Developing Sustainable Mountain Agriculture in the Hindu Kush-Himalayan Region

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Introduction

Agriculture is the most important sector in the HKH region. About 60% to 90% of the population is engaged in various agricultural activities, including crop production, animal husbandry, forestry, and horticulture. During recent years, mountain agriculture in most HKH areas has been showing trends of increasing unsustainability due to increased population pressure; declining agricultural productivity; and declining soil, water, and forest resources. The basic issue facing mountain agriculture is low productivity of land, which is responsible for widespread poverty in the region. Thus, to reduce poverty, it is essential that the productivity of the mountain agriculture be increased on a sustainable basis.

This paper will discuss recent developments in soil and water conservation technologies as a key to the successful development of agriculture in the HKH region. The paper will also examine some important developments in institutional innovation that emphasise the prospective role of farmer-led knowledge sharing organisations.

Need for Investment in Mountain Agriculture

Mountain agriculture in the HKH is characterised by low productivity, which is attributed to many factors. The more important factors are: (i) soil erosion due to farming on steep slopes, (ii) shortage of water for crop growth, (iii) inadequate access to appropriate technologies, (iv) lack of marketing facilities, (v) inadequate credit, (vi) weak community organisations, (vii) small landholdings, and (vii) increasing population pressure.

To improve incomes and the sustainability of mountain agriculture in the HKH, there should be investments to improve agricultural productivity and environmental protection. These investments should also improve the management of watersheds[1] in the HKH region, since these watersheds play a critical role in the regulation of water flow in the lowlands of Bangladesh, China, India, Myanmar, Nepal, and Pakistan to reduce flooding and to provide water for irrigation and power generation; prevention of soil loss to protect power generation reservoirs and irrigation structures; conservation of biodiversity and protection of natural ecosystems; and sequestering carbon to alleviate the threat of global warming (Garrity and Agus 2000). In the past, the development of mountain agriculture in the HKH has been neglected as governments and funding agencies have focused their investments in the more accessible and productive lowland areas. However, recently there has been a shift in the development strategy of governments and funding agencies to focus on poverty reduction in the areas where the poor are concentrated.

[1] Here defined as the land area drained by a common river system

The renewed interest by funding agencies and governments in investing in poverty reduction programmes will provide an opportunity for the development of the HKH region, which is characterised by poor physical and social infrastructure. Poverty has been shown to be the root cause of a natural resource degradation that could have serious consequences on food security in the HKH region (Scherr 1999). Investment in poverty reduction programmes in the HKH region is imperative, as it will bring not only the benefit of income improvement but also environmental benefit both to local areas and to those in the neighbouring lowland. However, there is a need to identify and formulate suitable projects that have good prospects for improving the incomes of the people in the region.

Importance of Soil and Water Conservation

Many households in the HKH region are forced to grow food crops on steep slopes because of lack of alternative opportunities. But continuous crop production on steep slopes causes annual rates of soil loss that can exceed 100 tonnes per ha (Partap and Watson 1994; Sajjapongse and Syers 1995). The soil erosion problem is exacerbated by the widespread deforestation in watershed areas. Consequently, Asia has the worst soil erosion problems in the world. The combined effects of soil erosion and deforestation in the HKH region have resulted not only in reducing crop productivity, but also in flooding and destruction of road, irrigation, and hydropower facilities in lowland areas. Thus, soil and water conservation is the key to achieving sustainable agriculture in the HKH region.

Promising soil and water conservation technologies

- To address the problems in the HKH region, a soil and water conservation technique that can reduce soil erosion and conserve the valuable water resources is required. Conservation measures available to smallholders include bench terraces, planting of fruit trees and timber or pulp tree species, minimum tillage and mulching, grass strip cropping, sloping agricultural land technology (SALT), and natural vegetative strips (NVS). Among these techniques, SALT and NVS are probably the most promising techniques for the HKH region, since the others have serious constraints.
- SALT is a form of agroforestry for managing sloping lands using hedgerows. It is technically a simple system of growing food and cash crops in between rows of fast growing, multipurpose, nitrogen-fixing trees and shrubs planted along contour lines, and managed in the shape of double hedgerows at regular intervals of 3-6m depending on the gradient of the slope. The hedgerows are key elements of the entire system, since they act as erosion barriers; stabilise the slopes by facilitating the formation of natural terraces; increase soil fertility; conserve water; and become the source of animal fodder, fuelwood, and most importantly, mulching biomass. The main drawback of SALT, however, is that it is too labour-intensive to attract farmers' sustained interest. In addition, seeds of multipurpose, nitrogen-fixing trees and shrubs for the establishment of hedgerows are not readily available in some localities, and even if available, are not easily multiplied. Therefore, the adoption rate of SALT in Asia has been poor.
- The NVS techniques are contour strips that are installed simply by laying contour lines across a field, and then allowing natural vegetation to grow in a strip along these contour lines. They have proven to be exceptionally effective in soil and water

conservation, often virtually eliminating soil loss from a field 1-2 years after installation, even on slopes of 30-40%. Because they are composed of regenerating perennial grasses native to the area, they are robust and stable, needing only minimal maintenance over the years. They generally do not grow as vigorously as exotic forage grasses, but this ensures that they do not compete so vigorously with the farmers' more valuable annual and perennial crops, which is often a problem with forage grasses in contour strips. The unique quality of NVS is that they provide a contour buffer strip solution so simple that it is suitable for farmers who have no cash and very little labour to spare. The main drawbacks of NVS are that they do not improve soil fertility, do not reduce soil water evaporation, and do not provide animal fodder or fuelwood to farmers.

