CHAPTER VI

General discussion

One of the important ecodynamics of shifting cultivation is the succession of different plant communities and their species composition and soil nutrient status during the fallow period. The vegetation developing during fallow period covers the soil and facilitates cool temperature of the soil. During the fallow period, the fallow land gradually undergoes phytosociological as well as soil fertility changes. Provided the fallow periods are long enough, a shifting cultivation system proves to be in no way harmful to the soil (Ruthenberg, 1983).

A comparative phytosociological studies of the vegetation on young (6-year old) and old (20-year old) jhum fallows clearly depicted that the shorter the jhum cycle, the lesser the dominance and the greater the species diversity (Table 2.9). More tree species with lesser number of shrubs, saplings and herbs characterized the 20-year old jhum fallow vegetation, whereas a 6-yr. old jhum fallow is characterized by lesser number of tree species with more shrubs, saplings and herbs. However, a close physiognomic similarity seems to exist between young and old jhum fallows because *Melocanna bambusoides* is dominant in both fallows. This species is one of the important components of secondary successional communities developing on jhum fallows in most part of Mizoram and its replacement by tree species requires a long period as evident from its dominance on both 6-yr. old as well as 20-yr. old jhum fallows.

Subsequent to burning of fallow vegetation, pH of the upper soil layer increases (Table 5.1). The increase in pH due to burning is also reported by Lal & Cummings (1979) and Ramakrishnan & Toky (1981). Dramatic increase in exchangeable potassium, calcium and magnesium was also evident especially on the older jhum fallow. Available phosphorus also increased slightly. Young & Golledge (1948) observed that the ash formed by burning of plant cover supplies Ca P, K, Mg and S to the soil. As reported by Corbet (1934), ash of plants is generally very rich in potassium. The decrease in organic carbon after burning especially at the upper (0-10 cm) layer of soil may be attributed to high intensity of fire which depletes organic carbon. This is in conformity with the earlier report by Ramakrishnan & Toky (1981) who studied soil nutrient status after slash and burn agriculture in Meghalaya. Lal & Cummings (1979), however, reported that organic matter in soil is not affected by burning of vegetation.

A net loss of carbon after first year of cropping was also reported by other workers (Jha et al., 1979; Nye & Greenland, 1964; Zinke et al., 1978). Jou & Lal (1977) concluded that the depletion of organic matter depends upon the intensity of cropping, type of vegetation and the ratio of cropping to fallow period. With optimum cropping and fallow period, the humus in the soil could be maintained at a relatively high level even after many years of shifting cultivation (Birch & Friend, 1956; Coulter, 1950; Reed, 1951).

Like organic carbon, the total soil nitrogen content also declined after burning. The decrease in soil nitrogen was less prominent in younger (6-yr. old) jhum fallow, which may be attributed to lower intensity of fire because of smaller quantity of slash available for burning on this jhum fallow. Under longer jhum cycle, the build up of nitrogen was greater during the fallow period, and due to thicker pre-jhuming vegetation, the soil experienced a high intensity burn, resulting in greater loss of nitrogen through volatilization from the surface soil as also reported by other workers (Normann & Wetselaar, 1960; Rosswall, 1980; Ramakrishnan & Toky, 1981). However, an increase in total nitrogen was observed from the last sampling (i.e. after crop harvest) during the first year of cropping to first sampling (i.e. before burning) during the second year of cropping. This may be due to the decomposition of litter contributed by the weed and crop plants that grow during the first year of cropping.

A comparatively higher status of the soil in older (20-yr. old) jhum fallow during first year of cropping is due to the presence of thicker pre-jhuming vegetation cover which conserves and builds nutrients in the soil. The present study depicts the importance of jhum fallow vegetation in determining the nutrient status of the soil expressed mainly through litter accumulation and burning operation. Ruthenberg (1983), also reported that in humid and semi-humid climates, where there was thick vegetation cover, the main store house of nutrients is not the soil but the standing biomass. Thus, the general principle of shifting cultivation may be formulated that fallow vegetation cover reduces leaching and stores nutrients which are made available to crops to a significant degree through their rapid transformation brought about by burning.

Initially during the cropping season, the total biomass is more or less equally partitioned between crop and weeds (Table 4.3). The contribution of weeds to total biomass declined with the passage of time presumably due to suppression in weed growth due to luxuriant growth of the crop. Another cause of decreased contribution by weeds is their removal from the fields during weeding operation. The bulk of the standing biomass was contributed by the crop as jhum fields provided the conditions for more vigorous growth of the crop plants compared to the weeds as the agro-ecosystems are always manipulated in favour of crops. The production of much reduced weed biomass in the plots which recorded greater crop biomass (Table 4.3) also lends support to this argument.

