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Socioeconomic Services of Khampti Tribe of Arunachal Pradesh Concerning Introduction of Homestead Agroforestry

Prosanta Hazarika, Malashkiva Kotoky, Mayur Suman and Protul Hazarika

ICFRE- Rain Forest Research Institute, Sotai, Jorhat, Assam (785 010), India

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Corresponding hazarikapaug08@gmail.com

0000-0003-3915-5643

ABSTRACT

A socioeconomic survey was done during (2019–2022) in 15 villages of the Khampti tribe of Namsai, Arunachal Pradesh, India. A questionnaire was prepared and interviewed the households about socioeconomic, life style, livelihood, education, primary livelihood activity, land holdings and land use pattern, energy consumption, livestock profile etc.To compare the profitability of different land uses, the annual profit was calculated. More than 50% of the households were lived in kaccha houses, 32% live in semi pucca houses and 15% had pucca houses. Average annual income of the households was maximum (25%) within the range of ₹ 15,000–20,000; 23% incomes more than ₹ 40,000; while 5.3% within the range of ₹ 10,000–15,000. About 66.66% households were depended on agriculture for their livelihood. Similarly, 20% households were depended on both agriculture and government job, whereas, 1.77% households were dependent only on government jobs and 0.88% on business. 50% population completed their studies up to class 10; 22% had their secondary education (class 12) and few (4.64%) had done post-graduation. Average 73.87% of the total land was used as agricultural land and 25% as homestead land. Cow was the highest reared livestock than pig, goat and buffalo. Annual energy consumption was recorded for LPG (67.55%), fire wood (17.34%) and kerosene (15.11%). Further, their homesteads do not have agroforestry planning to optimize land use. Therefore, we developed five agroforestry demo plots in Namsai district. In the initial years (2020–2022) of agroforestry could enhanced economic return up to 3 times and also widen the livelihood options.

KEYWORDS: Agroforestry, sustainability, socioeconomic, Khampti, homestead, livestock

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1. INTRODUCTION

Homestead garden is a traditional agroforestry system and considered as an important land use system for generation of livelihoods to the rural poor. It is an alternative way of mitigating ecological crisis to sustaining crop production and thus the back bone of the rural economy, food security, conserving biodiversity and sustainability (Amare et al., 2019; Duffyet al., 2021; Mbow et al., 2014; Sarvade and Singh, 2014; Rend´on-Sandoval et al., 2020). Throughout the previous 40-50 years, the comparatively importance has beendiverted from the traditional forestry to homestead forestry; in such a condition, homestead garden plays a vibrant role in socioeconomy providing firewood, fodder, medicine, fruits, and timber (Uddin et al.,2001) and also self-sustaining agro-ecosystem with various ecosystem services (Kefale, 2020; Wiryono et al., 2023). Agroforestry is the intentional mixing of trees and shrubs into crop and animal production systems to create economic, environmental, and social benefits(Wilson and Lovell, 2016). The homesteads play an important role by providing space for conservation of unique diversity woody species and edible, useful, medicinal and rare plant species to mitigate local needs to improve the livelihoods and commercial importance (Abebe and Asfaw, 2023; Bijalwan et al., 2011; Mehari and Abera, 2019; Galhena et al., 2013; Hazarika et al., 2014; Hazarika et al., 2021a). Agroforestry system focuses on improving or developing sustainability of socio-economic return and also a sustainable form of fulfilling the landscape by the plantation of native tree species (Kitturand Bargali, 2013). Agroforestry practices provide multiple benefits including high productivity and additional income while maintaining the soil health (Kang et al.,1984; Kang and Akinnifesi, 2000; Sarvade et al., 2016; Sarvade et al., 2019) and instrumental for rehabilitation of degraded land (Jinger et al., 2023; Tomar et al., 2021). Agroforestry provides a greater range of environmental benefits than traditional kinds of annual crop cultivation, alongwith, improves soil fertility which increases vegetable yields, extends the harvesting season and improves the quality of produce (Sahle et al., 2021; Torralba et al., 2016). Benefit: cost ratio of various agroforestry systems was also studied by researchers and claimed that agroforestry system are capable for supporting the farmers economically (Bhatia et al., 2022; Sharma et al., 2022; Kaler et al., 2017). Diversified cropping through agroforestry can support business throughout the year and hence provide a source of year-round income.

Tai-Khampti being the major tribe of Namsai district, their traditional practices on agriculture and other livelihood options including agriculture are obsolete and less productive and hence unable to support the demands of the growing population. Introduction of agroforestry is a viable alternative for better land management and to enhance their livelihood. The objective of the study was to analyze the socio-economic status of the Khampti tribe of Namsai district, Arunachal Pradesh to identify gaps and potentiality for socioeconomic upliftment of the tribe. The other objective was to study the outcome of newly introduced demo agroforestry practices in the homesteads for generation of economy and to further support the livelihood options.

2. MATERIALS AND METHODS

2.1. Study area

The study was conducted on Khampti tribe in Namsai district, Arunachal Pradesh, India during 2019-2022. The district is located in between latitude 27°30' to 27°55'N and longitude 95°52' to 96° 20' E and sharing border with Lohit and Changlang towards the east; Assam to the West; Lohit and Assam towards the North, and the south border adjoins Changlang district (Figure 1).

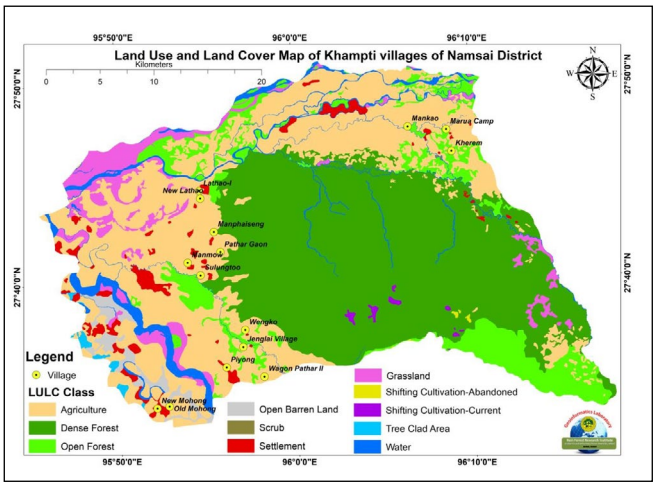

Figure 1: Location map showing of 15 Khampti villages of Namsai district, Arunachal Pradesh

