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SUSTAINABLE AGRICULTURAL DEVELOPMENT: THE ROLE OF INTERNATIONAL COOPERATION

PROCEEDINGS
OF THE
TWENTY-FIRST
INTERNATIONAL CONFERENCE
OF AGRICULTURAL ECONOMISTS

Held at Tokyo, Japan
22–29 August 1991

Edited by
G.H. Peters, Agricultural Economics Unit, Queen Elizabeth House,
University of Oxford, England
and
B.F. Stanton, Cornell University, USA
Assisted by
G.J. Tyler
University of Oxford

INTERNATIONAL ASSOCIATION OF
AGRICULTURAL ECONOMISTS
QUEEN ELIZABETH HOUSE
UNIVERSITY OF OXFORD

1992

Dartmouth

R.P. YADAV*

*Sustainable Development Strategies in
Less Favoured and Marginal Production Areas**

INTRODUCTION

'Sustainable development' has become an integral part of the terminology of development jargon. It is still an elusive concept. The most profound definition of sustainable development is found in the Brundtland Report, 'Our Common Future', where it is defined as 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs'. It assumes three things: a long-term perspective, equity between generations, and dynamic phenomena. Sustainability with respect to intergenerational equity cannot be achieved as long as a glaring inequity in the distribution of resource endowments exists. At the global level, 'only one-fifth of the world's people live in the rich countries but are using up about four-fifths of the world's annual resource output' (Trainer, 1989). Similarly, at the national level, a small proportion of the population uses most of the resources, while the larger proportion of the population subsists on meagre resources. This widely-quoted conceptual definition of sustainability can be realized only if major steps are taken towards redistribution of resources both at global and at national levels. The current socio-political structure remains a major obstacle in the way of such a redistribution. Consequently, people in poor countries must often sacrifice long-term environmental stability for their short-term subsistence needs (Mellor, 1988).

On the more operational level, in the context of resource use, 'Sustainability is the ability of a system (e.g., the fragile resource – agriculture) to maintain a certain well-defined level of performance (output) over time, and, if required, to enhance the same, including through linkages with other systems, without damaging the long-term potential of the system' (Jodha, 1990). In other words, sustainability implies an increase in use intensity and higher productivity of land resources without permanently damaging such resources.

This paper is principally focused on issues related to sustainability in less favoured and marginal production areas, in general, in mountain regions in particular. The prospects of sustainability for agriculture in marginal areas are severely constrained by the specific features of their natural resource endowments. Sustainability was maintained in the past because of low pressure on

*Mountain Farming Systems Division of the International Centre for Integrated Mountain Development (ICIMOD), Nepal.

these resources through the application of traditional, land-extensive practices. Indigenous systems were oriented towards resource use with conservation without raising the use intensity and the productivity of the land. In most cases a sustainable balance was achieved between the needs of the mountain people for food, shelter, fuel and water, and the capacity of the natural environment to provide these. Unfortunately, continued population growth and market-induced demands have increased the pressure on land and other natural resources, and this has prompted greater resource use intensity, consequently leading to negative changes known as 'indicators of unsustainability' (Jodha, 1990).

Less favoured and marginal production areas generally have a fragile resource base. Areas which have a low potential for crop farming (mountain regions with steep slopes, deserts, rain-fed arid and semi-arid tropical areas with low and irregular rainfall, and coastal areas prone to salinity and water-logging) fall into this category. Such areas cannot tolerate the higher intensity of use associated with specialized usage and have higher input-output ratios than better land resources (Jodha, 1990).

The conditions of biophysical resources bases and their proper use, through technological and institutional measures, constitute the supply aspect of sustainability, whereas the management of population and of market-induced pressures on mountain resources constitute the demand aspect of sustainability. The efforts, on both the supply and the demand side, to reverse the unsustainability situation, or to avert unsustainability prospects, should constitute the essence of development strategies.

THE SUPPLY ASPECTS OF SUSTAINABILITY

The biophysical resource base

The long-term productivity of the natural resource base is determined by the inherent capacity of the resource and the pattern and method of its usage. Given its inherent characteristics, the natural resource base of marginal areas is limited in use. More intensive uses can be productively maintained for a short period with a high degree of artificial support (for example, subsidies in chemical, biological and physical forms) or by causing serious damage to the inherent capacities of the resource base itself. In either case, intensive resource use is a definite step towards long-term unsustainability. This problem is more pronounced in regions with fragile land resources, for example the mountains and dry tropical areas. Generally, in this situation, the range of options ensuring a proper match between resource characteristics and resource use is extremely narrow. However, as a result of human adaptation mechanisms and their ingenuity over the generations, the range of options has been widened. Features of traditional, integrated farming systems in these regions corroborate this (Whiteman, 1988; Moomk, 1986; Altieri, 1987; Jodha, 1990). However, these options, having evolved in the context of low demand on fragile resources, are becoming increasingly unfeasible or ineffective in the

