Shifting cultivation, variously termed as rotational bush, fallow agriculture, swidden cultivation or slash and burn cultivation, is an age old practice of cultivation in Northeast India, which is still a predominant farming system. Traditionally in Nagaland, jhum cultivation was productive and sustainable. After one or two years of use, fields go into fallow. Farmers move to the next plot and forest land to protect the soil and allow for a build-up of nutrients. A number of problems caused by slash-and-burn shifting cultivation or jhum as commonly practiced by indigenous tribes in Northeast India has been reported\textsuperscript{1,2}. This primitive form of agriculture resulted in serious environmental problems: loss of forest cover, erosion of topsoil, desertification, and declines in forest productivity. In contrast, shifting cultivation favorably is considered a diversified system, well adapted to local conditions in moist forest and hilly tracts\textsuperscript{3,4}. Far from being primitive and inefficient, jhum is an ingenious system of organic multiple cropping well suited to the heavy rainfall areas of the hill tracts. The economic and energetic efficiency of jhum is higher than alternative forms of agriculture such as terrace and valley cultivation. When the cycle lasts 15-20 yrs, jhum is sustainable. However, increasing population has led to shortened jhum cycle and land degradation. A possible alternative to jhum cultivation is terrace cultivation. But this, too, has its limitations because extensive parts of Nagaland are too hilly for economic use of terracing. Farmers must, therefore, cut down more primary forest for their food needs. In Nagaland, out of a total area of 7,000 sq km of jhum land, around 500 sq km is cleared of vegetation and burned annually for jhum cultivation\textsuperscript{5}. Now, due to shortening of jhum cycle, the crop productivity is declining, which has reached to level of 3-4 yrs. Practice of jhuming has been under discussion in many of scientific forum for its effect on agro ecosystem. ICAR has developed some of technological sound alternate for jhuming, three tier system is one of them. But due to socio economic reasons these alternate models are not having acceptability among jhumias. Jhum plays an important cultural role in local customs, traditions, and practices, besides offering economic security to farmers. Only occupations providing monetary and social benefits perceived by jhumias to outweigh the cultural and security benefits embodied by jhum are likely to gain acceptance. In early days, the misconceived ideas for generation of alternate method of cultivation to jhum had resulted in total failure. In this regard, many of the farmers in Nagaland, Kohima, Phek district have developed and practicing Alder based farming system. Alnus nepalensis D. Don, is a non leguminous nitrogen faxing tree species. Alnus nepalensis is a deciduous or semi-deciduous tree with a straight trunk, up to 30 m in height and 60 cm (rarely to 2 m) in diameter; twigs ribbed, glabrescent; bark dark grey, often with yellowish
patches and slightly raised lenticels (Fig. 1). Leaves alternate, elliptical, ovate to oblong, yellow-brown scales; petiole strong. Narrowly cylindrical clusters of tiny flowers or catkins occur in autumn as males or females, separate on the same or different twigs; male catkins grouped in a terminal panicle up to 16 cm long; catkins yellow, hanging in clusters at the end of twigs; female inflorescence grouped in a short, axillary raceme of 3-8 catkins; erect, woody, occurring on branching side twigs. Fruits, which resemble the cones of the pine family, are dark brown, upright on short stalks, elliptical, composed of many spreading, hardwood scales; seeds light brown, circular and flat with 2 broad, membranous wings, more than 2 mm across. *Alnus* is the classical Latin name for alder. Common names of *Alnus nepalensis* are: Himalayan alder, Indian alder, Nepal alder, Nepalese alder, and *ni po er qi mu*. *A. nepalensis* occurs naturally throughout the Himalayas, from Pakistan through Nepal, northern India, Bhutan and upper Burma to southwest China. In Nagaland, which also comes under Eastern Himalayan zone, Alder is common on higher altitude. The climatic conditions of Nagaland are highly congenial for the tree species. As *A. nepalensis* is a pioneer species; it grows well in full light but will also tolerate shade. At lower altitudes, it occurs in moist sites, such as near rivers, but it will colonize in rocky sites exposed by landslides or land abandoned after cultivation. It occurs naturally in both pure and mixed stands and is common in streambeds, near streams, in ravines and in drier forests. It is found naturally in moist, cool, subtropical monsoon climates with a dry season of 4-8 months; it also grows in humid, cool or subtropical mountain areas in tropical zones with high rainfall. Prefers moist and well-drained soils, including loam and loamy sand gravel, sand and clay. It does not require high soil fertility but prefers permeable soils. Grows well on soils with high water content but not on waterlogged soils.