2.2. Survey methods

The socioeconomic survey was conducted in Namsai district of Arunachal Pradesh during 2019–2020. To collect the first-hand data, a structured questionnaire was prepared and interviewed among 15 randomly chosen rural households of 15 villages viz., Old Mohong, Pathar Gaon, Piyong, Lathao-1, New Lathao, Sulungtoo, Kherem, Marua camp, Mankao, New Mohong, Manphaiseng, Manmow, Wagon Pathar, Jenglai, Wengko of Namsai. Approach for resource mapping participatory rural appraisal (PRA) meetings was held (Figure 7). The homesteads owners (with pre-consent) were interviewed and information was recorded. Collected data were classified into social and economic categories. The social factors included- name and age of

the respondent, type of family- nuclear or joint, family size-number of female and male, type of house-kaccha, semi pucca and pucca, educational status, livelihood activity of the household, rate of acquaintance with agroforestry systems. Economic questions included average monthly income of family, primary livelihood activity, monthly energy consumption, land holdings–agricultural and homestead land, livestock profile and agricultural production. To compare the profitability of different land uses, the annual profit was calculated for two consecutive years after practicing agroforestry. The collected data were analyzed and presented in tabular form and fugures were plot.

2.3. Social status

Type of families was categorized as nuclear or joint based on the number of member in a family. The houses were surveyed and categorized as kaccha, semi pucca or pucca. Social status of the Khampti households was evaluated based on religion, caste, festive occasions, customs or rituals and their marriage system.

2.4. Economic status

Average monthly income of the families was grouped as- ₹ 5,000 to 10,000 rupees; ₹ 10,000 to 15,000; ₹ 15,000 to 20,000; ₹ 20,000 to 30,000; ₹ 30,000 to 40,000; more than ₹ 40,000.

2.5. Life style and livelihood

Lifestyle was evaluated based on their clothes and dresses. Options of livelihood were analyzed under three categories-agriculture, service holder and business. Service holders were categorized whether they are school teacher, college teacher, Government employee and job in private companies or daily wage labor. Business was categorized as one having grocery shop, stationary shop, agribusiness, fuel wood & timber business, cottage industry, MSME/other industry or any other business.

2.6. Education

Literacy is identified as a dynamic issue for socio-economic growth of a society. Status of education and their literacy rate was evaluated in 15 Khampti villages in 4 different groups i.e secondary (10th standard), higher secondary (12th standard), graduation and post-graduation. Youth literacy rate is the percentage of people aged 15 to 24 years who are literate divided by the total population in the same age group (UNESCO).

2.7. Landholdings and land use pattern

Households had their landholdings which are divided into homestead and agricultural land. Some has own landholdings while others borrow for cultivation. Total area under agriculture, total area under homestead and area under other plant species were evaluated. Usually, the agricultural land covers the maximum area with smaller homesteads. Soil type of the land and crop cycle period were also noted. Major agricultural crops and homestead plant species were listed.

2.8. Livestock profile

Apart from plant resources, Khampti people of Namsai district were observed to rear livestock in their homesteads. Some of them consider the livestock as secondary livelihood. Livestock profile was checked for cow, buffalo, bulls, goat, pigs and poultry. Source of fodders was surveyed whether they are collected from forest, trees outside forest, agricultural land, or purchase, or from homestead.

2.9. Energy consumption

Energy consumption type i.e., fuel wood, kerosene, LPG or others and their annual consumption quantity were analyzed. Sources of fuel wood were also surveyed.

2.10. Economic outcome from homesteads and livestock

The average annual income and the income from the homesteads along from their livestock were analyzed.

2.11. Establishment of demo agroforestry in homesteads

Establishment of agroforestry plantation was done incorporating productive components, application of biofertilizers instead of chemical fertilizers, production and application of vermicompost etc. Selection of five agroforestry demo plots was done considering the criteria of distribution of one from each of the five circles in Old Mohong, Piyong, Pathar Gaon, Lathao and Mankao villages of Namsai district Arunachal Pradesh. Size of each of the agroforestry demo plots were more than 1 ha. The seedlings planted in 5 different demo plots are presented in table 7. Plantation was done in three consecutive years (2020 to 2022) along with filling up of causality of seedlings. The benefit cost ratio (BCR) is calculated out annually for the intercrops evaluating market price of the products at harvest.

BCR=Total net intervention benefit/Total net intervention cost

Where, BCR is the benefit–cost ratio.

3. RESULTS AND DISCUSSION

3.1. Social status

It was observed that, most of the families were nuclear families i.e., families having an average of 5 members with a range of 2 to 7 individuals and the rest were joint. Similarly, the average size of the joint families was 8 members with arrange from 5–15 individuals. A total of 164 families out of 225 families were nuclear and the rest 61 were joint families (Figure 2). They mostly livein 'Chang Ghar', 'Kaccha' house i.e., made of wood and bamboo with the roof made of 'tokow pat' (*Livistona jenkinsiana*) or 'Semipucca' i.e., the houses made of concrete post with wooden 'Chang' and tin roof. Few live in 'pucca' houses which are of two kinds; one is

similar to 'Chang ghar' but made of concrete materials with tin pat roof and the other is general concrete house. As per the records, 117 households were having kaccha houses, 73 families had semi pucca houses and 35 families lived in pucca houses (Figure 3).