context of the pressures generated by population growth, market-induced forces and public interventions (Liddle, 1975; Reiger, 1981; Jodha, 1990). Consequently, to compensate for falling incomes or to meet basic needs, cultivation has been extended to sub-marginal areas, monoculture has been induced by promotion of HYV crops (the RR21 variety of wheat is grown on 80 per cent of the total wheat area in Nepal); grazing land has been overstocked and deforestation has become excessive. Thus there is a mismatch between resource potential and usage, leading to the emergence of indicators of unsustainability. In such situations, the re-establishment of a 'match', between resource characteristics and their use patterns, is an important step in enhancing the sustainability of fragile resources (Jodha, 1990).

Any conceptual or operational framework for mountain area development must take into consideration the factors of slope and altitude which separate the mountains from other areas. Compared with the two-dimensional spatiality of the plains, mountain habitats are characterized by three-dimensional spatiality. This additional dimension, verticality, obstructs the applicability of development of other experiences of plains to mountains, since it disconnects the highlands physically, economically and culturally from the plains because of the barrier of physical inaccessibility. Because of slope and altitude and associated conditions, mountains have six distinct characteristics: inaccessibility, fragility, marginality, diversity, 'niche' or comparative advantages of mountain areas, and human adaptation mechanisms. These are also called mountain 'specificities'. The explicit consideration of these mountain characteristics in designing policies, programmes and projects for the hills and mountains is referred to as the 'mountain perspective'. The principal lacuna in development strategies in the past has been the lack of this mountain perspective. The characteristics are not only interrelated but also demonstrate considerable variability within mountain areas. For instance, all locations throughout mountain areas are not equally inaccessible, fragile or marginal, nor do human adaptation mechanisms exist uniformly throughout mountain regions. These mountain specificities could serve as a useful filter to screen public interventions in order to understand their sustainability implications and the changes required to enhance the sustainability of mountain agriculture (Jodha, 1990).

Mountain characteristics

Six mountain characteristics are briefly described here:

Inaccessibility The vertical dimension of mountain areas encompassing altitude, slope and undulating topography contributes significantly to the inaccessibility characteristics of the mountains. The direct manifestations of inaccessibility are isolation, poor communications, high transport costs and a slow pace of transformation. Measures to mitigate these constraints are transport subsidies, processing of value-added products, and construction of roads

and other transport infrastructure such as short take-off and landing (STOL) airports, mule tracks and ropeways.

Fragility Fragility refers to the vulnerability of mountain resources to rapid degradation through even a small degree of disturbance (DEFIL, 1988). This poses a serious constraint in the greater use of resources that are prone to ecological degradation. The management of fragile land is usually carried out through conservation by 'non-use', afforestation and improved watershed management practices with a strong focus on resource-centred technologies.

Marginality Marginality is an attribute of identity (be it in the context of physical and biological resources or social groups) that reflects a relatively lower status or priority in the context of the 'mainstream' or dominant features of society. The basic factors contributing to marginality are remoteness and physical isolation, fragile and low-productivity resources, and a number of man-made handicaps that prevent participation in the mainstream of activities (Chambers, 1987; Lipton, 1983). In terms of its biophysical aspects, marginality shares the attributes and consequences of fragility, and its socio-economic dimensions are poverty, isolation and neglected minority/tribal communities. The solutions for marginal areas are similar to those for fragile areas and a 'target-group' approach to address specifically poor, disadvantaged or ethnic groups.

Diversity or heterogeneity Because of the immense variations in biophysical and socio-cultural factors among and within ecozones, even over short distances, diversity or heterogeneity is a major characteristic of mountain areas. This extreme degree of heterogeneity is a function of the interaction of various factors, ranging from climatic to geologic and edaphic conditions (Troll, 1988). In terms of its operational implications, the diversity of the mountains offers both a range of opportunities and a set of constraints.

Mountain 'niche' Mountains have specific ecological and physical features that offer several unique opportunities (products and activities) for which mountains have comparative advantages over the plains. Examples include special medicinal plants, fruits and flowers, and hydropower production sites. While harnessing these opportunities, exchange with other regions on equitable terms can contribute towards the sustainable development of mountain regions but reckless exploitation causes resource degradation and unsustainability. The sustainable development of comparative advantages provides a basis for trade and exchange between different altitudes and ecozones (Calkins, 1976).

