, old landslide scars are evident everywhere and occur regularly during ‘hurricane season’ when 100 mm of rainfall may typically fall in less than one hour. For individual farms and households along the line of disruption, a landslide is short-term disaster. Houses have collapsed, fields have slipped, and trees and perennial crops destroyed. However, over two or three years, the landslide scar is relatively quickly replanted, fields organised, and new homesteads built. Scars are recognised as relatively stable and unlikely to re-slide in the near future. Furthermore, the exposed soil has more weatherable minerals and is

generally more fertile. The line of the scar is usually also better-watered, with springs and greater access to small-scale irrigation possibilities. These old landslides are clearly evident in the lush vegetation and greater production opportunities afforded by the new local environmental conditions.

Marginality

This affects hillside communities in most aspects – most obviously physically, but also socially, economically and politically. Physical isolation manifests itself in long distances, usually on foot, to the nearest town and source of information exchange. It shows itself also in communities that only visit each other occasionally for festivals and feasts. In so far as external relations are concerned, communities are often ignored, rarely prioritised in development plans, and infrequently involved in policy debates. They are separate from the mainstream economy, well away from markets, sources of credit, infrastructure, and advice on subsidies.

Nevertheless, such isolation appears to bring into operation a willingness and desire (and maybe a necessity) to innovate. It leads to traditional techniques to conserve, many examples of which occur in Andean communities. Quiroz (1999) recounts the richness of the knowledge and understanding shown in farmers' own experiments in the Venezuelan Andes. This is not to say that such innovation and expertise does not occur elsewhere. However, in marginal hillside areas most reports suggest that a far higher proportion of land users experiment (for example, 90 per cent of all settler farmers of the upper Chanchamayo in Peru were dedicated experimenters [Rhoades and Bebbington 1988]). It is difficult exactly to account for this phenomenon, but clearly the fact that marginality reduces the gaining of lessons and advice from elsewhere, throws farmers much more into gaining such knowledge directly by their own experimentation.

Diversity and complexity

Farmer experimentation reflects the great dynamism and change in hillside environments, but that same dynamism presents considerable challenges both to local people and to development practitioners. The dynamics extend to influences on the political system as described for the Peruvian Amazon by Pinedo-Vasquez and Pinedo-Panduro (2001). One may ask: how can we possibly intervene successfully, when the whole system is changing so rapidly and so unpredictably? There is a diversity of conditions of the natural environment, often over very short distances. The quality of soils may vary from excellent in small pockets where a barrier has retained good depths of sediment, to very poor, thin, stony soils on eroded slopes. Similarly, other aspects of the biophysical environment may change rapidly over time and space. This diversity is compounded by a complexity of ethnic groups, minority tribes, languages, and cultural practices existing on steep slopes. It means that blueprint solutions, blanket forms of aid assistance, and simple extension messages cannot possibly be appropriate to more than a very small percentage of the people and places in hillside environments. So, for example, spatial diversity of soil types is reflected in complex niches, part of the mosaic of micro-variability of field plots. It is impossible to recommend a fertiliser or cropping strategy for such complexity. Indeed, the farmers own response to this complexity is to

plant and manage a wide diversity of species, varieties, and genotypes in order to utilise the micro-variability.

These two related attributes of complexity and diversity in small-holder farmers' livelihoods have been well described in a number of recent books on natural resource management topics: in the context of agricultural experimentation (Prain et al. 1999), plant genetic resources (Almekinders and De Boef 2000), and soil fertility (Scoones 2001). In the Peruvian example cited above, the biodiversity found in the landholdings of Muyuy residents is largely a response to complex production and management technologies gained in periods of political instability and fluctuating markets. Yet, as the authors of the study note, most development projects in rural areas are still promoting single crops or single products. This ignores the important role of diversity in matching the very different specific needs of different farmers. Diversity acts as insurance and provides farmers with options to respond to change. Taking plant genetic diversity, for example, it supports access and exchange, and this in turn contributes to the dynamic and adapted nature of farmers' management. Almekinders and De Boef (2000) talk of "reversing the treadmill" (p. 325) and embracing diversity and complexity as positive attributes of resilient agricultural systems. So-called 'modern' agricultural systems are vulnerable to environmental disturbances, such as pests and diseases, or even small variations in climate. El Niño climatic events, for example, are a major problem for farmers in the Bolivian Andes, affecting choice of crops, soil management, and indeed whether to seek work outside the rural areas because of wholesale crop failure (source: NRSP/DFID Project R7584 – www.nrsp.org.uk). So, diversity and multiple routes of change are the only answer to these challenges.

