

Agriculture related problems of land degradation in Meghalaya, India.

B. K. Tiwari¹ and M. B. Tiwari²
1-Centre for Eco-Development
North-Eastern Hill University, Shillong 793 014
2-Department of Botany
St. Mary's College, Shillong 793 003.

Introduction

Agriculture has contributed remarkably to changes of environment in the tropics. These changes are more evident in hill regions like Meghalaya where they are manifested in the form of land degradation and desertification (Ram and Ramakrishnan, 1988). In most parts of the state, destruction of forests has reached the proportions of ecological crisis. The ecological consequences of these destructive processes are manifold: soil erosion, changes of vegetation composition, loss of genetic resources, increased run off and siltation of water bodies. More than 10 percent of the total area of the state is barren and uncultivable wasteland. This area is composed of stoney barren hillocks and high grounds which cannot be used for any productive purpose with the present economic and technological capability. However, the fallow lands and cultivable wastelands can be reclaimed for agriculture, if suitable scientific measures are adopted.

Wastelands in Meghalaya 2

Cultivable wastelands constitute about 20 percent of the total land area of Meghalaya. Compared to the other north-eastern states, the area under this category is highest for Meghalaya. The total area under fallow at any time is about 14 percent, whereas total area sown is only about 8.5 percent (Table 1). The state has a large portion of fallow and cultivable wastelands which together account for about one third of the total land area of the state. These lands can be brought under agriculture if proper scientific and technological innovations are applied which may provide tremendous impetus to the agriculture based economy of the state, as more than 60 percent of the state's income comes from primary agriculture.

Table 1 : Land use in Meghalaya*

Wastelands	—	10%	
Cultivable			
Wastelands	—	20%	
Fallow Land	—	14%	Current fallow — 3% other fallow — 11%
Net area sown	—	8.5%	
Forest	—	36.1%	
Other use	—	12%	

*Source : Department of Agriculture, Government of Meghalaya report, 1981-82.

Shifting cultivation

Shifting cultivation locally known as 'jhum' is a primitive land use system practiced by over 250 million people in the tropical regions of the world (FAO/SIDA, 1974). Shifting

cultivation follows five stages : site selection, clearing, burning, cropping and fallowing. Generally, the cropping period varies from one to three years and fallow period from fifteen to twenty years. Crop productivity drops year after year due to fertility loss and weed infestation, forcing the shifting cultivators to move to new pieces of land. The abandoned site regains its productivity during the fallow period and the farmer returns to the site. Traditionally, fallow period was long enough to restore soil fertility and the area under shifting cultivation used to be only a small fraction of the total land area. Most of the uncultivated lands were covered by natural forests, and therefore, shifting cultivation continued as a sustainable farming system in the region. Over the years, largely due to increased population, the fallow period in most areas is reduced to 5-7 years (Table 2) resulting in an inadequate regeneration of soil and development of vegetation. The 'modified' system of shifting cultivation with reduced fallow period impoverishes and degrades soil, water and genetic resources, and is, therefore, ecologically unsustainable.

The total area under shifting agriculture in 1974 was 87,500 hectares which was reduced to about 62,400 hectares in 1982 (Department of agriculture, Government of Meghalaya report, 1981-82). Although at any moment of time, not more than 3% of the total area of the state is under shifting cultivation, it is affecting as much as one third of the total land directly or indirectly. Some relevant data on shifting cultivation in Meghalaya is given in table 2.

Table 2 : Shifting Cultivation in Meghalaya*

Geographical area of Meghalaya	22429 sq. km.
Annual area under shifting cultivation	530 sq. km.
Fallow period	5-7 years
Minimum area under shifting cultivation at one time or other	2655 sq. km.
Population dependent on shifting cultivation (Census 1981)	2,56,947

Source : Task Force Report on Shifting Cultivation, Ministry of Agriculture, Government of India 1983.

