*Research article*

# Farmers' Perception on Existing Problems of Soil Fertility Management in Mid-Hills of Nepal

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**Abstract** Maintaining soil fertility is essential for prosperity and sustainability of any agricultural system. Nepal is facing major issues in maintaining soil fertility in agriculture sector mainly in mid-hills. Mid-hills, which accounts for more than 37% of total agriculture land has upland terrace farming system, which is intensively cultivated, with high labor input and high degree of subsistence. With the rise in population and increase in food demand soil fertility management is essential. The farmers are engaged in traditional farming practices which has evolved into complex system where livestock, husbandry, crop production, forestry are practiced together. The undulating topography, climatic condition, unavailability of fertilizer is some of the key factors causing land degradation and low productivity. Accordingly, the objective of this study is to identify farmers' perception on existing problems of soil fertility in mid-hills of Nepal. This study was conducted on the basis of questionnaire surveys and field visits. Questionnaire surveys were conducted among households in eastern mid-hill region of Dhankuta District, Nepal. The results showed that farmers possessed indigenous knowledge for identifying and characterizing fertility of soils. Farmyard manure was used widely in maintaining soil fertility. Generally, farmers responded that soil erosion and low fertility was major problems faced in agriculture. Lack of resources and proper soil and management strategies was the main cause of the problem resulting in soil degradation and thus nutrient loss and decrease in productivity. To overcome such problems scientific approach on understanding the physical and chemical characteristics of soil should be applied to propose suitable sustainable conservation practices.

**Keywords** Nepal, mid-hills, soil fertility management, soil erosion, land degradation

## INTRODUCTION

Soil fertility is the ability of soil to receive, store and transmit energy to support plant growth. It is important component for overall development of plants and crop productivity. For an agrarian economy maintaining soil fertility is very important to sustain agriculture.

Nepal is a small agrarian country, which lies in South Asia and is divided into 3 major physiographic regions, mountains, mid-hills and the lowlands. The mid-hills region of Nepal consists of 37% of total land area with rugged mountain topography and the altitude can vary considerably with a short horizontal distance. Thus, the mid-hills include deep river valleys well below 1000 m, and the nearby ridges can rise to more than 3000 m. Accordingly, climate and vegetation shows great vegetation over a very short distance, and give rise to great ecological diversity and complexity. In general, farming is rain-fed which is traditionally practiced in innumerable terraces. The terraced farms are not properly maintained and are extensively cultivated. Farming in mid hills is a complex system characterized by crop production, livestock, and forestry; where forests provides bedding material and fodder for livestock, which in turn provides with draft-power and manure. Depletion of soil nutrients, water shortage and soil erosion are some the main cause for land degradation. Due to the topography and economic conditions of the farmers access to chemical fertilizers and other

technologies are very limited. Soil fertility is largely maintained through the application of compost and manure but in recent years a decline in soil fertility has been reported (Shrestha et. al., 2000). Even though over the years, research in enhancement of soil fertility and conservation has been done (Keatinge et al., 1999; Acharya et. al., 2000) and in addition significant amount of relevant indigenous knowledge has been recorded (Thapa et. al., 1997), there has been decrease in soil fertility and is a major concern for the farmers (Turton et. al., 1995). There has also been limitation of farmers in adoption of new techniques by farmers (Shrestha et. al., 2000).

Therefore, the objective of this study is to discuss the understanding of farmers' perception on soil fertility, soil management and conservation strategies in the research site.

## METHODOLOGY

### Site Description

This study was conducted from September to November 2016 in 5 different VDC (Village Development Committees) of Dhankuta district. The five VDC were Dandabazar, Budhimorang, Pakhribas, Hattikarkha and Batah. These VDC were chose on the basis of agricultural land area, population engaged in agriculture and agricultural productivity importance The topography of Dhankuta district is hilly with minimum elevation at 120 m to highest at 2702 m. Dhankuta district is a major agricultural region with more than 83.45% of people engaged in agriculture whereas the national average is 65.6%. The agricultural land has been categorized into khetland (irrigated lowlands) and bariland (upland) and the district's major crops are maize, paddy, wheat, potato, millet, legumes, ginger, tea, cardamom, sugarcane, vegetables, orange etc. depending on the type of land. Livestock forms an important part of agriculture with different animals like cows, buffalo, pigs, goat, sheep, chicken etc. been reared. Livestock is an important income source and makes significant contribution to GNP in agricultural sector. The soil of the district is defined as the alluvial, residual and clay mixed sandy soil according to the elevation as well as the topographic physiology**.**

