SHIFTING CULTIVATION IN NORTHEASTINDIA: SUSTAINABILITY ISSUES AND STRATEGIES FOR IMPROVEMENT

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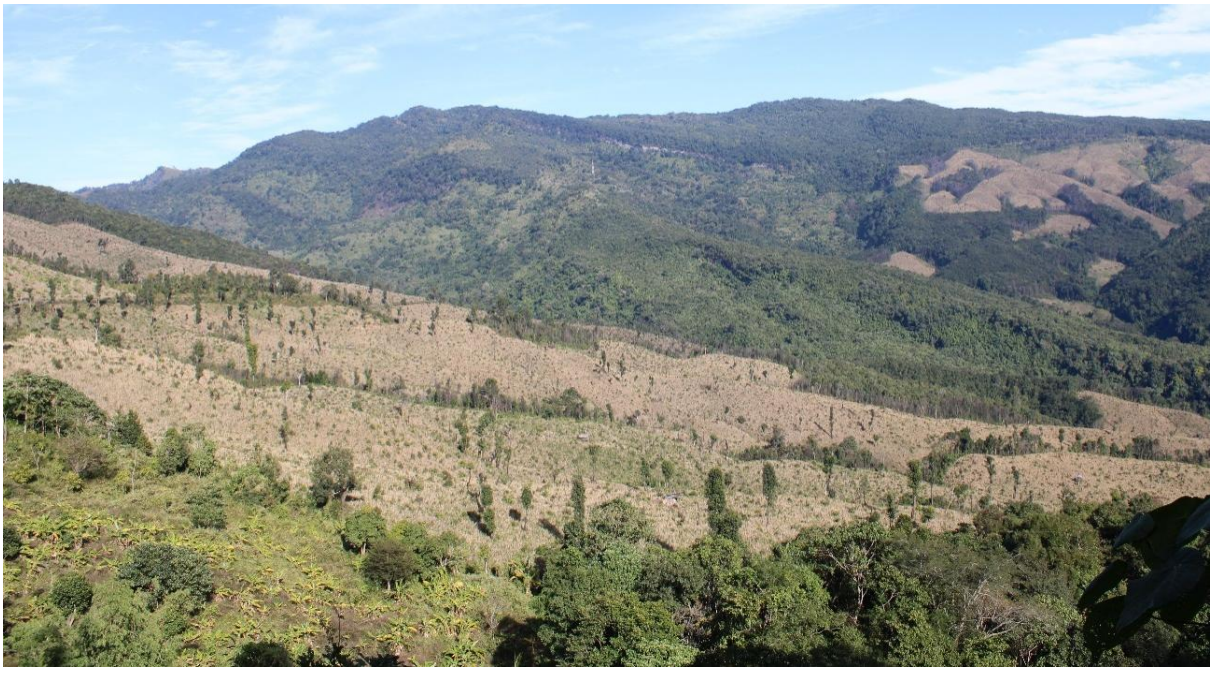

Shifting cultivation, also known as Jhum cultivation in India is a primitive slash and burn agricultural practice is widely practiced in the West and Central Africa, Southeast Asia, and South/Central America. In India, it is a general agricultural practice among the tribes dwelling in the hilly terrains of North Eastern States, except plains of Assam, Manipur and Tripura (Table 1). Shifting cultivation covers about 86 percent of the total cultivated area and it is intricately linked to the socio-economic, cultural and religious belief of these tribes. It is characterized by clearing and slashing of fertile forest areas generally of the size <1.5-2.0 ha followed by burning the phytomass and tillage before the cultivation phase.

The cultivation phase involve mixed cultivation of large varieties of food grains, vegetable crops, root crops and fruit crops for one or two years or until the soil fertility declines. This phase is followed by a fallow phase where the cultivated area is left fallow (called jhum cycle) for a period of 10-20 years in general for the land rejuvenation process. However, in the course of time, the increasing population pressure has shortened the jhum cycle drastically to 5 to 6 years or even lesser, which is not enough for regeneration of the land. This shortening of jhum cycle is responsible for its negative effects on the ecological balance causing yield reductions and food insecurity.

Table 1.Dynamics of area under jhum cultivation in north-eastern region of India

Category	Area(sq. km)		
	2005-06	2008-09	2015-16
Arunachal Pradesh	1025.07	821.67	509.11
Assam	160.15	82.02	52.60
Manipur	752.10	296.68	499.96
Meghalaya	291.87	281.73	237.87
Mizoram	1028.53	602.08	691.55
Nagaland	1239.09	1414.53	979.33
Tripura	89.28	30.31	65.17
Sikkim	---	58.98	92.09
Total	4586.09	3588.00	3127.68

(Source: Author's own compilation)

SUSTAINABILITY ISSUES ASSOCIATED WITHTHE PRACTICE OF SHIFTING AGRICULTURE

Loss of Forest Cover: Indiscriminate felling of natural forest for the shifting cultivation resulted in progressive and large-scale deforestation. Estimations show that shifting cultivation considerably reduced the forest area in India by 765 km^2 over a short period between 2017 and 2019 (ISFR 2019). Slash-and-burn agriculture is a major reason behind the decline in forest cover in the north eastern region of India.

Soil Erosion and Soil Fertility Decline: Land use change from natural vegetation to shifting agriculture is accompanied by enhanced landslides and soil erosion, changes in physico-chemical properties soil and soil nutrient depletion. Soil loss due to erosion from steep hill slopes (60–79%) in first year, second year, and abandoned jhum was estimated to be 147, 170, and 30 t ha^{-1} yr^{-1} respectively (Singh and Singh 1981). Bare soil and shorter jhum cycle disintegrate soil stable aggregates, disrupt pore continuity from surface to subsurface, reduces water infiltration and percolation, and increases surface runoff. This practice also caused annual loss of 10669, 372, and 6051 tonnes of N, P and K, respectively from the soils of northeast India (Sharma 1998). Conversion of forest for shifting agriculture also significantly reduced the concentrations of Fe, Mn, Cu and Zn in soils of the region (Choudhury et al. 2021).

