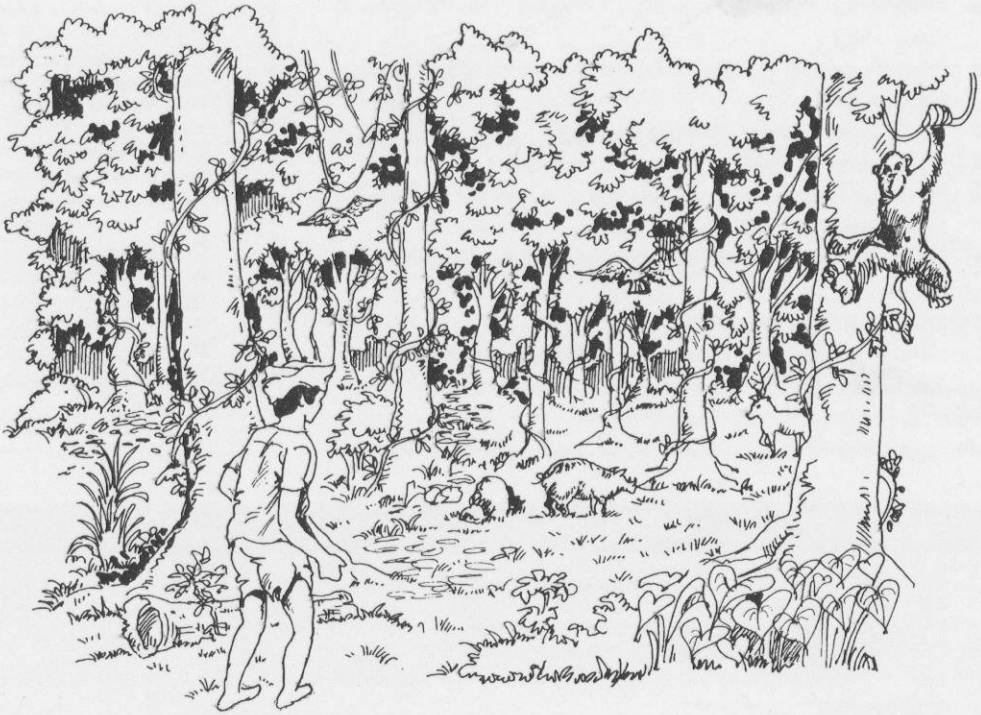
Biodiversity Values in Fallow Areas of Northeast India



Most communities practicing shifting cultivation in northeast India do not have a single specific word for biodiversity'. Instead, they identify their "surrounding" environment, i.e., the plants and animals that are useful to them, and those connected with their legends/folktales/beliefs/rituals, as well as those plants needed by their domestic animals. Their 'surrounding' (environment) that gives them their biodiversity needs include their *jhum* fields, fallow lands and the forests. They also include the turtles and fishes of the rivers and streams, as also all the animals that drink water from the rivers and streams.

This article is an attempt to capture the meaning and values of plant diversity of fallow lands as perceived by the shifting cultivators.

Crop germplasm varieties in shifting cultivation fields of northeast India.

■ Upland rice	:	> 298+
■ Brinjal	:	> 37
■ Ginger	:	> 60
■ Chillis	:	> 68
■ Maize	:	> 674
■ Turmeric	:	> 60
■ Grain legumes	:	> 200
■ Sweet potato	:	> 5
■ Cucurbits	:	> 76
■ Taros	:	> 250
■ Yams	:	> 242

Biodiversity values: perceptions of the shifting cultivators

Developing the fallow lands into a good forest (vegetation) is the primary goal of fallowing the land. For the people, fallow lands with all their biodiversity are as important for their livelihood as the other forests.

Food security

To the traditional shifting cultivators, food comes from the *jhum* fields, fallow lands, nearby forests, rivers and streams. The varieties of crops grown in a year has a tremendous impact on the food security of their households and domestic animals.

Construction materials

Perception of biodiversity includes all the timbers, bamboo, canes, thatch grasses, etc. needed to construct their houses, as well as shelters for their domestic animals (cattle as domestic animals by most traditional shifting cultivators is generally a recent adoption).

Fiber

Traditional shifting cultivators living in remote areas still largely depend on their home grown cotton for their fiber needs, such as *puanri* (a kind of cotton-padded winter blanket specially made and carried as a prized item by a newly married girl to her husband's house among the Darlongs of Tripura). Cotton fiber is used for clothing while the bark of a wild plant is used to make rope (used in harnessing cattle).