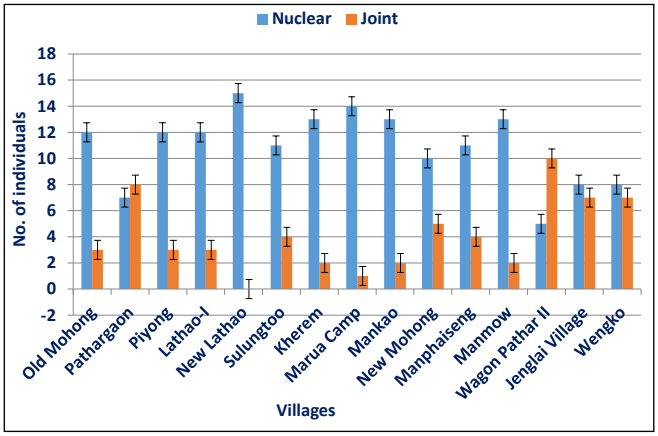

Figure 2: Showing family type of 15 Khampti villages of Namsai

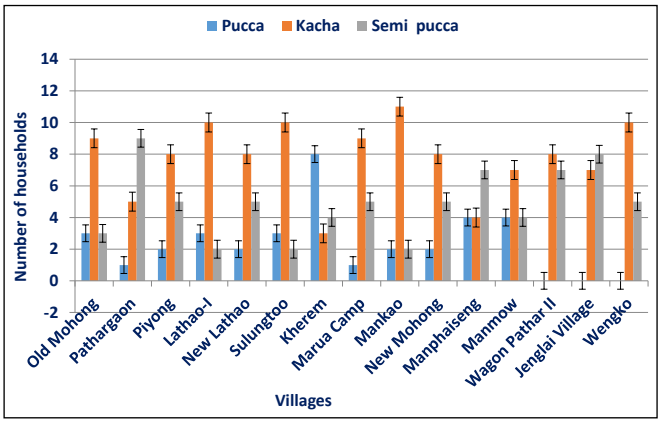

Figure 3: Showing house types of 15 Khampti villages of Namsai

The Khamptis are Buddhists and worship God Buddha in a prayer room in every morning and evening by offering flowers (*nam taw yongli)*. The community worship place is called as 'Pagoda'. The religious guru/priests are known as 'Monk' and 'Bhante'. The 'Bhante' is not only the religious priest but also traditional healer or medicine man. Two types of traditional treatments are followed by 'Bhantes' i.e., by means of 'Mantras' or with herbal medicines. The treatment procedures are still available with the 'Bhantes' in the form of 'hand written book' in Tai language.

The Khamptis have their unique cultural heritage and their language script is similar as Thai. The festivals that are being observed are Poi Pee Maw (New Year festival), Panchong (Mela), Kamphai, Potuwa, Sangken, Maikosomphai (Religion based). Sangken is the main festival of Khampti people which is celebrated on 14th April every year and Poi-pee-Mau is the Khampti New Year (Phukan, 2019) They have their own customary laws. Marriage within the caste and inter caste marriage is also frequent among them.

3.2. Economic status

Average annual income of each of the Khampti villages was analyzed and is presented in Table 1. Out of 225 households surveyed for 15 Khampti villages, a total of 31households (13.77%) irrespective of their villages were come under the income group of ₹ 5000-10,000 per annum; 12 households (5.34%) came under the income group of ₹ 10,000-15,000. Similarly, a total of 58 households (25.77%) were grouped under the income group of ₹ 15,000–20,000 and 48 households (21.34%) came under the income group of ₹ 20,000-30,000. However, annual income within the range of ₹ 30,000–40,000 was enumerated for 24 households (10.66%) and more than ₹ 40,000 were found for 52 families (23.12%).The village Lathao 1and New Mohong were recorded to have the lowest income families (6 each) with average annual income of ₹ 5,000–10,000, followed by Marua camp and Jenglai with 5 families each. Whereas, annul income of the households of Pathar Gaon was recorded as the richest village with having 13 households of more than ₹ 40,000 of annual income followed by Manphaiseng and Manmow with 8 households each having more than ₹ 40,000 (Table 1).

3.3. Lifestyle and livelihood

The traditional dress for male is 'Khampti Lungi' and dresses for female are 'Rheha', 'Mekhela' and 'Longpat'. Apart from these Khampti males use to wear full-sleeved cotton shirt called 'siu pachoi'and multi colored lungi/ sarongcalled 'phanoi'.Women wear long sleeve shirt called 'siu pasao', deep coloured mekhela called 'sinn' and silk scarf called 'phamai'. The married women wear unique green colored cloth covering the middle part of the body. Women are traditionally skilled in weaving and they weave their traditional dresses in their handloom. It was found that the villagers are mainly engage in agricultural activities as their livelihood source. Further it was notice that 66.66% households were dependent on agriculture, 20% households were engaged both in agriculture and government job and 10.66% households were found to engage both in agriculture and business. Only 1.77% households were recorded to depend only in govt. service and 0.88% households were depended on business as their livelihood source which is being presented in Figure 4.

3.4. Educational status

The educational status of the respondents in 15 villages is presented in table 2. Out of the total population (1318) surveyed of 15 villages in 225 households, it was found that

Table 1: Number of families grouped according to average annual income of 15 Khampti villages of Namsai district, Arunachal Pradesh

Name of Village	5000-10000 (₹)	10,000-15,000 (₹)	15,000-20,000 (₹)	20,000-30,000 (₹)	30,000-40,000 (₹)	More than 40,000 (₹)	Total Household
Old Mohong	0	0	5	7	1	2	15
Pathar Gaon	0	0	1	1	0	13	15
Piyong Khampti	2	6	1	2	1	3	15
Lathao1	6	1	3	5	0	0	15
New Lathao	3	0	8	4	0	0	15
Sulungtoo	0	0	11	4	0	0	15
Kherem	0	1	8	1	1	4	15
Marua camp	5	2	8	0	0	0	15
New Mohong	6	0	4	3	2	0	15
Mankao	0	1	1	3	5	5	15
Manphaiseng	0	0	2	2	3	8	15
Manmow	0	1	1	4	1	8	15
Wagon Pathar	4	0	0	4	5	2	15
Jenglai	5	0	2	2	0	6	15
Wengko	0	0	3	6	5	1	15
Total	31	12	58	48	24	52	225
Percentage	13.77	5.34	25.77	21.34	10.66	23.12	

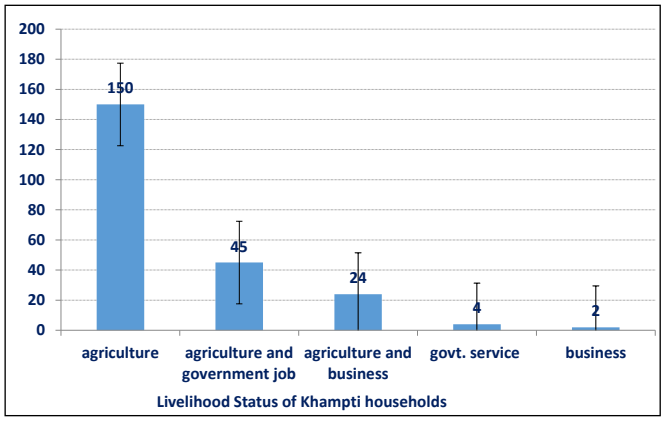

Figure 4: Livelihood status of the Khampti households in Namsai District

15.63% individuals had completed secondary education, 6.90 % had completed higher secondary, whereas, 6.30% were graduates and 1.44% completed post-graduation. Among the villages, Manmow has the highest youth literacy rate of 71.79% followed by Jenglai (45.16%) and Lathao has the least youth literacy rate (16.12%).

