

**INVESTIGATION ON SHIFTING CULTIVATION PRACTICES
CONDUCTED BY THE HILL TRIBES FOR THE
DEVELOPMENT OF SUITABLE AGROFORESTRY
TECHNIQUES IN MYANMAR**

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ABSTRACT

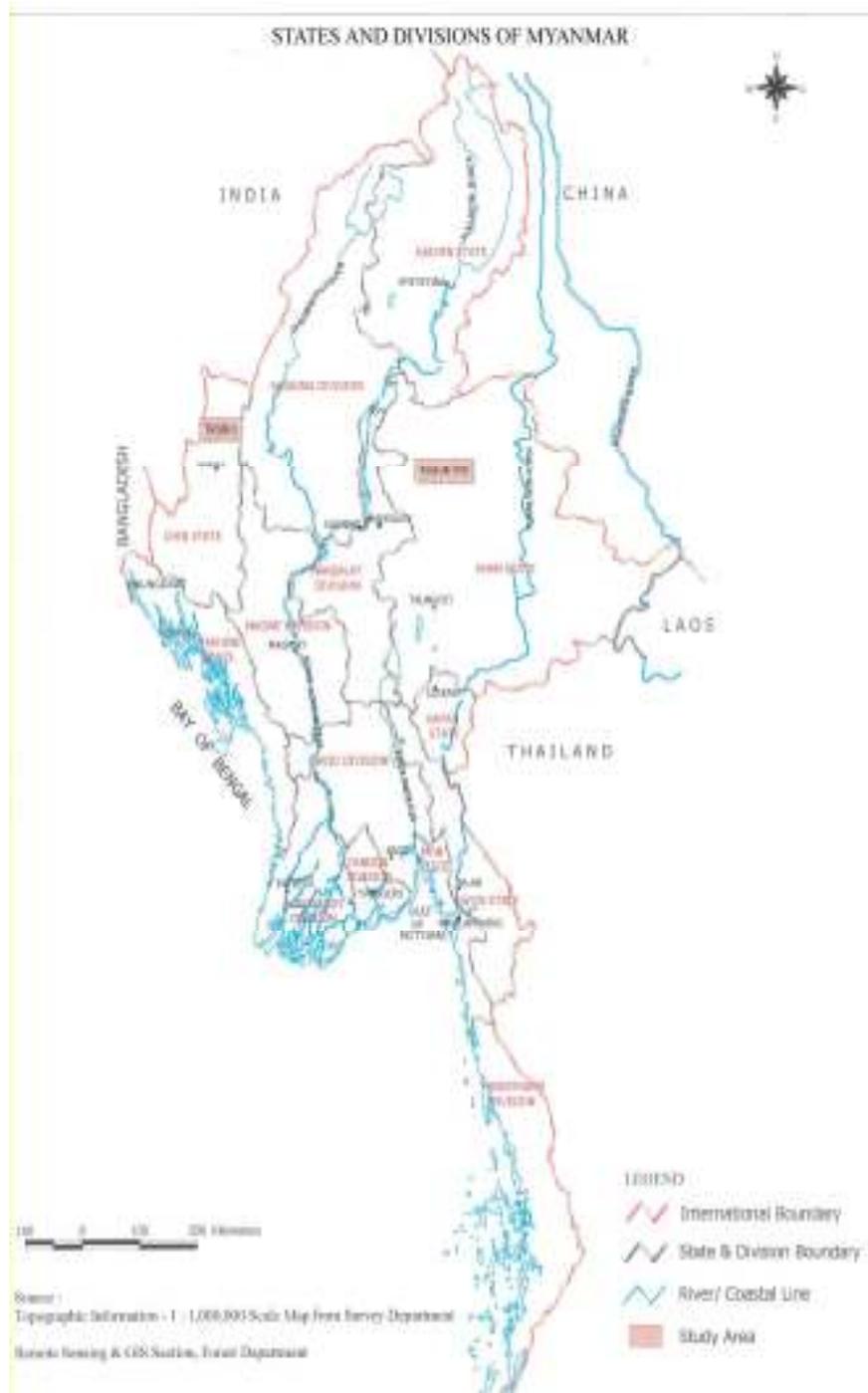
This paper deals with shifting cultivation practices in Myanmar. The definition of the practice and the outcome of the taungya forestry are firstly explained. The socio-economic situations and farming practices conducted by different Chin nationals of Teddim in Northern Chin State, and Shan, Palaung and Danu nationals of Kyaukme in Northern Shan State were then depicted. Farmers' innovation in fallow land management was observed in this investigation. Some agroforestry practices suitable for these study areas are finally suggested.

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1. INTRODUCTION

Myanmar has an area of 676,557 sq. km in the Southeast Asia. The country is bordering with India and Bangladesh on the west, China on the north and northeast, Laos and Thailand on the east, and the Andaman Sea on the south. Except for the two valleys of Ayeyarwady and Sittaung located in central and lower area of the country, the remaining areas are mostly hilly and mountainous. Pertaining to its climatic condition, the rainy season lasts approximately from mid-May to end of September or early October. The rainfall in the northern and southern most areas is as high as 2,500 mm. However, the central Myanmar is a rain shadow area with a rainfall less than 1,000 mm. From the month of November through January is the cold season with less or occasionally no rain at all. Starting from February, the temperature as a whole increases gradually reaching a maximum in May up to as high as or more than 40 degree Celsius. Maximum length of the country from south to north and, its width from east to west are 2,090 and 805 Km respectively. Four main rivers: the Ayeyarwady, the Chindwin, Sittaung and the ThanLwin are flowing from north to south and all are navigable.

There are 14 administrative regions in the country: 7 States, namely Chin, Kachin, Kayin, Kayah, Mon, Rakhin and Shan, and 7 Divisions, namely Ayeyawady, Bago, Magway, Mandalay, Sagaing, Taninthayi, and Yangon. Yangon is the capital of Myanmar. The names of the States are based on the names of predominant nationals (e.g. Chin national is predominated in Chin State). (See- Map showing States and Divisions) A total of 135 different nationalities reside in the country and the total population in the year 2000 was estimated at 50 million. Agriculture and forestry industries are the main organs of the Myanmar economy of the country and 75% of total population lives in rural areas.



2. LITERATURE REVIEW

In the Myanmar language, shifting cultivation is called "*Shwe Pyaung taungya*"². Literally it means moving hill-farm. Shifting cultivation practice prevails in Kachin, Kayah, Kayin, Chin and Shan states.

The Forest Department of Myanmar has estimated that 22.8% of the total land area are affected by shifting cultivation (Forestry fact sheet, Forest Department, 1993). Shifting cultivation is said to be the main underlying cause for deforestation in Myanmar (Forest Department, 2002).

The prevailing view on shifting cultivation practice by the general public, most officials and researchers in Myanmar is that the practice is a destructive land use that should be discontinued. The Myanmar Forest Policy (1995) gives the directives, "to discourage shifting cultivation practices causing extensive damage to the forests through adoption of improved practices for better food production and a better quality of life for shifting cultivators".

The same perception had prevailed in Thailand and the Thai foresters formed forest villages to control shifting cultivators and to establish teak plantations employing the villagers (Boonkird et. al, 1989). In Laos, sedentary farming is encouraged in shifting cultivation areas and shifting cultivators are allowed to grow, and harvest teak³ and the perennial fruit trees they grow (Roder et. al, 1995).

Nepal has the same view on shifting cultivation and the country uses area control system to the practice. The shifting cultivators are given land and the cultivators practice rotational shifting cultivation on the allotted land. The cultivators are required to form user's group first and to prepare operational plan on how to make use of the land allotted by the Forestry Department. Technical assistance in cropping and providing tree seedlings of *Delbergia sisso*, teak (*Tectona grandis*) to the cultivators are made by the department. In Dahnusa of Nawalprasi area, 40 user-groups have been formed and 1,200 ha of land area was allotted to the groups (Experience of the writer who visited Nepal in November, 2003).

On the other hand, Lori Ann Thrup et. al (1997) has different, but reasonable view on the practice. The authors recommend to recognize the diversity, rights, and

² In this report, two words-ya and taungya (not the word "taungya system") are used in the same meaning of shifting cultivation.

³ In Myanmar teak belongs to the State wherever it is situated.

their knowledge of shifting cultivation and to incorporate their valuable experience in carrying out developmental programme.

Taungya system, one of the reforestation techniques by employing shifting cultivators or land hungrys, was devised based on shifting cultivation practice. Taungya is a Bamar⁴ word- *Taung* (hill) and *ya* (farm). Dr. Dietrich Brandis, a German botanist-turned-forester, devised the system after seeing a Karen's shifting cultivation in 1856 at Kaboung forests of Taung Gu District, Lower Myanmar (Brandis, 1869). The system, however, was expanded only after late 19th century from Myanmar's neighboring countries to as far as Africa (Lowe, 1987). Many publications about the taungya system have been published (For example, King, 1968, Menzies, 1988, Watanabe, et al, 1992, Bryant, 1994).

The underlying objective of the taungya system is to control shifting cultivation practice and to establish commercially valuable forest plantations employing shifting cultivators. Accordingly, the system is often alleged as a labour exploiting system. The allegation is true, as the British foresters had succeeded in establishing valuable teak plantations at a lowest cost by employing this system. The following table depicts that teak plantation established by means of taungya system cost only 31 Rupees⁵ even at the age of 40 years while the plantation established by hiring labour (often called departmental plantation) amounted to 110 Rupees at the age of 10 and Rupees 33 for plantation made by seed broadcasting method. One can guess how the Karen shifting cultivators were exploited in the days of British colony in Myanmar. There were conflicts between the then foresters and the Karen shifting cultivators at that time.

⁴ Myanmar was formerly spelled as Burma. The word "Myanmar" encompasses 135 nationalities. Bamar, which constitutes over 60% of total population in the country, is one of the nationalities in the country.

⁵ Myanmar was colonized by the British beginning from 1824 and regained her independence in 1948. The country during the period was one of the States in British-India, and Rupee (India currency) was in use.

Table (1) Comparison of initial plantation establishment cost by three methods

Method	Cost/acre (Rupee)	Age of plantation (Years)
1. By hired labour	110	11
2. By Taungya system	31	40
3. By broadcasting teak seed at the time of bamboo flowering	33	10

Source: Tharrawaddy Working Plan, Government of Myanmar, 1918.

3. OBJECTIVE OF THE STUDY

Reports on shifting cultivation on Myanmar is scarce and it seems unfortunate as the country has different types of shifting cultivation. The objective of the study is therefore to document various shifting cultivation practices conducted by different hill tribes, to study local indigenous fallow management, if any, which guarantees sustainable agriculture, and to develop appropriate agroforestry practices for the respective places based on information obtained in the study.

4. STUDY AREA AND METHODOLOGY

According to the Myanmar Forest Department, the shifting cultivation affected area in the country was estimated at 22.8% of total land area (See forest cover map). Chin, Kayah, Kayin and Shan States have a vast expanse of shifting cultivation fields.