Human adaptation mechanisms Over many generations, mountain communities have evolved, through trial and error, their own adaptation mechanisms to handle the constraints indicated by several of these mountain characteristics. Accordingly, either the resource characteristics were modified (for example, through terracing, ridging and irrigation) or activities were designed to adjust to the requirements of resource conditions or mixed (integrated crop-live-

stock–forestry) farming. Thus farmers have traditionally made sustainable use of fragile resources. The proper understanding of indigenous knowledge could, therefore, help in designing better options (technological and institutional) for sustainable agriculture in fragile resource areas.

Mountain perspectives: country experiences

China Before 1978, the Chinese government placed an emphasis on foodgrain production throughout China, notwithstanding the unsuitability of some areas for this activity. Production brigades and production teams were required to meet certain targets determined by high echelons of government. This policy led to the production of foodgrains even on unsuitable marginal lands (which were otherwise fit for growing grasses, forests and other perennial crops). Consequently, this led to negative changes and environmental degradation. Thus, prior to 1978, there was a general insensitivity to the needs and limitations of mountain people and mountain environments (Wenpu and Qinfa, 1988). The collectivization, restriction on subsidiary activities, and emphasis on self-sufficiency in food reduced the individual incentive as well as the scope for harnessing the unique and diversified opportunities offered by mountain areas. Thus the government policy completely disregarded the mountain perspective and consequently led to increased environmental degradation. It was only in the post-1978 period that, through the introduction of the Household Responsibility System and agri-ecological regionalization, farmers began to be involved in diversified production activities to suit the different mountain ‘niche’. Permission to retain and privately re-invest surplus encouraged them to choose a mix of the most appropriate options. A substantial increase in agricultural production took place after the reform. However, in some areas the focus on private incentives has also encouraged people to pursue private gains at the cost of society and this has led to the degradation of natural resources in mountain areas. The immediate cases are negligence in the collective management of common property such as local irrigation systems or common pastures or farm roads, and the high use intensity of fragile lands to increase incomes without conservation measures (Dafu, 1988).

Himachal Pradesh (India) The experiences in Himachal Pradesh provide a successful example of the consideration of comparative advantages. The main emphasis in agriculture was the shift from self-sufficiency in foodgrains to maximization of farm income through cash crops (fruits and vegetables) that are highly remunerative and for which the state has a comparative advantage because of climatic and other factors. The necessary road access and market facilities, support prices, strong research and extension systems for generation and dissemination of appropriate technologies, and requisite support services were provided. The state, as well as the central government, made substantial investments in road construction throughout the country. This in a very real sense provided a road to development in Himachal Pradesh. In addition, the state’s investment in the development of hydropower led to the generation of government revenue by selling electricity to the neighbouring states. In

Himachal Pradesh almost all villages, including those in remote and difficult areas, have access to roads and electricity. This has facilitated the transformation of the economy.

Over the period 1951–81, there has been a noticeable shift in the pattern of labour use and the composition of aggregate output. During this period, the share of agriculture in the total employment figures fell from 91 per cent to 70.8 per cent and correspondingly the share of the non-agricultural sector rose from a mere 9 per cent to 29.2 per cent. In three decades (1950/1 to 1982/3) the aggregate output of the agricultural sector fell to 43.4 per cent from 69.4 per cent, while the share of the non-agricultural sectors increased to 56.6 per cent from 17.3 per cent (Sharma, 1987).

In 1954, when the state was established, hardly 1 000 hectares of land were used for fruit growing. By 1988/9, the area and production reached 150 000 ha and 3.1 million tons, respectively (Verma and Partap, 1990). Assessments made in Himachal Pradesh (and also in Nepal) reveal that off-season vegetables generate more employment opportunities for small and marginal farmers and agricultural labourers. Summer vegetable production in Himachal Pradesh rose from less than 30 000 tons in 1966 to 312 000 tons by 1985/8. About 200 000 small and marginal farmers were engaged in vegetable growing (Tiwari, 1990).

Marketing and other support services were developed to support both fruit and vegetable production. The Himachal Pradesh Horticultural Produce Marketing and Processing Corporation Ltd (HPMC) was established as a public sector company to undertake marketing and bring together all other post-harvest services for the promotion of horticultural development (Rana, 1990).