3.5. Landholdings and land use pattern

The village economy is predominantly an agricultural based economy. Although, most of the households having more than10 bighas of land; they do not cultivate the entire agricultural land in a year. Indeed, they cultivate a part of the land as per their requirement for the year or give others to cultivate on the system called 'Adhi'. Adhi system is a system where half of the production is given to the owner of the land by the cultivator. An average of 800 kg of rice was recorded to produce per bigha of land. The market value of per 100 kg of rice is ₹ 500–700 an thus the land owner could earn ₹ 4000–5700 from a bigha of land. Apart from the paddy they used to cultivate maize, mustard, sorghum and potato in their farmland/agricultural lands. Out of 225 households, 9 households were recorded to have small tea gardens in homesteads or other than homestead area. No proper organized cropping system was observed in the Khampti villages of Namsai.

From the survey, it was observed that Lathao 1village (average of 30.93 bighas/household) has the highest landholdings. New Lathao has the lowest landholdings (average of 9.5 bighas/household) followed by Old Mohong (average of 12.9 bighas/ household). The survey revealed that 73.87% of the landholdings were utilized for agriculture and 25.16% of the landholdings as homestead garden (Table 2).

Table 2: Village wise educational status of Khampti villages of Namsai district, Arunachal Pradesh

Name of village	10th	12th	Graduate	Postgraduate	Total	Literacy rate (%)
Old Mohong	13	10	7	0	30/50	37.50
Pathar Gaon	6	4	4	2	16/98	16.32
Piyong Khampti	14	4	13	2	33/83	39.75
Lathao	6	4	4	1	15/93	16.12
New Lathao	6	5	5	0	16/82	19.51
Sulungtoo	12	11	6	1	40/98	40.81
Kherem	7	5	5	3	20/102	19.60
Marua camp	5	4	4	1	14/86	16.27
New Mohong	19	3	3	0	25/98	25.51
Mankao	16	9	5	1	31/91	34.06
Manphaiseng	21	0	0	0	21/89	23.59
Manmow	28	12	12	4	56/78	71.79
Wagon Pathar	11	4	4	0	19/78	24.35
Jenglai	27	4	8	3	42/93	45.16
Wengko	15	12	3	1	31/99	31.31
Total	206	91	83	19	409/1318	
Percentage	15.63%	6.90 %	6.30%	1.44%		

Out of 225 households surveyed, 75 households had agricultural land within the range of 0–9.9 bighas, followed by 68 households with a range of 10–19.9 bighas, 44 households had 20–29.9 bighas, 4 households within the range of 30–39.9 bighas range, whereas10 households had 40–49.9 bighas and only 1 household had 50–59.9 bighas of agricultural land and the other one had 60–69.9 bighas of agricultural land.

Similarly, out of 225 households, 179 households had homestead within the range of 0-9.9 bighas, 16 households had homesteads within the range 10–19.9 bighas, followed by 8 households with 20–29.9 bighas range and only 1 household from Kherem village with 30–40 bighas of homestead garden. Sulungtoo village had 138 bighas of land largest under home gardens with an average of 9.2 bighas. While households of New Lathao occupied 37 bighas of homestead land which was the lowest land under homesteads (average home garden area/ family 2.46 bighas). Old Mohong had small home garden with an average of 2.6 bighas per households followed by Kherem 2.9 bighas and Lathao-I with 3.4 bighas. Average land area of homesteads occupied by other villages were recorded as 3.8 Bighas in Wengko, 4.23 bighas in Pathar Gaon, 4.46 ha in Marua Camp, 4.86 ha in Manmow, 5.4 ha in both Mankao and Piyong Khampti, 5.27 ha in New Mohong, 6.66 ha in Manphaiseng, 7.96 ha in Wagon Pathar and 8.57 ha in Jenglai Village. An overall analyzed data of land use pattern of 15 villages which is divided into agricultural and homestead land and presented in Figure 5.

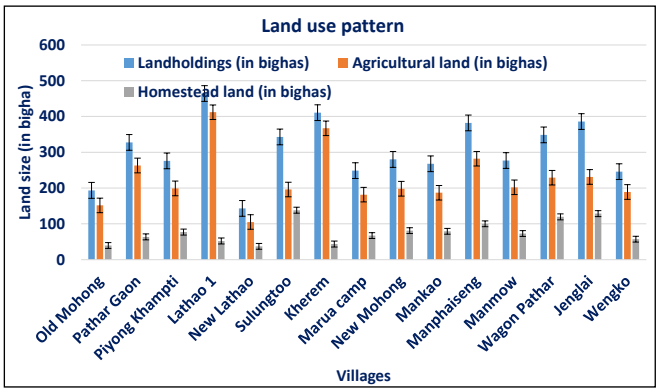

Figure 5: Land use Pattern of the villages in Namsai

Soil type of the agricultural field was analyzed for the 15 villages. It was observed that these villages have varying soil type. Old Mohong, Pathar Gaon, Piyong, Lathao, Sulungtoo, Marua Camp have clay soil. Whereas, soils belong to New Lathao, Wengko, Jenglai, Wagon Pathar, Mankao and New Mohong villages have sandy loam. Moreover, Manphaiseng and Manmow villages were found to have clayey loam soil. On the other hand, sandy clay was found only in Kherem. Two crop cycle were found, one is from April or May (*Kharif* season) and the other is from September or October (*Rabi* season)

Khamptis of all the villages raise one crop in a year in their

agriculture fields. They used to cultivate their traditional and native variety of rice i.e., 'Khampti Lahi', Bordhan, Ranjeet and Boradhan. Tea was also grown in their homesteads and in farm land too. The home gardens comprise of trees, shrubs, herbs, aesthetic plant and fruits and vegetable trees. The plant species for livelihood in homesteads were *Areca catechu, Livistona jenkinsiana, Piper betel, Cinnamomum tamala, Citrus limon, Elettaria cardomomum, Curcuma longa, Ananus comosus, Zingiber officinale, Phyllanthus embilica, Phyrinum capitatum,Terminalia chebula, Calamus tenuis,Citrus sinensis, Cymbopogon nardus, Musa* sp., *Piper nigrum, Citrus grandis, Lawsonia inermis, Phrynium capitatum* and *Averrhoa carambola.*(Hazarika et al., 2021b)

It was observed that almost all the homesteads were lying without seasonal crops and vegetables except a few. Seasonal crop recorded to grow in the homestead gardens are presented in the table 3.