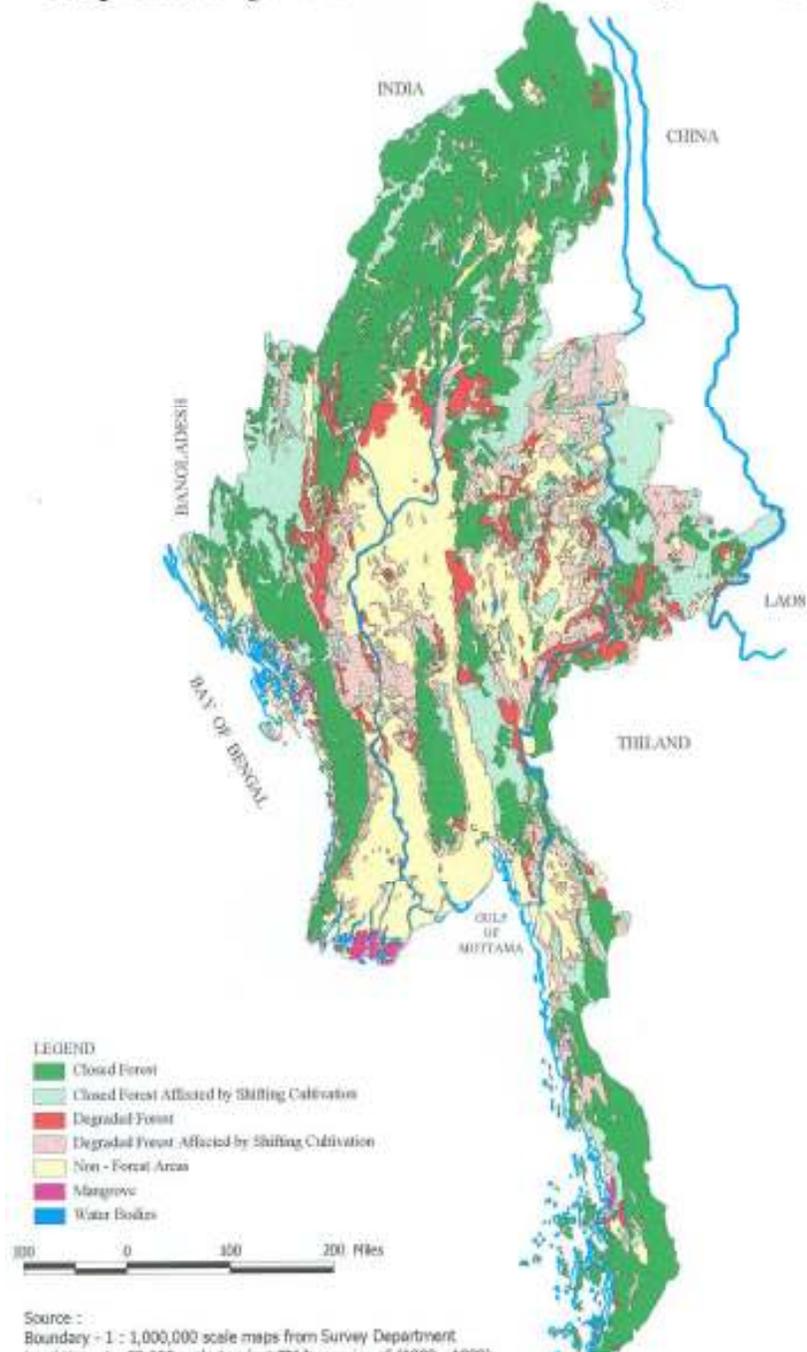
Kyaukme township of northern Shan State and Tiddim township of Chin States are selected as the study areas. The criteria for choosing the two townships as study areas are that the townships are two of shifting cultivation prevailing areas in the country.

As committed in my application form, I have made field visits to the tribes' shifting cultivation areas as well as their villages of the two townships, and conducted socioeconomic survey, studied on farmers' preference in site selection, their farming practices, major and subsistence crops they grow, medicinal plants they use, and tree species found around their farming areas. Meteorological data of

Kyaukme and Tiddim townships for the past ten years are presented in this report (Appendix 1).

Besides, soil samples were taken from the surveyed areas for soil tests and the results are reported. Precise position and its elevation, which are measured by GPS II, for most surveyed areas, are also presented in the report. Some fruit trees thriving well in Kyaukme and Tiddim were also noted to be used in developing appropriate agroforestry practices (Appendix 2).

Map Showing Forest Cover Status of Myanmar (1989)



5. EXECUTIVE SUMMARY ON POPULATION ESTIMATE ON SHIFTING CULTIVATORS IN MYANMAR, LAND USE, SOCIOECONOMY, FARMING PRACTICE, BELIEF, AND FACTORS TAKEN INTO PROPOSING APPROPRIATE AGROFORESTRY PRACTICES

(a) Population Estimate of Shifting Cultivators in Myanmar

Shifting cultivation had been practiced in Europe until the middle of the 20th century, and the practice is still prevailing in tropical countries. World's population on shifting cultivators was estimated between 250 and 300 million working on 30% of total exploitable soils (Hack 1974, Sanchez 1976 *in* FAO 1991).

For Myanmar, the author estimates the number of families involved in this practice at 2 million families. His estimate based on land area affected by shifting cultivation, on average annual land area per family for shifting cultivation and fallow period observed in this investigation. It is explained below.

In the survey it has been observed that the fallow period in the practice of shifting cultivation in Kyaukme of northern Shan State is less than 5 and that of Chin is between 5 and 10 years. One UNDP funded developmental project reported that the fallow period in the southern Shan region has been reduced to 3 years.

Based on the aforementioned assumptions, each family uses on the average one hectare of land annually, with an average fallow period of 7 years and, the shifting cultivation affected area in the country was estimated at 22.8% of total land area, there might be approximately 2 million families involving in this practice. Provided that fallow period of 3 or 5 years is assumed, the population involved in this practice will become higher than the present estimate.

Population estimate on shifting cultivators in Myanmar was stated in some reports. Wint (1996) stated that about one million families were involved in shifting cultivation practice. His estimate was based on the population living in 5 States of Chin, Kachin, Kayin, Kayah and Shan in the year of 1980 assuming all nationalities in the said States were involved in the practice. The Ministry of Forestry (1995) estimated that 1.5 to 2 million families practice shifting cultivation on an area of 2.43 million ha that constitutes mostly unclassified and degraded forests.

(b) Land Use and Soil Type

In Myanmar, all types of land belong to the state. There is no private land at all. Tables 2 and 3 below give land use in Kyaukme and Tiddim. In the tables, forest area comprises a very large portion of the total land area. It, however, has been observed that some shifting cultivation areas were in the reserved and public forest areas.

Table (2) Land use in Kyaukme

No	Description	Area in acres	%
1	Wet land rice growing area	17,700	1.8
2	Shifting cultivation	38,014	3.9
3	Home garden	32,959	3.4
4	Reserved forest area	21,635	2.2
5	Unreserved forest area	812,158	84.2
6	Cultivable waste land	12,524	1.3
7	Others (town, village, road, etc.)	29,465	3.1
	Total	964,455	100.0

Source. Facts for Kyaukme Township, 2002. **Note. 2.471 acres=1 ha**

Table (3) Land use in Tiddim Township

No	Description	Acres in Acres	%
1	Agricultural land	29,328	4.96
2	Cultivable waste land	214,007	36.3
3	Reserved forests	50,069	8.5
4	Unreserved forests	296,533	50.3
5	Others (town, village land, etc.)		
	Total	589,937	100.0

Source. Facts for Tiddim Township.

In the surveyed areas, each village has its traditionally owned land area, and the villagers, though the area is not demarcated systematically, practices shifting cultivation within the area. Streams, large trees (especially Ficus species is left uncut for the species is assumed as religiously sacred tree in Myanmar) and large rocky stone are marked-posts in the traditional demarcation for a village's own land. Therefore, shifting cultivators in the surveyed area have their traditionally owned area for practicing of rotational shifting cultivation practice.

In regard to having access to land for shifting cultivation, most hill tribes have a custom that they do shifting cultivation in their old fallows. If one would like to practice shifting cultivation in a fallow land, he has to get permission from the previous farmer who had cropped the land before. Village councils are playing an important role in land allocation for shifting cultivation in the areas of Chin State.

Soil in Chin State is classified as Cambisol (Orthic) and stated as the soil texture is loose and soil depth is shallow. The hills are sloppy and the soil scientists therefore recommended the area to give priority on growing trees for soil conservation.

Soil in Shan State is classified as Acrisol. The soil is reddish and has deep soil depth. The soil in the area is reported to be suitable for growing of both seasonal and perennial crops with land conservation measures (Personal Communication to Central Agricultural Research Institute, Myanmar).

According to the results of the soil tests, the soils in the surveyed areas are acidic and in phosphorous deficiency. An organic matter content of the soil under wild sunflowers is significantly higher than any other soils tested in this investigation.

(c) Decrease in Fallow Period

With the increase in population and some changes in land use, the fallow period of both areas has gone down. In Chin, the period has reduced from 10 years in the early 1960s (Maung Gale II, 1967)⁶ to 3-7 years, and in northern Shan State from 10-12 in 1970 to 0-5 years (Personal communication to old people during the

⁶ Forest situation in Mt. Natma in Chin State. A research paper presented in the Forestry Research Congress held in 1967, Yangon. (Text in Myanmar)

surveying period). In case of Nar khaw in Kyaukme, the period has gone down to ZERO.

There were many reasons for shortening fallow period in the country. For example, in order to fully utilize wasteland in the country, one act regarding to land use was enacted in 1992. The act allows any citizen to apply land at the disposal of the government for growing of perennial and seasonal crops, and livestock rearing. Other individuals or organizations might have applied some fallow lands for the aforementioned purposes and this also would be one of the reasons in shortening the fallow period.

In this report, the writer recommends to use Pyinkado (*Xylia xylocarpa*) and alder species (*Alnus nepalensis*) to replenish soil fertility. Especially, alder species is adaptable to the surveyed hilly areas. Alder is one of the multipurpose trees which can grow well areas more than 1,000 m asl (above sea level) and has vigorous coppicing power. Both are nitrogen fixing species and their litter decomposes easily. Wild sunflower plants are suitable for growing only in areas with deep soil layer.

(d) Socio-economy

The population of Kyaukme was 181,040 with a total land area of 4,035 Km² in the year 2002. The population density was 45 persons per Km². The distribution of the nationalities in the area are Shan 56%, Bamar 24%, Palaung 10%, and the remaining are Danu, Lisu, Kokan and foreigners (Myanmar born Chinese, Indians, Pakistani and Nepalese).

There are a total of 3 high schools with 4,325 students, of 8 secondary schools with 4,897 students and of 157 primary schools with 13,845 students in Kyaukme. There are one 150-bedded hospital, nine 16-bedded hospitals and 20 dispensaries and 21 private clinics in the township.

For Tiddim, the total population is 78,900 with a total land area of 2,470 Km² giving population density of 32 per Km². The distribution of nationalities in the township is Chin (99%), and the remaining are Bamar, Kachin and Kayin.

There are nine small national groups under the Chin national in Tiddim township, and they are Sai zang, Tei zang, Khua no, Sih zang, Mizo, Dim, Tiddim, Van te and Hua ngo. In this survey, shifting cultivation practices conducted by Sai zang, Sih zang, Dim and Khua no groups are reported.

There are four State high schools with 1,769 students, 12 secondary schools with 5,108, and 105 primary schools with 12,182 students. There are one 50-bedded township level hospital and some 25 dispensaries in the township.

Both townships are striving to produce rice to meet their own consumption. The rice production of Kyaukme for the year 2001 could meet only 77.73% of its home consumption. The major cereal crops grown in the study areas are dry land rice or taungya rice, corn, maize, potatoes, beans and pulse of various kinds.