Hydrological Deterioration: Conversion of forest for jhum cultivation also has some serious hydrological consequences in the north eastern India. Soil erosion, run-off, sediment yield and percolation losses are higher under short jhum cycle than longer one. Soil erosion from the catchment area resulted in silting of reservoirs and streams that may further cause unprecedented floods. Drying up of wells, springs and seasonal streams, lengthening of dry spells are reported from this region. For example, though Brahmaputra river basin (including Barak) have an average annual flow of 54.0 m ha m its utilisable flow is hardly 2.4 m ha m (Sharma and Sharma 2009).

Climate Change: Burning of vegetation and oxidative loss of SOC during jhum cultivation resulted in emission of more CO_2 and other trace gases to the atmosphere. Jurvélius (2004) reported that deforestation and shifting cultivation accounts for nearly 20 percent of annual global CO_2 emissions. Extreme temperatures as well as drought like situations have been reported from many of the states due to decline in forest cover.

Biodiversity Loss: North East India is a biodiversity hotspot but, deforestation due to shifting cultivation has started depleting its biodiversity at a faster pace. In fact, many endangered plant and animal species are facing extinction threats. The frequent and periodic clearing of forests creates an ecosystem where secondary plant species are totally different from the native species of the parent forest. Also, shifting cultivation led to fragmentation of the habitat, reduction in plant diversity, and loss of forest corridors that have adversely affected faunal diversity (Gupta 2000).

STRATEGIES TO IMPROVE SUSTAINABILITY OF SHIFTING CULTIVATION

Despite harmful impacts on the environment, it is virtually impossible to stop shifting cultivation as large number of farmers dependent on it. Therefore, it is important to identify alternative practices or production systems to make the system more sustainable. Some of the viable alternatives are discussed as follows.

Agroforestry: Trees on the farm help to control soil erosion and conserve water, ameliorate microclimatic condition, supply fuel wood, fodder, timber and fibre, fix atmospheric N, mitigating global warming through C sequestration along with enhancing the aesthetic and recreational values of the landscape. Very steep slopes (>33%) needs to be brought under forestry and natural vegetation through afforestation and development of silvi-pastoral systems; horticultural cash crops in the hilly terrain up to 25-33 percent slope, whereas upland paddy could be cultivated in areas with 10-15percentslope (Ray et al. 2021). As these practices maintain soil cover that in turn reduces the extent of soil erosion, runoff and sediment yield. Non-arable hilly areas with steep slopes and shallow soil can be best managed by growing suitable multipurpose trees.

Integrated Farming System: To maintain productivity and profitability with minimum degradation of natural resources, the best viable option is integrated farming with combinations of various compatible components of agriculture. Livestock, poultry, duckery or horticulture-based farming systems are economically viable with higher net return and check soil erosion thus, prevents loss of soil organic matter, N, P and K.

Conservation Agriculture (CA): Through minimal soil disturbance, permanent soil covering, and ecologically viable crop rotations/ diversification CA based practices viz. contour cultivation, retention of crop residues/ standing stubbles, bio-terracing, hedgerow crops on farm boundaries or contours/ terrace risers, vegetative barriers, minimum tillage and no–till farming effectively restrict runoff and associated soil, water and nutrient loss in steep slopes. This facilitates growing second crop in succession after the rainy season crop; thus, helps to boost crop productivity of the agro-ecosystem.

Plantation and Horticultural Crop: Growing plantation and horticultural crops such rubber, coffee, tea, black pepper, cashew, banana, citrus, pineapple etc. on the sloppy jhum land are also promising options. Planting rubber in Tripura; tea in Tripura, Manipur, Meghalaya and Arunachal Pradesh; cashew and broom grass in Meghalaya; floriculture in Mizoram and passion fruit cultivation in Nagaland, Manipur and Mizoram has helped to transform shifting cultivation of these regions to a more sustainable form.

Nutrient Management: Adoption of chemical fertilizers along with organic manures had increased SOC content, aggregate stability, moisture retention capacity, and infiltration rate of the soil while reducing bulk density (Saha et al. 2010). This could help in avoiding frequent shifting of agricultural lands as soil health declined is the main reason for shifting cultivation

Organic Farming: As use of chemicals in agriculture is inherently low in this region, it has a large scope for promoting organic farming. Proper marketing strategies for selling organic produce help farmers to earn higher net income. In fact, scope for enhancing productivity in short time period with good organic management is more in these low input farming systems. Households maintaining livestocks (pig, poultry, cattle, goats, etc.) could produce sufficient quantity of on-farm manures required for organic farming.

Soil and Water Conservation: In these hilly regions, mechanical soil and water conservation measures are the best possible option for controlling soil erosion, retaining maximum rainfall within the slope and safe disposal of excess run off from the top to the foothills. Structures such as contour bunds at 1-5 meter vertical interval in all the land uses with common grassed waterways, bench terraces towards the foothills for growing vegetable crops, half-moons terrace for fruit crops and water storage at appropriate location for irrigation/fish purposes may also be used to reduce soil erosion and conserve water.

CONCLUSION

Notwithstanding the ill effects, shifting cultivation in the fragile hill agroecosystems of north eastern region of India will continue to be the mainstay of tribal livelihood. Thus, strengthening the existing cultivation practice with judicious use of resources that can enhance livelihood security will be a viable strategy for indigenous farmers as well as policymakers.

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