Pakistan The government in Pakistan seems to have disregarded the mountain perspective in its policies and programmes which are uniformly applied throughout the country without making any distinction between the mountains and the plains. Thus most development interventions have failed because of their plains biases. Inaccessibility has been a major constraint in the economic development of people in the mountain areas. Isolation, poor communications and the lack of a marketing infrastructure generally compel farming communities to disregard the opportunities offered by diversity and comparative advantages in favour of food security considerations.

Nevertheless, in the last decade, some innovative programmes have been initiated in Northern Pakistan, where mountain specificities are duly considered, and these have brought considerable developments to the area. First, the inaccessibility barrier has been broken through the building of the Karakoram Highway (KKH) connecting Pakistan with China in the north. Link roads have been built to connect villages with the KKH. The Aga Khan Rural Support Programme (AKRSP), commencing in 1982, introduced an innovative institutional mechanism in the project area with the objective of increasing the capacity of local people to identify their needs and problems and to use opportunities to resolve them. The institutional model emphasized the formation of village organisations (VOs), where the majority of village residents expressed an interest in working together, for village development. Other important principles of this model have been to promote the solidarity of the

VOs through collective management of common property regimes with a specific focus on the participatory approach, upgrading and creation of appropriate skills by providing training, and capital formation through group savings. VOs undertook many productive physical infrastructure, irrigation channel, link road and storage construction activities.

These developments have facilitated the gradual change from a subsistence crop-dominated production system to a cash crop-dominated production system taking agro-ecological characteristics into consideration. Input supplies increased and agricultural marketing expanded. It has also become cheaper to transport subsidized flour from the plains to Gilgit. Similarly, the opportunities for employment in tourism, construction, common public sector agencies and other non-agricultural activities have multiplied.

Nepal In Nepal, because of the problem of inaccessibility in many hill areas, emphasis on foodgrain production has been the policy of the government. This has adversely affected the environmental conditions of the mountains since increasing areas of marginal land on steeper slopes are brought under grain cultivation on highly erodible and fragile soil.

The inaccessibility of substantial areas of the mountains in Nepal has made the import and distribution of improved agricultural inputs and foodgrains costly, and it has also constrained the development of high-value cash crops because of the lack of marketing infrastructure. Thus farmers are compelled to concentrate on foodgrain production, and this has been further necessitated by the rapid increase in the mountain population. Although previous Five Year Plans have recognized the need for regional specialization, based on comparative advantages, this recognition was not put into operation because of the lack of adequate transport, poor marketing, and inadequate research and support services in the mountains.

Despite the various efforts made to increase the production of cereals, the productivity of major foodgrains has declined overtime (Yadav, 1987). Improved varieties of cereals that have been recommended for the hills and mountains require high inputs of fertilizer and assured irrigation, whereas most hill agriculture is carried out under rain-fed conditions. Both unreliable supplies and the high cost of fertilizer inhibit development. Nepal has not yet shown any definite signs of transformation in hill agriculture, from subsistence to commercial, except for a few products around its urban centres.

Innovative programmes such as Small Farmers' Development and Production Credit for Rural Women, which are oriented towards the specific target groups of small farmers and poor rural women, have addressed the marginality problems in the mountains. However, programme coverage is still extremely limited.

THE DEMAND ASPECT OF SUSTAINABILITY

It is the continuing additional pressures on existing resources that create unsustainability in fragile resource areas in general, and in the mountains in

particular. Four factors, among others, seem to place additional pressures on mountain resources.

- (1) *Human population* In mountain areas, there are too many people in relation to available resources, and projections for the future indicate that the population is likely to increase. The population in the hills of Nepal increased from 6.34 million to 8.46 million between 1961 and 1981, in spite of the fact that 1.19 million people migrated from the hills to the plains during the same period (Banskota, 1985). Seasonal migration and trading with other regions are common features of mountain communities. These activities have, to some extent, reduced the pressure on existing resources and, at the same time, supplemented family income through earnings outside the region. The development of roads in the mountain areas has facilitated further migration and trading activities.
- (2) *Livestock population* Along with the increase in human population the livestock population has increased. This also brings additional pressure to bear on limited resources. Since livestock are an integral part of the hill farming system, they have to be maintained and over-stocking leads to the degradation of forest and grazing land.
- (3) *Market-induced demand* Mineral resources, hydropower, forests and other cash crops, for which the mountains have comparative advantages over the plains, are extracted by private and government agencies for profit and revenue generation. These market-led interventions have been instrumental in pushing self-sufficient economies towards increased commercialization, with negative consequences (Mehta, 1990). This process has led to the substantial extraction of resources from the mountains, to the increasing benefit of the plains and at the cost of the marginalization of mountain communities. These agencies are insensitive to local needs and to the negative effects of the over-extraction of resources. There is ample evidence regarding deforestation for commercial use and the environmental insensitivity of mining activities, and hydropower and irrigation schemes and so on from various areas in the Hindu-Kush-Himalayas region (Banskota and Jodha, 1990). Similarly, in terms of interregional trade, based on timber exports and the harnessing of irrigation and hydropower, North Pakistan's mountain areas continue to be net exporters of resources to the plains (Khan, 1989).
- (4) *Tourism* Mountains have special advantages for the promotion of tourism. In some mountainous countries, tourism has emerged as a major source of foreign exchange earnings and a potential source of off-farm employment. For example, in Nepal, 20 per cent of the total foreign exchange earnings came from tourism in 1987/8. At the same time, tourism places additional stress on the environment through excessive use of fuel wood, by creating a demand for food in areas where food is already deficient and by polluting the environment with rubbish. Firewood consumption by trekkers (porters) has had the most critical impact on the environment. Thus mountain tourism has the potential for bringing about both positive and negative changes in mountain habitats. Therefore attempts should be made to minimize the pressures on the limited re-