Rice is the staple food in Myanmar and on average per capita rice consumption in this survey was at 0.4 Kg a day or 146 Kg for a year. In terms of Myanmar measurement, 146 Kg of rice is equivalent to 4.3 baskets⁷. The price of rice (medium quality) in the year 2002 was at 3,000 Kyats per basket and therefore, a family with 5 members would cost 65,000 Kyats for rice alone. Therefore, most of the shifting cultivators have to spend more than 50 % of their revenue for rice alone. Expense for education is low as the country practices free education in basic level.

Now, most Shan shifting cultivators are accustomed to use Ajinomoto (Monosodium glutamate) in their daily meals- not only in preparing curry, but also in making snack and pickled tea. Some fruits trees found in Tiddim are avocado and apple, and in Kyaukme are orange and pineapple. Kyaukme is famous for production of dry and pickled tealeaf.

National average for family members per house hold is at 5. In this survey, on average family members per house hold in Shan is at 5, however, except Thei zang village, Chin shifting cultivators of the remaining three villages have larger family size; 12.4 in Saung pi, 7.1 in Saing zang and 8 persons in Dim lo. This is because of the fact that married couples of a family stay together with their parents.

Previously, only sons have had the right to inherit goods from their parents in Palaung, and only the eldest son has had the right to inherit goods from his parents in Chin local tradition.

(e) Type of shifting cultivation

As mentioned before, from the spatial point of view, form of shifting cultivation in the surveyed areas is the rotational type. They have their own villages settled down in appropriate areas. And they make rotational farming (shifting

⁷ In Myanmar, cereal crops (rice, beans, maize, etc.) are measured by volume, not by weight.

cultivation) around their villages. The distance between their villages and shifting cultivation fields ranges between 1 and 3 miles in these surveyed areas. Land preparation is mostly carried out by manual labour.

Shan shifting cultivators have changed from rotational to sedentary farming practice, and from subsistence cropping, often found in shifting cultivation, to commercial cropping. They make commercial cropping in field and seasonal and perennial food crops of various kinds and small-scale livestock rearing are made in their home compound. Their home compounds are large enough for doing farming.

Chin shifting cultivators are still in subsistence farming. They still make group hunting. And the Chin villages located in higher places, more than 5,000 feet asl, do not grow dry land rice. They get a major portion of their earning from livestock rearing and outside job opportunities rather than cropping.

On average shifting cultivation in the surveyed area ranges between 2 and 4 acres. It has also been observed that crop production per unit area in the present surveyed areas is lower than that of other countries. Dry land rice produced in this surveyed areas lies between 750 to 1,000 Kg/ha and maize production ranges between 250 and 500 Kg/ha. Intensified taungya in Java, Indonesia, however, produced rice at 2000-3000 Kg per ha (800 to 1,200 Kg/acre), and maize at 1,000-1,500 Kg (400-600 Kg/acre). The same rice productivity was reported in shifting cultivation of Thailand. Maize production in Columbia is as high as 5,000 Kg per ha (Norman et al, 1996)

(f) Religion and belief

Pertaining to religious belief, Chin people are mostly Christian and the remaining tribes of Danu, Palaung and Shan are Buddhists. In Kyaukme, Buddhism is the major religion constituting of 95% of the total population, and the remaining population are Christian, Hindu, Islam and animist comprises 0.01% (Basic information of Kyaukme, 2002). Christian prevails in Tiddim.

In this survey, beliefs and rituals of Chin and Shan shifting cultivations were studied. Both Chin and Shan shifting cultivators believe in the fact that there are spiritual guards in the forests and at every individual tree. Therefore, they, whatsoever is their religion, choose auspicious day for site selection, for beginning of tree felling in making new field. The Shan offers food, a bottle of liquor, steamed

rice and 2 grilled chickens, to the spirits of the hills if sickness comes to them very often and stay longer. Steamed rice and some boiled meat are put in a specially designed basket made of bamboo and lay down outside the village outskirts at sunset when infant child used to cry at the time of sunset. They believe that the infant cries out because a hungry spirit possesses him.

The writer has worked for nine years in teak plantation establishment by means of taungya system in Tharyarwady forest division. There, he had to work with the Karen shifting cultivators and the Karen requested him to make an official declaration before felling trees for taungya plantation. Included in the declaration are that the forest department has officially sanctioned the selected area to establish teak plantation, the land would be cleared, and all spirits residing in the area are requested to get out of the place. Unless such declaration was made, the Karen would not work in the plantation activities.

In regards with the ethno-botanical aspect, the Karen knows which shrubs and herbs are good for what ailments and activities. For example, they use poisonous shrubs and herbs, but not harmful to man, for fishing. The poison of the shrubs and herbs used for fishing does not last very long and not as harmful as chemical poison.

In previous days, the Karen shifting cultivators selected forests for shifting cultivation as follows. A Karen leader takes a piece of soil from an area, put it under his pillow and sleep for a night. If he has had a good dream that night, he selects the area for cultivation. If not, he avoids the area for making the new cultivation. (Marshall, H. I, 1922).

6. THE MAJOR AGROFORESTRY SYSTEMS

There are three main agroforestry systems; Agri-silviculture system (tree and agricultural crops), Agro-silvosivopasture system (tree, agricultural crop and animal), and Silvopastoral system (tree and animal). To be an agroforestry technique in practice to one area, availability of labour force of the area (to implement the practice) is considerably important. Commonly, three factors are considered in developing agroforestry practices; adaptability, sustainability and productivity. Adaptability here means adoption (of new practice) by farmers. If an agroforestry practice developed is too much complicated, farmers will be reluctant to adopt it even the practice ensures high productivity with less resource depletion.

Buddhism is the most dominant religion in Shan, Palaung, and Danu hill tribes, while Christian prevails within Chin people. Difference in religion also has a great impact on agroforestry design that the former is somewhat reluctant to rear livestock. Beans and vegetables prevail in daily meals of Shan, Danu and Palaung people.

Accessibility is also to be considered in developing agroforestry practice. For example, grape fruits are grown and available in large quantity at Putao, northern most area of Myanmar. Because of poor road accessibility, it is difficult to dispose the fruit outside the area.

To be workable in practice, the findings in socioeconomic situations, agro ecological information, knowledge and experience of the cultivators, matters for soil conservation and improvement, and products to be prioritized are taken into consideration in developing appropriate agroforestry techniques for the surveyed areas.

The proposed agroforestry practices in this reports are tea-based agroforestry practice and hedgerow planting for Palaung hill tribe, homegarden and improved-fallow practice for Danu hill tribe, alley cropping for Shan (Narkhaw), improved fallow practice and hedgerow planting for Shan (Narpon), silvo-forage and improved fallow practice for Chin shifting cultivators.

(a) Components Found in the Shifting Cultivators' Farming Practices

Crops

Dry land rice, maize and millets are major crops in the surveyed areas. In Shan state, dry land rice, maize (CP-888, CP-999 varieties), sesame (*Sesamum indicum*), sweet potatoes (*Ipomoea batatas*), Casava (*Manihot esculenta*), soybean (*Glycine max*), beans (*Phaseolus spp*), pumpkin (*Cucurbita spp*) and small amount of tobacco (*Nicotianatea tabacum*) are grown. In Chin areas, rice, beans, maize, taro, millet, pumpkin, chilies and squash are grown.

Trees

Growing tree in the shifting cultivation areas investigated is very rare. However, some Shan shifting cultivators of Nar Khaw cut trees 5-6 feet above ground deliberately when they clear land. Periodic branch trimming is made to the

stems and farmers use the tree stems as posts for climber food crops. The trees thus left produce new shoots quickly, which are, as a rule, trimmed during the cropping period, but not later in fallow period. This practice let the area to be reforested faster than other means. Chin cultivators have their own small woodlots for timber and firewood production. No cultivation is made in the woodlots.

Except in Kyushaw area, trees that can produce good timber in other places are scarce. Kyaukme is now importing timber from neighboring areas. This situation suggests (that) growing tree for future timber consumption is greatly required.

A wood lot of Pyinkado (*Xylia xylocarpa*), second to teak in Myanmar, was found in a no-forestry governmental compound in Kyaukme. Pyinkado does not grow naturally in this area, but the growth of the Pyinkado trees suggests the species can thrive well in the area (See Appendix 3)

(b) Livestock Rearing

Chin Shifting cultivators rear livestock. Rearing of pigs and chicken was observed in every household. Besides the livestock they rear wild ox or mythun (*Bos frontalis*) at their home for meat and cash purposes. Few Shan, Danu, and Palaung on the other hand make livestock rearing. Palaung and Shan rears mules and draught cattle (ox) for transporting purpose.

7. CONCLUSION

Different tribes are doing different shifting cultivation practices. Danu tribes practice shifting cultivation in hills with an average height of 2,600 feet. Wild sunflower herbs are used as plant indicator for choosing land for shifting cultivation. Major crops they grow are rice, maize and sweet potatoes. Cropping period is 3 years in a place. Danu exercises a good fallow management practice. The management is very useful for sustainable crop production in areas where a short fallow period is used. Because of their fallow management practice, they can carry out crop cultivation for 3-4 years in a place.

Palaung used to live in higher places and they make shifting cultivation in hills with higher altitude (more than 3,400 feet) than the place where Shan live in. The Palaung prefers areas for shifting cultivation in the areas where Bonmeza (*Albizzia chinensis*) and Yone (*Anogeissus acuminata*) grow. Major crops grown by

the Palaung are rice and tea. They prefer western aspects to eastern aspect to establish tea plantation. They have two ways of land use; cropping land by rotational shifting cultivation and establishing perennial food crop (tea) in fallow land.

Shan, the major population in Kyaukme, lives in lower area of the township. The areas are within easier reach than that of Danu and Palaung. But fallow periods of the Shan areas are low, zero in some areas. Introduction of new maize crop (CP, 888 and CP, 999 varieties) was observed in Shan shifting cultivation area. Some Shan shifting cultivators have moved from subsistence to commercial cropping.

Chins in the surveyed areas are still doing subsistence cropping. The areas they live in are high in altitude and difficult to access. Men are involved in heavy works of tree felling, burning and harvesting, and then they leave their cropping field for 3 months for outside jobs. During the time, women on the other hand take care of the field and conduct sowing, weeding, livestock rearing at home and carrying fodder and crops from field to their villages. Fallow period in Chin areas is longer than that of Shan, Danu and Palaung. Maize, potatoes and yams are major crops for the Chins.

As mentioned before, the agroforestry techniques proposed in this report are based on the agro-ecological and socioeconomic situations found in the survey. The techniques are not very new and strange to the tribes; they are within their reach. In short, the techniques are developed based on the idea how to incorporate the tribes' present farming practice into new ones. Four important suggestions for the surveyed areas are shown below.

- ❖ to enhance some shifting cultivators' understanding of the fact that every soil improvement activity cannot be successful without considering the role of trees,
- ❖ to improve farmer confidence in agroforestry viability through the establishment of demonstration plots in respective areas
- ❖ to introduce fast growing nitrogen-fixing multipurpose tree species, and
- ❖ to introduce quality seed for high yield production.