3.6. Livestock status

Out of 225 households, 114 were not preferred to rear any live stocks due to some reasons. Among them, cow and poultry were being reared most. Other livestock were goat, pig and buffalo. It was also observed that out of 225 families, 123 families reared cow, 72 reared poultry, 38 families were found to rear pig, 22 families reared goat and only 12 families found to keep buffalo. Cow and buffalo were kept for milk and plough. It has been found that they got the fodder mostly from their homestead or agricultural land. Livestock status of Khampti villages in Namsai district is presented in table 4. From the data, it was found that in the 15 Khampti villages had 635 cows, 79 goats, 76 pigs, 40 buffaloes and 722 poultry.

3.7. Energy consumption

The study revealed that Khamptis used fuel wood, L.P.G. cylinders and kerosene to meet their energy needs (Table 5). Of which, LPG cylinders were used mostly for cooking. They collected fuel woods either from homesteads or from the forests. Sometimes they used to purchase the fuel woods from the local markets also. Data showed that out of 225 households, 197 households (87.55%) used L.P.G. as their energy source and 34 households (15.11%) depends on kerosene. Moreover, all the households used fuel wood. Numbers of households were using different energy sources annually in 15 villages was evaluated and presented in table 5.

3.8. Economic return from all the sources

The Khampti people were used to take meats which are available in their local markets. Price of broiler chicken was ₹ 200/kg and local chicken was ₹ 300/kg. Likewise, pig was recorded to sell at ₹ 400/kg and goat at ₹ 400/kg. They found to rear cow and buffaloes for milk and other dairy products.

Table 3: Seasonal crops growing in the traditional homesteads of Khampti villages of Namsai district

Annual & cashcrop	*Kharif* season (April and May)	Rabi season (September and October)
Colocasia esculenta L.	*Zea mays* L.	*Phaseolus vulgaris* L.
Zingiber officinale Roscoe	*Colocasia esculenta* L.	*Brassica juncea* (L.) Czern.
Curcuma longa L.	*Lagenaria siceraria* (Molina) Standl.	*Brassica oleracea* var. capitata
Ananas comosus (L.) Merr.	*Benincasa hispida* (Thunb.) Cogn	*Brassica oleracea* var. botrytis
	Capsicum annum L., *Cucumis sativus* L.	*Brassica nigra*, *Brassica napus* L.
	Solanum melongena L.	*Solanum tuberosum* L.
	Solanum myriancanthum Dunal.	*Sesamum indicum* L.
	Cucurbita pepo L.	*Raphanus sativus* (L.) Domin
	Luffa cyclindrica M. Roem	*Coriandrum sativum* L.
	Corchorus olitorius L.	*Allium cepa* L.
		Allium sativum L
		Lycopersicon esculenta L.

Milk was sold at ₹ 60 to 70 per lit in the market. Table 6 represents the village wise average annual earning of the household and their earnings from homestead, livestock and service or business. The survey revealed the average annual income of a household of Khampti tribe from all the sources was ₹ 28,445.60 with a range of minimum ₹ 19033.3 and maximum average annual income of ₹ 43946.60.

However, the analyzed data revealed that there is no correlation between the size of land holdings and annual income (Figure 6). The data indicated that the economic return from their land is very low as compared to the land holding sizes. This is due to the lack of proper agroforestry planning and land management. Hence, five (5) homesteads (plots) of 5 Khampti villages were selected for improving their agroforestry system and for that PRA exercises were conducted in those villages. Selected Demo plots are

Table 4: Livestock status of Khampti villages in Namsai district, Arunachal Pradesh

Name of Village	Number of livestock				
	Cow	Buffalo	Goat	Pig	Poultry
Old Mohong	20	0	16	9	68
Pathar Gaon	71	17	7	14	26
Piyong Khampti	40	0	10	9	57
Lathao1	45	0	7	5	28
New Lathao	29	0	6	6	55
Sulungtoo	33	0	6	0	38
Kherem	32	0	0	5	50
Marua camp	11	0	0	3	39
New Mohong	10	2	13	8	61
Mankao	32	4	0	0	55
Manphaiseng	16	11	0	0	70
Manmow	32	4	0	0	55
Wagon Pathar	49	2	10	9	54
Jenglai	53	4	2	1	74
Wengko	58	0	1	15	60
Total	635	40	79	76	722

Table 5: Number of households using different energy sources annually in 15 villages of Namsai

Village	Fuel wood	LPG	Kerosene (L)
Old Mohong	15	12	3
Pathar Gaon	15	15	6
Piyong Khampti	15	14	3
Lathao-I	15	15	2
New Lathao	15	15	0
Sulungtoo	15	15	1
Kherem	15	15	1
Marua Camp	15	15	1
Mankao	15	15	0
New Mohong	15	13	3
Manphaiseng	15	14	8
Manmow	15	13	1
Wagon Pathar II	15	4	5
Jenglai Village	15	7	0
Wengko	15	15	0
Total	225	197	34
Percentage (%)	100	87.55	15.11

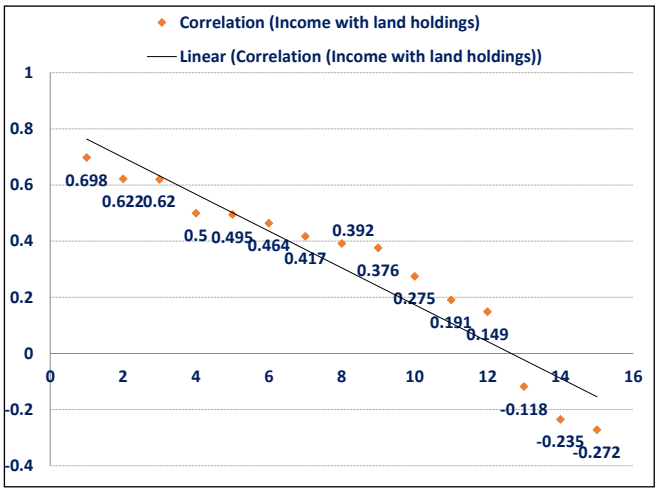

Figure 6: Correlation between land holdings and annual income of the Khampti villages

scattered in each one of the five circles of Namsai district Arunachal Pradesh. viz. Old Mohong, Pathar Gaon, Lathao, Piyong Khampti and Mankao. However, in a previous study in home gardens of Eastern Cape, observed a positive correlation between size of the garden and annual income of the household from home garden (Ogundiran et al., 2014). Similarly, Mengistu and Fitamo (2015) reported a positive and significant correlated with household food security with respect to the number of meals eaten per day crops produced from home their home gardening (0.281 at p<0.01).