sources by looking for different options such as alternative energy sources, promotion of afforestation and strict monitoring of litter, and by building appropriate site for garbage disposal, by imposing restrictions on the number of tourists allowed in an area within a given time period, and by opening up more trekking routes (Sharma, 1989).

DEVELOPMENT STRATEGIES

Broadly, development strategies for mountain areas should include the following considerations:

- (1) *Sensitivity to mountain characteristics* The review of country experience in the HKH Region indicates that there is a strong association between the success of development initiatives and their sensitivity to mountain characteristics (Jodha, 1990). Therefore there should be explicit consideration of specific mountain characteristics in designing policies, investment programmes and projects for the hills and mountains.
- (2) *Population control* During the past three decades, the accelerated population growth in most of the HKH region has resulted in a considerable imbalance between population and resources. Significant efforts need to be made to control the population. Since population growth, poverty and resource degradation are mutually reinforcing, a joint assault needs to be launched on all fronts simultaneously to reverse the downward trend.
- (3) *Massive investment in the development of transport, hydropower, and marketing networks* The transformation of stagnant (or even declining) hill economies into rapidly growing economies requires massive investments in transport, hydropower and marketing networks. Himachal Pradesh provides a good example of this type of investment. The more infrastructure a region has, the more development potential it acquires. A precondition of specialization is obviously the development of transport to reduce the cost of bringing in inputs and services and exporting products. Because of the number of rivers and streams criss-crossing the mountain terrains, there is tremendous potential for the installation of mini- and micro-hydroplants. The installation of large hydropower plants has all too often benefited the people in the plains and not the mountain communities, whereas the installation of small hydro-plants benefits mountain communities. They are easy to construct and operate, and even local manufacturers are capable of supplying the necessary equipment to install small plants.
- (4) *Highland-lowland interaction* The ecological and development problems of the mountains are inextricably linked with the lowlands (plains) through watersheds and river systems, migration and markets and these often have transnational and national political boundaries. International cooperative action is needed to deal effectively with the destructive forces of nature, the short-sighted interventions of man, and the movement of people and products. The sustainability of mountain regions is greatly

dependent upon the lowlands that provide a market for the products and resources for investment. Similarly, if watersheds are managed properly in the highlands, the siltation of river basins and productive land is reduced. On the other hand, the continued deterioration of highland resources will ultimately affect the lowland areas as well.

Sustainability can be maintained through complementarities in production between the hills and the plains. Surplus food production in the plains could benefit the hill people in two ways. Firstly, the constraint on wage goods that is essential for labour-intensive programmes could be released. Low-income people spend the bulk of their additional income on food, and a high employment policy increases the income of the poor, with demand for food subsequently increasing (Mellor, 1976). This increase in demand for food could be met from the marketable surplus generated in the plains. Secondly, the surplus would have an effect on the domestic price of foodgrains, depending upon the quantities exported. It is innovations in the production of foodgrains, for which the demand is inelastic, that are passed on to consumers, including hill people.

Conversely, the hills will produce fruits and vegetables, livestock products and handicrafts, the demand for which is elastic. In the production of such commodities, the benefits of technological innovations are passed on to the producers. Thus technological innovations in foodgrain production in the plains will not only benefit plains producers, through an increase in production, but will also benefit the hill people who are potential consumers. Hill people will further benefit from technological innovations in horticulture, livestock and cottage industries (Yadav, 1987). Thus investment policies should be designed so that upland/lowland linkages are strengthened to benefit mutually the people in both regions on a sustainable basis.