Culture

The perception of traditional shifting cultivators on biodiversity also includes those plants and animals connected to their beliefs (animistic religion or nature worship) and traditional rituals. Some plants and animal parts have special uses related to their culture: e.g., a particular bamboo species used for bamboo dance, a species of small bamboo with long internodes used for drinking/sucking rice beer from common pot, feathers of hornbill/wild red fowl, skin of black bear, teeth of wild male boar, etc.). They also relate certain trees (e.g, *Ficus*) as the dwelling place of spirit.

Fodder

These are the plant species (grasses, leaves of bamboo and trees, creepers) which are extensively foraged by their domestic animals, such as cattle and mithun. Traditionally, the mithuns (*Bos frontalis*) were exchanged as bride price among many of the shifting cultivator communities.

Medicine

The traditional shifting cultivators normally have cures (made from combinations of plants, or plants and animal parts) for almost all kinds of ailments. The medicinal plants come from their fallow lands and nearby forest areas. Many communities also carefully nurture and grow such plants near their dwelling places (such as *Centella asiatica,* a kind of creeper used for heart and stomach ailments by the Khasis of Meghalaya). They also value plants which are used for treating domestic animals, such as for deworming of dogs, etc.

Household utility items

Traditional shifting cultivators generally depend on the biodiversity of their forests and fallow lands for all their household needs, all of which are valued. These include bamboos, canes and fiber trees. In fact, bamboo is used by traditional shifting cultivators from cradle to grave (eg., bamboo knife is used to cut the umbilical cord at the time of birth, bamboo mats are used for wrapping the body at the time of burial, etc.).

Dye and resins/gums

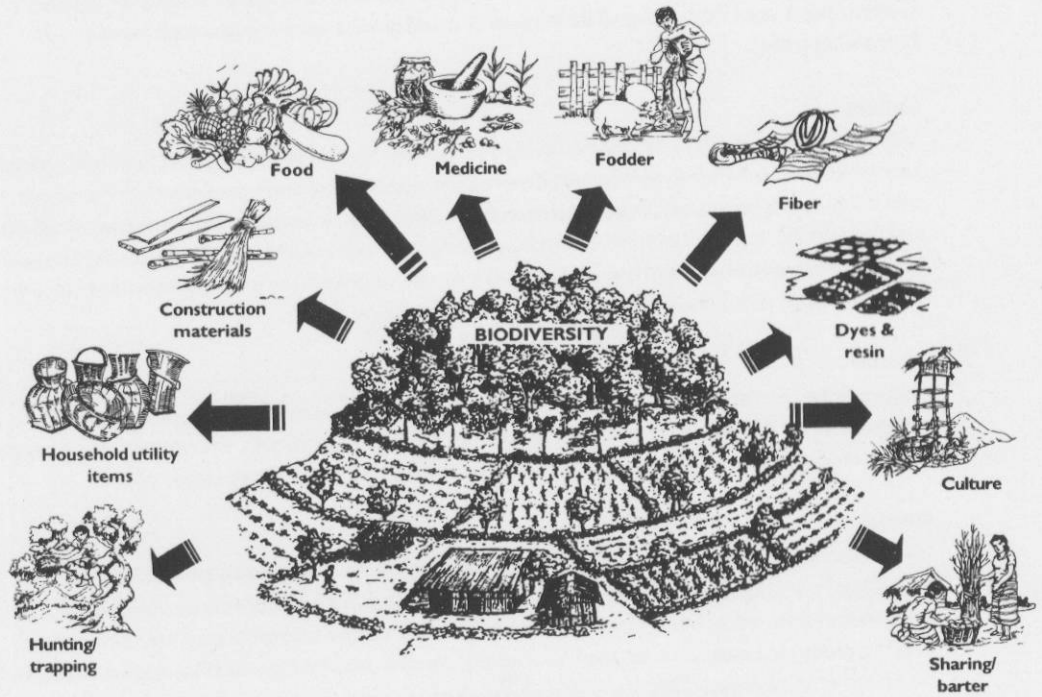
Plants are used to dye their cotton fabrics, whereas the gums extracted from trees are generally used for trapping birds. Resins are used for rituals and as insect repellents. Communities carefully preserve plants from which dyes, resins and gums are extracted.

