Identification of Key Resource Issues: Discussion and Recommendations

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1. INTRODUCTION

The aims of the workshop were not only to present updated information on recent research findings relating to resource management in watersheds in the Middle Mountains, but also to identify gaps in knowledge and areas in need of future research. From all the papers and presentations, it is evident that there are widespread and complex problems in sustaining the resources in this very intensively used environment. Most of the resource problems are the result of rapid increases in population, a lack of infrastructure and harsh, marginal environments. Until recently, the farmers have been able to meet demands for biomass production by increasing yields, and have intensified production by introducing multiple cropping systems and expanding cultivation into more marginal areas. However, there are signs indicating that resource constraints and degradation processes are increasing and that, at the same time, production is stagnating. Based on this workshop, a number of issues have been identified that require more careful consideration. These issues can be grouped into the following six categories, which are summarized below:

- land use dynamics and conflicts
- soil erosion
- soil fertility management
- irrigation and water management
- indigenous knowledge
- inequities and institutional issues

2. LAND USE DYNAMICS AND CONFLICTS

Agriculture has intensified, moving from a cropping intensity of 1.8 to 2.6 crops per year over a 10 year period. At the same time, there has also been a marginalization of agriculture revealed by the expansion of bari land onto steeper slopes. With cropping intensification and expansion it has been possible to increase biomass production, although both of these agricultural practices are problematic. The former is in need of greater inputs, while soil losses by erosion is the main concern of the latter. It has also been widely reported that yields are stagnating even under increased fertilizer input, which suggests future problems with sustaining the productive capacity in agriculture. The dominant cropping pattern has also shifted from a rice, maize and wheat dominated production to one based on market economics, which includes potatoes, tomatoes and vegetables.

There is contradictory evidence that forest production is increasing. Forest cover has expanded and the number of trees planted on private land has increased. However, the forest cover expansion is mainly in the form of pine plantations and sufficient information has been provided to suggest that the quality and diversity of the forest has declined. It was also shown that the deforestation and afforestation efforts follow in a cyclic manner. However, the concern is that recovery and afforestation are never sufficient to reach the previous peak of forest conditions, hence a slow, overall decline in the production capacity has been noted. Community based forestry is seen as a mechanism for improved management, but training community forestry managers

is proving to be complex and present needs exceed the current training capacity. The demand for forest products has steadily expanded and includes all forest products (fuelwood, timber, fodder and litter). It has also been shown that small scale hydro is not necessarily reducing the pressure on fuelwood demand, and that its introduction creates a complex change in the local social structure. Forests play an integral part in agriculture and the lives of the local residents, and since they receives no inputs, the long term sustainability of the current production capacity is clearly in question.

The only non-productive land in the Middle Mountains are significant areas of degraded lands. Until recently no attempts have been made to revegetate such sites due to the enormous effort required for rehabilitation and the questionable production capacity to be obtained after reclamation is initiated. The planting of appropriate vegetation cover as part of an agro-forestry system has great potential but must be viewed in a long term context, since the initial establishment is slow. In addition, the long term benefits of this vegetation cover downstream, resulting from reduced sediment contribution to the stream and irrigation systems, must be included in any cost/benefit evaluations.

3. SOIL EROSION

Soil erosion is the biggest problem with farming and other land uses in mountain systems. The impacts of erosion have far-reaching effects both on-site and downstream but the concerns for agriculture and hydropower development are governed by entirely different processes. For dryland agriculture, soil erosion is most critical during the pre-monsoon season when vegetation cover is at a minimum. Some 60-80% of all annual soil and nutrient losses occur during one or two major storm events during this season. In contrast, the key problem facing hydropower dams is the infrequent occurrence of exceptionally large storms which devastate the watershed and result in almost catastrophic losses of reservoir capacity. This was illustrated most effectively at the Kulekhani hydropower project, where unusual climatic events were shown to have severe impacts on reservoir capacity. Interaction between energy production and watershed management is critical. In general, erosion rates are high, but farmers are managing water and sediments as well as can be expected in such mountainous environments. Soil erosion is most problematic for poor farmers working marginal land, while rice farmers benefit from the accumulation of eroded sediments. Conversion of steep grazing and shrub lands into agricultural lands should be decreased. Sites already converted may be afforested with fodder trees.

Extrapolation of the information from a watershed scale to a macro scale is not possible. Research should be focused on bridging the gap between micro and meso scales, as the jump from meso to macro may be too challenging.

An investment in soil conservation practices is critical but needs to be diverse and flexible in order to address the different processes and their effects. For example, the establishment of an early vegetation cover and the provision for sediment collection during the pre-monsoon season is most critical for the upland farmers. The maintenance of settling ponds, the retention of sediments throughout the entire watershed and provisions to reduce sediment inputs into reservoirs are key strategies for hydro-power development. In fact, the wisdom of constructing large reservoirs in the Middle Mountains must be questioned given the recent evidence in the Kulekhani, where the predicted rate of erosion was clearly exceeded by an order of magnitude.

