FODDER PLANTS AND LIVESTOCK MAINTENANCE: INDIGENOUS KNOWLEDGE ASSOCIATED WITH GARO TRIBES OF MEGHALAYA, INDIA

† DINGSMIT B SANGMA AND ‡T.N. MANOHARA

† RAIN FOREST RESEARCH INSTITUTE, JORHAT, ASSAM.

‡ INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY, BENGALURU, KARNATAKA

ABSTRACT

The Garo tribes are inhabitants of Garo hill districts of Meghalaya. Due to their natural association and dependence on forest for daily needs, they have old practice to utilize forest products for food, fodder, medicine etc. Although, agriculture is the prime source of livelihood for a majority of rural population in the Garo Hills, dependence on livestock as an alternative source of income is significant. Livestock management is unique and is locally called '*bathan*'. The farmers have comprehensive indigenous knowledge of taxonomy, nutritional value of fodder plants and were able to identify 43 species of fodder trees under 32 genera belonging to 22 families. The farmers have some knowledge on utilizing locally available plants for treating common ailments of their livestock's. Forestry is the major source of leaf fodder and bedding material for livestock in the hills. Therefore, stall feeding practices for livestock should be encouraged. Farmers should be educated on the benefits of Agroforestry to encourage private plantation of fodder tree species. For conserving the forest fodder- resources in a holistic manner there is a need for the integration of ecological, environmental, social and economic sustainability in forest bio-diversity resource management.

Keywords: forage, lopped**,** palatable**,** population, silvipastoral system, animal husbandry.

INTRODUCTION

India is predominantly an agricultural country and livestock is an integral component of agricultural system. It is blessed with huge livestock population and possesses three tenths of the world's cattle population, besides numerous others. Livestock including poultry provides additional income to the small and marginal farmers and contributes significantly to rural economy. About 80% of its contribution to Gross National Product is from cattle, buffaloes and sheep. Goats, pigs and poultry covers the balance 20%. While eggs, meat and milk production makes through the availability of cash to the livestock farmer round the year, which is utilized for purchase of seeds, manure and fertilizers for agriculture operations; the establishment of dairy, poultry, sheep and goat or pig farms helps to solve unemployment problems and provide valuable protein, vitamin and mineral rich materials like eggs, milk and meat. Organic manure from livestock and poultry enrich the soil for higher production of crop, vegetable and flowers as well as horticultural produce. The livestock density varies according to the agro-geographic condition as well as the preference of the people and their needs. Although numerically the cattle wealth appears to be enormous but the production of dairy and meat products is miserably very low. This is mainly because of deficiency in the cattle feed and fodder. Straw and stubble from agricultural crops such as rice, wheat, millet and leguminous crops supply only a fraction of all fodder needed by the livestock. In the context of short supply of agricultural residues and natural grasses as cattle feed, fodder and forage plants from forests become very important especially during the crucial lean periods when grasses are either grazed or become very rough and unpalatable. The role of fodder trees and shrubs in providing highly nutritious green leaf fodder is of great importance to livestock production. Tree leaves are exceptionally rich in essential nutrients like crude protein, nitrogen, calcium, phosphorous etc. In hill areas fodder and forage plants constitute the main source of green fodder to the livestock. Generally the numbers of animals that are grazed in the forests are much more than the forests can support. This has naturally resulted in the depletion and disappearance of grasslands. Trees are lopped for feeding the cattle at site and for stall feeding at home. Many trees do not provide leaf fodder throughout the year on account of unpalatability, but their fruits/pods are highly

palatable and nutritious. Some species are highly preferred in one season while in the other species their leaves are toxic and not lopped or fed. Similarly, a tree species may be a good fodder in one geographical region, while in other regions it not at all used. Therefore, agri silvipastoral system is the viable alternative systems for high quality forage production and efficient livestock production (Roy and Pathak, 1983; Roy, 1988, 1989; Singh, 1989; Saha and Gupta, 1987). A comprehensive detail on fodder trees is presented by Singh (1982). Palatability and nutritive value has been worked out for most of the tree species. Many species possess more than 20 percent crude protein and are highly palatable. Although leaf fodders are rich in crude protein content it is not easily utilized by animals, due to the fact that leaves contain higher percent of cellular carbohydrate (crude fibre) and tannins. Though lopping is the principal mode of collecting nutritious leaf fodder, it reduces the growth increment in many lopped tree species unless done up to optimum level (Roy, 1990). Continuous lopping will damage the plants. Hence a lopping cycle could be adopted. In recent years the problem of grasslands and the cultivation of suitable forage plants in the forest are attracting increasing attention. While selecting the species for cultivation care may have to be taken to see that they serve dual purpose of providing fodder and also small timber and fuel. Most of the cultivation practices in hills are along the slope which results in severe soil and water erosion leading to nutrient hunger in soil in the region. Further, the development of the livestock industry to optimal level in many developing countries continues to face several setbacks. Among these impediments, regular availability of feed and water and basic but drugs and veterinary personnel are crucial. Of these animal nutrition (feed) particularly during the dry season and animal health (medication) has been identified as major factors that cripple the traditional and modern livestock production in remote areas.