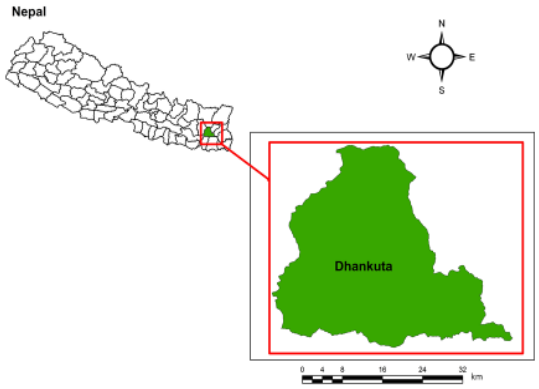


**Fig. 1 District map of study area**

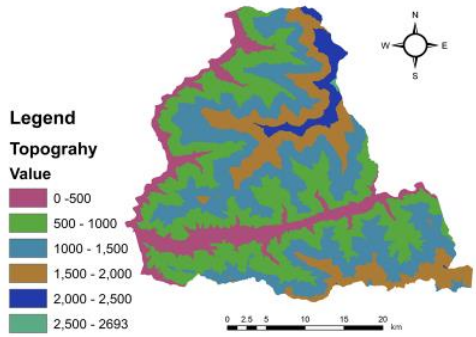


**Fig. 2 Topography map of study area**

**Table 1 Topography distribution of study area**

| Elevation (m) | 0-500 | 500-1,000 | 1,000-1,500 | 1,500-2,000 | 2,000-2,500 | 2,500-2,693 |
|---|---|---|---|---|---|---|
| Area (ha) | 11823 | 30998 | 29002 | 13915 | 13.31 | 78 |
| Area (%) | 13.31 | 34.91 | 32.66 | 15.67 | 3.36 | 0.09 |

### Household Interviews

Interviews were conducted in five VDC of Dhankuta district. Total of 35 farmer representatives of 5 villages were selected for the interview. To minimize the errors due to possible lack of knowledge in managing the fields, only those farmers who owned the field were interviewed excluding farmers working in rented fields. Questionnaire was designed to understand farmers` perception on fertility of soil, soil fertility management and problems faced in agriculture and conservation practices.

In this study descriptive statistics, graphic analysis and simple tabulation were used to summarize the data observed.

**Table 2 Questions in the questionnaire sheet**

| Category | Related questions | Details |
|---|---|---|
| Basic information of household | -General information | Name, Age, Gender, Numbers of family members and Address |
| Farmers' perception of soil fertility | -Degree of soil fertility | Physical characteristics (color, hardness etc.) |
| Crop cultivated | -Types of crop | Rice, wheat, maize, tubers, vegetables |
| Water resources | -Source of irrigation water | Rainwater, river, springs, groundwater |
| Soil fertility practice | -Kinds of practice | Fertilizer, farmyard manure, compost, green manure etc. |
| Soil degradation | -Soil erosion effect<br>-Severity | Decrease in land productivity, nutrient loss, sediment yield |
| Soil erosion management | -Erosion management practices and conservation measures | Terracing, buffer strip, mulching etc. |

## RESULTS AND DISCUSSION

### Problem of Soil Erosion and Soil Erosion Management Practices

According to Turton et. al., (1997) soil erosion is one of the major causes that threaten soil sustainability in Nepal. Also, soil loss through surface erosion from hilly agricultural land varies from less than two tons per hectare per year to a high soil loss of 105 tons per hectare (Acharya et. al., 2007). Due to mountainous physiography, poorly managed sloppy terraces, and degraded rangelands, erosion on these lands are highest. Interviews with the farmer shows different problems faced in agriculture in the research site (Fig. 3). 45% and 25% of respondent answered that soil erosion and low fertility respectively were the major problem faced. Other problems such as, landslide, disease and pest were also observed. Annual loss of soil from soil erosion in Nepal is estimated to range between 182 to 708 ton/year (MOEST, 2006). The forest area has been converted into degraded lands and the vegetation cover is extremely low in some areas. Also, landslides are common phenomena in the geologically fragile hills thereby increasing the area of degraded lands.