Capital Assets

In order to appreciate how and why people can live in challenging environments, such as hillsides, it is necessary to understand the resources they have at their disposal, usually termed their 'resource endowments' or 'entitlements' (Sen 1992). A good recent example of the importance of endowments in their relation to poverty is amongst the hill and tribal people of the Chhotanagpur Plateau of eastern India (Banik et al. 2004). Endowments are not just material assets; they include everything that people can access and transform into a livelihood outcome. Sen, for example, explains how people can starve in the midst of food plenty because of a collapse of their means of command over food (Sen 1981), a situation that pertains in many hillside areas. Because the biophysical environment is either deficient (for example, thin, poor, stony soils) or hazardous (landslides, hailstorms) or simply naturally poor (for example, growing season), it has often been concluded that livelihoods are inevitably insecure and sustainable management of natural resources is effectively impossible. Is this necessarily so?

To concentrate solely on the biophysical is to ignore a wealth of other resources. It is said that the blind or deaf compensate (if only partially) for the loss of one faculty by enhancement in another, such as touch, taste, or smell. Similarly, it seems from anecdotal evidence that there is compensation for the lack of biophysical resources in

a greater abundance of attributes related to society, local economy and human resources. Such compensation is implicit in the many case studies recounted in the UNEP volume on 'Cultural and Spiritual Values of Biodiversity' prepared for the Global Biodiversity Assessment. They recount a wealth of value in the non-biophysical aspects of difficult environments, such as those that occur on hillsides (Bernbaum 1999). There is a spiritual, cultural and social distinctiveness, which cannot simply be explained by isolation or inaccessibility. The natural forest islands around orthodox churches in highland Ethiopia are one example. How can these compensatory mechanisms be addressed within one framework that can bring together all the resource endowments at a society's disposal that constitute the building blocks of a sustainable environment? The answer has been the development of the SRL Framework. It balances what are called the five 'Capital Assets' and provides a framework for analysing how livelihoods may be constructed by any combination of different assets and how dynamic societies trade off one asset for another according to immediate and longer term needs.

The different capital assets and their manifestation on hillsides are described in Table 3.2. Essentially the livelihoods approach is concerned with people, and understanding their strengths (assets or resource endowments) and how they endeavour to convert these into positive livelihood outcomes (DFID 1999). The approach is founded on a balance of assets required in order to achieve a positive livelihood outcome. This can be constructed as a pentagon (Figure 3.5a) in order to present information about the diversity of assets that may be combined in order to construct a livelihood. The shape of the pentagon (Figure 3.5b) may then be used schematically to show the variation in

Table 3.2: Capital assets in the Sustainable Rural Livelihoods Framework, with a particular emphasis on areas prone to land degradation*

Natural capital	"The natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived." Included here are aspects of the natural environment such as soils, topography, water, and the livestock, crops, and other plants that together support livelihoods. In hilly areas, these stocks of natural resources may be quite vulnerable – e.g. deforestation and loss in biodiversity; land clearance and erosion.
Human capital	"The skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve livelihood objectives." Innate and learned skills in hilly areas include physical fitness and ability to carry heavy loads on steep slopes.
Physical capital	"The basic infrastructure and producer goods needed to support livelihoods." Infrastructure includes accessible transport, secure shelter and buildings, adequate water supply and sanitation, affordable energy, and access to communications. Producer goods include tools and equipment to enable people to exploit the natural capital. Hilly areas are usually always deficient in physical capital, except water.
Social capital	"The social resources upon which people draw in pursuit of their livelihoods." These social resources are developed through networks, membership of more formal groups, allegiances and relations of trust, reciprocity, and exchanges. Social capital is probably the key transforming and 'safety-net' capital for poor, mountain societies.
Financial capital	"The financial resources that people use to achieve their livelihood objectives". It comprises access to cash (including remittances from migrants) or to credit, which enable the land user to make choices about investments in natural or human assets (e.g. building a terrace, or hiring labour).
* adapted from DFID (1999) by Stocking and Murnaghan (2000)	