The productivity of crop plus weeds was considerably higher in 20-yr. old jhum fallow than in 6-yr. old jhum fallow which indicates that the longer the jhum cycle the greater is the productivity (Table 4.6).

During the second year of cropping, among the treatments which were tried with a view to suggest innovation methods over the existing shifting cultivation, the application of chemical fertilizers was found to be most favourable as revealed by crop production in the chemical fertilizer treated plots in both 6-yr. and 20-yr. old jhum fallows (Table 4.5).

As revealed by energetic and productivity studies, jhum cultivation on the 20-yr. old fallow gives better return than on 6-yr. old fallow. The greater crop biomass accompanied by lower weed biomass, better crop yield and greater energy efficiency of 20-yr. old fallow during first year of cropping, as compared to 6-yr. old jhum fallow signify the role of longer jhum cycle in regenerating the system making it more productive and efficient. The decline in crop yield with shortening of jhum cycle has also been reported by other workers (Ramakrishnan & Toky, 1981; Ruthenberg, 1983).

A more or less equal soil nutrient status on both young and old jhum fallows during second year of cropping is due to the greater utilization of the soil nutrients brought about by vigorous growth of plants (both crop and weeds) and better crop yield on the older fallows. Comparatively greater biomass production on older jhum fallow depicted greater nutrient uptake which narrowed down the difference between the nutrient status of the two fallows that existed during the first year of cropping. Thus, from the energetic and productivity point of view, the 20-yr. old jhum fallow was only marginally better than the 6-yr. old jhum fallow during second year of cropping.

Effect of land tilling

Comparatively low crop yield and decrease in biomass production and energy efficiency on the tilled sub-plots on both jhum fallows during second year of cropping may be attributed to an increased loss of soil nutrients through erosion as a result of adverse effect of tilling on physical structure of soil. A study of the physico-chemical characters of the soil revealed comparatively low concentration of various elements in the tilled sub-plot. The inherent soil fertility level, after a year of cropping was drastically reduced by the end of second year cropping. The present study revealed that low crop yield, less biomass production and less energy efficiency is due to loss of soil nutrient through erosion in all sub-plots particularly, the tilled sub-plot where erosion was most severe. The high energy input on tilling operation brought down the output : input ratio in terms of money and energy. Data revealed that land tilling during second year of cropping as a means to improve the existing shifting cultivation practice in Mizoram is not a sound proposition and hence cannot be recommended as an innovative approach.

Effect of fertilizers

A comparatively better crop yield and greater biomass production with high monetary output : input ratio was achieved through the artificial addition of the chemical fertilizers during second year of cropping. The treatment also ensured that there was not much decline in the soil fertility of the jhum fallow after one year of cropping subsequent to the first year of cropping. However, the ouput : input ratio in terms of energy is very low due to high energy value of chemical fertilizers. The results of the present study clearly indicate that the addition of chemical fertilizers after the first year cropping, could be a promising means of innovating the traditional shifting agriculture system in Mizoram from the productivity point of view.

Effect of farm-yard manure

Addition of farm-yard manure increased crop yield and biomass production, and maintained the inherent capacity of the soil to some extent. The output : input ratio in terms of money is also quite high, but in terms of energy it is a bit low, though not as low as observed in the sub-plot treated with chemical fertilizers. Thus application of farm-yard manure to the jhum field during second year of cropping could be strongly recommended as a means to improve shifting cultivation in Mizoram, especially in view of the fact that it is easily available in sufficient quantity.

Effect of chemical fertilizers plus farm-yard manure

The sub-plots treated with a combination of fertilizers and farm-yard manure gave a higher crop yield (Table 3.5), but the output : input ratio of energy was comparatively very low. On account of low energetic efficiency of such plots which received both chemical fertilizer and farm-yard manure, this treatment may not be recommended as a means of improvement in the existing shifting cultivation in Mizoram. However, if the increase in crop yield is the sole consideration, this too could be given a fair trial.

On the whole, the 20-yr. old jhum fallow is more responsive to the various treatments than 6-yr. old jhum fallow during second year of cropping. The application of fertilizers and/or farm-yard manure on the jhum fallows during second year of cropping promised good returns and thus, the cultivation of jhum fallow just for one year which is commonly practiced in Mizoram could be replaced by a practice whereby the same jhum fallow could give good return at least for two successive years and this can be achieved only by following the innovative approaches indicated above.