Transition from Food Crop System to Agroforests

In many parts of Asia, including the HKH region, sloping lands are not suitable for annual food and cash crops because the soils are fragile and infertile, but they have a strong comparative advantage for agroforestry[2] (Garrity 1999). In many Asian countries, a previously non-existent market for farm-grown timber has evolved, with farm-gate prices many times higher than previously. Many upland farmers can now earn money by planting timber trees on their farms. Generally, trees are planted along the borders of their fields, along the contours, or in their fields as intercrops with food crops.

Many farmers who have adopted SALT and NVS tend to see them as a foundation for further development of a more diverse and complex agroforestry system. In their farms they plant fruit trees or timber trees along the contour to take advantage of the deep, fertile topsoil that accumulates just above the contour lines. Nevertheless, they continue producing annual crops, often moving toward higher value crops or employing more intensive management on their food crops.

Farmer-developed agroforests already cover more than 1,000,000 ha in Bangladesh, India, Indonesia, Philippines, Sri Lanka, Thailand, and Vietnam. Villagers have created many types of complex agroforest land use systems. These agroforests are predominantly based on fruit trees, timber trees, or perennial crops (e.g., coffee, rubber, tea, coconut, and cocoa). The trees provide food, cash income, fuelwood, and livestock feed. Agroforests play a major role in regional economic development by supplying local agro-industries and providing inputs to marketing chains that branch out far beyond the rural areas.

In addition, agroforests protect watersheds from soil erosion and flooding risks, conserve a greater amount of biodiversity, and provide a greater sustained source of income for local communities than other forms of annual crop systems or tree monocultures.

If such agroforestry systems can be developed in the HKH region, they could also play a major role in its economic development, which can have a significant impact on poverty

[2] Agroforestry is defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees in farm and rangeland, diversifies and sustains smallholder production for increased social, economic and environmental benefits.

reduction and environmental protection. However, agroforests are successful only when they meet smallholders' income needs (De Foresta and Michon 1997). Such a system is usually composed of two sets of commercial tree species suited to local conditions; one set providing regular cash income and the other providing seasonal or irregular cash income. This composition ensures economic and ecological viability of the forest in the long run, provided that clear tenure rights on the basic units are recognised.

Farmer-led Organisations for Sustainable Agriculture

Many specialists in forestry and agroforestry now believe that in Asia the farmer will be the forester of the future. That is, small farmers will be producing timber for local and national markets, and the denuded upland landscapes will gradually be reforested. The question is how we enhance this process in the HKH region in terms of investment to ensure farm households' access to adequate agricultural extension, farm credit, good tree germplasm, better systems of agroforestry, and better market infrastructure.

Farmers in mountain areas will continue to grow food crops to meet their basic needs, but they can grow these crops in association with tree crops to optimise their incomes and protect their environment. Small farmers can engage in farming and management of agroforestry in both a productive and resource-conserving manner provided the agroforestry specialists give them adequate extension services. Awareness of this has focused attention on evolving demand-driven, community-based approaches to watershed resource management, in which those who occupy the land actively participate in management and sustainable utilisation of their local watershed resources for multiple purposes. Ultimately, only the land users can solve the problem of land degradation.

Much attention has now been given to the role of local organisations in the management of natural resources (e.g., forest, water, and soil). Among the organisational models for enhancing local initiatives in attacking land degradation challenges, one of particular interest is called 'Landcare', which was initiated by farmers in Australia. Through this movement, local communities organise to tackle their agricultural problems in partnership with public sector institutions. The experiences of 4,500 groups in Australia and 200 in the Philippines suggest that such an approach may provide a means to more effectively share and generate technical information, spread new practices, enhance research, and foster farm and watershed planning processes (Garrity 1999).

Farmer-driven approaches show promise of being more effective and less expensive than current transfer-of-technology approaches. Institutions like Landcare could revolutionise extension systems. Conservation farming based on NVS technology was one practice that was popularised in the southern Philippines through Landcare. Another has been the expansion of nurseries for growing new species of fruit and timber trees to diversify the farm enterprise. As a result of Landcare activities, hundreds of household nurseries have been established by the membership using their own resources, without outside financial support. A similar approach should be developed in the HKH region if the governments are keen to promote appropriate soil and water conservation and development of agroforestry among small farmers.

Environmental Transfer Payments

Farmers in the HKH region have a crucial role to play as stewards of biodiversity and watershed services. It is becoming evident that investment in upland development, including mountain development, may also have positive benefits for the world environment, since improvement in the management of watersheds in the HKH region will impact people and infrastructure in the lowland areas of several countries. There is, therefore, opportunity for society to support this through environmental transfer payments. Among a number of areas where environmental transfer payments may help alleviate key global and national environmental problems, one particular area is the planting of trees for carbon sequestration to reduce the amount of carbon dioxide in the atmosphere, which will reduce the threat of global warming.

Conclusion

The poverty problem in the HKH could be resolved through investment in effective soil and water conservation measures, which in turn will increase agricultural productivity and the incomes of the farmers. This investment should be supported not only by farmers in the mountain areas but also by people in lowland areas through environmental transfer payments. Two promising soil and water conservation techniques are sloping agricultural land technology and natural vegetative strips technology. The adoption of SALT and NVS will facilitate the development of a more diverse and complex agroforestry system, which will make agricultural systems more profitable and sustainable. To enhance the process of conversion of food crop systems to agroforestry systems, farmers must be empowered to manage their natural resources through the establishment of demand-driven, community-based organisations such as Landcare in Australia and the Philippines.

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