

Nondegrading Land Use Strategies for Tropical Hillside

by Lee Ann Jackson and Sara Scherr

By 2020, current food production methods will be unable to meet the food demands of the growing world population. As high-productivity lands become more scarce and food demand increases, people will increase the cultivation of lands that were once considered too fragile for intensive use. Large populations will depend on hillside agricultural production for their livelihoods. Although sloping lands are sensitive to erosion, nondegrading land uses do exist. These alternative uses support local economic development while protecting watershed stability. To prepare for 2020, policies must evolve that address the needs of hillside inhabitants while promoting land use systems that are appropriate to the physical and economic conditions of these areas.

Hillside Characteristics

An estimated 500 million people, 10 percent of the world's population, already live on tropical hillsides. Conservative estimates predicting a world population of almost 8 billion in 2020 suggest that tropical upland watershed populations could increase by as many as 60 million people. The impact of this population increase on food production and the environment will depend on current environmental and economic conditions and the rate at which population increases.

Today, production systems in tropical hillsides vary widely. Conditions range from highly fertile volcanic hillside soils that support intensive cash crop plantations, like those in East Africa, to sensitive hilly areas that have been set aside as biodiversity reserves to preserve unique habitats, as in Madagascar. This brief focuses on issues related to tropical hillside areas with conditions that fall between these two extremes--the hilly areas in Southeast Asia and Central America, for example. Because of migration from surrounding areas, these types of hillsides are particularly likely to experience population increases and land use transitions over the next 25 years.

Combinations of physical, economic, and social characteristics distinguish tropical hillsides from flatter landscapes and influence land management strategies. The addition of slope to the landscape affects other land characteristics, such as altitude, shadiness, and soil conditions. These conditions can vary dramatically within small hillside areas, creating niches with differing productive potential. These characteristics require complex land use systems to control soil and water movement.

The sloping nature of the landscape also influences the economy of these hillside areas. Market access is often limited because it costs too much to develop and maintain infrastructure where slopes are steep and topography undulates. Lack of market access, in turn, influences whether land users are inclined to practice land conservation and may constrain their ability to use the land sustainably.

Limited investment in these areas has led to poor social conditions. Public policies have ignored and in many cases directly interfered with populations' efforts to use hilly land for productive purposes. Hillside people suffer from high rates of poverty, infant mortality, and malnutrition and from low levels of education.

Hillside Land Use Systems

Governments have often tried to limit agricultural use in these areas, but attempts to exclude users have often failed. Because property rights have not been enforced, land is perceived to be open to anyone. According to the Food and Agriculture Organization of the United Nations, hilly and mountainous areas are experiencing 1.1 percent annual deforestation, almost twice the rate of deforestation in lowland rainforest areas. Migrants, attracted from the surrounding areas by the lure of available land, move to the hillsides in search of better economic opportunities. These people are unlikely to bring with them knowledge of the types of production systems that are suited to the conditions of these areas.

With increasing population density and policies that create incentives for overuse, potentially degrading practices are replacing historically sustainable systems. For example, as fallow periods in shifting cultivation shorten, soils have less chance to recover their productive potential. These changes in land use are likely to continue due to the momentum of natural population growth and the need for more land to produce food to supply growing populations.

In the past, concern over the effects of deforestation uphill and of erosion and sedimentation on watershed stability downhill have dominated policy discussion. Policymakers have argued that marginal hillsides are unsuitable for intensive cultivation, due to their slope, lower potential for crop productivity, and physical remoteness. Recent research shows, however, that these lands can support a variety of potentially benign land uses that protect the watershed functions of the landscape. If population density and economic conditions in these areas create incentives to manage soil and water movement within production systems, both intensive and extensive systems can provide adequate erosion control. By protecting soils, encouraging diversity within the landscape, managing water movement, and avoiding extremely sensitive areas, land users can control degrading forces and encourage watershed stability.

Many production activities exist for hilly areas covering a wide range of intensities (Table 1). As land use intensity increases, so does the use of inputs such as chemicals, labor, capital, and soil amendments. For example, multiple cropping with hedgerows, a land use in which perennial plants grow in association with annual or perennial crops along contour lines of hills, requires more inputs than taungya, in which food crops are grown in rotation with commercial timber trees.

Table 1--Examples of land use options for hillsides listed in order of increasing intensity

Intensity	Option
Lower	Natural forest Long fallow shifting cultivation <i>Taungya</i> (food crop-timber tree rotation) Perennial field crops Annual cropping with tree intercrops
Higher	Multiple cropping with hedgerows Intensive gardening

The land use intensity chosen depends on the willingness and ability of land users to invest in land improvements. Investments may take various forms such as terracing, tree planting, soil building, and enrichment. In hillside areas where seasonal outmigration plays a large role in the yearly production cycle, farmers will be unable to tend their land throughout the year, and their production systems will have to thrive without constant inputs. Where farmers can work the land throughout the year, they may need to apply more inputs to replace nutrients and organic matter.