4. SOIL FERTILITY ISSUES

There is an awareness that soil fertility is becoming one of the major issues that govern poverty and future production capacity in the Middle Mountains. The most critical issue is maintaining soil fertility management

with insufficient inputs and increasing demands for biomass production. The response to the use of chemical fertilizers has been disappointing and reflects the problem of an inability to maintain sufficient levels of organic matter in the soils. Manure supplies are insufficient, so forest litter is being used in an extensive manner to supplement organic matter in agriculture. This results in the depletion of nutrients in the forest, while the input into agriculture is not enough to sustain double and triple annual crop rotations. Additionally, as pine becomes the dominant tree species in the forest, litter becomes dominated by pine needles, which have a poor nutrient content and leach soil cations during the decomposition process.

Acidification is the most serious soil fertility problem, and is influencing phosphorus availability. The inherited parent materials in the Middle Mountains are frequently acidic and the addition of acid-producing fertilizer is simply adding to the problem. Lime inputs need to be contemplated but responses might be disappointing since most macro-nutrients are also deficient. The problem of soil fertility is widespread with the poorest conditions found in the forests and grazing lands. Only the irrigated areas, which benefit from nutrient inputs through irrigation water and via sediments, have fertility conditions which can be considered adequate given the intensity of crop production.

Livestock plays an important role in nutrient management, as organic matter is essential to the maintenance of soil tilth. However, feed shortages limit manure production. A more extensive use of nitrogen fixing crops and fodder trees is needed to conserve the soils and to provide additional feed and organic matter.

Soil fertility decline and the resulting impact on production is a major concern. Improving soil inputs is becoming a formidable challenge. Soil fertility changes need to be related to production to illustrate the relevance of research to the farmers. The impact of chemical fertilizer and improved seeds on yield should consider the cost of inputs relative to the purchasing of food.

5. IRRIGATION AND WATER MANAGEMENT

The greatest concern of the farmers is related to water shortages for both drinking and irrigation. Springs are almost fully utilized as drinking water sources, reducing the flow available for irrigation. Irrigation systems have expanded in recent years, but further expansion will be difficult given the widespread shortages of stream base flow during the dry season. New water conserving technologies, such as sprinkler or drip irrigation, are needed in order to effectively utilize this scarce resource. An effective alternative to flood irrigation is to grow less water-consumptive crops that also have potential for marketing. An investment in water harvesting systems will aid in reducing labour requirements for women and help in the irrigation of winter crops.

Solar pumps, which provide an alternative to kerosene pumps, have been utilized to provide irrigation water to nurseries and cash crops. The potential of solar energy should be further investigated at a practical level, including study of its impacts on agriculture and the economy.

6. INDIGENOUS KNOWLEDGE

Indigenous knowledge must be promoted and supported. Farmers are acutely aware of the problems in the watershed, however, infrastructure support is required. There are many indigenous systems that could benefit from external inputs, but good documentation is needed before they can be effectively used as a communication tool between the farmer, extension workers and researchers.

Hill women provide the labour and knowledge in agriculture, livestock husbandry and forest management. They are likely much more knowledgeable on issues relating to forest management, fodder production and animal

health than are their male counterparts. This became evident in surveys which included both male and female farmers.

Women are also more acutely aware of the processes of degradation since their working hours are increasing as the distances for fodder and firewood collection are increasing with forest productivity declines. This is particularly evident in the families of poor farmers that have small land holdings and must rely on communal forests and grazing lands.

7. INEQUITIES AND INSTITUTIONAL ISSUES

Large scale foreign aid programs are often inappropriate and do not target specific community groups such as women and the lower castes. The caste system and land tenure issues must be considered alongside any management options, as they are indicative of the farmers economic limitations. The invisible woman farmer must be made visible and become part of the system. Off-farm employment opportunities provide possible alternatives to the farming of marginal land, but with men migrating off-farm for work, the labour of women is increased. Dairy development has increased and provides cash income to the family, however, the increased number of buffalo increases women's labour for household gains but women rarely see any personal gain. Since women have no control over land or cash, the shift to a greater market orientation results in women being marginalized from the decision making process. Access to resources, credit, property and training for women are essential.

The very unequal distribution of land, which is greatly influenced by the caste system, is another issue that needs discussion and attention. Policies to foster community control over land and restrict absentee land holdings as well as the size of such holdings are a possible option. A land reform policy with better local participation should be advocated.

The collaboration between agencies has been discussed at length; however, the actions by individual departments do not practice an integrated approach. Better collaboration between Forestry and Agriculture, and between the energy producing agencies and the department of Soil and Water Conservation, are just two examples where improved integration is needed. The problem of interaction and collaboration between agencies is still large and major efforts are needed to foster better interactions to improve resource management and the decision-making processes. Currently, issues related to deforestation, soil losses and soil fertility declines are not addressed sufficiently within centralized government agencies. To alleviate the impact on marginal farmers, the need is at the farm level. These issues must be coordinated at the national level by fostering grass-roots approaches. The importance and empowerment of farmers requires promotion. Financial resources should be channelled toward farm level programs. Local based extension is essential in providing better links and feedback to farmers on research results.