3.9. Introduction of agroforestry plantation in demo plots

Agroforestry systems developed in five homesteads of Khampti villages arepresented in Figure 8. Seedlings of *Areca catechu* were planted in five demo plots with seasonal crops *Cajanus cajan* (L.) Millsp, *Colocasia esculenta* (L.Schott, *Cucuma longa* (turmeric), *Sesamum indicum* (til), *Vigna mungo* (black mung), *Zea mays* (maize), *Zingiber officinale* (Ginger) were intercropped. *Zizyphus mauritiana*, *Aquilaria malacensis* were planted in each demo plots. Fruit trees such as *Citrus limon* (lemon), *Zizyphus mauritiana* (apple ber), *Mangifera indica* (mango), *Litchi sinensis* (litchi), and *Garcinia lanceifolia* were planted. Spice trees - *Cinnamomum zylenicum* (cinnamon), *Piper nigrum* (black pepper) etc. were also planted in the demo plots. Plantation were done in three consecutive year are presented in table 7 and the intercrops at harvest and sale in the market presented in Figure 9.

Economic return from the annual crops has been calculated for the year 2021 and 2022 as per the local market value of the harvested crops and presented in table 8. As per the assessment, in the year 2021 agroforestry demo plot of Chow Newata Mannaw (Lathao) had earned ₹ 97,000/, Chow Makang Manlong (Old Mohong) had earned ₹

Figure 7: A: Semi pucca house type of Lathao village. ; B: .Pucca house type of; C: Socio-economic survey; D: Inter cropping of Brassica oleracea var. capitata; E: Homestead of Pathar Gaon; F: PRA meeting at Pathar Gaon village, Namsai; G: PRA meeting at Mankao village, Namsai; H: PRA meeting at Lathao village, Namsai; I: Preparing land for Agroforestry in Old Mohong village, Namsai

1,05,000/-, owner of Chow Peng Manlong (Pathar Gaon) had earned ₹ 95,000/-, Chow Ayoka Manlong (Mankao) had earned ₹ 76,200/- and Chow Mutuwom Manchey (Piyong Khampti) had earned ₹ 75,000/- from their annual crop. In the year 2022, agroforestry demo plot owner of Mankao (Kherem) had earned a sum of ₹ 96,267.00, owner of Lathao demo plot had earned ₹ 1,85,154.00, Old Mohong owner had earned ₹ 90,814, Pathar Gaon owner had earned ₹ 1,22,500.40 and the owner of Piyong had earned ₹ 90,576 from the annual harvest (Table 8). From the data, it was evaluated that Lathao shows an increment of amount ₹ 1,65,234.00 in the second (2nd) year which is the highest income being gained after agroforestry plantation, followed by Pathar Gaon with a profit of ₹ 1,22,500.00.

Benefit cost ratio (BCR) of homestead agroforestry systems of Namsai district, Arunachal Pradesh were calculated and presented in table 9. It was said when BCR value greater than 1, the land-use system can be termed as profitable (Hasan et al., 2020). Calculated value of BCR indicated that ratio increased with time of the agroforestry system and also greater than 1. Therefore, all of the five agroforestry land use systems established in the Khampti homesteads were profitable. Among the agroforestry land use systems profitability was highest (6.91) in the year 2020–21 obtained by Chow Makang Manlong (Old Mohong) and lowest was 4.44 obtained by Chow Mutuwom Manchey (Piyong Khampti). In the second year i.e. 2021–22 BCR is slightly increased but there was a jump maximum up to 10.49, obtained by Chow Newata Mannaw (Lathao). The data of BCR revealed that agroforestry land use

Table 6: Status of annual income of Khampti households of Namsai district, Arunachal Pradesh

Villages	Agriculture (₹)	Average annual income of each household				Range of household income
		livestock and poultry (₹)	homesteads (₹)	Govt. service/ business (₹)	Total Household income (₹)	
Old Mohong	11400.00	9313.00	3566.60	6433.30	30712.90	20000-30000
Pathar Gaon	13166.60	17580.00	6600.00	6600.00	43946.60	30000–40000
Piyong Khampti	10213.00	9520.00	2120.00	6633.30	28486.30	20000–30000
Lathao	8433.00	7220.00	2333.30	1933.30	19919.60	10000–20000
New Lathao	10000.00	7727.00	3300.00	17000.00	38027.00	10000–20000
Sulungtoo	4133.30	6253.00	4133.30	1666.60	16186.20	10000–20000
Kherem	16200.00	5433.00	2900.00	3600.00	28133.00	20000–30000
Marua camp	7800.00	2340.00	3493.30	533.30	14166.60	10000–20000
New Mohong	14046.00	5026.60	3433.30	1193.30	23699.20	30000–40000
Mankao	9433.00	4167.00	3833.30	1600.00	19033.30	10000–20000
Manphaiseng	12866.60	5800.00	2533.30	16400.00	37599.90	30000–40000
Manmow	10900.00	7000.00	3500.00	16366.60	37766.60	30000–40000
Wagon Pathar	10653.00	10707.00	2966.60	5466.60	29793.20	30000–40000
Jenglai	11247.00	8227.00	3406.60	5333.30	28213.90	30000–40000
Wengko	13106.60	10826.60	3933.30	3133.30	30999.80	30000–40000
Total	163598.10	117140.20	52052.90	93892.90	426684.10	
Average	10906.53	7809.33	3470.13	6259.46	28,445.60	

Table 7: Plant species in 5 Agroforestry Demo plantations developed in Khampti homesteads of Namsai district Arunachal Pradesh

Name of plant species	Pathar Gaon	Piyong	Mankao	Lathao	Old Mohong
A. Number of seedlings planted in 5 agroforestry demo plantation in Namsai district					
Acacia catechu (L.f.) Willd.	00	00	500	00	00
Aquilaria malaccensis Lam.	2040	540	1040	540	540
Areca catechu L.	400	400	1400	400	400
Bambusa tulda Roxb.	10	10	10	10	10
Cinnamomum zeylenicum Br.	25	25	100	100	100
Citrus limon (L.) Osbeck	200	100	200	100	2000
Cocos nucifera L.	15	20	12	10	15
Dalbergia sissoo Roxb.	100	140	100	100	100
Garcinia lanciefolia Roxb.	25	125	100	50	100
Litchi chinensis Sonn.	250	250	250	250	250
Livistona jenkinsiana Griff.	45	55	42	30	25
Magnifera indica L.	50	50	50	50	50
Piper nigrum L.	40	160	00	00	160
Zizyphus mauritiana Lam.	300	200	200	200	200
Machilus bombycina King ex Hook. f.	20		20	50	20

Table 7: Continue...