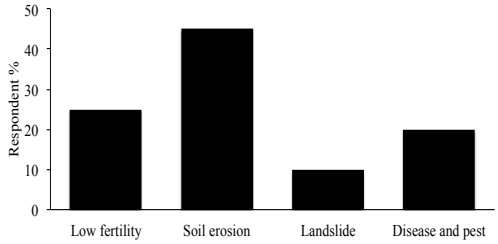


**Fig. 3 Different kinds of problems faced**

Figure. 4 show farmers perception on the severity of soil erosion in the research site. The results show that severity of erosion is not alarming. But, the study of Turton et. al., (1997) suggested that although farmers responded unchanged or increased soil fertility, soil analysis showed critical level

of soil fertility. Therefore, there is need to know the amount of erosion and the factors contributing to it so that required conservation strategies could be applied. Most of the respondent answered that soil erosion led to decrease in productivity followed by soil degradation, nutrient loss and sediment yield (Figure. 5)

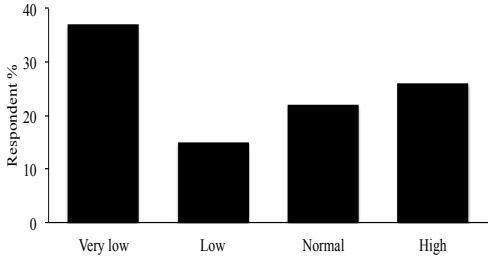


**Fig. 4 Severity of soil erosion**

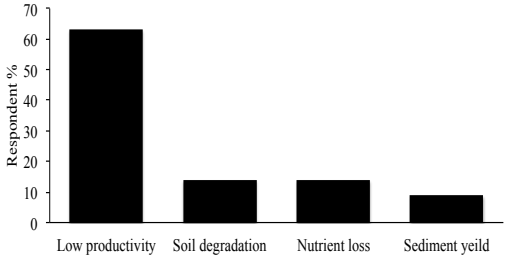


**Fig. 5 Effects of soil erosion**

High soil erosion and low fertility can be result of soil conservation and soil fertility management practices. Farmers did have the concept and understanding of soil erosion and practiced various soil erosion management practices (Fig. 6). Due to topography, 69% of the farmers replied that they were practicing terrace farming where steep slopes were converted into terraces. These slopes were not properly made and managed which further increases the possibility of soil erosion.

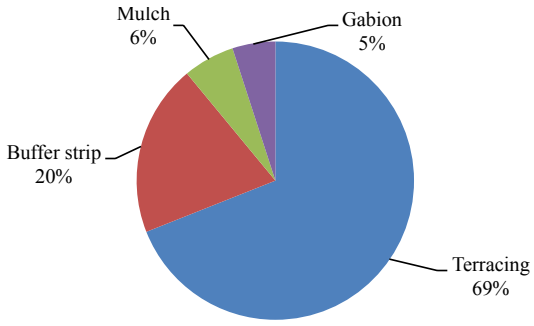


**Fig. 6 Soil erosion conservation practices**

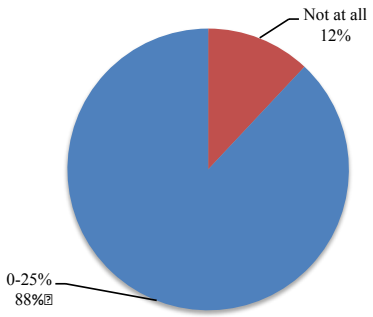


**Fig. 7 Land area under conservation**

Farmers also practiced the construction of buffer strips to minimize the soil erosion and loss of nutrients. Mulching using crop residues were also observed. Most of the farmers understood the importance of conservation of their fields, but only small part of their fields was under conservation. 88% of farmers replied that they have some kinds of conservation strategies applied in 25% of their land area, whereas 12% replied that they did not had any conservation methods applied (Fig. 7).

The reason for low conservation practices can be related to weak economic conditions, lack of knowledge and training in conservation strategies among the farmers. When asked, only 23% of the farmers had any or some kind of training participation in conservation strategies.

## Dependence on Rainwater

Water is an essential factor in maintaining soil fertility and increasing the productivity. Nepal is rich in water resources with series of rivers and streams flowing down from the mountains, but due to lack of infrastructures farmers have to depend on rainwater for agriculture. 60% of farmers replied that they were dependent on rainwater for irrigation (Fig. 8). Dhankuta district receives an avg. rainfall of 2100 mm with rains at peak between the month of June and July (Fig. 9). Apart from the rainy season there is scarcity of water. Erratic pattern of rainfall is also a concern for the farmers. Water conservation strategies should be adopted for supply of water during the dry seasons.