Policies to Address Current and Future Needs

Policies that have been developed for flatter, less diverse landscapes or for more fertile, economically integrated sloping lands probably cannot be transferred to less productive sloping lands. Both ecological variation and expected transitions in population density will affect the types of policies needed to ensure sustainable land use. The unique characteristics and needs of these hillsides require new types of land use, technology, and research policies.

Land use policies and regulations should avoid promoting inflexible and unvaried land use activities as solutions to multifaceted land use problems. Hillside farmers who are intimately familiar with the diverse conditions of their land will have informed opinions about how to maintain productivity. Policies and regulations should support farmers in the development of creative solutions to their land use problems.

Land use options must be compatible with social and economic conditions such as population density and market access. Although not all sloping areas will be intensively cultivated, policymakers should craft development strategies to encourage intensive production systems in sloping areas with high and growing population densities and limited emigration options. In heavily populated areas, governments can relax the requirement that sloping lands remain in forest, while requiring that land use effectively protect watershed functions.

To encourage the necessary investment in land improvements and maintenance, governments should recognize legitimate alternatives and identify opportunities to enhance the profitability of land improvements. Loosening policy-induced constraints, such as the limitations on harvesting trees (even those planted by the farmer), may achieve this goal. Making it legal to farm in restricted areas may allow farmers to receive extension and credit services from public, private, and nongovernmental organization (NGO) sources.

Because lands on hillsides are inextricably linked physically and economically to lands downslope, policies must consider regional and off-farm effects of particular land uses. Local institutions can help to coordinate land use management efforts and to identify regional land degradation problems. National or international agencies may need to be involved when the environmental impacts of land use in upland areas cross national borders.

Technology policy must also evolve to address hillside needs. Extension services must disseminate technical information on new and modified agricultural practices that support the hillside land use principles. Varietal mixes for different planting dates and intercrops might be promoted to ensure soil cover for longer periods.

Techniques to decrease production, marketing, and information exchange costs can help increase the local value of crops and make farming more profitable. Changes in production and processing technology for perennial crops or systems can reduce the time lag before income or products begin to flow. Modifications in land management practices can also alter the pattern of labor use to better utilize peak-period labor and take advantage of periods of slack labor demand.

Where socioeconomic conditions create incentives for intensification, policies can encourage land-improving investments. For example, establishing on-farm demonstrations with representative farmers and providing short-term subsidies for the early innovators can encourage land investment. Where institutional or credit constraints hinder intensification, institutional change or support for informal group credit arrangements may be useful.

Agricultural research policy should focus on the distinctive economic and technical needs of these areas. Research on compatible mixes of agriculture and forests will highlight the benefits and

trade-offs of various combinations of land use practices. Low-cost alternatives such as mulches and cover crops that maintain organic matter and soil cover need to be identified and validated. Far more research should focus on the perennial components of land use, to improve their economic value as principal or interstitial components of land cover. New or improved woody perennials that produce products such as starches or oils could provide both income and food. Low-cost management of natural vegetation for productive and protective purposes also deserves research attention.

Local innovation will play an important role in hillside research, since conditions are too diverse for scientists to be able to cover the wide range of ecological conditions. Scientists should explore innovative institutional arrangements for partnership between researchers, local change agents, and local resource users. Agricultural research policy for hillside areas may need reevaluation to direct more research funds toward land management, especially for countries with a relatively high proportion of hillside area or large hillside populations.

A variety of *nonagricultural policies* exist that could also support hillside land husbandry while addressing the welfare needs of hillside inhabitants. Nonagricultural income generation and provision of basic infrastructure and public services in the hillsides could encourage resource conservation and investment rather than resource "mining" strategies. These policies would complement the results of the types of policies listed in this brief, which are more specifically focused on agricultural production and land use.

To support the sustainable use of hillsides, policies must be compatible with population distribution, economic incentives, and physical conditions. With supportive policies, direct improvements in production, reduced environmental degradation (downslope and downstream), and improved welfare conditions will provide needed economic and social benefits to these often neglected areas.

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"A 2020 Vision for Food, Agriculture, and the Environment" is an initiative of the International Food Policy Research Institute (IFPRI) to develop a shared vision and consensus for action on how to meet future world food needs while reducing poverty and protecting the environment. Through the 2020 Vision initiative, IFPRI is bringing together divergent schools of thought on these issues, generating research, and identifying recommendations. The *2020 Briefs* present information on various aspects of the issues.