

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

During the last three decades or so several negative changes have taken place in all the areas. Some of them are visible and others are disguised. The most conspicuous visible changes can be taken as increasing landslides, soil erosion, deforestation, and the decreasing level of agricultural crop yields which have been directly affecting the quality of life of the mountain people. Increased out-migration rate and widening hunger gap periods are other crucial negative changes that are emerging, however reasons behind this are not easily perceivable.

This persisting scenario implies that the whole mountain agriculture, in general, is basically moving towards unsustainability. Instead of improvement, deterioration is taking place in the context of all three elements of the sustainability matrix (e.g. resource base, production flow, utilisation/management).

An attempt was made to assess each of the three mountain farming systems in terms of their sustainability, based on the negative as well as on the positive changes that have taken place. Modern agricultural technologies have also brought about several positive changes which can be best seen in the Naubise study site (horticultural crop-dominated farming system). Probably, accessibility and the big ready-made market (Kathmandu) may have greatly strengthened the adoption of improved technology in the area which contributed to increased crop yields, crop diversification, and increased biomass production at farm level thus releasing the pressure on forests.

Dhuskun study site (crop-dominated farming system) has emerged as the most affected area in terms of unsustainability; traditional strategies that helped sustain the system have been overstrained. Backward and forward linkages of the farming system which are a very crucial element of sustainability, particularly in remote and isolated areas, are breaking down. The Yelung study site (livestock-dominated farming system) is moving towards unsustainability, although the situation is not as serious as it is in Dhuskun.

There are several issues and factors that are causing the deterioration of various farming systems. However, four major elements have been identified as causal factors behind the unsustainability of the farming systems and they are (i) high population pressure on land; (ii) inappropriate institutional interventions; (iii) lack of market integration; and (iv) the breaking down of farmers' traditional strategies without the support of appropriate technology and support services. All of these elements are not uniformly distributed in all the farming system study areas. All these elements are found in crop-dominated farming systems, (i) and (ii) in livestock-dominated and (i) in horticultural crop-dominated farming systems. Contrary to this, some major elements contributing to positive changes leading towards sustainability have been identified and they are - (i) availability and adoption of improved agricultural technology; (ii) market integration; and (iii) biomass production and utilisation at farm level. All of them are contributing to positive changes in horticultural crop-dominated farming system.

Finally, appropriate development interventions must be made so as to strengthen/minimise the effectiveness of those elements responsible for sustainability/unsustainability of the mountain farming system in order to achieve the long-term goal of sustainable mountain agriculture. Several farmers' strategies for traditional resource management are still relevant and feasible options, in a changing environment induced by increased demographic pressure and technological innovation, to obtain the above goal.

## Recommendations

The general recommendations are to search for ways and means that will strengthen/minimise the elements contributing to the sustainability/unsustainability of each mountain farming system in order to achieve sustainability. Consequently, this approach will strengthen/minimise the positive/negative changes that are taking place in the farming systems. Hence, various operational measures that will contribute towards achieving sustainable mountain agriculture have been identified and recommended for each type of farming system.

As far as the inappropriate institutional interventions are concerned, ways and means to rectify government development interventions are being sorted out. In the case of forests, the Government had already begun to transfer the ownership rights to the people or community through the provision of *panchayat* (former) forest (PF), *panchayat* protected forest (PPF), community forest (CF), lease forest (LF), etc. Some positive impacts of the intervention have now been realised. At least the forest area, which used to be freely grazed and haphazardly lopped, is now quite controlled. However, people's participation in the conservation and protection of forest/pastureland is not as encouraging as expected. This is mainly because the new development intervention does not fully confer the ownership rights of the forest on the people or community. People still fear that the Government might control or interfere again, once the degraded forest/pastureland are reforested/afforested. Therefore, strong legal provisions and their effective implementation are essential. Similarly, farmers' irrigation management systems should be further emphasised.

As mentioned earlier, some of the farmers' traditional strategies are still feasible even for the future. Therefore, they should be revitalised. The other important element is the high population pressure on land and this is not an easy issue to deal with. Despite government efforts to control the high population growth rate, the population in the country as a whole is increasing. In the absence of other employment opportunities, the increased population is dependant on the already overcrowded cultivated land, particularly in the hills and mountains. Consequently, the fragmentation of land is increasing and the per capita suitable landholding size is declining, although the size of landholdings in the region is reported to have slightly increased which is mainly due to the extension of marginal and submarginal land and forest/pastureland. The negative multiplier effects of population pressure in the hills and mountains are numerous and greatly aggravate the causes of unsustainability of mountain agriculture. Therefore, one of the biggest challenges is to tackle this high population pressure. This problem warrants persistent efforts requiring a long time and a great deal of people's motivation.

