

Masrang Khola: The MSEC Benchmark Site in Nepal (Based from the Country Report)

Introduction

The kingdom of Nepal with an area of about 147,500 km² lies at the northern rim of South Asia. On the basis of physiography, geology, and geomorphology the country is divided into five major agro-ecological regions, commonly known as Terai, Siwalik, Middle Mountain, High Mountain, and High Himalayan regions. The middle mountain region occupying the largest land area of about 30% of the total has the highest population density per unit cultivated land. Even the marginal areas with steep and very steep slopes have been encroached for cultivation in order to feed the increasing population. Consequently the land resources have been overutilized.

Nepal is basically an agrarian country. Over two-thirds of the country's total land area is occupied by hills and mountains where the majority of the country's population live. Much of the country's land base is environmentally fragile and susceptible to erosion and degradation. Cultivation on sloping and terraced land is a common feature of the Nepalese hill agriculture. Over the centuries, Nepalese farmers have been adopting a system of land use compatible with their environment such as shifting cultivation. But such a traditional farming system has not been able to cope with the rapid growth of both human and livestock population.

Over the recent decades, degradation of land and mountain ecosystems has become increasingly widespread. The traditional farming system and cultivation on steep hill slopes have accelerated the rate of erosion and degradation. Agricultural productivity especially in the hills and mountains is declining due to the erosion of fertile surface soils every year. Therefore, there is an urgent need to develop suitable land management systems for sustainable agricultural production and environmental protection.

In Nepal, soil erosion has been identified as the major problem concerning sustainable agriculture in hill and mountain farming systems. It causes severe on- and off-site environmental, economic, and social impacts. It is, in general, realized that there is lack of (a) feedback mechanisms to alert producers to problems that may arise from their actions, and (b) strategies to deal with them within the time frame of normal on-farm decision making. These are the most critical barriers to the adoption of more sustainable practices in many countries. To overcome these problems, the Management of Soil Erosion Consortium (MSEC) Project has adopted a new research paradigm based on a participatory, interdisciplinary catchment approach. The three key elements of this approach are: the focus on on- and off-site impacts, the provision of scientifically sound information for decision-makers, and the involvement of the whole range of stakeholders from land users to policy-makers.

While the indigenous methods of hill farming in Nepal were designed to minimize erosion, population growth and strain on the land resources have led to intensification of agriculture generally at the cost of loss of nutrients and productivity in the long run. The challenge now is to introduce farming practices aimed at minimizing soil erosion and nutrient losses. Understanding the hydrological processes, the relationships between rainfall, runoff, and sediment and nutrient transport and the socioeconomic conditions of the farmers in the area is an important part of the research.

Benchmark Catchment

The criteria for site selection as recommended by the IBSRAM site selection mission were considered in the selection of the site in Nepal. The factors considered were its representativeness, replicability, accessibility, farmers' willingness to participate, availability of research facilities, size of the catchment, biophysical and socioeconomic characteristics, and peace and security situation.

Initially Dee Khola Catchment within the Likhu Khola Watershed in Nuwakot District in central Nepal was identified as the study site for the MSEC project in Nepal. But due to some problems, later, it was agreed to look for another catchment. The national team presented their recommendation during the MSEC assembly in 1999 in the Philippines. After several visits to and assessment of the recommended sites, the national team and IWMI finally decided to have the project at the Masrang Khola Catchment. Biophysical and

socioeconomic information were gathered through discussion with the farmers and key informants like the village head.

The catchment (Figure 1) has an area of 124 ha and represents the typical farming situation in the hills. The topography is moderately to very steep with 40 to 100% slopes. It is situated at 27°49' N latitude and 84°32'30" E longitude. It is located at Chandhi Bhanjyang V.D.C. Ward 9 and 8 of Chitwan District in Narayani Zone in Central Nepal. The catchment has elevation ranging from 650 to 1,400 m asl.

Biophysical characteristics

Climate

Climate in the area is subtropical to warm temperate. The average annual rainfall is about 2,337 mm, 85% of which falls from May to September (Table 1). The mean annual temperature is about 22°C with a maximum of 35°C in May and a minimum of 9°C in January (Table 2).

Soils

Soils in the area are, in general, well to excessively drained, sandy loam to loam in texture, and acidic in reaction. These soils are tentatively identified as Inceptisols, Alfisols, and Entisols (Soil Taxonomy, USDA, 1975). Organic matter and NPK contents are generally moderate to high.

Land use and cropping system

The cropping system in the upland area is corn as the summer crop followed by either millet, pulses, vegetables, mustard or potato as the winter

crop. In the lowland area, paddy is grown as the summer crop followed by fallow, wheat or spring corn as the winter crop.