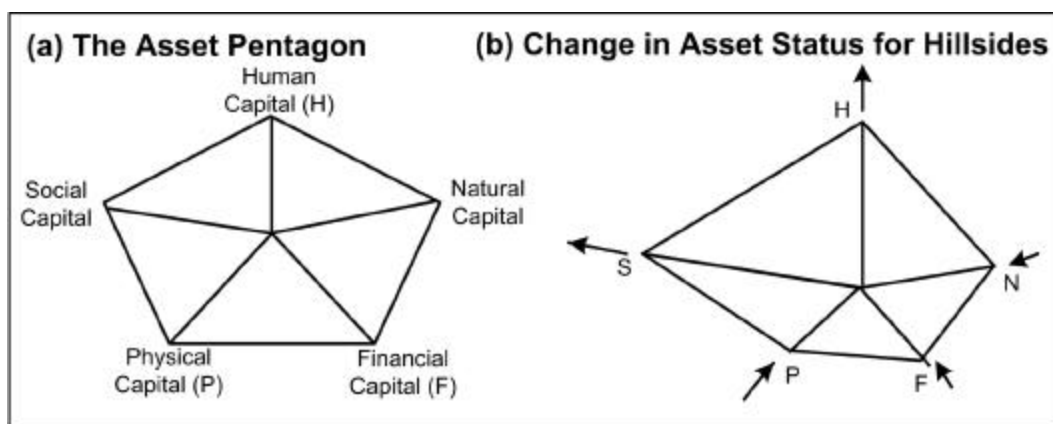


Figure 3.5: Capital assets pentagon (a) and a possible representation of dynamic change in hillside environments (b)

the combination of assets for any particular situation. The centre of the pentagon represents the situation of zero assets, while the outermost points are maximum access. In hillside environments (Figure 3.5b), social and human capital may be high (good social networks and available labour, for example), while physical and financial capital may be somewhat deficient (poor climate and growing season, and poverty). Pentagons such as these can be a useful focus for “debate about suitable entry points, how these will serve the needs of different social groups and likely trade-offs between different assets” (DFID 1999, Section 2.3). In other words, they encourage holistic thinking about the real-life building of a sustainable livelihood by using the resources at local people’s disposal. The SRL Framework and the pentagon are tools for assembling the relevant information and assigning it to useful categories. It is not a panacea for either full quantification of all factors or for solving intractable problems.

As the guidance notes at DFID (1999) describe, there are important relationships between assets categories that should be investigated before interventions are proposed. Assets combine in many complex ways. There is **substitution** between assets. For example, a lack of financial capital in mountains may well be compensated for by enhanced social capital. Understanding this may then encourage further development of these strengths in recognition that there may be little that could be immediately accomplished in the way of financial assistance. In the course of time, a reverse substitution may occur, as the communities become more financially secure through the exploitation of other assets (e.g. tourism). There is also **sequencing** between assets. An escape from poverty may need a recognisable sequence of use of other assets. So, the natural capital of hillsides could be identified as an entry point to overcoming the lack of financial capital. Then human capital in providing guides and social capital in knowledge could be brought into play to secure the ultimate goal of increase in financial capital or wealth status of the community.

Social capital has been described as a ‘resource of the last resort’, and is therefore of especial interest in understanding the transforming processes on hillsides and how

coping structures are built to deal with the hazardous environment (Grootaert 1998; Pretty and Ward 2001). It makes a particularly important contribution to people's sense of well-being through giving identity, honour, and a sense of belonging to a group. Social capital is at the heart of strong groups in civil society, and the formation of new organisations and institutions. It is a resource especially used by the poor and vulnerable, providing a buffer to cope with external shocks, an informal safety net for survival during periods of insecurity, and to compensate for a lack in other types of capital (DFID 1999). Social capital is important because social networks, mutual trust, and reciprocity lower the costs of working together. By working together, social groups improve efficiency in their economic relations (economic capital), enable more effective exploitation and management of natural resources (natural capital), and allow the sharing of infrastructure and services (physical capital). Social networks facilitate innovation, the development of knowledge, and the sharing of this knowledge. Of all the 'capitals', it holds the key to the distinctiveness of mountain societies, their colourful nature, and their ability to endure hardships. When it is under threat or breaks down, perhaps because of political instability, social capital may decline rapidly or be driven underground, thereby excluding the more vulnerable groups.