- i) It has been observed that the adoption of improved agricultural technologies (HYV seeds, fertilizers, etc) has proved successful in reversing the trend of declining crop yields resulting from the reduced supply of biomass for livestock feed and composting from forest resources. This approach can be encouraged in accessible areas where modern inputs can be easily made available. However, one has to be cautious regarding the sustainability of fertilizer-based technology in the context of heavy government subsidy in fertilizer cost and the rising global price of petroleum-based products.
- ii) Farmers should be encouraged to adopt improved methods of compost preparation and application in order to reduce the losses of plant nutrients in the existing practice. This will increase nutrient supply to crops and augment crop productivity using the same amount of compost materials without exerting any additional pressure on natural resources. Thus, this option may contribute towards improving the sustainability of mountain agriculture. Agricultural extension and training services for educating and motivating the farmers need to be strengthened in order to make this venture successful.

- iii) Desirable changes in cropping patterns and crop rotations, such as inclusion of legumes in intercropping or sole cropping, might help improve soil fertility and contribute towards sustainability.
- iv) In the '*bukma*' system of cultivation practised in Yelung and in other areas, improvements are possible through planting suitable leguminous forage crops, such as white clover and others, during the fallow period. There could be a two-fold advantage from this practice: firstly, the fertility of the soil can be replenished in relatively shorter periods through fixation of nitrogen by legumes and, secondly, the feed supply situation for livestock will improve.
- v) Recently farmers are becoming interested in planting fodder/fuelwood trees on farmlands. This trend should be encouraged by educating and motivating the farmers and making arrangements for the adequate supply of tree saplings of desired species, based on farmers' needs in specific areas. This approach will not only help meet the farmers' requirement for fodder and fuelwood but also contribute to environmental conservation by reducing pressure on forest resources and controlling soil erosion on farmlands.
- vi) In the context of rapid deforestation and resulting environmental problems, such as soil erosion, landslides, flooding, siltation, etc, forestry development programmes should receive higher priority than they have received in the past. The knowledge and experiences of the farmers in natural resource management need to be incorporated through increased people's participation at all stages of the programmes. Local people should not only be involved in programme planning and implementation but also made responsible for forest management and utilisation of forest products.
- vii) It has been observed that fodder trees are disappearing from natural forests and such trees are seldom included in new plantations undertaken by the Government. In the context of increased shortages of livestock feed in the hills and mountains, adequate priority needs to be accorded to fodder trees on new plantations.
- viii) Examine further and find out the ways and means to encourage the use of improved cooking stoves. Their widespread adoption can greatly release the pressure on forests by improving the efficiency of fuelwood. In addition to environmental improvement, the use of stoves will also minimise health hazards caused by smoke emitted by traditional cooking systems.
- ix) Replace unproductive animals with more prolific livestock. This practice can also help to reduce the size of livestock but with increased outputs, which are required for household consumption, and cash income that can be invested in productive activities.
- x) Encourage stall-feeding practices, particularly in areas with a degraded natural resource base. Widespread adoption will help revitalise forests and pastureland substantially. One glaring example can be observed in the Naubise area.
- xi) Improve the nutrient value of available dry fodders with some chemical treatment (e.g., molasses, urea). Effective ways and means must be sought for wider practice of this among farmer communities. Despite the Government's general suggestions during the last several years, this practice has yet to gain popularity.
- xii) Local people should be encouraged to manage the natural resource base (e.g., forest, pastureland, etc). Some efforts in this respect have already been made. However, practical measures that ought to be taken by the Government are still lacking. At present, some initiatives have been taken by

farmers themselves. One example can be quoted from the Yelung site where one user group has been formed to effectively use and manage alpine pastureland and meadows for *chauri* farming.

- xiii) Emphasis on the production of low-weight, high-value products. Installation of processing units for agricultural and livestock products will be very effective in this respect. Farmers can be encouraged to establish a small 'cream separator' unit to produce value-added products. This would be an effective, operational measure for areas that are beyond the reach of the Dairy Development Corporation.
- xiv) Other agricultural support services can be equally helpful in improving the mountain farming system.
- xv) A multidisciplinary approach in the research and development of rainfed farming, integrated crop-livestock-forestry farming, and local resource-based, low input use technology are the real challenges for the future development of sustainable mountain agriculture.