In case a fallow land is abandoned for a long period, it can regenerate and regain its fertility status. However, in many areas these fallow lands are put to intense grazing by domesticated cattle and goats. The grazers arrest growth of vegetation, reduce water percolation due to trampling, thus increasing run off, which further accelerates soil erosion. In the absence of grazing pressure on fallow lands, the vegetation develops faster covering larger surface of soil in lesser time, and the erosion losses are significantly reduced. Thus one of the important factors contributing to land degradation is the unscientific grazing of the hill slope lands. There is an urgent need to regulate the population of free grazing animals. A ban on this will go a long way towards restoration of degraded lands and conservation of land resources. A part of the community land may be converted into grassland for community grazing. Guinea grass (*Panicum maximum* Jacq.) and buffel grass (*Cenchrus ciliaris* L.) have great potentiality for this purpose (Maass et al., 1988). The distribution of grasslands interspersed with the cultivated fields in a mosaic fashion will check the loss of soil as parts of the sediment and nutrient loss from

cultivated fields may be retained by the grasslands.

The first effects of land degradation are manifested in the form of reduced income of farmers from the land i. e. low productivity. At its severest, erosion causes a total collapse of agriculture, migration of people and abandonment of land. Case studies highlighting these ill effects are available from Afghanistan, North West India, Africa, Tropical America and Latin America (Stoking, 1988). The severe disruption of Nepal's economy is interesting because it is relatively well documented and linked directly to erosion and consequent loss in land productivity (Junor, 1981). Although we do not have authentic information for Meghalaya, the migration of rural poor to urban centres for menial jobs have been noticed from different parts of East Khasi and Jaintia Hills, As the lands no longer provide livelihood, many young persons migrate to cities seeking cash employment and the fields are left to the care of the elderly and very young. In such situations rural society becomes more and more dependent on cash remittances from the town. Of late, such type of migration has also been noticed in Meghalaya, particularly from villages near urban centres; however, no data based information is available.

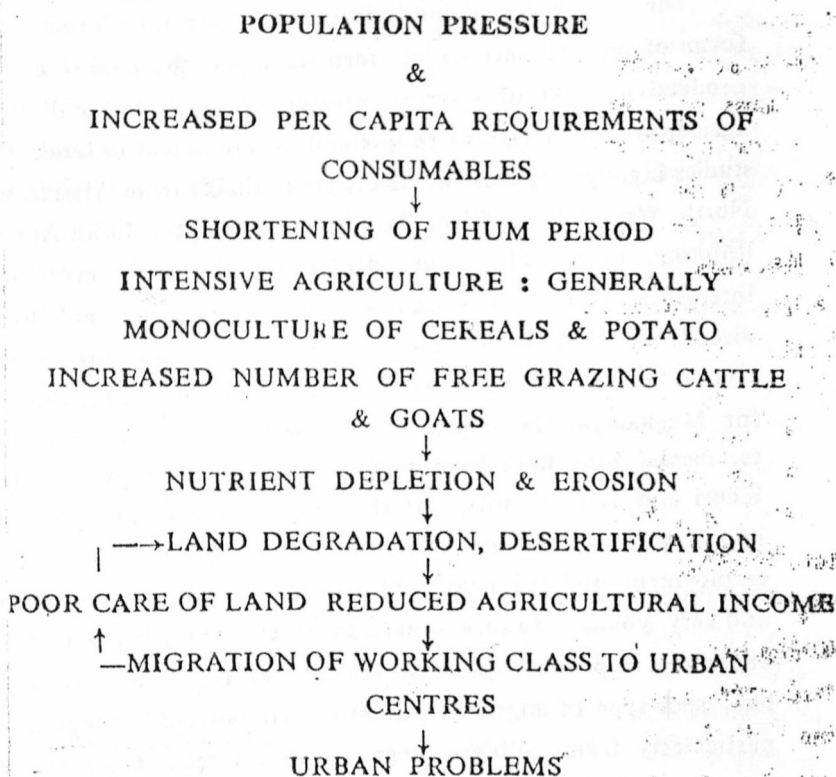


Fig. 1. Chain of events leading to land degradation and urban problems in Meghalaya.