8. CASE STUDIES OF SHIFTING CULTIVATION IN KYAUKME AND TIDDIM TOWNSHIPS

Shifting cultivation practice by Danu hill tribe

I. Location and socioeconomic information

1. **Name of tribe** Danu.
2. **Location** Konesone of Kyaukmegyi village-tract, Kyaukme town-ship, northern Shan State. The village is located at an elevation of 2,610 feet, and in the position of N22° 31' E 097° 02'.
3. **Shifting cultivation in Danu word**
Shwepyaung Taungya (Often taungya)
Danu speaking is mostly similar to that of Bamar national, the majority of population in Myanmar. There are some differences in pronunciation. They use (Tha) instead of (Sa). For example Bamar national says (Hta min **sar**- eating rice), they speak (Hta min **thar**).
4. **Demographic information**
The village has a total of 63 households with 316 individuals with the ratio of male to female at 1.05: 1. The dependent ratio (under 16 and above 60-year old people) is at 40 and working population is at 60%. Compared to other people, the Danu shifting cultivators are less in population than other tribes and the areas they live are less fertile than those of the other tribes.
5. **Education**
There is one primary school in Konesone village and a total of 56 primary level students was there in the school. Some 15 secondary level students from the village at the time of survey are at Kyaunkme high school.

6. Revenue and expenditure

Income from crop production constituted between (50-70%), followed by income from NWFPs of bamboo shoot, mushroom, and firewood collection (20-30%). Revenue from livestock rearing is minimal. Total revenue ranges between 130,000 to 231,200 Kyats.

In expenditure, expense for food alone accounted for (70%) of total revenue, followed by farming at (15%), educational expense 10-15 % and medical expense at (5-10%).

II. Farming System

7. Plant indicator for site selection

Wild sunflower (*Ththonia diversifolia*)

8. Farming practice

The cultivators make cropping for 3-4 years in a place. Rice is grown in the first year, followed by maize and/or groundnut and sweet potatoes in the successive years. Sweet potatoes needs earth mounding. Land preparation and growing crops are mostly made by manual labour. Some cultivators have more than one cropping fields. As they have more than one field, their annual new shifting cultivation area, as a rule, is not larger than 2 acres (0.8 ha) per household. Major crops grown are rice, maize, groundnut and sesame. Subsistence crops are lemon grass, chilies, climber beans, and pumpkins. Guava, passion fruit (climber species), and ornamental shrubs were found in their home compounds.

Table (1) Agricultural calendar for Danu shifting cultivators

Month	Activities
January	Ya cutting in new field/ sesame harvesting in old field
February	Fire protecting in both new and old fields
March	ditto
April	Ya burning
May	Soil working and growing rice/earth mounting
June	Weeding/sweet potatoes growing
July	Growing sweet potatoes, weeding and searching food in natural and forest fallows
August	Maize harvesting in old field
September	Weeding /sesame growing in the place of maize planting areas
October	Rice harvesting
November	Sweet potato harvesting/
December	Ya cutting

9. Fallow period

3-5 years.

10. Fallow management

During the fallow period, the Danu people deliberately grows wild sunflower (*Tithonia diversifolia*) plants. The process is that Danu transplant wild sunflower plants into the abandoned field in rainy season. They make slashing the wild sunflowers once a year in late rainy season (September and October). The cultivators repeat this practice for 2-3 years. The practice enriches green manure to the soil and in the third/fourth year, they slash and burn the plants and grow agricultural crops. Some Danu farmers use chemical fertilizer (urea and potash) in

crop production, especially in maize and groundnut production.

Soil samples (0-20 cm depth) under wild sunflower plants were taken for soil test. The results show that the contents of OM (Organic Matter) and N₂ in soil under sunflower plants are significantly larger than that of other areas. Again, pH value of the former is nearly neutral. See table below. (See table 2)

Table (2) Soil properties of wild sunflower growing area

No	pH	N %	Avg; P %	Ext. K %	OM %
1	7.38	0.1422	0.000024	0.0183	11.83
2	6.57	0.1304	0.000009	0.0109	12.39
3	6.7	0.0296	0.000027	0.0203	7.49
4	7.31	0.0341	0.000033	0.0124	8.73
5	6.03	0.1192	0.000114	0.0236	6.60

11. Crop productivity

On average un-husked rice production is at 25 baskets/acre (1,250 Kg/ha). This is higher than that of Palaung shifting cultivators. Maize production was at 28 baskets (1,937 Kg/ha), and groundnut at 35 baskets/acre (seed weight-700 Kg/ha).

12. Medicinal plants

- Tuber of Meik-thalin (*Zingiber barbatum* Wall) used as counter pain
- Bark, roots and leaves of Thetyin-gyi (*Croton tiglium* Linn) are used for nerve pain treatment.
- leaves of Lauk-thay (*Tadehagi triquetrum*) used for malaria
- roots of Yinbya (*Dichroa febrifuga* Lour) are boiled and taken for fever.

III. Proposed Agroforestry practice

The Danu shifting cultivators know how to make soil (Organic matter) or enrich their abandoned soil during the fallow period. Their farmlands are located between 1-3 miles away from their village. However, with increased population, the fallow period will go down from 3-4 years to zero in the future. The cultivators thus should introduce half of their farmland, close to their village, into "**3-layered homegarden agroforestry practice**". The arrangement for the components is that Pyinkado (*Xylia xylocarpa*) in the top layer, perennial food crops (banana and citrus plants, etc.) in the second layer, and coffee and seasonal food crops in the third layer. Pyinkado can thrive well in the area (See Table in appendix 3). the species a nitrogen fixing species with deep roots and it will enrich soil fertility through nitrogen fixing and litter fall process while providing shade for coffee plants beneath it. The tree species will also act as host tree for passion fruit that now has good market in Mandalay, the second largest city in Myanmar. The cultivators can grow crops in the remaining farm lands using their fallow management practice.



Wild sunflower in fallow (*Tithonia diversifolia*)



One year-old wild sunflower 3 clumps in 1m²
weight 13 kg (Green Weight)

Shifting Cultivation Practice by Palaung Hill Tribe

I. Location and socioeconomic information

1. Name of tribe Palaung. There are two main groups in Palaung-Shwe (golden) Palaung and Ngwe (Silver) Palaung. The surveyed shifting cultivators are Ngwe Palaung.

2. Location Kyu Shaw, Kyaukme township, northern Shan State. The village is located at an elevation of 3,429 feet and in the position of N 22° 35.437' and E 96° 57.777'. Kyu Shaw and its neighbouring village have total area of 2,400 ha. Except foot-path, road access to the village by cart or tractor is available. The Palaung use mules for transporting goods.

3. Shifting cultivation in Palaung word

Nar

4. Demographic information

The village has a total of 83 households with 431 individuals dividing male and female at the ratio of 1: 1.05. The dependent ratio (under 16 and above 60-year old people) is at 43 and working population is at 57%.

5. Education There is one primary school in the village and a total of 79 primary level students was there in the school. Some 11 secondary level students from the village at the time of survey were living at Kyaunkme for their further studies, it is learnt.

6. Revenue and expenditure

Revenue from tea production stood first and followed by rice production. Total revenue for the farmers ranges between 90,000 and 350,000 Kyats. Expense for food alone cost the cultivators more than 70% of their total revenue. They import salt, tobacco, and kerosene for lighting, clothing and some medicines. Revenue form

livestock rearing is small and they rear mules and horses for transporting purposes.

II. Farming System

7. Plant indicator for site selection

The following tree species are used as plant indicator in site selection for shifting cultivation. The Palaung assume the areas where the following species grow as areas with good fertility.

(1) Bonmeza (*Albizzia chinensis*)

(2) Yone (*Anogeissus acuminata*) Wall

Bonmeza grows well in the area and the species is one of the MPTS (Multipurpose tree species) with rapid growth. Its litter fall decompose easily.

8. Farming system

Before depicting the cropping system, it is necessary to explain the place where the Palaung makes cropping. The tribe makes cropping in hills with great steep slope. Some slopes are as steep as 50 degree. One proverb depicts the livelihood of Palaung as "*Lapet kaung sarchin, Palaung taungtet hnay*". The proverb means that Palaung lives in high hilly areas to get quality tealeaf. The following table shows seasonal agricultural activities by the Palaung.

Table . Agricultural calendar for Palaung shifting cultivators

Month	Activities
January	Ya cutting in new field/ tea leaf harvesting
February	Tea leaf harvesting (once a month)
March	ditto

April	Burning the slash/ Tea leaf harvesting
May	Cleaning and Soil working /Tea leaf harvesting
June	Rice growing/Tea leaf harvesting
July	Weeding, searching food in natural and forest fallows
August	ditto
September	ditto/cleaning weeds in tea plantation
October	Rice harvesting
November	Rice harvesting
December	Ya cutting

Substance crops of pumpkin, chili, lemon grass, and sweet potato are intercropped with rice.

Some farmers grow rice in successive years. At that time, during the first and second years, the cultivators produce tea-seedlings at their home compound.

In the third year, they transplant the tea seedlings to the field at a spacing of 1 x 1 m in rainy season. They prefer western aspect of hill-side to eastern aspect for making of tea plantation. They expressed that tea (leaf) production of the former is better than that of the latter.

9. Crop productivity

Per acre unhusked rice production is not more than 15 baskets (745 kg per ha). Tea (leaf) production is at about 320 Kg of green tea leaf per acre (790 Kg/ha). The Palaung makes pollarding of tea trees once in every 5-7 years. And their tea trees are too high (6-12 feet) to harvest leaf and to make follow up tending operations.

10. Fallow period

Fallow period ranges between 5-7 years for rice fields. No systematic fallow management was observed, but they protect the fallow land from fire.

Table (2) Soil properties of Kyu Shaw shifting cultivation

No	pH	N %	Avg; P %	Ext. K %	OM %
1	5.30	0.108	0.000015	0.0046	5.73
2	5.30	0.1108	0.000396	0.0082	5.86
3	5.54	0.0352	0.000082	0.0097	6.03
4	5.37	0.094	0.000136	0.0106	5.04
5	5.32	0.1125	0.000068	0.0079	6.12

The soil in Kyu Shaw shifting cultivation field is acidic and extractable phosphorous % is very low. The content of organic matter is at medium level.

III. Proposed agroforestry practice

At first, the author, observing crop production in steep slopes and some land slides happened in previous years, discussed to leave forests undisturbed at the top of every hill. Because of large landslide, some villagers were moved to lowland areas of Kyaukme in the year 1999. The Palaung said that they have left some forests located east of their village and they are protecting it for water access. They, however, are reluctant to leave forests at the top of the hills in which they are growing crops for fearing of wild games' disturbances to their crops. Secondly, tea (leaf), the farmers' major crop, has a large and wide market in Myanmar. Thirdly, the Palaung have skillfulness in tea plantation management and its processing techniques-steaming tealeaf for making of dry and pickled leaf to some extent.

And finally, the cultivators need fuelwood for steaming tea-leaf in the tea-leaf processing and for warming,

cooking. Therefore, aforementioned four things are to be taken into proposing appropriate agroforestry practice for the villagers.

