Chapter 1

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Generally tropical soil is low in nutrients and depends on nutrient cycling from organic substances. There is a complex relation among biological, chemical and physical properties of soil which regulates the turnover rate of various organic matters. The change of land use management practices influences the rate and amount of organic matter loss (Guggenberger et al., 1994, 1995). A reduction of 20–50% soil organic matter (SOM) has been reported by Sombroek et al. (1993) as a result of clearing tropical forests and their subsequent conversion into farm land. Shifting cultivation is one of the major causes of destruction of forest in north eastern India. Despite the existence of various resource protection programmes, forest degradation is continuing unabatedly mainly to meet the growing requirements (food, fodder, shelter) of the ever increasing human population. According to Jordan (1985) and Brouwer and Riezebos (1998) the consequences of logging, slash-and-burn, annual crops and perennial tree crops on natural tropical forests are, (i) decrease of biomass bound nutrient stock due to nutrient uptake by crops, (ii) export of nutrient with harvesting and burning; (iii) disturbance of internal nutrient cycle with loss of organic litter layer and root mat and therefore higher nutrient leaching, (iv) decrease of soil organic matter, cation exchange capacity and available soil nutrients for plants, (v) soil erosion and degradation of the humus horizon and (vi) decrease of evapo-transpiration.
Arunachal Pradesh, the largest biodiversity rich state in the north eastern India, is bestowed with a highly rugged hilly environment receiving high rainfall. The local people of Arunachal pradesh mainly depend on the sloping land agriculture, particularly shifting agriculture (locally called 'jhum kheti'). The jhum cultivation with long fallow period of about 20 to 30 year after one or two cropping was a sustainable cultivation system. The length of fallow was enough to regenerate the soil quality to support economically viable agricultural production. But the agricultural system became a hazardous one in recent decades due to over exploitation of these ecologically fragile systems, where the jhum cycle has been reduced to 4 to 5 years or even less than that. Besides jhum, there is another cultivation system practiced by the hill farmers in the terraced land on the lower part of hilly slopes where irrigation is possible by redirecting the natural water canals coming down from the upper part of the hill. Locally the cultivation system is known as ‘Pani Kheti’. In these terraces, wetland paddy is mono-cropped once in a year and the nutrient washout from the upper part of hills enriches this system. There are few more land use systems came into existence in this region through Government initiatives particularly as options to rehabilitate the abandoned jhum lands, viz. agroforestry and horticultural system. The study in these ecological interventions in terms of productivity and soil quality are scanty. However, the food production systems are not managed properly and therefore, people often encounter low production. The growing human population has again put pressure on the forests, and also increased the demand for food. Thus, the
people are looking for a sustainable food production system. In this regard, the State Government of Arunachal Pradesh is taking much effort on reducing shifting cultivation, for which several agroforestry and horticultural interventions have been recommended. Several studies have been conducted in various parts of the world to assess the feasibilities of more closely linking inputs and outputs in agricultural systems, particularly in a holistic landscape context, for sustainable productivity (Brown et al. 1994). For instance, Woomer and Swift (1994) reviewed the fertility status and management of tropical soils and concluded that the synchronization of nutrient release (mineralization) and nutrient demand by the crops are of importance in soil fertility management for sustainable agriculture in the humid tropics. They have also suggested several strategies of biological management of soil fertility. Recently organic farming has been introduced that avoid using chemical fertilizers for soil nutrient management, in which crop residue management could be useful in avoiding toxicity of fertilizer in the long-run (Kumar and Goh, 2000). However, any effort of organic farming could prove substantial only after identifying the crop residues that has rich nutrient content and faster decay rates and that should not have any allelopathic effect. The soil factors play a much important role in enriching plant diversity in an area and vice-versa. Every species in an ecosystem has its own way of reacting to the soil reactions, resulting in a wide variation of soil nutrient distribution patterns, which again influences the growth of microbial population and other soil living organisms.

In abandoned ‘jhum’ lands, poor soil nutrient status results in reduced
agricultural productivity and takes number of years to recover to the pre-
disturbance nutrient conditions. Many rehabilitation measures have been
suggested for the rehabilitation of abandoned jhum lands i.e. terrace cultivation,
horticulture, agroforestry etc. However it is necessary to understand the effects
of these changed land uses on soil quality in order to effectively rehabilitate the
degraded sites for providing sustainable livelihood to the hill farmers.

The present study is to characterise the fertility status of top soil as affected by
shifting cultivation and different other land use systems to determine the impact
of the suggested alternative land use systems for the rehabilitation of jhum
lands in Arunachal Pradesh. The research was carried out also to understand the
feasibilities and suitability of the crop residue management for sustainable
production in this sloping land agriculture, particularly in abandoned jhum
areas as a rehabilitation measure of the degraded land.

The study had the following specific objectives:

- To estimate the plant/crop diversity and soil nutrient enrichment
  patterns involved in ecological interventions like terracing,
  agroforestry and horticulture in abandoned jhum lands.

- To characterize the quality, decomposition and nutrient release
  patterns of various crop/plant residues and their recycling for soil
  organic matter and nutrient build-up in soil.

- To evolve appropriate strategies for the maintenance of soil fertility
  to ensure sustainable production in rehabilitated jhum lands.