People's Participation in Mountainous Agroforestry Systems in Asia:
Toward community-based landscape approaches

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Paper prepared for:
International Symposium on Highland Ecosystem Management
Royal Angkhang Agricultural Station, Chiangmai, THAILAND, 26-31 May 1998

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Abstract

Agroforestry systems have evolved over centuries through farmer experimentation and changing conditions. Today, agroforestry is an integral component of community forestry, watershed management and natural resource management efforts in mountainous areas throughout Asia. People's participation is the key to sustainability of mountainous agroforestry systems. An emerging trend in agroforestry research and development is the evolution toward community-based landscape approaches. Such approaches underpin the potential contributions of agroforestry to watershed management as well as to sustainable development for households and communities. In mountainous areas, agroforestry is increasingly adopted by farmers because of the crucial role of biomass derived from perennials as well as the changing patterns of availability and access to tree products.

Asian watersheds are in rapid decline, and heading for an impending crisis. The rates of sediment deposition in the oceans are much higher in Asia than anywhere else in the world. Most of the nearly 130 million people who live in upper watershed areas throughout Asia face poverty and other daunting constraints. In the past 50 years, most watershed management programs and projects have been failures, owing to top-down, technology-first approaches used in government and donor interventions. Lessons learned have pointed the way to new approaches that emphasize better land husbandry practices and active people's participation.

Successful watershed management must be built on two pillars: 1) sound, practical, suitable technical innovation, and 2) participatory institutional innovation. Agroforestry has a role in both. Conservation-oriented farming in the uplands is gaining recognition. Two key strategies are emerging. First is the adoption of a problem-solving approach; second is the promotion of a suite of agroforestry-based practices appropriate for upland farming systems. Suitable agroforestry practices can provide the service functions of watersheds, which are of greatest concern to outside stakeholders, as well as the productivity functions that are of most urgent concern to local people living in the watersheds.

The SANREM project in the Manupali watershed in Mindanao, Philippines and the Sam Mun Highland Development Project in northern Thailand are excellent case studies of community-based approaches where agroforestry is integrated into successful watershed management at the landscape level.

Agroforestry: An option for mountain development in Asia?

Agroforestry is the deliberate growth and management of trees along with agricultural crops and/or livestock in systems that are ecologically, socially and economically sustainable. More simply: *Agroforestry is the use of trees in farming systems.*

Agroforestry is often integrated into community forestry, whereby rural people manage forest and tree resources for their own benefit. Increasingly, agroforestry is linked with watershed management and landscape-level interventions. As we examine the theme of people's participation in mountainous agroforestry systems in Asia, the most exciting trend may well be the *evolution toward community-based landscape approaches* in the mountains, highlands and uplands throughout the region.

Agroforestry in the context of mountain development

A study on agroforestry in mountainous areas of the Hindu Kush-Himalayan region (Denholm, 1991) identified two key factors affecting the evolution and adoption of agroforestry by farmers:

- The crucial role of *biomass derived from perennials*—both in farming systems and in the subsistence strategies of hill farmers.
- The *changing patterns of availability and access to tree products* as a result of increasing use pressures on common property resources.

In Asia's most extensive and dominant mountain range, many agroforestry systems can be compatible with farmers' resource management and production strategies focusing on biomass supplies and services. However, population growth, market forces and public interventions have creates new stresses on the fragile mountain ecosystems and watersheds.

Mountain specificities and imperatives for agroforestry

Farmers in mountain areas face a unique set of constraints and opportunities: physical isolation, distance, transportation difficulties, climatic and environmental hazards, limited production, and diverse agroecological conditions (Denholm, 1991). These factors may be grouped under the six categories of "mountain specificities" developed by Jodha (1990): *inaccessibility, fragility, marginality, diversity, niche/comparative advantage, and human adaptation mechanisms.*

Agroforestry can relieve pressures on degraded common property resources by providing some of the production and service functions needed by farmers. At the same time, many agroforestry practices are suitable to the specific and unique characteristics of mountain areas cited above. These attributes make agroforestry an appropriate option for mountain areas, especially in the current context of land scarcity, conservation needs, and pressure for higher production (Denholm, 1990).