- (1) Top of every hill, at least one-fourth of total hill slope, should be put under forests with utmost protection. Cropping, grazing, hunting etc., in the protected area should not be permitted. This will help protect land slide and soil-erosion in the area.
- (2) Cropping will be made in the fallows of middle and lower portion of the slopes, but burning the slash will not be made. The felled stems and branches will be laid down along the contour line at an appropriate distance (10-12 feet apart) to protect soil erosion and to release nutrients to the soil.
- (3) Food crops will then be grown using minimum tillage means- such as dibbling bamboo sticks in the first and second year. During the first and second years, seedling production of tea and forest trees –Bonmeza and/or Yon (good for timber as well as for firewood) will be made.
- (4) In the third year, growing forestry seedlings on edge of the already formed contour lines at 12 feet apart, and line by line growing of tea seedlings 4 feet apart in-between lines of the contour will be made. The former will play not only in productive role, but also in service role for the latter as tea plants thrive well beneath the Bonmeza. Intercropping of the species can improve humidity, temperature and light scattering. These will enhance tea yield and its quality.
- (5) This proposed system has a potential of producing not only tea, but also timber, firewood and green manure. Inter-planting of trees in tea plantation can

reduce run-off checking soil erosion and moderate high summer temperature.

The height of tea trees should not be allowed more than 3 feet. Cutting crown in the form of V-shape from the top of the crown towards the inner part should be made. This will allow sun light into the crown and will increase new shoots production.

- (6) This practice may be named as "**tea-based agroforestry practice**" under the category of agri-silviculture system.
- (7) For rice and vegetable production, bench terrace making in mid and lower portion of the hills is suggested. This is a rice-based cropping system and the system can be employed in deep soil areas. The terraces are constructed employing A- frame and then cut and fill soil to produce a series of terraces. Retaining banks of soil, tree stems or stones on the forward edges reinforces bench terraces. Ipl ipl, K-156 species, is recommended to grow on the edges of the terraces. K-156 has good growth and vertical shooting habit that does not shade on the agricultural crops around the plants.



Plate 1. Steaming green tea leaf (Kyu Shaw)



Plate 2. Steamed tea leaf (Palaung tribe, Kyu Shaw)



Plate3. Bonmeza (*Albizia chinensis*) and fallow land

Shifting Cultivation Practice by Shan Tribe

I. Location and socioeconomic information

- 1. Name of tribe** Shan
- 2. Location** Nar Khaw of Kyaukme township, northern Shan State.
The village is located at an elevation of 2,290 feet and in the position of N 22 32.146' and E 97 04.834'. Cart or tractor road access to the village is observed.

3. Shifting cultivation in Shan word

Hai

4. Demographic information

The village has a total of 60 households with 308 individuals dividing male and female at the ratio of 1.17:1. The dependent ratio (under 16 and above 60-year old people) is at 28 and working population is at 72%. A total of 12 households was selected for to get necessary information. Average There, dependent ratio is at 34 and working population is at 66%. Persons above 60 years old were 3.

5. Education

There is a total of 18 primary level students in the village. In the selected 10 households, 8 primary students and one high school student were observed.

6. Revenue and expenditure

Revenue from tea production stood first and followed by rice production. Total revenue for the farmers ranges between 145,000 and 460,000 Kyats and revenue from cropping ranges between 57 and 98%. In expenditure, expense for food constituted between 50 and 68 % of total revenue, followed by social and religious, education expenses at 12 and 10 respectively. Expense for farming is low as the farmers use their own seed and home labour for cropping.

II. Farming System

7. Plant indicator for site selection

Not by plant, but by soil colour-brownish soil

8. Farming practice

Previously, the villagers were shifting cultivators and now there is no more land area for agricultural expansion and fallow period became zero. On average cropping area lies between 2 and 4 acre per household. Rice growing is less profitable and villagers now grow maize (CP-888). The maize variety was introduced by a Thailand Company in early 1990s and since then the farmers were involved in maize growing. There was the company's branch office at Kyaukme township and the company distribute seed at a reasonable price and buy maize at the time of harvesting. The farmers make weeding by manual labour and then plough field by cattle in April-May when monsoon sets in the region. In June they start to grow maize seed- 6 kg of seed for one acre is required. Three times of weeding in-between lines of maize are carried out between June and August. Harvesting maize begins in early October. Total labour requirement, excluding cattle power, for one acre of maize growing, weeding and harvesting is at 40 man-days/acre. Prevailing labour wage/man-day in the year 2002 was at 500 Kyats for man and 450 Kyats for woman. The price of the quality seed was at 11,000 Kyats for every 6 Kg. They use two bags of urea fertilizer (20 Kg) and it cost them 8,000 Kyats. Therefore total expense for an acre of maize growing was at about 39,000 Kyats.

Farmers have no knowledge on making compost and they used to apply chemical fertilizer for maize production. After maize harvesting, they grow sesame (*Perilla ecimoides* Linn) as secondary crop. Field

preparation is made by cattle again and sesame seed broadcasting is done in end of November or early December. The crop is harvested in April. Labour requirement for sesame growing is at about 20 man-days per acre. A farmer can earn Kyats 60,000 per acre from maize and Kyats 20,000 to 30,000 from sesame growing in a year. To compare expenses between rice and maize growing, expenditure for an acre of dry land rice growing in Nar Pon shifting cultivators was studied. Total labour requirement for an acre of rice growing needs 15 more man-days than maize growing. No cattle labour is applied in rice growing. However, rice productivity is at about 15-20 baskets/acre and the price was at about 1,250 Kyats /acre at the time of survey. Rice growing gave less incentive to the farmers and thus they gave more attention on maize growing than rice. Subsistence agricultural crops are grown in their compound for their own consumption. The following table shows the varieties of vegetables grown by the 30 villagers in their home compound.

Table (1) Vegetables grown by Shan hill tribes in their home gardens, Nar Khaw Village

HH	Roselle	Pumpkin	Gourd	Ash Pumpkin	Lady Finger	Djeankol Bean	Drum Stick	Basil	Acacia Intsia	Edible Ficus	Egg Plant	Chilly	Ridged Gourd	Ginger
1		*	*									*		
2		*	*	*				*		*				
3	*	*	*	*			*	*			*	*		*
4	*	*	*	*			*	*		*		*		*
5	*	*	*	*			*	*		*		*		
6		*	*	*				*				*		
7		*	*	*				*				*		
8	*	*	*	*		*	*			*	*	*		*
9		*	*			*	*	*		*	*	*		*
10		*	*	*		*	*	*				*		*
11	*				*							*		
12		*											*	
13		*	*		*		*	*			*			
14		*	*				*							*
15	*	*												
16		*					*						*	
17	*	*	*											
18	*	*												
19		*	*		*						*	*		
20	*				*							*		*
21					*									
22					*		*		*	*	*		*	
23		*						*				*		*
24		*					*				*		*	
25	*		*		*		*	*		*	*	*	*	
26			*			*							*	
27	*	*	*				*			*		*	*	
28		*	*				*			*			*	
29	*	*			*		*						*	
30			*				*		*			*		

Notes: Edible ficus species (*Ficus infectoria* Roxb) in local name is Nyaun-chin and its new shoots come out in April-May are made into pickle and the Shan people eat with sticky rice.

This example shows the fact that the cultivators have shifted from subsistence to sedentary commercial crop growing when there is no more land. Soil samples were taken at 6 places and the following table shows the result. The soil is alkaline and rich in organic matter.

Table 2. Soil properties of Nar khaw maize field

No.	pH	N%	Avg; P	Ext; K	O.M%
1	8.16	0.1192	trace	0.0224	7.70
2	7.44	0.1159	0.000154	0.0142	11.83
3	7.01	0.1237	0.00017	0.0371	9.70
4	8.09	0.1131	0.000044	0.0135	11.02
5	8.08	0.1237	0.000012	0.0176	11.96
6	7.76	0.0369	0.000069	0.0158	8.80

9. Crop productivity

Per acre maize production on average is at 50 baskets and that of sesame is at 5 baskets/acre. Maize is sold at 1,200 Kyats/basket and that of sesame is at 6,000 Kyats/basket (2002 price).

10. Fallow period

Fallow period for this village is (0).

III. Proposed Agroforestry Practice

In order to maintain good soil fertility in the long run, **hedgerow-planting practice** is proposed to these cultivators. The reason is that the area, according to soil test result, is not acid soil and nitrogen-fixing species in hedge can thrive well. Secondly, the slope are not so steep (20-35 degree). Hedgerows reduce soil erosion, improve soil fertility and its moisture, provides biomass for green manure (compost) making and play as source of fodder and fuel wood. But this agroforestry practice needs regular pruning and trimming of brunches and root. Intercrop maize and beans alternatively in alleys. Interval between hedgerow and the width of hedgerow is to be decided hill-by-hill basis. The species to be

employed in hedgerow is suggested ipl ipl K 156 for the species is one of MPTSs (multi-purpose tree species) and it grows well in Myanmar.



An array of maize (CP-888) plantation at Nar Khaw)

Shifting Cultivation Practice by Shan Tribe (Nar Pon Village)

I. Location and socioeconomic information

- 1. Name of tribe** Shan
- 2. Location** Nar Pon of Kyaukme township, northern Shan State. The village is located at an elevation of 3,145 feet and in the position of N 22 28.664' and E 97 05.964'. Road access by cart is available

3. Shifting cultivation in Shan word

Hai

4. Demographic information

The village has a total of 55 households with 332 individuals dividing male and female at the ratio of 1:1. The dependent ratio (under 16 and above 60-year old people) is at 30 and working population is at 70%. A total of 12 households was selected to get necessary information.

5. Education

There is one primary school in the village and a total of 21 primary level students was there in the school. In the selected 12 households, 8 primary students and one high school student were there in the households.

6. Revenue and expenditure

Revenue from tea production stood first and followed by rice production. Total revenue for the farmers ranges between 145,000 and 460,000 Kyats. Revenue from cropping ranges between 57 and 98%, followed by revenue from outside job opportunities. In expenditure, expense for food constituted between 50 and 68 % of total revenue, followed by social and education expenses at 12 and 10 respectively. Expense for farming is low as the farmers use their own stored seed and home labour for cropping.

II. Farming System

7. Plant indicator for site selection

Wild sunflower plants

8. Farming practice

The cultivators in this village grow the maize and dry land rice. Their excuse for leaving the land as fallow was not because of soil degradation, but they are unable to eliminate weeds. They have to make weeding very often after one year cropping. Weeding density becomes higher in the successive years and cropping becomes unprofitable.

Some farmers are giving priority on growing maize over their cropping land for cash purposes and they buy rice for home consumption. Some, however, still follow the previous trend of growing hill rice in first year cropping period.

Some villagers have tea garden and their way of establishing tea plantation is quite interesting. Firstly, farmers select fallow area with some small natural re-growths. Secondly, they cut down bamboo and Laukya (*Schima wallichii* Choisy) and the stems are used in fencing. The reasons for cutting the species out of the areas are that tea does not grow under those species. According to the Shan shifting cultivators, the species has no synergetic action to tea plants. The latter actually acts as host tree for some pests.

Thirdly, they make light selective cutting, 3-4 feet above ground, to some trees and grow tea seeds (3 pits in a place and 3-4 seeds are put in each pit) around the stumps. Spacing for tea planting is irregular but it ranges between 4-5 feet apart. Spot weeding to the seed-grown area is made. In the second and third years, pollarding trees around the tea saplings is made. And in the fourth year when the height of the tea seedlings is at about 3-4

feet, all forestry trees standing around tea plants are cut and removed. And the farmers get a new tea plantation in the forest fallow land.

A small plantation established by this way is taken photo and is shown below.