Hunting and trapping

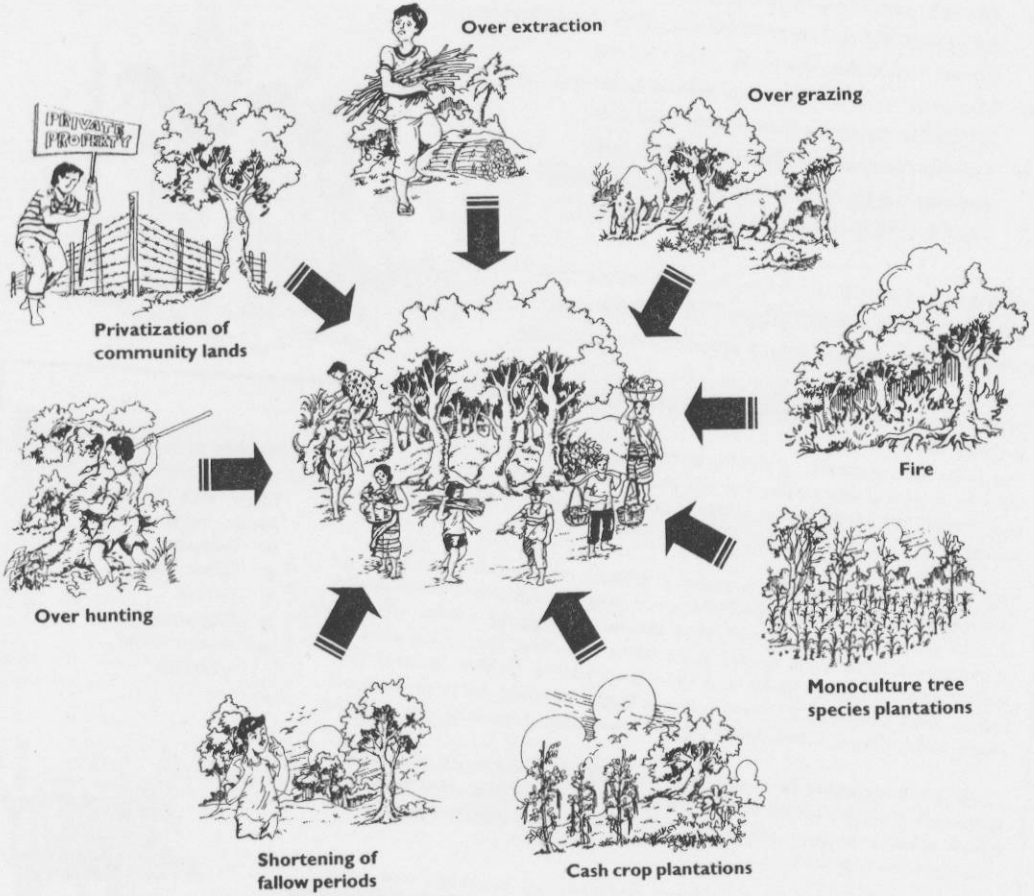
The communities also relate to animals and birds that they generally hunt and trap as important components of biodiversity. Bamboo and canes are used also to make bows and arrows, bamboo spears, fishing rods, etc.).

Sharing/barter among community members

Generally, women collect food and materials from the forest and these items are shared or bartered with their neighboring families. The neighbor reciprocates this in the next occasion.



Threats to biodiversity of fallow lands in northeast India



Management of fallow biodiversity in some communities in northeast India

- Free grazing is not allowed in the fallow lands for one to two years. The household that had done cropping in the preceding year is allowed to graze his cattle by tying it with a long rope.
- Strong regulation for accidental fire prevention is imposed (fines are collected among Tangkhul Nagas of Manipur);
- Only trapping of small game animals is allowed.
- No cultivation is allowed until the Traditional Village Institution decides otherwise.

Women and biodiversity of fallow lands

- Fallow lands are often 'social sites' for women where they gather together and collect firewood and wild vegetables. Community bonds are renewed in doing these activities.
- Women collect crop vegetables from previous years (one to two years fallow) and wild vegetables from subsequent fallows. They also collect root crops (ginger, Colocasia, Dioscorea, sweet potato).
- Khasi women collect tubers of wild herbs having medicinal properties, generally chewed with betel nuts.
- In some communities, the women exclusively manage the planting and propagation of plants used in shifting cultivation-associated rituals.

See *Gender and Agrobiodiversity Management Among the Lepchas in Sikkim, India*, pages 110-116, for more discussion on gender and natural resources management.