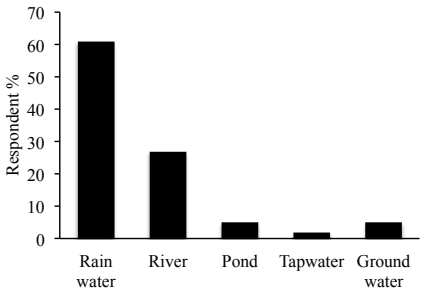


**Fig. 8 Different sources of irrigation water**

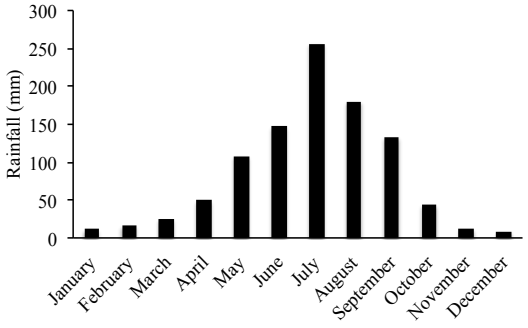


**Fig. 9 Average annual rainfall** (1989-2016, DHM)

## Soil Fertility Management Practices

Farmers indicated using conjunction of farmyard manure (FYM) and chemical fertilizer as a major supplement for managing soil fertility. Other practices, such as green manure, legumes were also used (Fig. 10). Farmers for making farmyard manure used indigenous method. Table 3 shows the amount of FYM applied, application frequency and preparation period of FYM. Farmers used leaves, shrubs, and other organic material together with crop residues and bedding material to make farmyard manure. Manure from cows, buffaloes, pigs, goat, poultry were widely used. Due to deforestation and lack of fodder for the livestock, the quality and the quantity of farmyard manure have decreased. Also, the amount of farmyard manure applied was directly related to the number of livestock owned. The improper handling and making of farmyard manure has resulted in loss of nutrients. Shrestha et. al., (2009) suggested that soil fertility is largely maintained through the application of compost and manure but in recent years a decline in soil fertility has been reported. Also, improper handling of manure can lead to environmental and health problems through surface runoff and leaching of nutrients and pathogenic microorganism (Ishikawa et. al., 2012).

The most common form of chemical fertilizers used were urea and DAP (Di-Ammonium phosphate). Although farmers considered chemical fertilizers easy to transport, store and use, cost and availability was a major concern. Farmers were unaware of appropriate timing and amount of fertilizers applied.

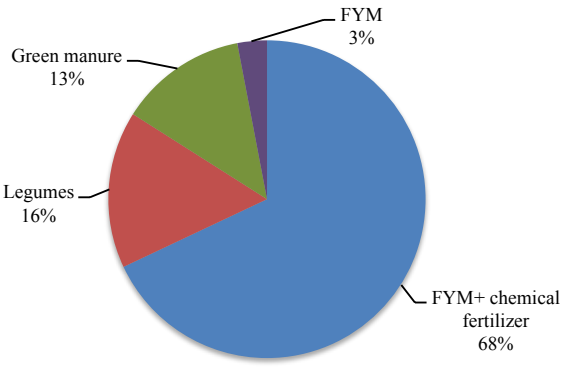


**Fig. 10 Different soil fertilizer application**

**Table 3 Respondent % for application amount, frequency and preparation period of FYM**

| FYM (ton/ha) | | Application of FYM | (times/year) | Preparation period | |
|---|---|---|---|---|---|
| Less than 1 ton/ha | 55% | 1 time/year | 20% | 3 months | 10% |
| 1-2 ton/ha | 18% | 2 times/year | 60% | 6 months | 61% |
| 2-3 ton/ha | 20% | 3 times/year | 17% | 9 months | 19% |
| Not available | 7% | 4 times/year | 13% | 12 months | 10% |

## CONCLUSIONS

Soil erosion was a major problem faced by farmers, which led to depletion of nutrients, thus decrease in productivity. Farmers used various kinds of soil management practices with farmyard manure the most dominant kind. Improper handling in preparation, storing and application resulted in low productivity. Farmers were also using chemical fertilizers, but it was restricted to availability and economic condition of farmers. Landslides, sediment yields diseases and pests were other problems, which existed. Soil conservation strategies were performed, but in very small portion of the field. Lack of irrigation facilities and dependence in rainwater was major concern. All this conditions had effect on the productivity. To better understand and overcome such problems scientific approach should be applied and suitable sustainable conservation practices should be proposed.

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