Of the total cultivated area of 54 ha, about 80% is used for cereal crops, 7% for cash crops and 3% for fruit crops. The main source of irrigation is Masrang Khola. There are mainly two crops grown in a year. In case of 'khet' (lowland), only a single crop of paddy is grown as the summer crop and only a few farmers have recently started growing wheat as a winter crop after paddy. Some farmers have also grown spring maize on khet land before paddy. The other crops grown in 'bari' (upland) lands are maize, millet, buckwheat, mustard, and legumes. The overall cropping intensity is 147.

Socioeconomic characteristics

A summary of the socioeconomic characteristics of the site is shown in Table 3.

Population

The socioeconomic survey carried out in from March to April 2000 showed that there are 54 households and a total population of 354 persons in the area. The main ethnic groups are the Gurung, Gharti, Chhetri/Thakuri, and Brahmins. The average family size is 6.65 members.

The people depend mainly on agriculture for their livelihood. A total of about 54 ha of land are cultivated, 62% of which is on bari lands and 26% is khet land. The average farm size is 0.66 ha, 0.25 ha for khet and 0.62 ha for bari. Among the households, the average farm size of Brahman, Chhetri/Thakuri, Gharti, and Gurung are 0.71, 1.26, 0.94 and 0.97 ha, respectively. About one-fourth of the total land is occupied by marginal and smallfarm households which comprise half of the total farm households. Half of the land is under medium farm households and less than one-fourth is under the large holdings.

Given the limited opportunities for rural employment and low agricultural production, a few households have migrated to other adjoining villages. About 62.5% of the population, mostly from the Gharti and Gurung ethnic groups, travels to other districts for waged labour.

Land ownership

Land ownership in the area is classified into three groups: owned land, leased-in land, and leased-out land. About 78 and 94% of the total households own khet and bari lands, respectively. All the households have land ownership certificates according to land types. The leased-in land system is significantly high while leased-out land is comparatively low. Generally, farmers have to pay half of their produce as land rent. The rent differs according to the soil, location of land, and land types.

Agricultural production and income

The major crops grown are maize, millet, paddy, mustard, and legumes. Farmers give top priority to maize cultivation. According to them the biophysical condition is most suitable for this crop which is utilized as human food as well as cattle feed.

The average yields of maize, millet, and paddy are estimated to be 1,175, 867, and 2,257 kg ha⁻¹, respectively. Local varieties as well as improved varieties are used in the area. Weeding is commonly practiced and FYM is used for the maize crop along with urea topdressing. The average seed rates used in paddy, maize, and wheat are 84, 30, 115 kg ha⁻¹, respectively. About 70% of the total households has reported that their product is only enough for less than nine months of their annual food requirements. Only 6% of the total households (Chhetri and Gurung) has surplus food production.

Farmers reported that off-farm income contributes to fulfilling their food requirements during the deficit period. The average income from the farm represents on 41.4% of the total. About 59% of the income comes from off-farm activities. Income from crops and livestock is almost the same.

Livestock is also an important source of farm income to support farmers' livelihoods. On average, the households own 2.5, 3.5, 2.0, 5.2, and 9.7 head of buffaloes, cows, bullocks, goats, and poultry, respectively. The Gurung have more buffaloes, cows, bullocks, goats, and poultry than other ethnic groups. Almost all the farmers rear some cattle in the farming system and farmyard manure is the main source of plant nutrients added to the soil. Some chemical fertilizers like urea and di-ammonium phosphate are also used but mostly for the paddy crop. The majority of the farmers are not aware of soil conservation practices except for traditional methods of terracing and planting trees and grasses on their farmland. Most of the households live at the subsistence level. About 70% of the households is not able to support their family from their own farm produce

Table 1. Precipitation (mm) recorded at the ATSCFS project site, Paireni village, Chandi Bhanjyang VDC, Chitwan.

| Month | Year | | | | |
|--------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | 1996 | 1997 | 1998 | 1999 | Mean |
| Jan. | 63.04 | 32.00 | 0.00 | 8.00 | 25.76 |
| Feb. | 40.01 | 0.00 | 15.00 | 1.00 | 14.00 |
| Mar. | 44.00 | 23.00 | 53.00 | 3.00 | 30.75 |
| Apr. | 98.99 | 110.00 | 74.00 | 22.00 | 76.25 |
| May | 167.00 | 75.00 | 138.00 | 383.00 | 190.75 |
| Jun. | 401.00 | 266.99 | 274.00 | 374.00 | 329.00 |
| Jul. | 628.98 | 730.00 | 732.99 | 803.00 | 723.74 |
| Aug. | 425.00 | 431.00 | 741.99 | 691.98 | 572.49 |
| Sep. | 122.00 | 235.00 | 253.99 | 399.00 | 252.50 |
| Oct. | 115.00 | 35.00 | 64.00 | 79.00 | 73.25 |
| Nov. | 0.00 | 13.00 | 0.00 | 1.00 | 3.50 |
| Dec. | 0.00 | 178.94 | 1.00 | 1.00 | 45.24 |
| Total | 2,105.02 | 2,129.93 | 2,347.97 | 2,765.98 | 2,337.23 |