A case study

The study was conducted in the Karbi-Anglong district of Assam, inhabited by a hill tribe known as the *Karbis*, who are predominantly shifting cultivators. In recent years, the fallow period in this area has reduced to five years on an average.

The number of plant species recorded in different shifting cultivation landscape elements are presented in Table 1. There was progressive increase in the number of plant species according to the age of fallows. Although the number of species was observed to be 60-98 species in the fallow lands from one to five years, the total number of species found in all the fallows was134. Of these number, 55 species were economically valuable to the local community either as medicinal plants, edible plants, fodder, fuelwood and miscellaneous construction materials.

There is a low percentage of the common species between forest and fallows compared with the number of plant species in the forest alone, and in the *jhum* fallows because the study site is a secondary forest with repeated cycles of shifting cultivation.

Number of economically important plant species of fallow lands (Karbi Anglong, Assam, India).

■ Medicine	17
■ Edible plants	12
■ Fodder	9
■ Fuel wood	5
■ Construction materials	12

Table 1. Plant species occurring in fallow lands, adjacent forest and crop fields.

No of plant species in the forest	No. of plant species in the jhum fallows (1-5 years)	% of common species between forest and fallows
160	134	18

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Domestication of Three Non-Traditional Species by Shifting Cultivators of Northeast India

Northeast India


Livistonia Jenkinsiana

Aleurites spp.


Thysanolaena maxima

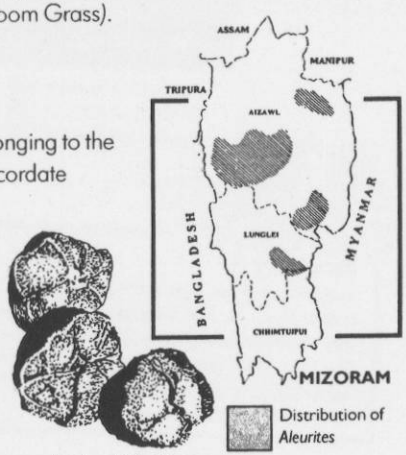
In their quest for a better crop and land use, many shifting cultivators of northeast India have started the cultivation and domestication of some non-traditional crops. These non-traditional crops came from neighbouring countries e.g. *Aleurites spp. (Tung)*, and from the wilds e.g. *Livistona jenkinsiana (Toko)* and *Thysanolaena maxima* (Broom Grass).

Cultivation of *Aleurites spp.* in Mizoram

The plant

Aleurites, which is locally known as "Tung", comprises five species belonging to the family Euphorbiacceae. It is a tree which bears monoecious flowers, cordate leaves and has a life span of about 30 years. "Tung" is profusely branched and may grow up to six to ten meters high.

The most productive plant part of *Aleurites* is its nut, which yields drying oil that is principally used for industrial purposes. Two species of *Aleurites, A. fordii* and *A. montana*, have been successfully domesticated in Mizoram. They are also broadly distributed in the tropical and sub-tropical regions of eastern Asia and Malaysia.



Fruits of *Aleurites*

Extent of adoption

In 1935, the British introduced Tung cultivation in Mizoram. But private plantation of this tree got momentum only in the year 1990 onwards. Since then, farmers have standardized the agronomic practices and processing, while marketing facilities are developing. Within ten years of its adoption, more than 7,000 hectares have already been covered by Tung and its annual dry seed yield is estimated to be over 5,000 tons.

Economics of Tung cultivation

For the determination of costs and benefits of Tung cultivation, data on one to six-year old plantations were collected.

Table 1. Cost and return (Rs) analysis for *Aleurites* (per ha).

PARTICULARS	YEARS						
	1st	2nd	3rd	4th	5th	6th	TOTAL
Revenue	750	0	0	7000	17500	35000	60250
1. Site clearance	750						750
2. Selling of Fruits				7000	17500	35000	59500
Production Cost	6100	2520	2520	1050	1400	1750	15340
Labor							
1. Site Clearance	1750						1750
2. Pit digging and sowing	750						750
3. Weeding	1170	840	840				2850
	840	840	840				2520
	840	840	840				2520
4. Harvesting				1050	1400	1750	4200
Materials							
1. Small Tools & Implements	500						500
2. Seed	250						250
Net Income	-5350	-2520	-2520	5950	16100	33250	44910

Benefit Cost Ratio at 10% AIR = 2.98
Benefit Cost Ratio at 15% AIR = 2.61
Benefit Cost Ratio at 20% AIR = 2.29

*Annual Interest Rate AIR
US $ = Rs. 45

Earn more !