Diet and Nutrition in rural areas :

The changing of agriculture has also affected the diet and nutrition of rural poor in the state. Tradition and emotional forces are the factors that decide the type of food to be consumed by the people. Since availability of a particular type of food depends on the prevailing environmental conditions which are subject to change with time, a change in food habits is

desirable. Unfortunately, this is not the case because the choice of food is largely determined culturally and thus very hard to change. This is particularly applicable to the tribal communities. For the local tribal people meat (generally obtained by hunting), fruits (generally obtained from naturally growing plants), rice, potato and other tuberous crops comprise the traditional food. All these food stuffs taken together provided a fairly well balanced diet to the tribal populations in the past. In the recent past, however, meat and fruits have become scarce due to large scale deforestation and related human activities. Furthermore, the advent of market based economy has made these items being sold at high prices due to their demand in urban areas. The high prices of these items lure the poor rural tribals to sell whatever little fruits or meat (in the form of pig, poultry etc.) they have to the rich. With the money from such trade, they purchase consumer items which were traditionally unknown to the rural populations. The present diet for a typical tribal family is therefore, traditional food minus meat and fruits, and is highly deficient in protein and vitamins. The tribals have, generally speaking, not adopted to pulses and milk items, and these are not traditional foods for them. This is leading to serious malnutrition and poor health among the rural population of the state, particularly the families who do not receive cash remittances from cities. It is logical to stipulate that the poor nutrition diet will affect labour intensive occupations like agriculture in the state of Meghalaya. This area has been neglected so far, and quantitative information based on researches are needed to substantiate these contemplations. A humble beginning has been made in this direction by Gangwar and Ramakrishnan (1989). However, the study is conducted on a plantation crop based village ecosystem, and thus the findings do not represent the typical Khasi village.

ecosystems practising shifting cultivation.

Polyculture vs monoculture

In traditional agriculture as many as 35 different plants of food value were grown by the local tribals in sedentary and shifting cultivation systems which included grains like rice and maize, pulses like Sesamum and Ricinus, and a variety of vegetable and fruit crops like Hibiscus, Capsicum, Legeneria, Cucurbita, Cucumis, Momordica and Musa. Tuber crops like cassava, colocasia, sweet potato and ginger were also grown in the mixture. The mixed cultivation of these crops provided a multistoried crop canopy with perennial crops such as cassava, banana and castor occupying the top layer, cereals constituting the middle layer, and cucurbits and legumes forming the lower most stratum.

With the shortening of fallow period and advent of sedentary cultivation, the number of crops is reduced (generally less than 5), and at many places on the cleared hill slopes monoculture of rice, maize, potato, cabbage, cauliflower etc. are being grown. Thus a mixed culture is being replaced by a monoculture. The two systems differ widely, and ecologically the traditional mixed crop cultivation has more advantages for hill slope agriculture. Some of which are :

1. Greater plant diversity results in optimum utilisation of nutrients and space.
2. Intricate plant stratification facilitates optimum utilisation of solar energy.
3. Closer canopy of crops checks soil erosion and weed invasion.
4. Leguminous crops improve soil fertility by biological nitrogen fixation.

5. Food security in case of failure of one or two crops.
6. Less pest management problems.
7. Starch yielding root and tree crops demand less soil nutrients than do protein yielding seed crops.
8. More intensive use of land under mixed cropping reduces the chore of land preparations.
9. Reduces labour stress by spreading labour requirements through seasonal planting and harvesting.
10. Meets nutritional requirements and food preferences by offering a greater variety of food crops. The danger of protein malnutrition is minimum in mixed cropping system of agriculture.

In other words, mixed culture represents floristically, structurally and functionally a more complex ecosystem than do the single or few crop systems. Thus, for hill slope agriculture, traditional system has greater ecological stability than the monoculture of grains. Under the former, the ground is more completely and continuously shielded by the plant cover and therefore, the chances of soil erosion and weed invasion are less. The period of time for which a plot may be cultivated without excessive decline of yields tends to be longer under polyculture. This shows that monoculture of grains is less durable and more prone to relatively rapid shift from one clearing to other. Thus reduction in fallow period, in addition to population pressure, is also caused by the change in the composition of crops grown under shifting cultivation. It may be proposed that traditional mixed culture may be popularised among the jhum farmers. To supplement the protein requirements, the conventional piggery and livestock farming may be popularised. Pisciculture should also be encouraged where suitable sites are available.