Agroforestry as an evolutionary process

Agroforestry systems have been evolving in Asia since indigenous peoples shifted from hunting and gathering to domestication and cultivation of plants for subsistence. Through trial-and-error methods over time, the pioneer agroforestry farmers learned how to utilize the natural environment, sustain productivity, and achieve year-round food security through mixing of annual and perennial crops under various spatial or temporal arrangements. These extensive agroforestry systems formed the basis of sustainable, albeit subsistence-level, livelihoods.

As population densities, land pressures and more intensive cultivation increased, many of the extensive agroforestry systems, exemplified by shifting cultivation, were severely affected by shortened fallow periods. This has led to serious loss of productivity as well as soil and watershed degradation. These negative trends need to be remedied. Otherwise, many Asian people will be further trapped and victimized in the vicious cycle of rural poverty and resource degradation (Koppelman *et al.*, 1996).

Agroforestry in tropical watershed management

The conventional view of agroforestry is that it is "the deliberate cultivation of woody perennials with agricultural crops on the same unit of land in some form of spatial mixture or sequence." This has led many people to see it merely as a set of distinct prescriptions for land use. This limits its ultimate potential. We now see agroforestry as the increasing integration of trees in land-use systems and conceive it as the evolution of a more mature agroecosystem of increasing ecological integrity. Leakey (1996) proposed that agroforestry be considered as a "dynamic, ecologically based, natural resource management system that, through the integration of trees in farm and range land, diversifies and sustains smallholder production for increased social, economic, and environmental benefits." This definition is currently being refined by ICRAF as a more holistic concept of agroforestry. It evokes the process of integrating the variety of current agroforestry practices into productive and sustainable landuse systems. Land use becomes progressively more complex, biodiverse, and ecologically and economically resilient. This new vision of agroforestry is transforming ICRAF's approach.

Sanchez (1995) noted that although agroforestry systems have been classified in a number of different ways, ultimately there are two functionally different types, *simultaneous systems* and *sequential systems*. Thomas (1996) showed that these may be further classified according to two sub-categories based on the land management unit: *field-based systems* at the household level, and *landscape-based systems* at the village or watershed level. Field-based sequential and simultaneous systems have received dominant attention. These are closely associated with the conventional perception of agroforestry as a suite of farming practices in which trees and crops interact in a field over space and time. Sequential field-based systems are exemplified by fallow rotation or shifting cultivation: crops and secondary (or managed) tree fallows occupy the field in a rotation sequence. Simultaneous systems are typified by alley cropping or complex associations of trees and crops managed in the same field at the same time, such as home gardens or agroforests.

The concept of *landscape-based agroforestry systems* is much less appreciated, but is most relevant to a discussion of the role of agroforestry at the watershed scale. In these

systems, the boundary of the management unit is drawn around a larger landscape unit than an individual field. The determination of an appropriate landscape unit will depend on local conditions, but it would generally extend to the lands in a sub-watershed, and directly influenced by whole villages or a group of villages (Thomas, 1996). Landscape-based agroforestry systems incorporate individual fields as components of a broader landscape management system. It moves beyond individual households to include management functions at a community level.

Strategic issues in Asian watershed management

As increasing populations expand into fragile mountainous areas in the tropical uplands, more watersheds are affected by severe soil erosion, declining soil productivity, and environmental degradation. Watershed degradation now poses a threat to the economies of many countries in Asia, and to the livelihoods of the ever-growing populations that depend on these resources. Unfortunately, past watershed management programs to arrest and reverse this trend have been largely ineffectual. But the lessons learned from these failures have been instrumental in promoting a major change in thinking with regard to watershed management (Douglas, 1996). The two key elements underlying this approach are

- *Better land husbandry practices*
- *Active people's participation*

Better land husbandry represents a shift in emphasis away from a fixation with soil conservation to a more holistic care of the land for sustained production. It follows recognition that, although there will be tradeoffs, the farmer's market objectives can be reconciled with society's watershed objectives. In this way, neither loses and both gain—a win-win situation. This affirms that the adoption of appropriate management practices that increase yields can likewise combat land degradation.

Emphasis on active people's participation in watershed management is a recent phenomenon in the tropics. It arose from the glaring pattern of failures observed in the past. 'Top down' methods used by the public sector to implement watershed management projects—in which the local people were passive recipients of external interventions and subsidies—led to countless failures. These failures have fostered more serious recognition that success depends upon enhancing rural people's inherent abilities to apply and adapt new and indigenous technologies, and to involve local institutions to manage and conserve resources.