Name of plant species	Pathar Gaon	Piyong	Mankao	Lathao	Old Mohong
B. Intercrop species (Propagules in kg)					
Brassica nigra (L.) K.Koch	80	00	80	80	80
Cajanus cajan (L.) Millsp.	50	00	00	00	00
Colocasia esculenta (L.) Schott	00	00	100	00	100
Curcuma longa L.	00	300	200	00	00
Sesamum indicum L.	10	10	10	10	10
Solanum tuberosum L.	200	200	200	200	200
Vigna mungo (L.) Hepper	10	10	10	10	10
Zingiber officinale Roscoe	120	00	120	120	120

Table 8: Comparison of income before and after agroforestry intercrop in Homestead Agroforestry demo plots of Namsai District

Sl. No.	Demo plots	Year 2020 (Before Agroforestry plantation) Income (₹)	2020–2021 (1st year return from agroforestry intercrop)					2021–2022 (2nd year return from agroforestry intercrop)				
			Cost of production/ input (Rs)					Cost of production/ input (Rs)				
			LP+P	L+M	TC	GI	NI	LP+P	L+M	TC	GI	NI
1.	AM	28,133	10,800	9,500	20300	96,500	76,200	7,150	11,730	18880	1,15,167	96,267
2.	NM	19,920	11,750	10,300	22050	1,19,050	97,000	7,750	11,750	19500	2,04,654	1,85,154
3.	MM	26,800	10,550	7,200	17750	1,22,750	1,05,000	7,500	12,550	20050	1,30,864	110,814
4.	PM	43,946	10,550	9,750	20300	1,15,300	95,000	8,500	11,000	19500	1,42,000	1,22,500
5.	MUM	28,487	11,550	10,200	21750	96,750	75,000	8,100	10,800	18900	1,09,476	90,576

LP+P: Land preparation + propagules; L+M: Labour + Management; TC: Total Cost; GI: Gross income/out put; (Rs); NI: Net Income (output-input)(Rs); AM: Chow Ayoka Manlong (Mankao); NM: Chow Newata Mannaw (Lathao); MM: Chow Makang Manlong (Old Mohong); PM: Chow Peng Mounlang (Pathar Gaon); MUM: Chow Mutuwom Manchey (Piyong Khampti); 1 US$=INR 73.93 and INR 78.37 (yearly average of 2021 and 2022)

Table 9: Benefit cost ratio of homestead agroforestry systems of Namsai district, Arunachal Pradesh

Sl. No.	Demo plots	Total production cost (₹)	Gross income (₹)	BCR	Total production cost (₹)	Gross income (₹)	BCR
1.	AM	20300	96,500	4.75	18880	1,15,167	6.09
2.	NM	22050	1,19,050	5.40	19500	2,04,654	10.49
3.	MM	17750	1,22,750	6.91	20050	1,30,864	6.50
4.	PM	20300	1,15,300	5.70	19500	1,42,000	7.28
5.	MUM	21750	96,750	4.44	18900	1,09,476	5.79

TPC: AM: Chow ayoka manlong (Mankao); NM: Chow newata mannaw (Lathao); MM: Chow makang manlong (OldMohong); PM: Chow peng mounlang (Pathar Gaon); MUM: Chow mutuwom manchey (Piyong Khampti)

system is profitable and can be extended to other area with acceptable reason of ability for income generation.

The data generated through the study on socio-economic status of the Khampti tribe of Namsai district, Arunachal Pradesh is distinctive and expected to be useful for any socioeconomic planning on this tribe. Further, their livelihood options and economic returns from agriculture, livestock and poultry, homesteads etc were studied. The study also focused on socio-ecological services of agroforestry. Similar study was also conducted in home gardens of Kirtinagar Block of District Tehri Garhwal, Uttarakhand, India recorded socio-ecological services of prevalent agroforestry systems in the home gardens (Negi et al., 2023).

