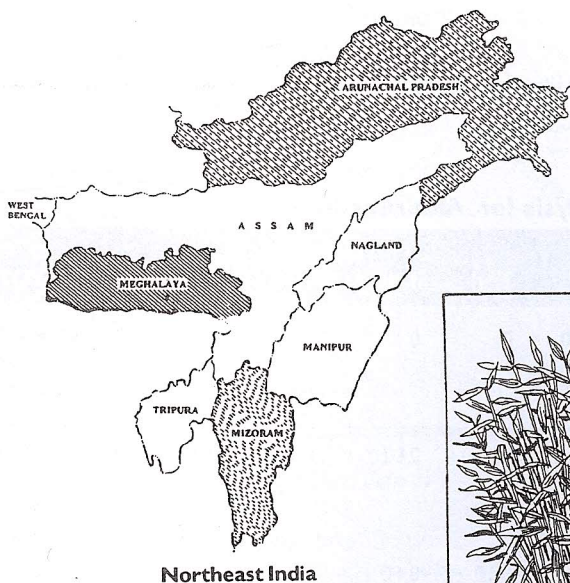
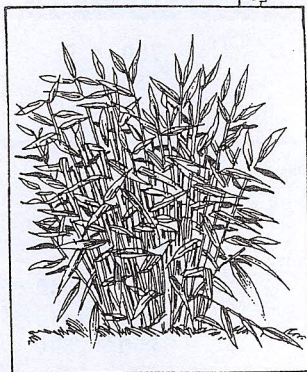


Domestication of Three Non-Traditional Species by Shifting Cultivators of Northeast India



Northeast India



Thysanolaena maxima



Aleurites spp.



Livistonia Jenkinsiana

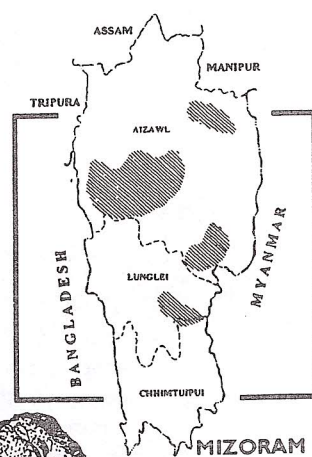
In their quest for a better crop and land use, many shifting cultivators of northeast India have started the cultivation and domestication of some non-traditional crops. These non-traditional crops came from neighbouring countries e.g. *Aleurites spp.* (*Tung*), and from the wilds e.g. *Livistonia jenkinsiana*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



Distribution of *Aleurites*



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

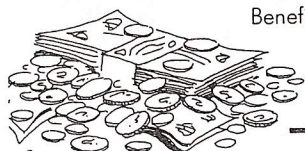
For the determination of costs and benefits of Tung cultivation, data on one to six-year old plantations were collected.

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

PARTICULARS	YEARS						TOTAL
	1st	2nd	3rd	4th	5th	6th	
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 !

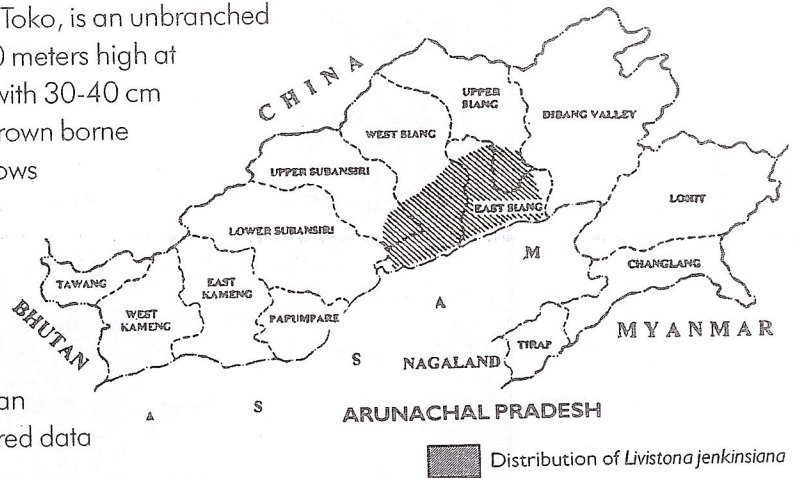
Intercropping can further enhance the productivity of the Tung plantation. Rice can be raised along with Tung during the first two years and ginger, tumeric and other shade-loving crops can be grown after the 2nd year of plantation.