Table 2. Meteorological records (average of 4 years, 1996–1999), taken from the ATSCFS project site, Paireni village, Chandi Bhanjyang VDC, Chitwan.

| Month | Solar Rad. (MJ m ⁻²) | Max. temp. (°C) | Mini temp. (°C) | Mean temp. (°C) | Mean Soil temp (°C) |
|-------|-------------------------------------|--------------------|--------------------|--------------------|------------------------|
| Jan. | 7.34 | 18.93 | 9.44 | 13.3 | 11.65 |
| Feb. | 12.52 | 24.01 | 11.68 | 16.76 | 13.42 |
| Mar. | 16.88 | 29.50 | 15.41 | 21.71 | 17.07 |
| Apr. | 23.52 | 33.74 | 19.44 | 25.74 | 21.05 |
| May | 25.38 | 35.00 | 21.63 | 27.30 | 24.17 |
| Jun. | 21.81 | 34.32 | 23.38 | 27.86 | 25.58 |
| Jul. | 17.54 | 33.13 | 24.21 | 27.19 | 25.04 |
| Aug. | 17.54 | 32.70 | 24.04 | 26.92 | 25.06 |
| Sep. | 17.60 | 32.59 | 23.16 | 26.33 | 24.29 |
| Oct. | 14.05 | 29.16 | 19.37 | 22.83 | 21.01 |
| Nov. | 9.66 | 24.25 | 15.25 | 18.40 | 16.44 |
| Dec. | 5.47 | 18.80 | 11.07 | 13.82 | 12.36 |

Table 3. Socioeconomic information of Masrang Khola

| Parameters | Simple variables | Number |
|-----------------------|-------------------------------------|------------------------|
| Demography | Total no. of households | 54 |
| | Population | 356 |
| | <15 years | 148 |
| | 15–60 years | 185 |
| | >60 years | 23 |
| | Male | 182 |
| | Female | 172 |
| Ethnicity | Brahman | 35 |
| | Chhetri/Thakuri | 73 |
| | Gharti | 81 |
| | Gurung | 165 |
| | Religion (HH no.) | |
| | Hindu | 38 |
| | Buddhist | 16 |
| Agricultural land | Total cultivated area (ha) | 53.55 |
| | Average farm size | 0.66 |
| | Khet | 0.25 |
| | Bari | 0.62 |
| Land utilization | In percentage | |
| | Cereal crops | 80 |
| | Cash crops | 7 |
| | Fruits | 3 |
| | Forest/pasture | 10 |
| Area and productivity | Maize | |
| | Area (ha) | 28.12 |
| | Productivity (kg ha ⁻¹) | 1176 |
| | Paddy | |
| | Area (ha) | 9.38 |
| | Productivity (kg ha ⁻¹) | 2257 |
| | Millet | |
| | Area (ha) | 2.27 |
| | Productivity (kg ha ⁻¹) | 867 |
| Input use | Paddy | Kg |
| | Seed | 84 |
| | Urea | 1.67 |
| | Di-ammonium phosphate | 1.0 |
| | Farmyard manure | 541 |
| | Maize | |
| | Seed | 30 |
| | Farmyard manure | 1438 |
| | Wheat | |
| | Seed | 115 |
| Urea | 7.0 | |
| | Farmyard manure | 456 |
| Food situation | | HH no |
| | <4 months | 3 |
| | 4–6 months | 18 |
| | 6–9 months | 19 |
| | 9–12 months | 10 |
| | Surplus | 3 |
| Livestock | | Average livestock herd |
| | Buffaloes | 2.5 |
| | Cow/calves | 3.5 |
| | Bullocks | 2.0 |
| | Goats | 5.2 |
| | Poultry | 9.7 |

| | | |
|-------------|--|---|
| | Milking Cows Buffaloes | Av milk produced per month in litres 47.4 84.0 |
| Credit | Source (%) Formal Informal | 70 30 |
| Cash income | Sources in % Crop products Livestock products Off farm | 21 21 58 |

Figure 1 Masrang khola Catchment with Microcatchment