Large areas of hill slopes are under potato cultivation. The growers of the state face problems with the marketing of their produce because potato is available at a cheaper price from western UP and Bihar markets and the cost of production is high in Meghalaya. Another problem with potato is that it involves preparation of ridges, which is responsible for large scale loss of the top fertile soil during field preparation and crop growth period. Thus, the soil loses fertility very rapidly, forcing the farmers to move elsewhere. Potato cultivation seems to be another cause of land degradation in high altitudes of Meghalaya. Although we have not come across any statistics on the area of land degraded as a result of potato cultivation or erosion losses in potato fields on hill slopes cleared of forests, it is evident to any careful observer of the landscape that potato cultivation on jhum lands are causing significantly high rates of erosion than the traditional mixed crop agriculture. Based on our observations we propose that potato cultivation on hill slopes should be discouraged in favour of polyculture of legumes, cereals and vegetables.

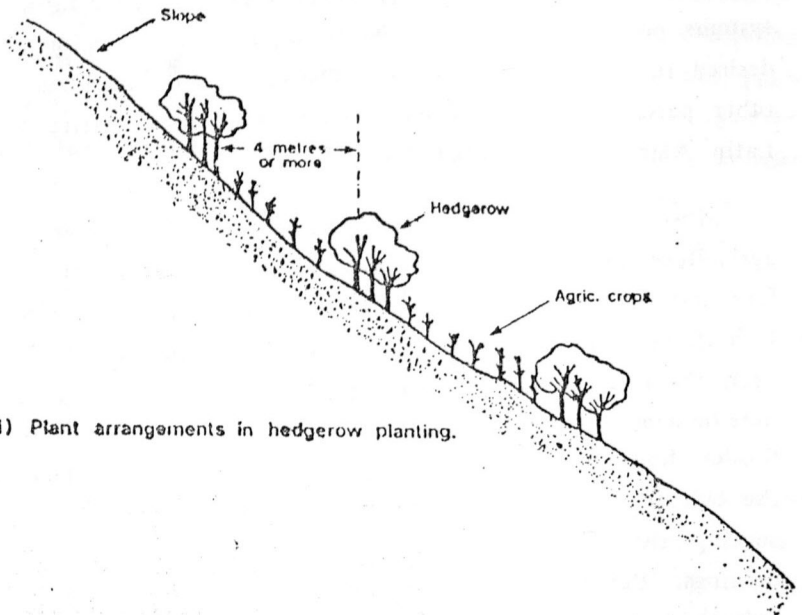
Alternatives/improvements to shifting agriculture

North-Eastern Hill University, Shillong, and Indian Council of Agricultural Research (ICAR) complex for N. E. region, Shillong have worked in this field, the former concentrating mainly on basic research, the latter on applied. Some alternatives have been proposed by the ICAR. Various departments of Meghalaya Government, particularly the soil conservation and forest departments have also contributed significantly towards development of alternatives and educating people regarding the ill effects of shifting cultivation. Some progress has been made

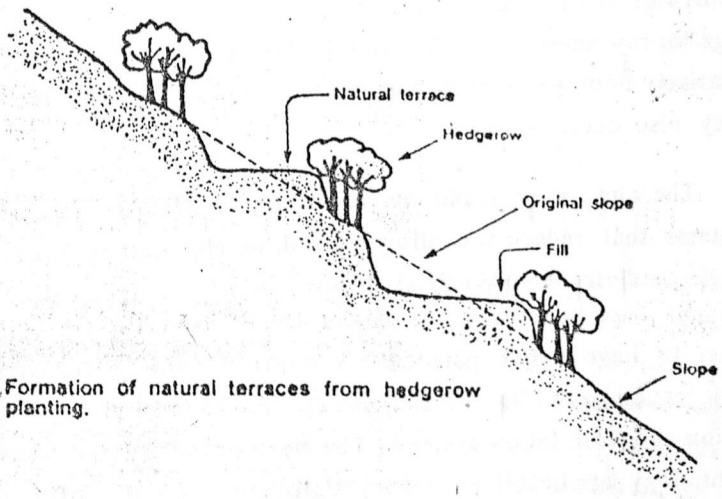
and the statistics show that the total area under shifting cultivation in the state is declining. However, the alternative farming systems proposed are not becoming popular in the region and desired results are not achieved. The same also holds true for other parts of the world such as south east Asia, Africa and Latin America (FAO, 1984).