**Amelioration of jhum land**

Nitrogen fixation in *A. nepalensis* takes place through a symbiotic relationship between *Alnus* with nitrogen-fixing actinomycetes of the genus *Frangia* and is therefore able to improve degraded jhum lands (Fig. 3). Symbiotic *Frangia* are located in specialised structures, or nodules, along the root system of the host plants. The root nodules are analogous to those induced by *Rhizobium* in legumes, and they provide an environment, where *Frangia* can grow and prosper, while providing the host-plant with fixed nitrogen. Unlike the *Rhizobium*-legume symbiosis, where most of the host plants belong to a single large family, *Frangia* can form root nodules in symbiosis with actinorhizal plants distributed among eight families consisting of over 200 species of angiosperms. The value of alder tree was recognized by the tribal farmers long back and more than 200 yrs old trees can be seen in the area. Agricultural crops, together with alder trees forms a very remunerative agro-forestry system and the ability of the tree to develop and retain soil fertility has been fully utilized by the tribal farmers of Angami, Chakhasang, Chang, Yimchaunger and Konyak tribes. Tree litter dry matter decreases with the number of plants ha$^{-1}$ (Table 1). Total litter yield depend on the number of plants and N fixed varied between 48.3 kg ha$^{-1}$ (60 trees ha$^{-1}$) to 184.8 kg ha$^{-1}$ (625 plants ha$^{-1}$). Besides fixing atmospheric N, the litter added to the soil provided P, K, Ca and other nutrient through the addition of biomass.

**Soil conservation**

Soil erosion due to high rainfall and hilly topography is very high in most of the Northeast state (Table 2). There is great need to check the rate of soil erosion. In this regard, the deep root system gives some stability to slopes that tend to slip and erode. Its seeds have been broadcast to stabilize landslides area effectively used to reforest abandoned jhum land areas.
because it grows as a pioneer in degraded habitats with low fertility soils. It is also planted to improve the stability of slopes liable to erosion and landslides, and for mine reclamation. Considerable quantities of nutrients are recycled through the litter of *Alnus* sp. Leaf and twig litter of *A. nepalensis* may produce 3-6 t/ha litter annually, containing N 3.4-3.7 gm, P 0.08-0.1 gm, K 0.6-0.7 gm and Ca 0.2 gm per 100 gm dry matter.

**Intercropping**

The farmers of Kohima and Phek district are growing paddy in Alder based agroforestry system. The high rate of regrowth of Alder helps in supplying good quantity of biomass for nutrient enrichment the soil. It is a good crop for intercropping (Fig. 2). In some of horticulture crops as turmeric, *Cinchona* and *Eletaria subulatum*, this is grown as shade crop. On terraced slopes, the species is commonly pollarded for poles and inter planted with crops like paddy, maize, barley, chili and pumpkin. The cultivation of large cardamom (*Amomum subulatum*) or *Cinchona* sp in combination with *A. nepalensis* is a common practice in the central Himalayas.

**Other benefits**

The foliage is of low to moderate value as fodder for Mithun and other cattle. Wood has a low calorific value of 18,230 kJ/kg. It dries easily, burns well and is an important source of firewood and charcoal. In the Philippines, kraft pulping of wood of *Alnus* sp gives a pulp yield of 47.6%, and bleaching improves the brightness to 76%. It is suitable for the manufacture of high-quality paper. Although not among the best construction timbers, *A. nepalensis* has an even grain, seasons fairly well, and is easy to saw and finish by hand or machine. The wood preserves fairly well but is perishable if subjected to alternately wet and dry conditions. It is also subject to discolouration by oxidation and fungal sap stain. It is suitable for boxes, splints and matches, poles, general carpentry, furniture parts, turnery and newsprint. The bark of *A. nepalensis* has been used occasionally for tanning and dyeing.

**Conclusion**

Shifting cultivation though a primitive practice still remains source of livelihood of majority of farmers in Northeast India. It has become the customs in the region; many of festivals and other social ceremonies are organized in *jhum* areas. The Indigenous farming system like Alder based farming hold good promises, where crops are grown along with Alder and regular pruning of Alder leaf biomass in the soil for nutrient enrichment is being done. This indigenous intervention is showing good effect in increasing the yield of *jhum* crops. There is need for proper identification and validation of such practices being followed in some areas and their proper expansion in other *jhum* areas for their amelioration.

**References**