Sustainable Rural Livelihoods Framework

The Capital Assets pentagon (Figure 3.5) is a useful means of organising the many types and pieces of information that relate to building livelihoods; the land user, the production system, local society, and changes to the biophysical environment. However, the important dynamic and transforming processes in rural environments cannot be displayed. That is why the Sustainable Rural Livelihoods Advisory Group at DFID developed the SRL Framework (Figure 3.6).

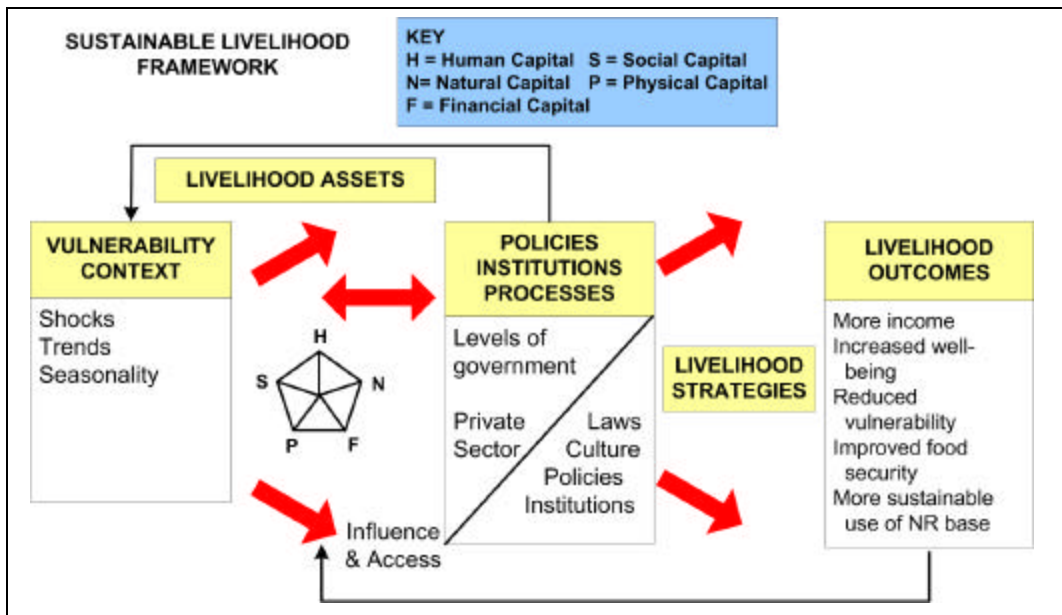


Figure 3.6: The sustainable rural livelihoods framework (source: DFID 1999)

The framework is a versatile tool to improve our understanding of the livelihoods of the poor, and to see how transforming processes and structures lead to livelihood strategies and eventually to outcomes. These outcomes then feed back to the assets. Stocking and Murnaghan (2001) give worked examples of the application of the capital assets pentagon in the context of land degradation, a common phenomenon of hilly areas, and how changes in assets affect this issue of global concern. The SRL Framework itself is now common in many publications from the leading development agencies, and examples can be found of its application for poor and vulnerable people (Bebbington 1999), food insecurity (Sutherland et al. 1999), and for developing countries generally (Ellis 2000).

As a tool for use in planning and management of ways in which assistance may be offered to poor people, the primary considerations taken into account by the framework are all part of the process of understanding the dynamics of rural society:

- vulnerability**, or the danger of asset destruction through external shocks;
- transforming structures and processes**, or the way people create assets and determine their access to them;
- livelihood strategies**, or the way people may switch between assets and the options they have;
- livelihood outcomes**, or the minimum needs for securing an acceptable livelihood.