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

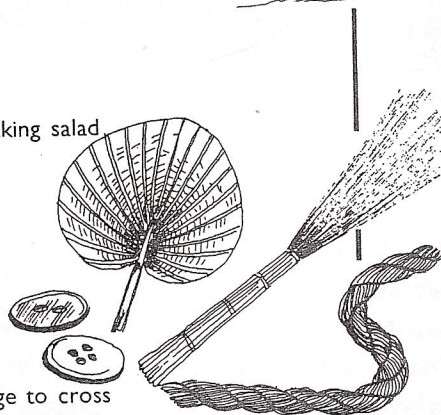
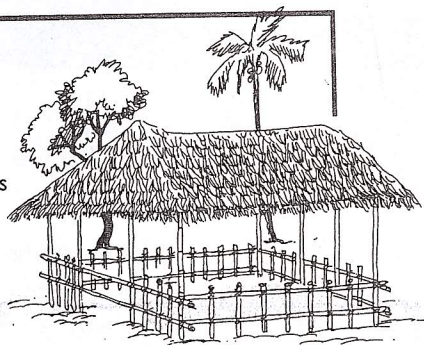
Nut

- 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).

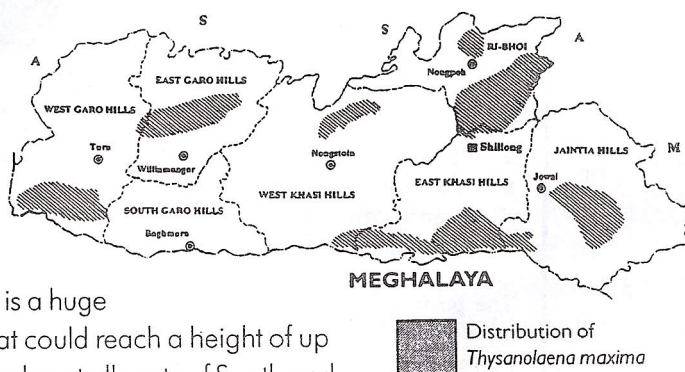
PARTICULARS	YEAR						TOTAL
	1st	2nd	3rd	4th	5th	6th	
Revenue	500	0	0	11250	15000	18750	45500
1. Site clearance	500						500
2. Selling of Fruits				11250	15000	18750	45000
Production Cost	-2750	2000	2000	4400	4450	3000	18600
Labor							
1. Site Clearance	2000						2000
2. Weeding		2000	2000	2000	2000		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.



Economics of *Thysanolaena maxima* cultivation

The yield of broom mainly depends upon the quality of planting materials, fertility of land and cultural practices adopted. The yield differs according to the age of the plant. The highest yield of inflorescence is obtained from three and four-year old plants. From the one-year old plant 0.5 kg of broom is obtained. The yield then begins to decline, and on the fifth year, the average yield is 1.5 kg while on the sixth, only 0.5 kg of produce per plant is obtained.

In most places, there is no categorization of the produce. In some places, particularly where plantations of different ages are available, grading of broom (inflorescence) is carried out based on the size of the inflorescence. Class I, consisting small inflorescence, fetches the highest price. This is procured from the one to three year old plants. Class II, the medium variety, is produced from the four to five year-old plants. Class III, the large inflorescence obtained from the six year-old plants, fetches the least price. The maximum quantity of produce comes from three to four year-old plants (Table 3). Depending on soil fertility, plant density and maintenance, the yield varies between 400 - 1,000 kg of inflorescence per hectare.

Uses of *Thysanolaena maxima*:

The inflorescence of the plant is used in making brooms, which are quite popular in India and fetch good price. These brooms have a ready market in northeast India and they are also exported to other parts of the country in large quantities.

Leaves

- Used as fodder and fuel during lean period

Grass Stems

- Used as raw materials for paper-making
- Used for making mats in small-scale cottage industry

Roots

- Prevents soil erosion as it binds the soil particles

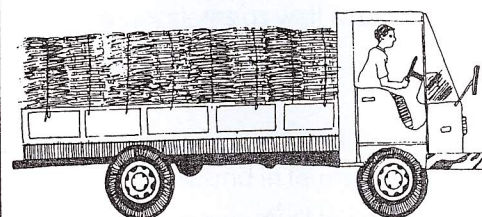


Table 3. Cost and return (Rs) analysis for *Thysanolaena maxima* (per ha).