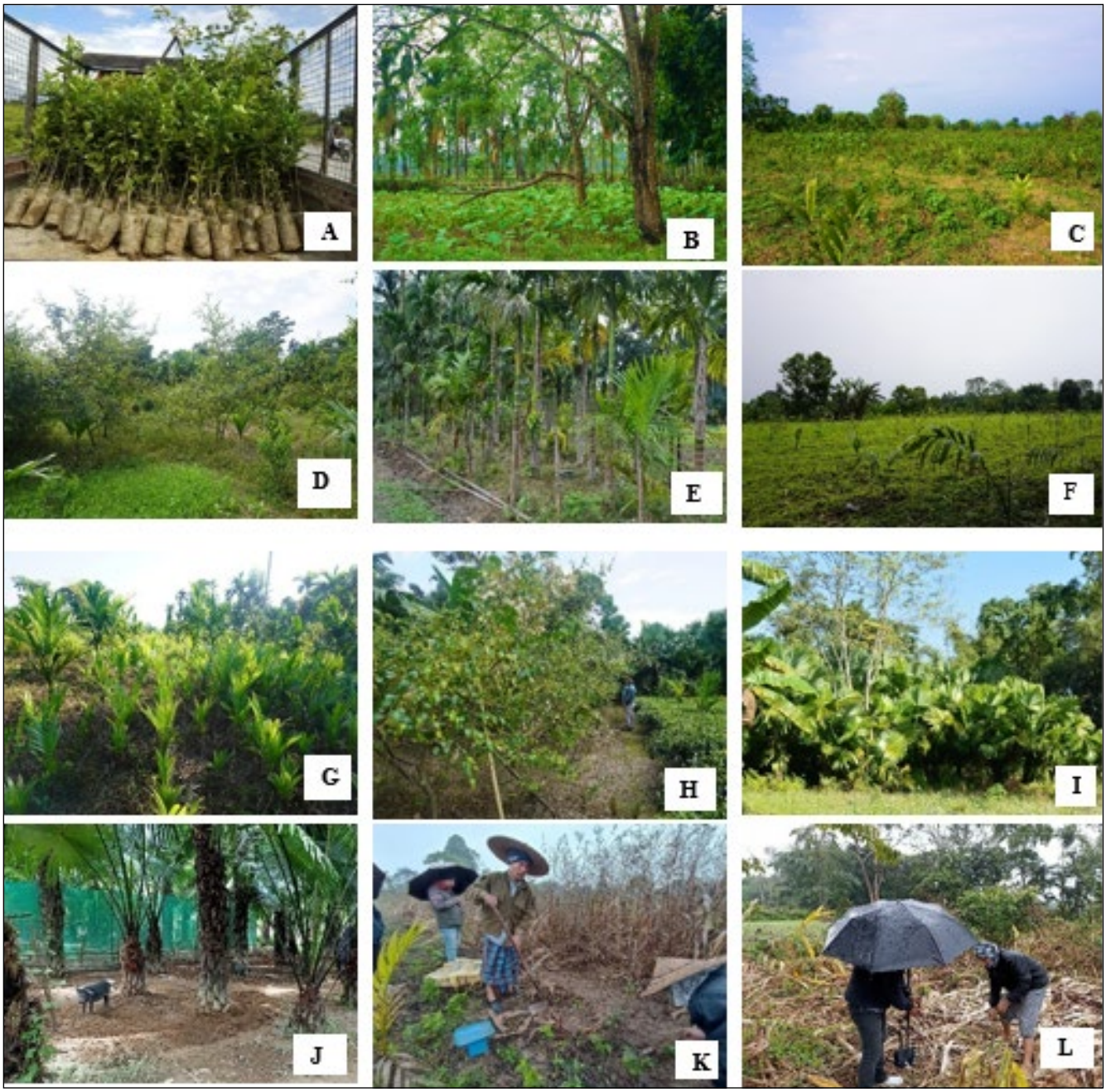

Figure 8: A: Citrus seedlings for agroforestry plantation in demo plots B: Demo plot of of Old Mohong village, Namsai ; C: Demo plot of of Pathar Gaon village, Namsai; D: Demo plot of Mankao; E: Demo plot of Lathao; F: Demo plot of Piyong; G: Plantation of *Areca catechu* in demo plots of Lathao village; H: Plantation of Areca nut; I: Inter cropping of tea garden with citrus, *Areca catechu* and *Livistona jenkinsiana*; J: *Livistona jenkinsiana* in the homestead of Pathar Gaon; K: Rearing of livestock (pig); L: Harvestingof *Brassica nigra* and Harvesting of *Curcuma longa*

From the survey it was observed that Khampti families of Namsai district Arunachal Pradesh are Matriarchy and also mostly of the families are nuclear (72.88%) at present. However, other tribal communities like Missing and Deuri of Assam and Singpho of Arunachal Pradesh were predominantly joint families (Hazarika et al., 2015; Manchey, 2016).More in number of Kutcha houses (52%) among the Khampti villages indicated that the tribe living in the villages is still depend on natural resources. However, there is a tendency for gradual transformation to semi pucca to pucca houses. Although, their primary livelihood option is agriculture and practiced the same by 66.66% of the household; but economic return from the agriculture is low in comparison to their land holdings. The average

Figure 9: Agroforestry intercrops for sale in local market: A: Harvested *Livistona jenkinsiana* leaves for sale; B: *Curcuma longa* after harvest; C: *Colocasia esculenta* after harvest; D: *Brassica nigra* after harvest; E: Local market of Namsai selling vegetables and poultry

annual income of the households' ranges from ₹ 14166.60 to ₹ 43946.60 denotes that most of them live below poverty line. It was observed that no correlation between annual income and land holdings could be established. One of the reasons, that they are not properly utilizing their lands for their economic activities. This was because the Khampti household does not use the total agricultural land holdings for cultivation at a time. Only they use to cultivate a part of the area as per to their family requirement for the year. A very few had done their higher studies which eventually decrease their literacy rate. Among the Khampti tribe literacy rate was found to vary village to village within the range of 20.27% to 54.05%. The present literacy rateof the tribeis quite low in comparison to the national average (77.70) and proper education policy need to be adapted to mobilize the education status of the tribe. The survey also revealed that the landholdings utilized by each of the households for homestead garden are substantial. Seasonal crops (vegetables) were recorded to grow in the homestead gardens such as *Zea mays, Colocasia esculenta, Zingiber officinalis, Curcuma longra* etc.in *kharif* season and *Sesamum indicum, Phaseolus vulgaris, Solanum tuberosum* etc in *Rabi* seasons. Annual income from the homesteads are also low because almost more than 70% of the homesteads area except a few exceptions were observed as laying unused. Cow is reared mostly and other livestock are goat, buffalo, and poultry. L.P.G. cylinders are mostly consumed as the source of energy. Higher level of education and income, large size of land holdings, modified houses, business and government jobs are found to confine only among traditional elite families. Women are actively engaged in selling goods in the local markets along with their traditional role which is a positive sign towards development.

However, the profitability of the Khampti households is considerably low due to lack of proper agroforestry planning, unsustainable land use .Integrated cultivation of multi-crops and multiple use of land were found to have higher economic gain than the monoculture system (Bijarpas et al., 2015). As such, the agroforestry demo plots were established in five selective homesteads enabled to improve economic condition of the owners. The introduced agroforestry systems in the homesteads as pilot mode were found viable also for better land management and to enhance their livelihood.There was a 3 folds increased in annual return from the intercrops in agroforestry demo plots ownersdue to cultivation of *Zingiber officinale* (ginger), *Brassica nigra* (mustard), *Curcuma longa* (turmeric), *Cajanus cajan* (arhar), *Colocasia esculenta* (taro), *Sesamum indicum* (sesame), *Solanum tuberosum* (Potato), *Vigna mungo* (black gram) and *Zea mays* (maize). Benefit cost ratio (BCR) was also increased gradually with time in each demo plots may be an indicator of application of technology and earned skills of the agroforestry demo plot owners. The study on evaluation of benefit cost ratio among the agroforestry systems was done by Sharma et al. (2022) and and (Yohannes and Teshale, 2021) recorded highest ratio for agri-horti-silviculture system in Una District of Himachal Pradesh, India and Moringa based agroforestry practice against mono-cropping system in Konso district (woreda), Southern Ethiopia respectively.

4. CONCLUSION

Improvement of socioeconomic condition of the Khampti tribe could be possible with proper utilization of land mass and bioresources of their homesteads. The literacy and educational status of the tribe were below the national level. Results of the newly introduced (demo) agroforestry indicated an improvement of the income over Khampti traditional homesteads and may be recommended for further extension. The agroforestry system introduced in the Khampti homesteads could enhanced household economy, widening up the livelihood. Integration of trees and fruit crops in long ran would be instrumental to uphold phyto-diversity and household income providing scope for value addition and self-employment in upcoming years.

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