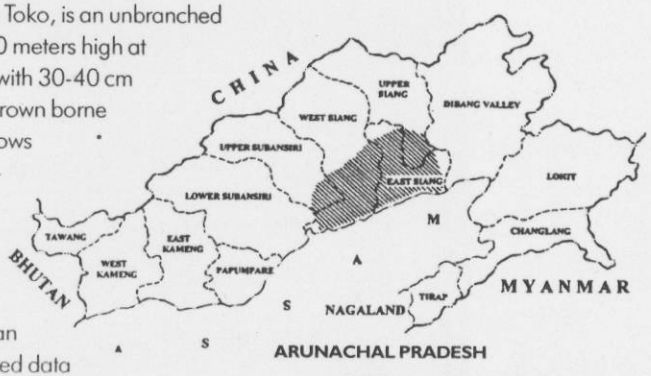
Intercropping can further enhance the productivity of the Tung plantation. Rice can be raised along with Tung during the first two years and ginger, tumeric and other shade-loving crops can be grown after the 2nd year of plantation.

Table 1 indicates that on its sixth year, a Tung plantation can generate a net profit of Rs. 7485 yearly per hectare. After the sixth year, the labor expense (which will only be incurred on harvesting) will be minimal, while further increase in yield will be observed, hence, profit will be significantly higher than in the previous years.

Cultivation of *Livistona jenkinsiana* in Arunachal Pradesh

The plant

Livistona jenkinsiana, commonly known as Toko, is an unbranched graceful palm that may reach up to 20-30 meters high at maturity. Its stem is comparatively slender with 30-40 cm diameter at breast height, with a globose crown borne at the tip of the solitary stem. This plant grows naturally in the tropical evergreen and sub-tropical broad-leaved forests up to an elevation of 1,100 m. The Adi and Nishi tribes of Arunachal Pradesh, India have been using the leaf, fibre and fruits of Toko for ages. At present, it is considered an endangered plant included in the IUCN's red data book of Indian plants.



Uses of *Livistona jenkinsiana*:

Leaves

- Roofing material for local houses
- Top cover of palanquins and boats
- Raw material for hats and hand fans
- Overhead shade for nursery

Midrib of the leaf

- Raw material for broom

Fibrous sheaths

- Raw material for rope-making

Pericarp of ripe fruits

- May be eaten raw or used for making salad

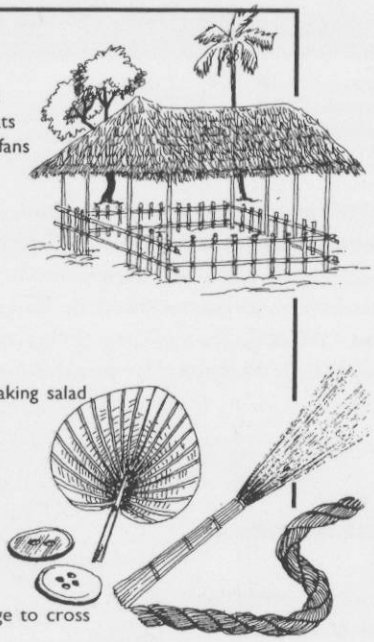
Nut

- May be eaten raw as a substitute for areca nut
- Used for making buttons

New soft shoots

- May be eaten as vegetable
- Stem used as temporary log bridge to cross over village streams
- Used as posts for temporary structures

The plant itself is planted as an ornamental and peripheral plant. The principal marketable produce, however, is the leaf which has a high demand in Arunachal Pradesh.



Economics of Toko cultivation

The use of tin roofs and concrete structures are not that popular among local tribes. Even those who can afford modern housing prefer to go for a thatch house. Toko leaves are usually used as roofing of these houses and have to be changed every four years. Thus, there is a good and growing market for Toko leaves. Though Toko production is still inadequate, the domestication of this plant has improved the economic well being of its growers. The spread of Toko also helps in the sedentarization of shifting cultivators, thus reducing soil erosion and preserving biodiversity by taking off the pressure on forests.

Table 2. Cost and Return (Rs) Analysis for *Livistona jenkinsiana* (per ha).