Table (1) Agricultural calendar for Sahn (Nar Pon) shifting cultivators

Month	Activities
January	Ya cutting in new field/ tea leaf harvesting
February	Firewood collection / tea leaf harvesting
March	House repairing/ tea leaf harvesting
April	Burning the slash/ Tea leaf harvesting
May	Land preparation /Tea leaf harvesting
June	Rice growing/Tea leaf harvesting
July	Weeding, searching food in natural and forest fallows
August	ditto
September	Maize harvesting/weeding in tea plantation
October	Rice harvesting
November	Rice harvesting
December	Ya cutting

Soil samples in the tea plantation established through this means were taken at 6 places and the following table shows the results.

Table (2) Soil properties of Nar Pon cropping field

No.	pH	N%	Avg; P	Ext; K	O.M%
1	8.16	0.1192	trace	0.0224	7.70
2	7.44	0.1159	0.000154	0.0142	11.83
3	7.01	0.1237	0.00017	0.0371	9.70
4	8.09	0.1131	0.000044	0.0135	11.02
5	8.08	0.1237	0.000012	0.0176	11.96
6	7.76	0.0369	0.000069	0.0158	8.80

Soil is alkaline and the content of organic matter is high, but it is deficient in phosphorus.

9. Crop productivity

Per acre maize production on average is at 40 baskets and that of sesame is at 5 baskets/acre. Rice productivity is at 15-20 baskets and a mature tea plantation is at 400 Kg of tea leaf (green weight) per 4,000 plants. The production of green tea (leaf) for a plantation of 4 years-old is observed at 300 visses (480 Kg/4,000 plants). The productivity increases gradually year by year and it reaches at 400 visses (640 Kg) per year when the tea plants become 7-8 years old.

10. Fallow period

Fallow period for this village is (3-4) years in maize and rice growing areas. However, they leave the land intended for growing tea in long fallow period. They do shifting cultivation in free hold land (*Bo bwapaing myay* in Bamar language) owned by their forefather for rice and maize growing and establish tea in long fallow areas. They make cropping for 3 years in a place. Rice is grown in the first year, followed by maize in the second and third years.

III. Proposed Agroforestry practice

Fallow period in rice and maize growing areas are also very low (3-4 years), and the period with introduction of new maize crop variety and with increases of population will go down to ZERO soon. Therefore, in order to maintain good soil fertility in the long run, **hedgerow-planting practice** as of Nar khaw is suggested for the area.

Indigenous knowledge on tea plantation establishment is quite good from the soil conservation aspects and it therefore should be encouraged. However, provision of quality seed, and technical transfer on management and harvesting method should be made. The writer therefore proposes hedgerow planting.



Maize plantation and fallow land (Nar Pon)



A tea plantation established by zero tillage system

Shifting cultivation practice by Thei zang hill tribe

I Location and socioeconomic information

1. Name of tribe Chin (**Thei zang** group)

2. Location Thei zang of Teddim township, Chin State. The village is located at an elevation of 3,185 feet and in the position of N 23° 12.101' and E 93° 53.183'. The village is located beside the Kalay and Teddim truck road.

3. Shifting cultivation in Thei zang word

Kham

4. Demographic information

Out of 70 households, 14 households were randomly selected and made enquiry made to get necessary information. Total population in the 14 households is at 75 distributing male and female at the ratio of 1:1.17. The dependent ratio (under 16 and above 60-year old people) is at 33 and working population is at 67%. One Chin man said that some were involved in outside works, for example in road construction at other region.

5. Education

There is one primary school in the village. A total of 22 students were reported by the village council; 13 primary, 7 secondary and 2 high school students.

6. Revenue and expenditure

A total of 13 mythuns, 11 pigs and 92 chicken were reared by the 14 households. Revenue from agriculture stood first 46, followed by outside work 27 and income from livestock came in the last at 26%. Total revenue for the farmers ranges between 110,000 and 355,000 Kyats. Expenditure for food ranges between 47 and 73% of total revenue. The cultivators use self-stored seeds and home labour in farming. Expense for education and clothing are ranged between 3 and 5% of total income.

II. Farming System

7. Plant indicator

Sagat (*Quercus spicata* Smith), climber species, wild banana (*Musa acuminata*) and bamboo for site selection (*Dendro calamus bradndisii*) growing areas are assumed as fertile soil. They prefer the areas for farming where the species are in existence. One cultivator reported that previously they selected land for shifting cultivation as follows; a place was first selected, fell 1 m² of bush and slept for a night. If he has had a good dream, the cultivator decides to continue on cropping in the place.

8. Farming practice

Per household taungya area lies between 2 and 3 acres on average. The areas for shifting cultivation for Thei zang villagers are sloppy. Some areas are as steep as 45 degree. The distance between their village and their farms ranges between 1 and 3 miles. Major crops are rice and millet. Subsistence crops are squash, chayote (*Sechium edule*) a kind of creeper bearing edible fruit, taro (*Colosasia antiquorum*), ginger, eggplant and etc. Cropping is made for 2-3 years in a place if the soil is fertile.

Land allocation for new taungya is done in November and felling begins in December. January and February are the months when they make cleaning in old taungya and collect firewood. Cleaning old taungya provides food crops, such chilies that grow and bear fruits well in the successive year. Taungya burning and re-burning of un-burnt debris are done in March/April. Rice and maize are grown in early May. Squash, taro, yam and chilies are grown in good burnt place of a field. June, July and August are the months for weeding and some cultivators go outside for other job opportunities. Housewives and their children often do weeding. Some maize variety is harvested in August. This provides intermediate income

for the farmers. Rice harvesting is done in October and millet in November and the harvest is mostly for home consumption. The farming cycle goes around again in next year.

9. Crop productivity

Per acre unhusked rice production is not more than 20 baskets (1,000 kg per ha) and millet at 5 baskets per acre. Subsistence crops provide food for home consumption and the surplus are sold out for cash.

10. Fallow period

There is a village council and the council decides land allocation for all villagers. Now, the village has a total area of 1,600 acres and the area is divided into 7 plots as even as possible. Each year, the villagers has about 200 acre for shifting cultivation. In short the fallow period for Thei zang is at 7 years.

In land allocation, the council gives priority to old cultivators and new cultivators are then taken into consideration. Old shifting cultivators are often given their old fallow land. New cultivators are allotted in places where previous owners are absent. Some cultivators, 5 households in this survey, have their own woodlots for timber and firewood production. Soil property test gives the information that the soil is moderate in organic matter content, but deficient in phosphorous and little acidic.

Table (2) Soil property of Thei zang

No	pH	N %	Avg; P %	Ext. K %	OM %
1	5.45	.0291	.000372	.0044	3.7
2	6.10	.1338	.00096	.0324	4.19
3	4.69	.0313	.000422	.0103	5.62
4	4.87	.0403	.000436	.0121	4.52
5	5.38	.0985	.000372	.0127	2.34
6	5.96	.1125	.000819	.0170	5.20
7	5.31	.1103	.000104	.0161	2.44
8	5.03	.0341	.000294	.015	2.81

10. Fallow management

No systematic fallow management was observed.

11. Medicinal plants

Common diseases reported in the village are malaria, dysentery and fever. Medicinal plants they use are Sindon-manwe (*Tinospora cordifolia* Miers) the root of which is used as embrocation, and Tumeric (*Curcuma longa* Linn) powder is mixed with spirit produced from rice and taken to were dysentery.

III. Proposed Agroforestry practice

One thing noticed in the village is that some persons, often males in the working age are involved in outside jobs, often in other regions. Over viewing their income distribution gives the fact that the cultivators get considerable income from outside jobs. Similarly, income from livestock is considerable large in the revenue distribution of the cultivators.

Agroforestry practice produces both wood and food while ensuring sustainable productivity. But it needs much labour than shifting cultivation. Taking all these factors in to account, the writer propose **Silvo-forage** practice for Thei zang shifting cultivators. The practice is less laborious than some agroforestry practices, e.g homegarden, and has the potential of promoting fodder

production. Besides, the practice is suitable in shallow soil depth with high slopes.

The practice is to manage MPTs (Multipurpose Tree Species) and perennial grass/ various kinds of beans (e.g. ipl-ipl and *stylosanthes gubanensis*). MPTS will conserve and improve soil fertility while providing fodder to the cultivators.

To implement the silvi-forage in practice, each household should be allotted land first and the allotted areas should be as close as possible to the village. Castor oil trees (*Risinus communis*) will be grown along the fence. This will act as live fence and provide income from the castor nuts once the plants are established.

Secondly, hedgerow planting in each plot by using of ipl-ipl in hedges 3-4 feet in width and some 9-12 feet apart along contour lines in slopes and intercrop with maize and beans alternatively yearly in alleys. Make periodic branch cutting to ipl-ipl when it gets to the height of 3-4 feet and use the forage as fodder for mythuns, and as green manure to the field. Maize/beans grown alternatively yearly in between lines of ipl-ipl can be used as fodder for pig and hen, and the stalks can also be used as fodder for mythuns. Women and their children can do these works.

In areas for food production, **improved fallow practice** is to be incorporated into the present rotational shifting cultivation system. There, alder (*Alnus nepalensis*,) is proposed to grow 18 x 18 feet in fallow land. It grows well in areas 1,000 metre above sea level and stimulates nitrogen-fixing activity with high temperature and moisture in July, the time of growing season for food crops. The species is also one of the MPTS and has nitrogen fixing potential even in acid soil with quick

coppicing power and is fire-resistant. Its leaves are non-palatable by free ranging animal, easy to decompose and the species has synergistic relationship with intercrops. But it needs pollarding at of 6-7 feet at the time of reopening. This provides firewood to the farmers and reduces competition with crops for sunlight and space. In India, soil improvement by this specie is good enough to reopen the fallow land after two years abandonment.



Shifting cultivation in Thai zang

Shifting Cultivation Practice by Sai zang Chin Tribe

I. Location and Socioeconomic Information

1. Name of tribe Chin (Sai zang group)

2. Location Sai zang of Tiddim township, Chin State. The village is located at an elevation of 5,880 feet and is accessible by truck.

3. Shifting cultivation in Paloung word

Kham

4. Demographic information

Twenty-one out of 150 households were selected for this survey. Total population in the village is reported at 1,083 (male 542 and female 541). In the selected families, however, there were a total of 150 individuals distributing male and female at a ratio of 1.1:1. The dependent ratio (under 16 and above 60-year old people) in surveyed households is at 48 and working population is at 52%. The number of persons aged over 60 years is at 7 in 150. On average family members per household for this at 7.14 and it is the largest family in this survey.

5. Education

There is one primary school in the village and in the selected 21 families, there are 25 primary students, 16 secondary and 6 high school students.

6. Revenue and expenditure

Livestock rearing was observed and there were 9 mythuns, 22 pigs, 13 horses, one goat and 104 chickens. Total revenue ranged from 40,000 to 184,000 Kyats. Revenue from outside jobs comes first ranging from 35 to as high as 90%, followed by cropping ranging from 25 to 70%. Livestock rearing was in the third place earning between 20 and 40%. Common outside works at the other places are road construction, brick making and firewood collecting. Pertaining to farmers' expenditure, expense for food, as usual, comes first standing as high

as 70 to 80% for some families. But expense for food exceeded than revenue in 9 families. Expenditures for health and education range between 10-15% of the total revenue.