Successful watershed management in the tropics is built on two pillars:

- *Sound, practical, suitable technical innovation*
- *Participatory institutional innovation*

Agroforestry has a key role in both. Although conventionally seen as merely a set of technical options applied at the field level, the concept and definition of agroforestry have expanded to the *landscape* level, providing a broader and more holistic vision. This section explores the role of agroforestry in watershed management and in mountainous areas from a *community-based landscape perspective.* The first part summarizes key information concerning watershed management in Asia, and some of the major issues emerging from past experience. The second part explores the role of agroforestry in Asian watersheds, particularly in the context of community landscape mosaics. The last part examines approaches in the Philippines and Thailand that are instructive case studies.

What has been learned about effective ways of promoting local management of natural resources in the Asian context? Early approaches to soil conservation were developed for large landholdings in temperate regions and were based on structural and engineering treatments (for example bench terracing). Attempts to apply these approaches to developing country agriculture, characterized by small holdings, diverse farming systems, extremes of climate and topography, wrenching poverty, weak government institutions, and very limited skills, have been disappointing (Magrath and Doolette, 1990).

Fortunately, alternative technical and institutional approaches are emerging. The concept of conservation-oriented farming in the uplands—in which farming systems and realistic farming practices combine to conserve soil and improve total production—is now recognized. Two complementary strategies for the development of conservation-oriented upland farming are evolving. The first is the adoption of a *problem-solving approach* aimed at identifying the key constraints on a site-specific basis. The second is the promotion of a *suite of agroforestry-based practices* that can form the basis of a comprehensive approach to farming system evolution in the uplands. Simple agroforestry practices include natural vegetative strip systems that provide a foundation for eventual conversion to tree-based systems. Complex agroforests, managed by smallholders, provide robust, sustainable income to farmers while conserving soil and water resources in ways that closely mimic natural forests.

Conventional approaches to watershed management have had little effect because they were dominated by top-down solutions to problems perceived by external stakeholders, not by the local people. External stakeholders, whether national governments or international entities, prescribed solutions that usually involved large-scale reforestation on lands managed by local communities or households. These interventions often ignored the food and income security objectives of local people. Time and again, past reforestation projects have been "passively" resisted through the destruction or neglect of the planted seedlings. Fire control is essential, and that can only be possible with active and self-interested support of local people. Recognition of reasonable and appropriate landuse rights is also fundamental to increasing local participation and "ownership" of reforestation initiatives.

Fifty years of disappointment has forced decision-makers to revisit their assumptions, and to wake up to the potential for collaborating with local farmers on solutions that can increase farm productivity as well as meet watershed protection objectives. This evokes a new era in which the smallholder is beginning to be seen as a critical part of the solution, not simply the scapegoat for the entire problem.

Asian watersheds: An impending crisis?

A watershed is defined as the land area drained by a common river system. In Asia, the land area located above 8% slope is operationally considered as watershed area. Land above 30% slope is considered upper watershed. Thus, the conventionally accepted watershed area of Asia is 900 million hectares or 53% of the landmass (Magrath and Doolette, 1990). About 65% of the region's rural population of 1.6 billion live in these watershed areas. The managers of these lands are smallholder farmers in rural villages. They are severely constrained by poverty, technological limitations and other factors. Therefore, as they seek more farm and grazing land to support their families, they have profound effects on the land and water resources of both the uplands and lowlands.

The population occupying the upper watershed areas in Asia, predominately located in the region's mountains, is roughly 128 million people (Magrath and Doolette, 1990). Increasing populations are accelerating pressure on scarce land and forest resources throughout the region. Approximately 19% of the region are under closed forest. Most of this remaining

closed forest is tropical rainforest, the reservoir of about 40% of the biodiversity on Earth. Degradation through overcutting and grazing is reducing productivity on much of the remaining forest stands (Doolette and Smyle, 1990). The forest cover is receding at a rate of about one percent per year. The most recent estimates suggest that the rate of deforestation is not slowing, but is accelerating. In much of the region, forest resources are integral to the agricultural system as sources of fodder and many other products.