PARTICULARS	YEAR 1st	2nd	3rd	4th	5th	6th	TOTAL
Revenue	**500**	**0**	**0**	**11250**	**15000**	**18750**	**45500**
1. Site clearance	500						500
2. Selling of Fruits				11250	15000	18750	45000
Production Cost	**-2750**	**2000**	**2000**	**4400**	**4450**	**3000**	**18600**
Labor							
1. Site Clearance	2000						2000
2. Weeding		2000	2000	2000	2000		8000
3. Harvesting and processing of leaves				2000	2000	2500	6500
4. Transport to the Godown				400	450	500	1350
Materials							
1. Small tools and implements	500						500
2. Seed	250						250
Net Income	**-2250**	**-2000**	**-2000**	**6850**	**10550**	**15750**	**26900**

Benefit Cost Ratio at 10% AIR = 2.16
Benefit Cost Ratio at 15% AIR = 2.03
Benefit Cost Ratio at 20% AIR = 1.91

Table 2 shows that in six years, a farmer earns a yearly profit of Rs 4480 per hectare. Like Tung, after six years, the expenses are reduced and production increases. Furthermore, the other plant parts like fruits, leaf sheaths and leaf midrib can also be utilized , hence, providing extra income to the farmers (which have not been accounted). Thus, the total income will be more than the amount recorded in this study. The cultivation of this species is economically viable but only for small-scale production as the demand for this plant outside Arunachal Pradesh is not very significant.

Cultivation of *Thysanolaena maxima* in Meghalaya

Thysanolaena maxima, commonly known as broom grass, grows naturally in degraded forests and abandoned wastelands of the hilly regions of northeast India. The plant is a huge tufted grass that grows in tussocks that could reach a height of up to 3.5 meters. Broom grass grows in almost all parts of South and Southeast Asia up to an elevation of 1,600 m.

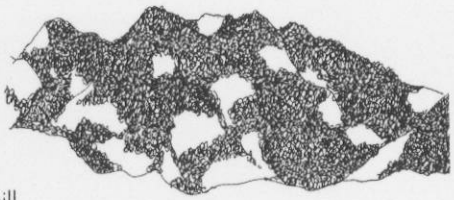
Ecological and Socio-economic Impacts of Modified Shifting Cultivation in Northeast India

Traditional shifting cultivation is an agricultural system characterized by a rotation of fields, rather than crops, by a short period of cropping alternating with long fallow periods, and by clearing by means of slash and burn. It is an age-old land use system practiced by over 300-500 million people in the tropical regions of the world.

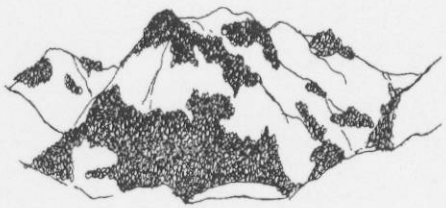
On the average, the cropping period ranged from one to three years, and the fallow period from 15 to 20 years.

This period is long enough to rejuvenate the soil and restore its fertility. Thus, this type of shifting cultivation continued to be a sustainable farming system. This was the practice of the hill farmers of humid tropics for a thousand years now.

However, due to increased population, the fallow period in most areas in northeast India has been remarkably reduced to more or less three to five years. This modified shifting cultivation allots inadequate time for soil regeneration and vegetation development. In effect, it degrades and depletes the soil, water and genetic resources and has siginificant ecological and socio-economic implications.



Shifting cultivation (THEN)

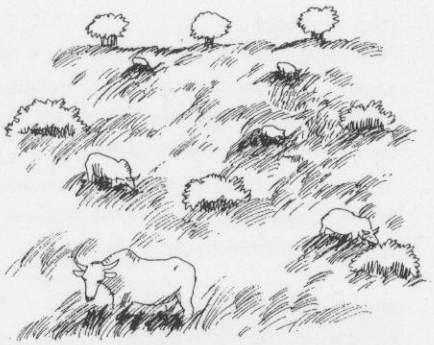


Shifting cultivation (NOW)

Ecological considerations

Animal grazing in fallow lands

A fallow land that is abandoned for a long period or managed properly can regenerate and regain its fertility status. However, in many areas, these fallow lands are subjected to intense grazing by domesticated cattle and goats. The grazers hamper the growth of vegetation and reduce water percolation due to soil compaction, thus, increasing runoff that accelerates soil erosion.



Proper Management of Fallow Lands

- Protect from fire by cutting fire lines
- Protect from intense grazing
- Maintain fresh sprouts of biennial and perenial food crops
- Sustain collection of wild, leafy vegetables, tubers, herbs, bamboo shoots, mushrooms, etc.
- Limit the collection of dry wood and sticks for firewood.
- Collect bamboo and thatch grass for construction of dwellings.