II. Farming System

7. Plant indicator for site selection

No plants, but soil with good texture

8. Farming practice

The hills where the Sei zan Chin cultivators make cropping are more sloppy than that of Tei zang cultivators. Some areas are as steep as 50 degree. And most families are doing shifting cultivation in their ancestral land. If some one wants to make land for shifting cultivation, he/she has to go to present landowner farmers with a present, usually a viss (1.6 Kg) of sugar and to ask permission for land (2-3 acres). Most of landowners hire land to the landless villagers for cultivation purposes. Provided that no landowner wants to give land to a landless farmer, the village council makes necessary discussion with landowners to give land to the landless villager.

Major crops are maize, beans and potatoes. Subsistence crops are pumpkin, chilies, etc.

There are two kinds of farming practices; cropping in old taungya and in new taungya. For old taungya, weeding and cleaning are done in January, but felling of old fallows for new taungya. Compiling debris in groups and burning them are made in February in old taungya and after that the farmers make growing potatoes. Maize and beans are grown in March.

Felling is continued in February and let the slash dry through March to April in new taungya. Substance crops of pumpkin, chili, egg-plants, and sweet potato are

grown in-between lines of maize plants and along the hedge of the field in May, June. Maize and beans are major crops grown in new taungya.

Weeding and soil working are done during the months in old taungya. Mostly women do the operations in new taungya in July through September. Men leave home for other places for outside job opportunity and come back at the time of harvesting (October, November). Some are involved in firewood collection for cash and home consumption purposes.

Potatoes and maize harvesting is done in late July or early August and beans in September-October in old taungya. Maize harvesting is done in late October and beans in November. Cleaning under bush for next year's taungya starts in December, and the cropping cycle goes round again.

9. Crop productivity

Per acre maize production lies between 6 and 12 baskets and Potatoes at 300-400 visses (480 – 650 Kg). Maize is grown for home consumption while potatoes and beans are mostly for cash purposes. They buy rice and mix it with maize and boil for meals. One farmer has an acre of apple. The size of apple too small compared with that of other countries and the fruit is sold by weight (Kyat 200 for 1.6 Kg).

10. Fallow period

Fallow period ranges between 5-7 years. No systematic fallow management was observed.

III. Proposed Agroforestry practice

Before proposing agroforestry practice, the village needs how practice to re-allocate land for landless farmers. This is beyond the writer. Landless villagers can apply land for farming in forest areas⁸. But the applicant may need to move to the area they apply for. In the cultivators' income distribution, revenue from outside jobs comes first. This means men carry out some heavy activities of tree felling, burning, re-burning and harvesting crops in a shifting cultivation field. Women are responsible for some light but time-consuming works of weeding, seed sowing, and carrying crops to home. Again, they work shifting cultivation in more sloppy areas than others with a fallow period of 5 to 7 years. Each household has livestock. All these facts provide information for the agroforestry practices proposed in Thei zang villagers- **Silvo-forage** for livestock rearing and **improved fallow practices** for maize, major crops, growing.



Fig fruit from natural forest

⁸The Forest Department has enacted a Community Forestry Instruction in 1995 and rural farmers, according to the instructions, now can apply leasehold land for 30 years even in reserved forests. If the applicant does not breach the rules prescribed there in, the applicant extend his/her land tenure for next 30 years. And his/her successor can inherit the land.

Shifting Cultivation Practice by Khua no Hill Tribe

I. Location and Socioeconomic Information

1. Name of tribe Chin (**Khua no** group)

2. Location Saung pi of Tiddim township, Chin State. The village is located at an elevation of 5,665 feet. The village is located 5 Km east of Kalay and Tiddim truck road, and has a total area of 8,400 acres (3,400 ha).

3. Shifting cultivation in Thei zang word

Kham

4. Demographic information

Out of 248 households, 20 households were randomly selected for questioning to get necessary information in the survey. Total population in the 20 households is at 75 distributing male and female at the ratio of 1:1.17. The dependent ratio (under 16 and above 60-year old people) is at 33 and working population is at 67%. One Chin man said that some were involved in outside works, for example in road construction of other region.

5. Education

There is one primary school in the village. A total of 22 students were reported by the village council; 13 primary students, 7 secondary students and 2 high school students.

6. Revenue and expenditure

A total of 13 mithuns, 11 pigs and 92 chicken were reared in the 14 households. Revenue from agriculture stood first 46%, followed by outside work 27 and income from livestock came in the last at 26. Total revenue for the farmers ranges between 110,000 and 355,000 Kyats. Expenditure for food ranges between 47 and 73% of total revenue. The cultivators use self-stored seeds and home labour in farming. Expense for

education and clothing are ranged between 3 and 5% of total income.

II. Farming System

7. Plant indicator

Sagat (*Quercus spicata* Smith), climber species and bamboo for site selection (*Dendrocalamus bradndisii*) growing areas are assumed as fertile soil. They prefer the areas for faming where the species are in existence. One cultivator reported that previously they selected a place for shifting cultivation as follows; A place was first selected, and fell 1 m² of bush and slept for a night. If he had had a good dream, the cultivator decides to continue on cropping in the place.

8. Farming practice

Per household taungya area lies between 2 and 3 acres on average. The areas for shifting cultivation for Thei zang villagers are sloppy. Some areas are as steep as 50 degree. The distance between their village and their farms ranges between 1 and 3 miles. Major crops are rice and millet. Subsistence crops are squash, chayote (*Sechium edule*) a kind of creeper bearing edible fruit, taro (*Colosasia antiquorum*), ginger, eggplant and etc.

Table (1) Agricultural calendar for Saung pi shifting cultivators

Month	Activities
January	Cleaning in old field/firewood collection
February	Fire protecting in both new and old fields
March	Taungya burning
April	Taungya re-burning
May	Rice and maize growing
June	Weeding
July	weeding and searching food in natural and forest fallows/outside job opportunities
August	Maize harvesting in old field
September	Weeding /sesame growing in the place of maize planting areas
October	Rice harvesting
November	Land allocation
December	Felling for new field

Land allocation for new taungya is done in November and felling begins in December. January and February are the months when they make cleaning in old taungya and collect firewood. Cleaning old taungya provides food crops, such chilies that grow and bear fruits well in the successive year. Taungya burning and re-burning of un-burnt debris are done in March/April. Rice and maize are grown in early May. Squash, taro, yam and chilies are grown in good burnt place in a field. June, July and August are the months for weeding and some cultivators go outside for other job opportunities. Housewives and their children often do weeding. Some maize variety is harvested in August. This provides intermediate income for the farmers. Rice harvesting is done in October and millet in November and they are for home consumption. The farming cycle goes around again in next year.

9. Crop productivity

Per acre unhusked rice production is not more than 20 baskets (1,000 kg per ha) and millet at 5 baskets per acre. Subsistence crops provide food for home consumption and the surplus are sold out for cash.

10. Fallow period

There is a village council and the council decides land allocation for all villagers. Now, the village has a total area of 1,600 acres and the area is divided into 7 plots as even as possible. Each year, the villagers has about 200 acre for shifting cultivation. In short the fallow period for Thei zang is at 7 years.

In land allocation, the council gives priority to old cultivators and new cultivators are then taken into consideration. Old shifting cultivators are often given their old fallow land. New cultivators are allotted in places where previous owners are absent. Some cultivators, 5 households in this survey, have their own woodlots for timber and firewood production. No systematic fallow management was observed.

11. Medicinal plants

Common diseases reported in the village are malaria, dysentery and fever. Medicinal plants they use are Sindon-manwe (*Tinospora cordifolia* Miers) which root is used as embrocation, and Tumeric (*Curcuma longa* Linn) powder is mixed with spirit produced from rice and take for dysentery.

III. Proposed Agroforestry practice

One thing noticed in the village is that some persons, often males in the working age are involved in outside jobs, often in other regions. Over viewing their income distribution gives the fact that the cultivators get considerable income from outside jobs. Similarly, income from livestock is considerable large in the revenue distribution of the cultivators.

Agroforestry practice produces both wood and food while ensuring sustainable productivity. But it needs much labour. Taking all these factors in to account, the most suitable agroforestry practice for Thei zang shifting cultivators is **Silvo-forage** practice that is less laborious than some agroforestry practices, e.g homegarden, and has the potential of promoting fodder production. Besides, the practice is suitable in shallow soil depth with high slopes. It is to manage MPTs (Multipurpose Tree Species) and perennial grass (e.g ipl-ipl and *stylosanthes gubanensis*). MPTS will conserve and improve soil fertility while providing fodder to the cultivators.

To implement the silvi-forage in practice, each household should first be given land and the land area should be as close as possible to the village. Secondly, hedgerow planting in each acre by using of ipl-ipl in hedges 3-4 feet in width and some 9-12 feet apart along contour lines in slopes and intercrop with maize in alleys. Make periodic branch cutting to ipl-ipl when it gets to the height of 3-4 feet and use the forage as fodder for mython and drought animal. Maize grown yearly in between lines of ipl-ipl can be used as fodder for pig and hen, and the stems can also be used as fodder for drought animal. Women and their children can do these works.

In areas for food production, **improved fallow practice** is to be incorporated into the present rotational shifting cultivation system. There, alder (*Alnus nepalensis*,) is proposed to grow 18 x 18 feet in fallow land. It grows well in areas 1,000 metre above sea level and stimulates nitrogen-fixing activity with high temperature and moisture in July, the time of growing season for food crops. The species is also one of the MPTS and has nitrogen fixing potential even in acid soil with quick coppicing power and is fire-resistant. Its leaves are non-palatable by free ranging animal, easy to decompose and the species has synergistic relationship with intercrops. But it needs pollarding at of 6-7 feet at the time of reopening. This provides firewood to the farmers and reduces competition with crops for sunlight and space. In India, soil improvement by this specie is good enough to reopen the fallow land after two years abandonment.

Shifting Cultivation Practice by Dim Chin Tribe

I. Location and Socioeconomic Information

1. Name of tribe Chin (Dim group)

2. Location Dain Lo of Teddim Township, Chin State. The village is located at an elevation of 5,809 feet and in the position of N ' 23° 19.32' and E 93° 41.56'. Like other Chin villages, road access by truck is available.

3. Shifting cultivation in Dim lo word

Kham Lou

4. Demographic information

A total of 19 shifting cultivators out of was 90 randomly selected and accessed their socioeconomic and shifting cultivation practice. In the surveyed households, there were 151 individuals dividing male and female at the ratio of 1.12:1. The dependent ratio (fewer than 16 and above 60-year old people) is at 43 and working population is at 57%.

5. Education

There is one primary school in the village. In the surveyed households, 9 high school students, 16 secondary and 21 primary students were reported.

6. Revenue and expenditure

Revenue from livestock raring stood first, followed by income form outside work. Income from cropping was in the third place. The 19 households surveyed possessed a total of 23 wild oxen (mythuns), of 33 pigs and sows, of 185 chickens, 3 horses and 2 goats. Every household reared pig and chicken. Out of 19, seven households received Kyats 154,000 on average from livestock raring. Other 10 households received on average income from outside job opportunities at Kyats 82,000. As explained before, some Chin people were working neighboring areas and sent their earning to their families left at the village. Some Chin lives and works in India,

which is bordering with Chin State. Four households received Kyats 12,500 on average from crop selling. The crop they harvested was merely for home consumption and food for livestock. They seldom sell the crop from their farm.