The framework is not a new 'miracle solution' to age-old problems. Its proponents see it as a way of thinking about livelihoods that helps us order complexity, making clear the many factors that affect how people build a sustainable living. It enables the development analyst to see how changes in one part of the livelihood system, induced by policies or aid interventions, may affect the livelihood outcomes from the use of all resource endowments. As such, it is a platform for rural development and a major initiative in the fight to eliminate poverty in difficult areas such as mountains.

Highlights from NRSP-HSPS Research on Building Sustainable Livelihoods

As the main output of NRSP-HSPS is "Improved hillside farming strategies relevant to the needs of marginal farmers developed and promoted" (Table 3.1), research has identified a number of key findings that are summarised here (Table 3.3). Other chapters in this book elaborate on these and other findings.

Project R6621 (project details are given in Table 3.3) comes from the early phase of NRSP in which technologies and their development were more prominent. It developed from a project in Honduras in the early 1990s that discovered that traditional soil conservation methods such as terracing are well known and are successfully used, but their construction costs can be prohibitive. Therefore, in the challenging semi-arid hillsides of the inter-Andean valleys of Bolivia rising in altitude to 4000 metres near to Cochabamba and Santa Cruz, the researchers of R6621 worked on live barriers as a

Table 3.3: A selection of NRSP-HSPS findings

Project No.	Title	Key Finding
R6621	Soil and water technologies, Bolivia (1998-99)	Live barriers of more than 20 species of grasses and shrubs evaluated for their technical performance and livelihood potential
R7412	Incorporation of local knowledge into soil and water management interventions which minimise nutrient losses in the middle hills, Nepal (2001-2)	Farmers can see for themselves that they can be researchers, developing innovative solutions for soil and water management. Farmers are more impressed when they hear directly of experiences from other farmers and see them in practice. Involving the farming community at all stages of research projects is necessary and provides essential feedback to researchers.
R7584	Community-led tools for enhancing production and conservation, Bolivia (2000-01)	Local professionals are the best way of reaching the poorest households and dealing with multiple problems of hillside communities
R7856	Strengthening social capital for improving policies and decision-making in natural resources management, Uganda (2002-3)	Identification of the presence of 'social capital' is an important way forward to elicit positive change. Social capital can be built through mutually beneficial collective action for managing natural resources. Village Policy Task Forces were especially successful in Uganda in leading development of bye-laws to encourage better NR management.
R7865	Scaling up strategies for research in natural resources management (Gündel et al., 2001)	NR research has had very few cases of validated scaling up: i.e. impact wider than the immediate target. Scaling up is the creation of sustained poverty alleviation and increasing local capacity for innovation at a larger scale. Research must be integrated within a wider pro-poor development process
Sources: Natural Resources Systems Programme, <i>Research Highlights</i> 1998-2003 [published annually] – available from NRSP office and website; Gündel et al. 2001		

technical innovation. Farmers in this area complained that their hillside plots, often less than 0.1 ha in size, were becoming unprofitable because of falling yields. The researchers reported that farmers were eager to try new techniques and to become involved in participatory research, a novel idea at that time. Over a dozen leguminous species were evaluated, with the best technical options being vetches, lupins, and broad beans. While the results were made available to more than 250 hillside farmers and they show possible avenues for further investigation, such as modelling, this technology-led approach to research has limited impact. NRSP changed its approach to a more central focus on livelihoods and scaling up the results of research.

R7412 started with the premise that farmers have always engaged in research. They test new ideas, crops, and techniques. It is unnecessary and possibly counterproductive for researchers to bring in outside technologies and expect farmers passively to validate the technical effectiveness in a new environment. Closer and more participatory engagement is an essential component of natural resources research that has any hope of yielding a sustained up-take. Working in the mid-hills of Nepal, where more than 12 million people subsist on hillsides with small terraced holdings, R7412 investigated the extent and performance of farmer knowledge in soil and water management. A major finding was that exploiting farmers' knowledge is a necessary but not a sufficient way to promote beneficial change. Research farmers were enthusiastic, but they acquired new knowledge from researchers in setting up experiments and analysing the results.