The seriousness of soil erosion is not adequately known, but may be deduced from indirect evidence. The most striking picture is that presented by the rate of sediment passing into the oceans from the major river systems of the world. The global data highlights Asia as being in a class by itself, where rates of sediment deposition in the oceans are an order of magnitude higher than from comparable sized areas anywhere else in the world (Milliman and Meade, 1983). Human pressure on the resource base is by no means the only major driving force for these enormous rates of sediment detachment and deposition. Asian landscapes tend to be geologically young, and exceptionally steep. These factors are also important; but the densest populations in the world are transforming these watersheds at a tremendous rate, and exacerbating their degradation.

Asian nations are progressively opening their economies, and participation in global markets is accelerating. This is having profound changes on upland livelihood systems, and on the upland and mountainous environment. The economies of mainland Asia are interacting more vigorously than ever before, as borders open and roads and railroads facilitate cross-border trade. World market demand for key perennial tree products produced in insular Southeast Asia is spurring smallholder expansion of rubber, oil palm, tree resins, and various fruits, as well as on-farm timber production. These forces will continue to impact land-use change in complex ways well into the future.

Watershed degradation does not have to be an inevitable consequence of using land for agriculture or forestry. It is possible for smallholders to engage in farming and management of natural forest resources in both a productive and conservation-effective manner. Despite the availability of a wide range of options, most development projects have relied on a limited and generally high-cost set of interventions. The issue is the development of the technical capital in resource management, but to an even greater extent, it is the social capital to facilitate this process. It is now becoming clear that agricultural productivity in upland areas can be intensified in an environmentally sound and sustainable manner. But new approaches will have to be applied to make this a reality.

Service versus production in watersheds

Outside stakeholders—lowland populations, national government institutions, and the global community—tend to be most deeply concerned about the service functions of watersheds. The attention of national policymakers is naturally drawn to the concerns of the more affluent lowland populations and the impact of upstream-downstream linkages on these groups.

The key service functions of concern to outside stakeholders are to:

- *Regulate water flow* to the lowlands to reduce flooding, and provide a dependable water supply to the lower watershed for irrigation and power generation.
- *Prevent soil loss* to protect power generation reservoirs and irrigation structures.
- *Conserve biodiversity* and protect natural ecosystems.
- *Sequester carbon* to alleviate the threat of global warming.

To some extent, residents in the watersheds may also share concerns about service functions. However, local people are most urgently concerned about the productivity functions of watershed resources, and how to:

- *Sustain agricultural production*
- *Retain forest resources for local uses*: timber, fuel, grazing, non-timber products

Can there be practical solutions that can meet both needs? In many circumstances, it is possible to improve the environment and increase the output of goods and services at the same time. One of the major goals of agroforestry research and development in Southeast Asia is to reduce the tension between these two goals by developing a range of choices that are both 'service' and 'market' oriented (Thomas, 1996).

Economic losses from watershed degradation may be divided into on-site and off-site costs. On-site costs derive from the direct effects of degradation on the quality of the natural resources, expressed in terms of declining yields, reduced livestock carrying capacity, and decreased supply of forest products. Off-site costs result from the indirect effects of degradation on the service functions of the watershed.

The primary justification for watershed management is usually a reduction in off-site costs, particularly when the watershed is upstream from dams or flood-prone valleys or plains. However, it is generally unappreciated that the off-site costs may be of a much lower magnitude than the on-site costs. For example, in Java, Indonesia, annual estimated off-site costs were US$25.6-91.2 million, only a fraction of the on-site costs due to productivity losses—estimated at US$335 million per year. In practice it is the on-site costs that are the primary economic justification for undertaking a watershed management program. Any reduction in off-site costs should be seen as a secondary justification (Douglas, 1996).

Watershed management involves a range of activities. Each activity would be expected to contribute to the aims of improving the sustained productivity of the natural resources, protect designated natural ecosystems, and improving rainwater management to provide the quantity and quality of water to meet the different needs of water users within and downstream of the watershed.

The two brief case studies presented below—of the SANREM project in Mindanao, Philippines and the Sam Mun Highland Development Project in northern Thailand—highlight successful community-based landscape approaches to agroforestry and watershed management in highland areas.

SANREM: Taking a participatory landscape approach

Research will play an increasingly important role in providing options and insights for integrated conservation and development approaches. The Sustainable Agriculture and Natural Resources Management (SANREM) Collaborative Research Support Program is a global program that takes a *landscape approach* with a *strong participatory bias*.