- (5) *Integration of crop-livestock-forestry* Farming systems, consisting of the integrated activities of crops, livestock and forestry, have been practised for generations by hill people. It is important to have a clear understanding of their interrelationships and investment programmes to emphasize the strengthening of their linkages and to maintain a proper balance. This integrated system must remain central in designing research and extension activities. A technology package, taking into account the farming system perspective rather than emphasizing the development of a single component technology, is necessary. This would require more time and resources to understand local constraints, opportunities and interrelationships among the various farming activities. Also, because of the wide variation in the conditions of the numerous micro-regions in the mountains, location specificity and diversity should be the central focuses of technological developments for agriculture.
- (6) *Leasehold forestry* In the mountains, large areas of forest are denuded. For example, in Nepal, the heavily denuded forest and shrub area, with an average crown density of 25 per cent is about 2.12 million hectares (HMG/LRMP, 1986). This constitutes about 37 per cent of the total forest and shrub area in the mountain region. This should be leased on a long-term basis to poor households and put to better use by integrating

forestry, livestock and horticulture. This arrangement will give the poor users the right to plant tree crops and grasses and to generate income to meet their basic needs and to bring about ecological rehabilitation at the same time, thus providing an innovative mechanism to combat both poverty and environmental degradation.

- (7) *Farmer-managed irrigation systems* These should be the primary mode of irrigation development in the mountains. This would require an emphasis on three aspects: (1) farmers' participation in need assessment to design, to operate and to manage; (2) consideration of low-cost structures; and (3) users' group management systems for irrigation, giving them a sense of ownership (Pradhan, 1989).
- (8) *Institutional innovation* It is commonly seen that many development projects, in spite of adequate financial and technical assistance, have failed because of the lack of proper institutional arrangements to carry them out. Even if they succeed in achieving certain targets, the continuity of a programme ceases after the completion of the project. The main reason is the lack of a clear mechanism for the equitable participation of the people in design, implementation and benefit sharing. Therefore institutional innovation is the key to increased productivity, environmental sustainability and greater equity. Experiences from successful projects in the HKH region indicate that the main basis of such institutional innovation is collective management in a participatory manner, investment in human capital through skill upgrading and capital formation through group savings (Bajracharya, 1990).
- (9) *Off-farm employment generation* Agriculture alone is unlikely to meet the needs of mountain communities. In the absence of sufficient employment and income rural communities are continually faced with increasing poverty, resulting in migration and rapid environmental degradation. It is therefore essential to identify viable off-farm alternatives and to promote practical approaches to employment generation, subsequently enhancing income in the hills. This requires an emphasis on four interrelated factors: technical innovation, improved extension and support services, integration with the wider market and enhancement of organization and management (Bajracharya, 1990).

In designing specific activities, the hills and the mountains should be partitioned conceptually into four categories, based on accessibility.

Area with road access Here the object is to shift gradually from self-sufficiency in foodgrains to maximization of farm income through cash crops (fruits and vegetable) and improved animal husbandry, in order to take advantages of the hill and mountain 'niche'. Both horticulture and livestock are of special significance to the poor and to small farmers in terms of employment and income, because they are more labour-intensive, both on and off the farm, than foodgrains (IFAD, 1979). Farmers could undertake these activities on a commercial scale only if they have a guaranteed market for their products. Because of the factor of bulk and perishability, the rapid movement of these commodities is essential. Roads linking the production area with the con-

sumer (market) centres facilitate rapid movement. Horticulture and livestock activities are supportive of each other in the sense that livestock provides manure (compost) for horticultural crops and orchards provide fodder for livestock.

Traditionally, the foodgrain sector has received emphasis in the hills and mountains and consequently greater priority for research and extension has also been given to foodgrains. This gradual shift from food self-sufficiency to horticulture and livestock would necessitate a higher intensity of research and extension for horticulture and livestock. Also it would require the strengthening of other agricultural support services such as credit, input supply and promotion of small entrepreneurs in trading and marketing.

Accessible areas provide better opportunities for promoting the development of mountain-specific, natural resources such as hydropower, minerals, tourism and small-scale industries. Here, of course, in promoting these activities, environmental impact analysis must be taken into consideration so that the mountain 'niche' is maintained without serious negative consequences. Small market towns and service centres should be developed at different places along the road to provide services to the rural hinterland.