The importance of extension and communication is illustrated by the adoption of research ideas by farmers, such as their adoption of melons first planted at the rehabilitation site. Farmer adoption of conservation approaches requires an understanding of the benefits of conservation and at the same time maintenance of their income generation requirements. The dissemination of technology requires a networking system.

8. RESEARCH REQUIREMENTS

Development programs can be made more effective if baseline research data is available. Unfortunately, there is a lot of uncertainty about resource data and a poor understanding of processes. The processes that lead to degradation need to be quantified, both in biophysical and socio-economic terms, before effective

management options can be developed. An integrated approach is required to evaluate natural resource issues. Both biophysical and socio-economic conditions must be addressed. Long term monitoring is required for representativeness and process evaluation. The need for information and potential interventions has been stressed.

The problem of scale was addressed and it was shown that land uses influence processes at different scales. More research is clearly needed to document the impact of land use intensification on the long term production capacity of the soils. Simulation modelling and scenario development were found to be effective tools to illustrate potential effects but long term monitoring programs are needed to add credibility to such predictions. Linkages within and between mountain regions is advantageous for sharing techniques and technologies. Information sessions between researchers, newsletters or regional field based training are potential approaches. Genetic material may be exchanged within and between mountain regions. For example, Asian rice may be exchanged with Latin America and Andean maize. A biodiversity group could be established within Nepal to deal with crop variety / genetic pool issues and forest biodiversity. Farmer exchanges between mountain regions is proposed as a potential program for technique exchanges.

The questions of: "When do indigenous systems breakdown and how can outsiders contribute to halt the breakdown?" need more research attention. This requires a better understanding of specific reasons behind why indigenous methods work and how they evolve. This is particularly important in the case of soil classification and management, where changes in biomass performance are often masked by climatic variations and inherited spatial variability.

Representative watershed studies should be coordinated within different agro-ecological zones. Coordination of methods and study sites selection will facilitate comparison of results and extrapolations from one watershed to the next. Collaborative research work with the regional agricultural centres (LARC, PAC and NARC) should be encouraged.

9. CONCLUDING REMARKS

Dr. E. Pelinck, Director of ICIMOD, closed the workshop by applauding the flexibility and patience shown by participants and stressed the value of participant responses to the study team. The dynamic approach was stressed, with conflicts between different resource uses leading to integration. The traditional conflict between biophysical and socio-economic disciplines has been overcome by focussing on the issues. Technical and institutional solutions must be integrated. Both private and common management are required. Scientific and indigenous knowledge must be merged. Further emphasis should be placed on erosion processes, both natural and anthropogenic. The movement from a subsistence to a monetary economy makes the Jhikhu Khola representative of future watersheds as market opportunities evolve within Nepal. Other issues requiring attention include monoculture versus biodiversity and high yield versus traditional varieties. Future work requires dissemination of information relevant to policy for specific applications. That information should be distributed to the professional development community, NGOs, HMG staff, the scientific community and, ultimately, the farmers. From a national perspective information sharing is vital. ICIMOD will aid with information dissemination through support of the workshop proceedings. Future work should focus on water, bari lands and specific versus integrated applications. Emphasis should be placed on Nepali researchers, Canadian research partners, students and farmers. Future partners include: regional research centres such as NARC, LARC and PAC; line agencies such as the Ministries of Agriculture, Forestry and Hydrology; Nepali educational institutions such as the Institute of Engineering and the department of Geology at Tribhuvan University; and NGOs due to their community focus. Institutions within the Hindu Kush Himalayan region could benefit from

collaboration and information sharing through coordination between member countries. Closer collaboration between the Andes, Himal and African Mountain researchers would also be advantageous.

Dr. John Graham, IDRC Singapore, thanked all participants, specifically input from HMG line ministries, regional research centres, other watershed studies, the Peruvian involvement, Swiss participants, ICIMOD and the study team. The research conducted in the Jhikhu Khola watershed is truly collaborative, including graduate students and farmer participation with 40-50 households actively involved in the project. IDRC's focus is on Research for Development with benefits to farmers both current and future. The Jhikhu Khola project has met this objective by combining excellent science with bottom up farmer participation. IDRC provides an internet link through the PAN-ASIA network to support information exchange with other research institutions and will include the results of the Mountain Resource Management (MRM) project. This will contribute to the knowledge base and open interaction with various agencies. There is a need for additional, comparative case studies and for long term research. Continued support for the MRM project by IDRC is proposed. The potential exists to link the MRM project with visitors from other countries and from within Nepal.