At the SANREM research site in the Manupali watershed in Mindanao, Philippines, ICRAF is collaborating in a consortium of partners. The research team is composed of scientists and practitioners from institutions including ICRAF, NGOs, universities, the tribal community, and local and national government institutions. The objectives are to:

- Develop the elements of a practical social contract for buffer zone management.
- Develop improved agroforestry systems for the buffer zone.
- Assemble a natural resource management system for the Katanglad National Park.

We found that the natural resource management strategies of the indigenous Talaandig communities living on the boundary provide a strong foundation for park protection (Cairns, 1995). However, population increase and commercialized vegetable production are causing serious encroachment pressures. The buffer zone area surrounding the park (classified as national production forestland) has high agricultural settlement pressure and is now predominantly grassland and shifting cultivation. The emerging path for household farming systems intensification is small-scale vegetable production combined with timber and fruit tree production.

We have surveyed and mapped (Glynn, 1996) the perceptions of local farmers on the performance of current tree species by elevation in the watershed (200 m to 1800 m). On the basis of these results we have initiated trials with farmers across this entire transect of elevations to evaluate the most promising agroforestry species for the range of ecologies and farmer circumstances. We are also working with scores of farmers on conservation farming practices and tree nurseries to elucidate more effective methods of diffusing new practices that will sustain crop yields and increase tree cover.

The policy group is tackling the challenge of combining these technical innovations with stronger community-level resource management systems that will support measures to build a 'safety net' of active enforcement of the park's integrity. This entails assisting to develop and implement a *municipal-level natural resource management plan*, as well as a management plan for the national park and its buffer zone. The lessons of this approach will be scaled up through partnership with the Integrated Protected Areas Network in the Philippines. Only with *democratization* and *decentralization* of power can natural resource management at the local level succeed. Fortunately, this process is well underway in the Philippines. Local governments have begun to have the resources and authority to respond to local needs. In other parts of Asia, such devolution is farther down the road.

Sam Mun Highland Development Project: Applying the landscape-based agroforestry concept

In Thailand, forest destruction and watershed degradation are of particular concern in the northern highlands, which are the headwaters of all major tributaries of the country's major river artery, the Chao Phraya River. Hundreds of farming villages exist in the upper watersheds, which has spurred the Forest Department to attempt to reforest lands with timber plantations, to remove populations from protected areas, and to enforce regulations against farming there, resulting in conflict with the resident villagers. These efforts have had limited effect. A framework was necessary that recognized the legitimate rights of communities to reside in upper watersheds and that explored ways in which the service functions of the watershed could be maintained or enhanced while enabling the communities to pursue farming activities that were in reasonable harmony with these objectives.

ICRAF is working with numerous partners to develop landscape management systems in key watersheds. The concept is to move beyond individual households to include management functions at a community level (Thomas, 1996). The agroforestry system is a community watershed land-use mosaic that includes forest, tree and crop components interacting in numerous ways. The utility of the landscape-based agroforestry concept is illustrated by the experience of the Sam Mun Highland Development Project, funded by the United Nations Fund for Drug Control Program (Limchoowong and Oberhauser, 1996). This was a pioneering example of the development of a community watershed mosaic system that

is having major impact on the whole approach of the Thai government in managing upland watersheds.

In 1987, the Highland Social Forestry Pilot Project was initiated by social science researchers at Chiangmai University and RFD, with support from the Ford Foundation. The boundary was drawn around the perimeter of a small highland sub-catchment. A participatory landuse planning approach provided a mechanism for villagers and the Royal Forestry Department to jointly negotiate and implement a suitable solution.

Leaders of community and youth groups were trained to make three-dimensional models of the watershed. Based on aerial photos and topographic maps, the models were constructed at a scale of 1:5,000 (Limchoowong, 1993). This proved to be an effective participatory tool by which villagers could provide information about the landscape and current landuse patterns and conflicts. It also provided a common basis for the villagers and RFD to discuss potential solutions like landuse zoning.

Watershed committees were established that identified the problems and developed community-enforced land use rules in place of rigid government regulations. The landscape was categorized into a mosaic of areas for various types of land use, which may include appropriate simultaneous combinations of protected natural forest, managed natural forest, field-based agroforestry, boundary plantings, annual crops, rice paddies, and others (Thomas, 1996). Zones for field agroforestry and annual crops are managed by individual households, subject to necessary conditions imposed by the community. After realistic boundaries were established for protected forests, and the security of landuse rights was confirmed in areas designated for agriculture, the communities became active agents in forest protection.