To address this concern, a part of the community land may be converted into grasslands for community grazing. Certain species of grass, or grass and legume combination, can be planted to increase grass yield as well as nutritive forage. The distribution of grasslands interspersed with the cultivated fields in a mosaic fashion enables checking of soil erosion, as part of the sediment, and dislodged nutrients from cultivated fields are retained in the grasslands.

Fire in fallow lands

In some parts of northeast India where livestock population is high, the fallow lands are invariably subjected to accidental or deliberate burning in the months of February and March. This is carried out to produce new shoots that are more palatable to the livestock and to get rid of unwanted vegetation. Frequent burning of vegetation evidently results to loss of vegetation, soil organic matters and most surface soil organisms. It also causes drastic change in the species composition of fallow lands. In extreme cases, such fallow lands continue to deteriorate and recovery of soil fertility needed for cultivation of agricultural crops would be difficult. Such lands are abandoned permanently and join the category of uncultivable wastelands, which particularly abound the Khasi hills of northeast India (see also *Sustainable Agriculture Systems in the North Mountain Regions of VietNam*, pages 191-195 for another example).

Crop diversity

Customarily, the hill people in India grew as many as 35 different plants in their shifting cultivation plots. With the shortening of fallow period and advent of sedentary cultivation, the number of crops is reduced (generally less than five). In some places, a monoculture system replaces the mixed culture.

Plants that can be grown in crop fields:

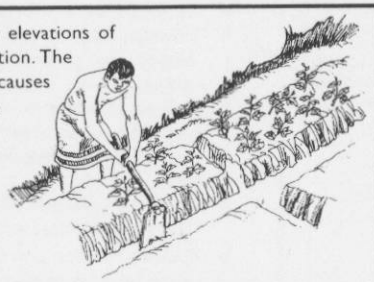
- Grains: rice, maize and millet
- Vegetables and fruit crops: pumpkin, watermelon, mustard brassicas, brinjal, lady's finger, gourds, cucumbers, beans, chillis, squash, *Cucumis*, *Momordica* and banana
- Tuber crops: cassava, yam, taro, sweetpotato
- Economic Plants and spices: cotton, cardamom, ginger, *Hibiscus*, pepper
- Others: *Sesamum*, cotton, castor

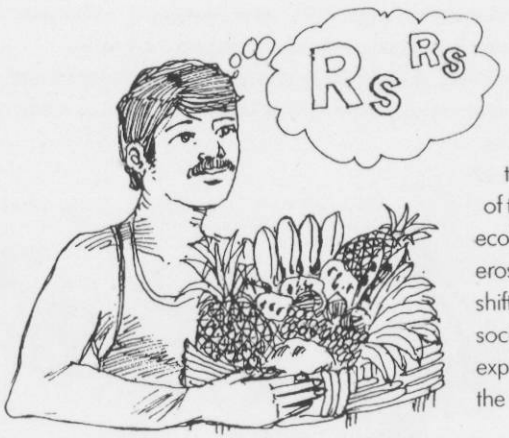
Ecologically, the traditional mixed crop cultivation represents, structurally and functionally, a more complex ecosystem than do the single or few crop systems. Also, for hill slope agriculture, the traditional system has greater ecological stability than the monoculture of grains.

Multistoried crop canopy with perennial crops:

Top Layer: cassava, banana and castor
Middle Layer: cereals
Bottom Layer: cucurbits and legumes

A number of shifting cultivators at high elevations of Meghalaya have adopted potato cultivation. The preparation of ridges along hill slopes causes a large-scale loss of topsoil, resulting to rapid depletion of soil fertility. The produce has a ready market and fetches good income. Some industrious farmers take two crops of potato every year. While others go for a rotation of potatoes and cauliflowers.





Socio-economic considerations

Impact of cash crops

Shifting cultivation does not provide enough income to support the family of a shifting cultivator. To remedy this, farmers have opted to plant cash crops. True enough, this shift to cash crops significantly improved the livelihood of the cultivators. Although some cash crops are more ecologically sustainable as they provide soil cover that reduces erosion losses, nevertheless, the introduction of cash crops in shifting cultivation areas tends to redirect resources from social sectors to mercantile sectors, and from domestic to export needs. As a result, it exposes the shifting cultivators to the vagaries of market forces.