R7584 is an example of the change in focus of NRSP towards greater awareness of the role of human and social capital. The research site was Tarija in southern Bolivia, an extremely degraded area, at altitudes of between 2,000 and 4,000 metres, where farmers keep livestock and grow a range of rainfed crops under difficult conditions. Developing community interaction between local professionals and community groups proved successful in a number of key natural resource topics. For example, the local agriculturalist helped farming families to map their soil types and plan cropping strategies. Livestock diseases were controlled through enabling farmers to administer intra-muscular and sub-cutaneous injections. The grazing land and livestock were improved through farmer-led experimentation of new management techniques. The researchers monitored the interactions and drew lessons as to the best way to enable communities to identify problems and adapt to changing circumstances. They claim that the poorest are enabled to help themselves. This project led to follow-up activities in Bolivia, using local professionals working within municipalities and isolated communities.

R7856 focused on Uganda's hillsides where soil erosion and loss of soil fertility are perceived by farmers to be among the greatest problems (see Chapter 18). Researchers investigating ways to address the problems found that the presence of 'social capital' is a necessary pre-condition for resource-poor farmers to participate in policy formulation. Social capital improved willingness not only to be involved in research but also to adopt innovations in natural resource management. The researchers hypothesised that by helping to build social capital, even the poorest could be helped. The '2002-2003 NRSP Research Highlights' (p.5) describes the case of one village, Habugarama, rich in complex social capital, where at least 12 local groups and organisations are active; these range from labour parties, savings groups, pig rearing, and swamp association, to 'Determined Women,' and drumming and singing groups. The researchers engaged with this social capital to build a capacity to develop, implement, and enforce local policies. Bye-laws in particular were targeted as one of the best means of supporting local natural resources management. Policy Task Forces at the village level have proved to be effective as a means for community groups to implement and develop new bye-laws. A useful finding is that in this process, officials at sub-county level become more embedded in local social relations and can be put under pressure to perform for the community and be responsible to it.

R7865 investigated the conditions necessary for scaling up of the application of new knowledge to natural resources management. Scaling up means to spread the benefits of a project more widely to more people and communities, and to expand findings institutionally to other sectors, stakeholders, donors, and the many agencies involved in development interventions. Natural resources research to date has taken a far too narrow view of scaling up in seeing the challenge simply as improving the ways to get technologies out to target groups. Scaling up, the R7856 researchers argued, is about creating sustained poverty alleviation and increasing capacity for innovation. There are no simple rules to achieve this. However, the potential pathways would include understanding institutional processes and a more integrated focus on geographical and

quantitative dimensions of project design and implementation. Eight elements of good practice for maximising scaling-up were identified as having a direct bearing on success in scaling up (Gündel et al. 2001). They range from identifying the target groups carefully to building networks and partnerships. Scaling up can and should be built into project design. These findings are not limited to hillside environments. However, they have significant application in projects where researchers can only work with a small target group and within restricted geographical areas.

Conclusions

People build livelihoods on hillsides, despite the fact that they live 'at the margin', spatially, socially, economically, and environmentally. It might be expected that the worst land degradation and mismanagement of the landscape would occur in such areas; that terrace systems and other human endeavours would be transient and poor; that societies would be impoverished in every sense. The evidence, however, is quite the reverse. There is a wealth of innovation, creation, and knowledge in hillsides areas, indicating that substitutions happen between aspects that are truly limiting, such as growing season and soil depth, to aspects that have good potential, such as social networks and human expertise. The Sustainable Rural Livelihoods Framework provides a good analytical tool to understand the various resource endowments or capital assets that people use to survive and endure. Social capital is especially important.

There are essential lessons arising from an understanding of how hillsides societies cope with a difficult biophysical environment. DFID's Natural Resources Systems Programme and its Hillsides Production System portfolio has made a major contribution to understanding livelihoods and the better management of renewable natural resources of poor rural households on hillsides. Capital substitution and building livelihoods out of meagre natural resources by concentrating on social aspects are ways in which sustainable livelihoods are fashioned. These understandings should lead the international community to draw positive lessons and outcomes from such an analysis, and use it to design targeted interventions, not only for hillsides but also for other poor rural situations.

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