PARTICULARS	YEAR						TOTAL
	1st	2nd	3rd	4th	5th	6th	
Revenue	3000	5200	9570	12350	4500	900	35520
Production Cost	3700	1400	1550	1550	850	400	9450
Labor							
1. Site Clearance	1000						1000
2. Weeding (2x per year)	1200	1200	1200	1200	650	250	5700
3. Harvesting (once/year)							
4. Pit digging and Rhizome planting	800						800
5. Transportation to godown	200	200	350	350	200	150	1450
Materials							
1. Small tools and implements	500						500
Net Income	-700	3800	8020	10800	3650	500	26070

Benefit Cost Ratio at 10% AIR = 3.46
 Benefit Cost Ratio at 15% AIR = 3.32
 Benefit Cost Ratio at 20% AIR = 3.19

It is clear that from a six year-old plantation, a cultivator can earn, on the average, a yearly net profit of Rs. 3,328 per hectare. An extra income can also be generated from the sale of stem, and the leaves can be used as fodder. Brooms have sufficient demand throughout the country and marketing is not a problem. The traders come to the village and buy the produce from the growers at prevailing rates.

Summary and conclusion

The economics of the three plantation crops is summarized in Table 4.

Aleurites spp.

- *Aleurites* spp cultivation gives good economic returns. However, the end product of this crop is an oil which is particularly used in industries. Therefore, it is highly dependent on external market forces. At present, most requirement of this oil is met from imports. This also necessitates that the cost of production should be minimal to warrant a competitive price.
- Poor infrastructure and hilly terrain puts these traditional farmers at a disadvantage vis-à-vis their counter parts elsewhere.
- Still, *Aleurites* spp. has a good economic potential and support from the government can provide the required impetus to the cultivation of this crop. It can provide an alternative livelihood to shifting cultivators not only in Mizoram but in other states as well where agroclimatic conditions favor the growth of this tree.

Livistona jenkinsiana

- At present, the produce has a small market which can possibly expand in terms of its demand. However, large market expansion is impossible as the leaves must to compete with modern house building materials. Thus, it can provide an alternative to shifting cultivation only to a limited extent. Intervention in terms of value addition and market expansion is desirable.

Thysanolaena maxima

- *Thysanolaena maxima*, on the other hand, has a high benefit-cost ratio and very good market, processing and value addition facilities have also come up in nearby low land trading centers. As a result, *Thysanolaena maxima* cultivation is expanding rapidly. Even without any external intervention, the farmers are getting good returns. In villages where the farmers have taken up the cultivation of this crop, within ten to fifteen years it has almost completely occupied all the lands previously used for shifting cultivation.

Table 4. Comparative statement of expenditure and return (Rs per ha) from a six year old plantation of *Aleurites* spp, *Livistona jenkinsiana* and *Thysanolaena maxima* at 15% annual interest rate.

Particulars	<i>Aleurites</i> spp	<i>Livistona jenkinsiana</i>	<i>Thysanolaena maxima</i>
Total production cost (Rs)	25,258	25,551	15,657
Total revenue (Rs)	65,891	51,884	52,092
Net profit (Rs)	44,910	26,900	26,070
Profit per rupee spent (Re)	2.61	2.03	3.32
Pay back period (years)	1.5	2.8	2.6

Table 5. Net income of the three species over six years.

	YEAR						TOTAL
	1st	2nd	3rd	4th	5th	6th	
<i>Aleurites</i> spp.	-5350	-2520	-2520	5950	16100	33250	44910
<i>Livistona Jenkinsiana</i>	-2250	-2000	-2000	6850	10550	15750	26900
<i>Thysanolaena maxima</i>	-700	3800	8020	10800	3655	500	26070

Table 5 indicates that *Thysanolaena maxima* had low starting cost and quick returns (on the second year). The other two species have high cost on the first three years. In particular, *Aleurites* can give the highest income over six years.

Suggested readings:

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Prepared by
B.K.Tiwari

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