Areas where road access is economically justified and which will become accessible within the next ten to fifteen years Initially, the emphasis should be on the subsistence, mixed farming system but preparatory activities should be undertaken for the transformation of subsistence agriculture into commercial agriculture. Thus most of the activities would be similar to those in areas that already have access to roads, with some time-lag.

Areas where there is sufficient potential to justify limited access improvements (such as suspension bridges, trails, mule-tracks, airports); these could be made accessible by road in the next 20 to 50 years Here the objective is to meet basic needs (self-sufficiency in foodgrains) through improvement, in income and productivity at subsistence or sub-subsistence levels. Agricultural research is oriented towards subsistence crops, mixed farming systems and low-cost technology. Emphasis is given to the production of compost and not to the use of inorganic fertilizers. Extension and other support services should be oriented towards meeting the needs of the mixed enterprise farming system, in which grain crops, livestock and horticulture are given proper emphasis. In terms of cash crops, emphasis is on low-weight and high-value crops such as medicinal herbs.

On and off-farm employment opportunities should be promoted through the intensification of agriculture in low valley areas, expansion of selected cottage and small-scale industries (processing), and public works – essential for an increase in the income of small farmers. Agro-forestry practices should be encouraged on sloping lands to meet food, fodder and fuel needs. In steep upland areas, the Sloping Agricultural Land Technology (SALT), widely practised in the hilly areas of Mindanao in the Philippines, should be adopted to reduce soil erosion and to stabilize and enrich the soil. This technology can increase a farmer's annual income almost threefold in a period of five years (Tacio, 1988).

Food-for-work and rural, public employment schemes should be carried out to reach the large number of poor and unemployed. Also in food-deficit areas, food distribution with transport subsidies should be provided. However, caution is needed to make sure that the low price of imported food does not depress the production of grain crops in the area.

Areas with no hope of access – expenditure on a road not justified in the long run These areas should be depopulated and the people from these areas resettled, in other mountain areas in the three categories discussed above or in the plains. These vacated areas should be declared natural reserves in order to promote biological diversity with natural vegetation.

CONCLUSIONS

Attainment of constant or high productivity levels on a continuous basis without damaging the long-term potential of resources is known as the sustainable use of resources. The prospects of sustainability in fragile mountain areas are severely constrained by the specific features of their natural resource endowment. In the past, sustainability could be maintained because of low pressure on these resources. However, continued population growth and market-induced demands have put greater pressures on land and other natural resources, and brought about higher resource use-intensity, consequently leading to negative changes, known as indicators of unsustainability.

The biophysical conditions of the resource base and their use constitute the supply side of sustainability, while the factors that place pressure on resources, such as population growth and market-induced demands, constitute the demand side. It is the management of both supply and demand aspects which constitutes the essence of development strategies for sustainable development.

The mountains have a fragile resource base and therefore fall into the category of less-favoured and marginal production areas. Mountainous areas distinguish themselves from the plains because of their characteristics of verticality which obstruct the applicability of development frameworks conceived for the plains to the mountains. Slope and altitude are manifestly in six important characteristics of the mountains: inaccessibility, fragility, marginality, diversity, 'niche' and human adaptation mechanisms. Of these characteristics, inaccessibility is the central (pivotal) factor influencing resource use and determining the adjustment of other characteristics. The road developments in Himachal Pradesh and the northern hill regions of Pakistan paved the way for bringing other components of development, consequently orienting agriculture away from subsistence practices towards commercialisation. This transformation process was accelerated by the provision of strong backward linkages, in terms of input supplies, and forward linkages in terms of processing and marketing. In addition, technological development, price incentives and subsidies further helped the process. The key factor for the success of these endeavours was the explicit consideration of specific mountain characteristics in designing policies and investment programmes.

On the demand aspects of sustainability, the control of population growth and market-induced over-extraction of resources are the most important factors for reducing pressure. Similarly, emphasis on skill formation and support facilities for agro-based processing and marketing activities and promotion of public works to increase off-farm employment are essential to reduce the pressure on land.

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DISCUSSION OPENING – TONGROJ ONCHAN*

Dr Yadav presented an excellent paper on the problem of sustainable resource management and development in marginal areas, particularly mountains. It is generally known that, owing to rapid population growth and increasing demand for food and other agricultural products, marginal and sub-marginal lands, including mountains, have been extensively used in many countries of Asia. This has resulted in serious degradation of natural resources and environmental quality. If left unchecked, it will certainly have an adverse effect on the sustainability of agricultural development.