II. Farming System

7. Plant indicator for site selection

Two persons reported that they would like to grow alder species in their fallow land. One farmer was keen to grow Taung-tama (*Cedrela multijuga*) in his fallow land. On average cropping area per household is 2.3 acres. Major crops grown by the villagers are maize, millet, potatoes and beans. They make cropping in a place for 3-4 years. Most of the areas the Chin make shifting cultivation are in steep slopes. Some areas are as steep as 40-50 degree.

8. Farming practice

The farming system in line with monthly basis for new site is that the cultivators fell under bush and trees in the slash in November-December. Felling trees is sometimes continued in January. In March, the cultivators burn the slash in new field and grow maize and potato in late April and early May. Substance crops of pumpkin, chili, lemon grass, eggplants, and sweet potato are intercropped. Weeding for new taungya is done in June and July. Women do the work. In August and September, the cultivators harvest maize and potatoes.

For old-field site, cleaning is done in January and burning the debris in February. They set fire in some bush-land to rejuvenate shrubs, herbs and grass for their mythuns. Potatoes and maize are grown in late February and early March. Beans are grown in April. Weeding in the plantations is carried out in May, June and July.

Harvesting the crops is done in August and beans in September. Some beans are harvested in November-December.

9. Crop productivity

Per acre maize production ranges between 10 and 30 baskets. But it is difficult to make average as some farmers worked in 2 acres produced maize for 40 baskets. Potatoes production was about 400 visses per acre (1,600 Kg/ha).

10. Fallow period

Fallow period in the village varies between 5-10 years. The village level peace and development council, upon receiving applications for land by the villagers and area available for that year, uses voting system in land allocation. The villagers have to make cultivation in the place allocated by this system. The system was started during the time of their forefathers.

III. Proposed Agroforestry practice

Considering the social and agro-ecological factors, income distribution, labour force and long fallow period, the most appropriate agroforestry practice to the place is the practice suggested in Thei zang; **Silvo-forage and improved fallow practices.**

Landslides during the rainy season are common in the region. To check soil erosion and land slide, every top of the hills should be kept under forests and the forest should be put under total protection. Cropping, grazing, hunting etc., should not be permitted in the protected area

Silvo-forage practice will secure fodder production; ipl-ipl for mythun, and maize and beans intercropped in alleys for mythuns and livestock (pig and chicken) reared at home. The hedge included in the practice will also conserve soil and enrich its fertility securing

sustainable production in the long run. Cut and carry system is suggested. Women (and some adult children) can manage the practice when their husbands are involved in outside job opportunities at other places. An area of 0.6 ha is capable of producing enough fodder for 5 goats, 2 cows, 2 buffaloes and some 20 chickens in a household at Gajuri town in Nepal. The area is divided into 23 small plots in slopes. *Leucaena leucocephala* (K-156 variety) and stylo grass are grown along at hedges in the plots. Some 120 fodder trees species of *Gajuma latifolia*, *Flemengia conjesta*, *Artocarpus lakoocha* and *Leucaena leucocephala* (K-8 variety) are grown in the soil erosion prone areas of the plots. The fodder trees are 7-8 years. Agricultural residues of rice and beans stalks and leaves from the trees provide good enough fodder for the animals reared on the farm.

Appendix - 1

Meteorological data for the two study areas

Table (1) Monthly mean precipitation of Kyaukme for the period between 1990 and 2001 (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	0	19	27	73	396	220	180	311	150	192	584	0	2152
1991	11	10	0	0	703	230	114	238	59	324	282	130	2101
1992	30	0	0	35	84	277	132	350	62	144	128	11	1253
1993	0	34	0	45	168	275	186	210	122	193	12	0	1245
1994	0	16	70	79	114	287	211	238	161	137	31	0	1344
1995	9	0	0	2	124	86	127	269	230	100	176	0	1123
1996	0	25	57	51	88	140	164	249	138	33	17	2	964
1997	0	0	44	30	58	278	349	130	267	73	15	10	1254
1998	0	0	21	59	278	130	114	233	196	19	5	0	1055
1999	3	0	0	46	206	71	124	197	135	95	39	0	916
2000	0	13	28	106	211	164	127	199	186	105	10	0	1149
2001	0	10	15	10	340	164	294	212	102	138	27	0	1312

Table (2) Monthly mean temperature of Kyaukme for the period between 1994 and 2001 (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	17	18	22	23	25.7	25.8	23.5	24.6	24.9	22.2	18.8	15
1995	16	17	21	25	26.2	25.5	25.1	25.1	24.7	23.4	19.4	15
1996	15	16	21	24	25.7	25.3	25.4	24.9	25.1	23.4	19.5	17
1997	15	16	21	22	25	25.1	24.8	28.1	23.9	22.5	19.3	18
1998	16	18	22	24	25.8	26.6	25.4	25.4	24.8	24.1	20.8	17
1999	16	20	22	26	25.1	25.9	25.8	24.7	24.6	23.5	19.7	16
2000	18	18	21	24	24.5	26	26.5	27.3	25	23.2	18.7	15
2001	15	19	22	26	24.2	24.8	24.6	25.8	25.8	21.1	19.3	17

Table (3) Monthly mean precipitation of Tiddim for the period between 1990 and 2001 (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	0	0	0	0	100	543	247	172	189	63	44	22	1380
1991	15	0	15	139	292	176	129	283	193	226	63	1	1532
1992	3	26	0	42	63	183	271	333	123	97	6	19	1166
1993	14	47	7	38	154	119	0	251	112	152	32	0	926
1994	0	5	91	81	152	201	200	207	221	13	58	0	1229
1995	1	0	25	18	81	367	184	247	323	148	180	0	1574
1996	0	7	226	36	65	74	226	357	309	94	41	5	1440
1997	0	2	28	92	41	97	267	348	273	33	24	44	1249
1998	36	20	108	93	176	272	275	405	342	43	9	0	1779
1999	0	0	15	34	228	197	344	297	236	189	12	62	1614
2000	17	7	75	67	373	170	207	246	348	203	67	0	1780
2001	25	5	3	30	255	336	272	151	206	159	93	0	1535

Table (4) Monthly mean temperature of Teddim for the period between 1995 and 2001(mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995				21	21.5	21	20.5	21	20	19.5	15	13
1996	13	21	17	19	19	19	19	19.5	18.8	17.3	16.5	13
1997	12	13	18	18	19	21	20.3	20.7	20.3	18.3	16.2	14
1998	13	14	16	19	22.1	21.7	21	20.9	21.2	20.5	17.8	13
1999	13	19	18	21	21.8	21.3	21.3	21.5	20.3	19.5	15.3	12
2000	12	14	16	20	19	20.8	20.3	20.8	20	18	14.8	12
2001	22	24	25	28	26.6	26.5	24.8	24.8	26.3	12.8	12.3	11

Table (5) Fruit trees found in Kyaukme

No.	Local name	Common name	Scientific name
1	Kywe gaw <i>thi</i>	Pomelo	<i>Citrus decumana</i>
2	Thin baw <i>thi</i>	Papaya	<i>Psidium guajava</i>
3	Tale <i>thi</i>	Pomegranate	<i>Punica granatum</i>
4	Metman <i>thi</i>	Damson	<i>Prunus communis</i>
5	Hmangu <i>thi</i>		<i>Elaegnus latifolia</i>
6	Kaw fe	Coffee	<i>Coffea arabica</i>
7	Metmon <i>thi</i>	Peach	<i>Prunus persica</i>
8	Pin Hme <i>thi</i>	Passian fruit	<i>Passiflora edulis</i>
9	Thitaw <i>thi</i>	Pear	<i>Pyrus communis</i>

Note: "*thi*" means fruit in Myanmar language

Table (6) Growth of Pyinkado (*Xylia xylocarpa*)

No.	G	TTH	UTL	Vol.(cu-ft)	No.	G	TTH	UTL	Vol.(cu-ft)
1	54	60	9	11.4	18	60	60	9	14.1
2	61	60	16	25.8	19	33	40	8	3.8
3	52	70	18	21.1	20	45	40	8	7.0
4	77	70	20	51.5	21	34	40	15	7.5
5	57	70	25	35.3	22	42	70	20	15.3
6	48	60	10	10.0	23	44	70	25	21.0
7	59	60	27	40.8	24	44	65	20	16.8
8	51	60	13	14.7	25	38	65	20	12.5
9	50	60	24	26.0	26	41	70	25	18.2
10	40	55	12	8.3	27	45	70	15	13.2
11	52	55	10	11.7	28	52	70	15	17.6
12	65	60	12	22.0	29	37	70	22	13.1
13	76	50	8	20.1	30	41	75	15	10.9
14	50	50	6	6.5	31	50	70	16	17.4
15	53	60	8	9.8	32	58	70	14	20.4
16	50	50	8	8.7	33	73	75	20	46.3
17	53	60	8	9.8					

Note: G means Girth in Inches, TTH represents Total Tree Height and UTL for Usable Trunk Length for sawn timber. The Pyinkado trees were planted in 1973 by an army official. The tree species does not grow naturally in Kyaukme area, but the woodlot gives information that the species can thrive well in the area. The price of Pyinkado sawn timber for the year 2002 was 150,000 Kyat/ton (one ton is equivalent to 1.4 cu-m).

Table (7) Some tree species found in Kyu Shaw

No	Bamar name	Scientific name
1	Nyaung	<i>Ficus spp;</i>
2	Sagawa	<i>Michelia champaca Linn</i>
3	Sagaseingyi	<i>Manglietia insignis</i>
4	Taungtama	<i>Cedrela multijuga</i>
5	Bonmeza	<i>Albizzia chinensis</i>
6	Petwun	<i>Berya mollis</i>
7	Yone	<i>Anogessius acuminate</i>
8	Htinyu	<i>Pinus spp;</i>
9	Thityar	<i>Schima wallichii choisy</i>
10	Yemana	<i>Gmelina arborea</i>

Table (8) Some tree Species found in Sai Zang area

No	Chin name	Scientific name
1.	Hiang Sing	<i>Alnus nepalensis Den</i>
2.	Vong Sing	<i>Gmelina arborea Roxb</i>
3.	Se Sing	Not known
4.	Sial Nuih Sing	<i>Quercus species</i>
5.	Teak Sing	<i>Pinus insularis,</i>
6.	Dhui Tong Sing	<i>Prunus avium Linn</i>
7.	Ngel sing	<i>Dysoxylum grande Hiern</i>
8.	Man Tawi Sing	Not known
9.	Tei Sing	<i>Cedrela microcarpa</i>
10.	Teh No Siang	<i>Castanopsis</i>
11.	Thei Sing	<i>Shorea cinerea</i>
12.	Ngei Sok Sing	<i>Rhododendron cufeanum</i>
13.	Ak Sial Sing	<i>Vitex puberscenes</i>
14.	Sik Sing	<i>Stereospermum personatum.</i>
15.	Pang Sing	<i>Salmalia malabarica</i>
16.	Nah Lun Sing	Not known
17.	Khum Sing	<i>Millettia brandisiana Kurz</i>
18.	Sing San Sing	<i>Amoora rohituka</i>
19.	Hong Ma Sing	Not known
20.	Sing Gi Sing	<i>Wendlandia grandis</i>
21.	Vang Sing	<i>Albizzia chinensis</i>
22.	Suak Lu Sing	<i>Emblica officinalis Gaertn.</i>
25.	Hai Sing	<i>Mangifera longipes Griff.</i>
26.	Ning Sing	<i>Dalbergia oliveri Gamble</i>
27.	Bil Sing	<i>Xylocarpus moluccensis</i>

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