Most farming systems developed for hill regions include agriculture, animal husbandry, pisciculture, and fruit, fodder, fuel and timber plantations. Another dimension may be added to it if we include bamboo and cone plantations which have been the most important forest produce for local tribes since time immemorial. Bamboo and cane are used not only for fuel, fodder, housing etc., but these plants have found a place in the culture of the people. These plantations will help in the development of handicraft industry and thereby supplement their earnings. Bamboo and cane in excess can be supplied to paper industries of the region many of which are facing serious shortage of raw materials. Besides, bamboo and cane can grow on relatively poor soil with minimum care. Being good soil binders, they also check erosion.

The alternative seems to lie in devising land management systems that reduce the fallow period, or eliminate it altogether while retaining its beneficial effects. A number of production systems have been proposed (FAO, 1984). Agroforestry systems seem to have ample potential to improve shifting cultivation as it encompasses the principles of traditional shifting cultivation and bush fallow systems. The most promising agroforestry technology applicable to shifting cultivation systems of north-eastern India is hedgerow planting of woody perennials in crop production fields, growing the crops in spaces or alleys between li



i) Plant arrangements in hedgerow planting.



ii) Formation of natural terraces from hedgerow planting.

the hedgerows. A combination of *Leucaena leucocephala*/maize has given promising results in the studies conducted at International Institute of Tropical Agriculture, Ibadon, Nigeria (Wilson and Kang 1981). *Alnus* sp. and *Trema orientalis* are recommended as hedgerow crops for tropical highlands receiving high rainfall. Both the species have nitrogen fixation capability. In addition to their protective function, the woody species could improve and enrich soil by fixation of atmospheric nitrogen, addition of organic matter, modification of soil porosity and infiltration rates, leading to reduced erodibility of soil and improving the efficiency of nutrient cycling within the soil-plant system (Naii, 1983). The International Council for Research in Agroforestry, Nairobi has recommended planting of leguminous tree species in contour hedges for erosion control and soil improvement on hill slopes. Indirect terraces are also formed when the washed-off soil collects behind hedges (Fig. 2). Lopping and pruning from such hedgerow species could also provide mulch to help prevent sheet erosion between trees. Research on these aspects of agroforestry is in progress at various places, and in near future more quantitative information from actual field observations will be available.

Perhaps more intensive research on the socio-economic set up of the local jhum farmers and evolving means to involve the people in conservation movements is necessary. A more acceptable alternative to shifting cultivation can be evolved by aiding the traditional cultivation with modern input of conservation technology, and at the same time, utmost care has to be taken so that the new system causes minimum changes in the custom and traditions of the people. The management practice to be recommended for the region has to be simple,

efficient and as far as possible free of external inputs. Complex and costly practices like terraces may not work. Some possible remedial measures and management practices based on general ecological principles and studies conducted at various organisations during the last 10 years are recommended here.

1. Popularization of traditional mixed cultivation of multiple canopy crops. Planting of crops at higher densities. Leaving of crop residues on the fields as protective mulch for the following crop cycle. Hedgerow planting on hill slopes.
2. Ban on free grazing cattle and goat on fallow lands to be cultivated later on. Raising of pastures for community grazing.
3. Development of biomass (viz ; bamboo, cane etc.) based handicraft and village industry for employment generation. Popularisation of energy efficient chulha.
4. Afforestation of hill slopes with fodder, fuel and fruit trees near human habitations to check destruction of forests uphill.
5. Timber tree plantation on wastelands and uplands.
6. Educating people about benefits of conservation and evolving a mass conservation movement.
7. Providing better facilities for family welfare and child care in order to check population growth.

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