Field observations suggest that the shift from food crops to cash crops, particularly in the case of small holders, adversely affects the food security and the health of women and children living in the rural areas. Cash crops

Cash crops grown include:

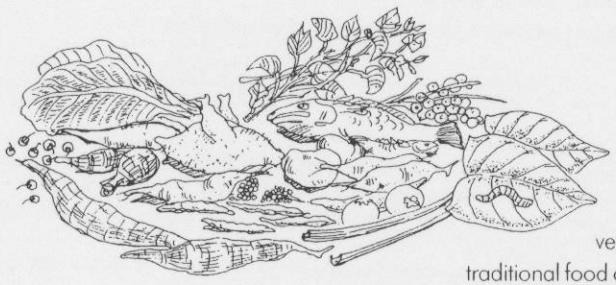
pineapple, cashewnut, banana, betel nut, tea, coffee, rubber, bamboo, ginger, cardamom and potato.

also depend heavily on storage facilities and transport network, which are poorly developed in this region, so growers cannot warrant a commensurate price for their produce. In addition, small farmers quite often get entrapped in the clutches of moneylenders and businessmen. By and large, comparatively well-to-do farmers have adopted the cash crops and the poorer ones have not benefited much.

Development of road networks, rural credit and marketing facilities is desirable for making the cash crops as alternative livelihood for the resource-constrained shifting cultivators of the interiors of northeast India.

Migration to urban centers

Repeated cultivation of land under the modified shifting cultivation degrades the land. This land degradation causes low productivity which consequently reduces the farmers' income. Severe soil erosion causes a total collapse of agriculture, hence, the migration of people to urban areas to seek employment. In such case, the fields are left to the care of the elderly and young children. As a result, rural societies become more and more dependent on cash remittances from urban employment.



Diet and nutrition

The modified shifting cultivation likewise affects the diet and nutrition of rural poor. Traditionally, the shifting cultivators of this region obtain meat by hunting and trapping), fruits (generally obtained from naturally growing plants), rice, leafy vegetables and tuberous crops comprise the traditional food of shifting cultivators of the region. All these foodstuffs taken together provide a fairly well balanced diet to rural populations.

Recently, however, meat, leafy vegetables and wild fruits have become scarce due to the shortening of fallow period and large-scale deforestation. Furthermore, the advent of market-based economy causes these items to be sold at high prices due to the great demand in urban areas. This lures the rural poor to sell whatever produce they have and the money will be used to purchase consumer items. The purchase of consumer items then becomes the priority over the provision of nutritional food for the family.

Most shifting cultivators of the region are quite acquainted with the skill of livestock rearing. However, this has remained to be a household activity and, therefore, less productive and least remunerative. Promotion of these activities are required for supplementing their diet, as well as creating avenues for earning extra income.

The modified shifting cultivation practice, clearly, brings along with it ecological and socio-economic considerations that should be properly addressed. Any strategy to be employed must be supplemented with modern input of conservation techniques. Although this should be done with caution so that the new system causes minimum changes in the customs and traditions of the local people.

Traditional shifting cultivation, with long fallow period and large interstitial lands covered by forests, is probably the best land use option for the hill slope agriculture in humid tropics in general, and northeastern India in particular. Wherever possible, such as in places where population pressure is low, the traditional shifting cultivation should continue or may even be promoted with suitable modifications by way of providing technological and managerial inputs. The modified shifting cultivation, with reduced fallow period and low crop diversity, is, however, not sustainable and therefore needs to be discouraged or further modified. The total population dependent on shifting cultivation need to be reduced by way of providing alternative livelihood, so as to keep more and more areas under pasture and tree cover. In so doing, the land will be more productive and sustainable.

Possible remedies and management practices to offset improper shifting cultivation practices:

- Popularization and continued operation of traditional mixed cultivation of multiple canopy crops at higher densities and leaving crop residues on the fields as protective mulch for the following crop cycle. In this way, the cropping period can be extended.
- Raising of pastures for community grazing.
- Development of biomass (viz., bamboo, cane etc.) based handicraft and village industry for employment generation.
- Afforestation of hill slopes with fodder, fuel and fruit trees near human habitations to check destruction of forests around shifting cultivation lands.
- Timber tree plantation on wastelands and uplands.
- Educating people about the benefits of conservation and evolving a mass conservation movement.
- Providing better facilities for family welfare and child care in order to check population growth.
- Creating awareness and providing better education for making the shifting cultivators less dependent on land-based activity and expose them to avenues and opportunities available elsewhere.

Suggested readings:

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