The result has been dramatic improvement in the watershed environment. Forest cover has increased substantially and the area in annual cropping has decreased. The establishment of fruit tree gardens has diversified income sources while enhancing soil conservation. Inter-village relations are managed through a watershed management network, which is authorized by the local sub-district government.

Such a community watershed mosaic system is an agroforestry system at a larger scale. The landscape unit includes forests, tree and crop components interacting through on-site watershed functions, and fire and grazing management. It also includes the allocation of investments and benefits at household and community levels, as well as through nutrient concentration and cycling, weed and pest dynamics, and other biophysical factors that interact within and across field boundaries. Such a framework is conducive to the management of landuse rights at the community level that are conditional upon the maintenance of the landscape management system.

The Sam Mun experience demonstrated clearly that local communities can become enthusiastic partners with government to solve watershed management problems. The people are aware of the symptoms of their problems such as low crop yields, water shortage, flooding and landslides, health problems, increasing heroin use among the youth, and poverty in general. However, they are not always aware of the causes of those problems, or how they themselves can solve or ameliorate them. As people come to understand the real causal factors, they see more clearly how they can be part of the solution. When the problems are understood to be relevant to them, and the solutions are achievable and yield tangible benefits, the local people will participate fully (Limchoowong, 1993).

Mae Chaem watershed

The ICRAF Thailand team based at Chiangmai University (CMU) is adapting and testing some of the key elements of the Sam Mun approach in the Mae Chaem watershed, also

located in the highland zone (1,000-1,800 meters elevation). This work is being done in close collaboration with RFD, CMU, the Queen Sirikit forest development project, and CARE-Thailand. The research program aims at understanding:

1. Landuse dynamics and livelihood patterns in Mae Chaem and how they are changing.
2. Potential roles for improved agroforestry systems and their likely biophysical and socioeconomic impacts.
3. Policies that may facilitate or constrain agroforestry expansion and development.

With additional support from the Asian Development Bank for a regional policy project, ICRAF (1997) is now moving ahead with field research and other work to:

- Construct a spatial database of the entire Mae Chaem watershed.
- Survey sites for detailed field research on major current land-use systems and promising agroforestry improvements, nested within the watershed or at selected sites.
- Conduct additional studies on 1) policies related to land and tree tenure and community management of natural resources, 2) transportation infrastructure and germplasm distribution, and 3) effects of trade and macroeconomic policies on local land-use systems.

It is hoped that the approaches, findings and results of this work can be scaled-up to other watersheds in Thailand. This may be particularly appropriate on state-claimed lands where villagers have tenuous land-use rights and seek to gain recognition of their *de facto* occupation. However, a major challenge remains in sensitizing the bulk of personnel in the responsible government agencies if the lessons are to be applied on a wide scale in the upper watersheds throughout Thailand.

Conclusions

What will it take to turn things around on Asia's fast-degrading watersheds? How can poverty alleviation and sustainable resource management be simultaneously addressed by highland farmers in mountainous areas? Community-based watershed management and mountain development requires an integrated and multi-sectoral approach to sustainable development, but government departments are compartmentalized and geared for top-down operations. They will need to change.

Participatory approaches transfer principles rather than standard solutions, and make available a basket of choices rather than a set package of practices. Problem analysis must not simply be done by outsiders for the community, but must be done by the community itself with backstopping by the outsiders. The solution is not to transfer some known technology, but to assist farmers to adapt technologies to their own circumstances. This is predicated on the recognition that rural people, educated or not, have a much greater ability to analyze, plan, and implement their own development activities than was previously assumed by outsiders.

What can agroforestry contribute? As a highly integrative field on the interface between the agricultural, forestry, social, and environmental sciences, agroforestry will play a critical central role in helping to provide key technical and institutional innovations at the landscape scale. As a natural resource management system that involves the increasing integration of trees into the agricultural landscape, agroforestry will play a major role—holistically and comprehensively—in providing better livelihood options to farmers in mountainous areas, while conserving fragile watershed resources.

In this way, it is hoped that the tens of millions of people living in the mountains, highlands and uplands of Asia can truly participate in managing their natural resources and shaping their own destinies, as well as those of future generations.

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