In discussing strategies for mountain areas, Dr Yadav correctly emphasized the importance of both the demand and the supply sides. On the supply side it is very useful to understand mountain characteristics, while on the demand side population growth is very important. Another interesting demand factor is tourism. The negative environmental effect of tourism in protected areas such as national parks and wildlife sanctuaries has been evident in many countries, including Thailand. To help alleviate this undesirable effect, so-called 'ecotourism' may be promoted. This simply means tourism in which

*Kasetsart University, Thailand.

eco-protection is incorporated in order to preserve nature. This concept, I believe, is receiving increasing attention in many countries.

Of the nine strategies for sustainable development in mountain areas proposed by Dr Yadav, I would like to comment on three: crop–livestock–forestry, leasehold forestry, and off-farm employment generation. First, crop–livestock–forestry strategy is already widely practised by upland and highland people, and should promote increasing economic and ecological stability. The important issue is that a technology package which will provide a proper balance of the three activities is required, though it is not yet clear that one has been developed.

The strategy on leasehold forestry deserves attention. Tree planting will help restore the forests. I agree that it is important to provide long-term land leases to rural households for use in forestry, livestock and horticulture production. However, issues of distribution and equity also have to be considered. We have an interesting experience in Thailand, where a very ambitious programme of massive reforestation has been launched. The government has been trying to lease out large areas of denuded forest to the private sector and the rural people, though up to now only big companies have been able to obtain leases. This has provoked a great deal of protest among the rural poor who for years have illegally occupied the land which, in fact, they believe they own. The issue of receipt of benefits from this programme is therefore important. Furthermore, there are also other factors which must be carefully considered in implementing the programme, such as the area to be leased out to a family, the types of tree to be planted, and the farming systems and technology to be recommended.

Off-farm employment generation is particularly important in reducing pressure on land and raising the income of the poor and the landless. Dr Yadav is right in pointing out that, although a great deal of data are now available on characteristics, problems and potentials of non-farm enterprises and off-farm employment, research has tended to be neglected and much remains to be done.

In the final part of my comment, allow me to mention a few issues which are relevant when considering development strategies in mountain areas. This discussion is mainly in the context of Southeast Asia.

- (1) Upland and highland people are usually indigenous tribal and ethnic groups but, increasingly, there are large numbers of newly arriving immigrants, many from lowland areas. To design a programme for a hill tribe, one must understand the people, their culture and their way of life. In some cases, we still do not know the exact population of the highlands. We suspect that it is increasing over time, but it is, of course, difficult to conduct a survey or a census in highland areas.
- (2) Land tenure in mountain areas usually involves public land use, though much of the land has been set aside as conservation reserves. Hence land is technically illegally occupied, although hill tribe people may have lived there for generations. Many people also believe that they are the rightful owners of the land they cultivate. Land tenure insecurity is therefore a serious problem. Some uplanders in the Philippines and

Thailand have been trying to obtain private property rights or legal land documents, but without success. In fact, in Thailand, we try to resettle them in lowland areas, though this has proved to be difficult, for various reasons. The issue of land rights is important as it has profound economic, social and environmental implications.

- (3) Technology and research efforts in the highlands are limited and technology being used is mainly indigenous. If production is to be increased, new technologies must become available. Further, one must realize that, in highland areas, low production and high instability are caused by the fragility of the environment, where steep slopes, high rainfall and unstable soils contribute to soil erosion. Hence major concerns of highland development are increasing, stabilizing and sustaining the productivity of highland farms and the rehabilitation of marginal highland areas. Soil erosion is perhaps the most critical factor. Engineering devices such as terraces, dams, dikes and channels can change landslope characteristics to reduce their effects. Reforestation is an important element of rehabilitation. Therefore soil erosion, fallow periods and reforestation, as well as farming system technologies, are important research topics. In recent years, government agencies, research institutions and private organizations have been paying increasing attention to the problem of highlands, though research is still too limited to have an impact on development.
- (4) Relationships between highlands and lowlands are such that migration occurs in both directions. In Thailand, an increasing number of lowlanders migrate to highlands and many of them settle there permanently. It is apparent that economic change and the well-being of the lowland people will have an effect on resource use in the highlands. Hence developing lowland areas is as important and necessary as developing the highlands.

It must be emphasized that it is important to pay attention to the welfare of highland people and help them to carry out economic activities which will simultaneously conserve fragile natural resources, with the ultimate objective of achieving sustainable development. Until now it is very unfortunate that public interest in the uplands has arisen less from a concern to improve the livelihood of local people than from a realization that lowland environmental and agricultural problems are directly related to upland deforestation and ecosystem degradation. This attitude and policy direction must change if sustainable development strategies in mountain areas are to be properly designed and effectively implemented.