Some plant explorers have dealt with the exploration of general flora of Meghalaya and there has been no separate study on the documentation of fodder yielding trees of the state. It is in view of the above that this study is being carried out to access the indigenous knowledge in the utilization of local trees and shrubs by local farmers in the area of feeding and health in the Garo Hills district of Meghalaya.

Study site and people

The present study was carried out during February-March 2013 in the Garo Hills district of Meghalaya. The villages are mainly inhabited by Garo tribes. They are found inhabiting in remote places and depend mostly on surrounding plant resources for their food, fiber, fodder, shelter, medicare, and other purposes (Neogi et al., 1989). The total area of the district is 3677 sq. km as per 2011 census (District Statistical Handbook, 2015). The total forest cover in Garo Hills district is 6925 sq. km (Indian State Forest Report, 2009). There are no major industries in Garo Hills and people are dependent on Agriculture and Animal husbandry. Dairying is practiced by most of the small and marginal farmers and landless laborer's in the district and to them this activity provides economic security by serving as a hedge against crop failure. Most of them consume meat as source of protein with rice. They practice *Jhum* cultivation and also followed a system of herbal medicine in treating their ailments. Rice and maize are the major cereal crops. Pulses and oil seeds are also cultivated in this region. They are mostly non-vegetarians. The staple diet of the tribe comprises of rice, dried fish and meat. Livestock is an important source of income, food, clothing and labour for the tribal people. Further, because of social and religious acceptance, the consumption of meat is relatively higher in this region, and that of milk and milk products is lower. Livestock comprises of cows, bullocks, pigs and poultry. According to the 2007 census, total livestock and poultry population in the Garo Hills (Meghalaya) is of 2,304,343 – 467,642 of cattle, 13,914 of buffaloes, 206,225 of goats, 8,410 of sheep and 1,400,095 of poultry birds. In Garo Hills Cattle are mainly reared for draught power in valley cultivation. In some part of Garo hills livestock is manage by '*bathan*' system. In *bathan*, the cattle from all households are reared at one place. The *bathan* system has been in operation for last 30-40 years in Garo Hills. Unable to cope up with maintenance of cattle because of the pressure of tedious agricultural operations in slash-and-burn and valley cultivation, the villagers identified a Nepalese to setup a *bathan*. The *bathan* is located away from the agricultural fields at the periphery of the village on a hilltop to prevent cattle from straying in the fields. The villagers deposit their cattle with the *bathan*'s caretaker who is responsible for their upkeep. The households do not pay any money to the *bathan* keeper. However, the sale of milk compensates *bathan* keeper. The *bathan* keeper is not under any obligation to pay back to the cattle owner. Cattle are accompanied for grazing every morning and herded back in the evening. The

grazing is regulated under constant supervision. Marginal land, fallow fields and harvested valley plots are used as grazing land. The calves are stall-fed and provided with salt licks. The cattles are confined to *bathan* round-the-year. However, the bullocks are taken for plough in valley fields. During calving, the concerned households bring home their cattle and return to *bathan* after deliveries. The villagers sell their cattle in need, particularly during festival or when requiring additional income. The *bathan* system of livestock management has some drawbacks such as the households lose out on the dung production for manure. The consumption of milk is traditionally abhorred by the Garos, but now gaining acceptance in area. Consequently, households buy milk, though in small quantities, from the vendor and thus end up paying for milk produced from their own cattle.

Nowadays livestock breeders, are rearing Holstein Friesian and Jersey cross breeds of cattle for milk and manure by stall- feeding practices in rural and urban areas of Garo Hills; Buffaloes, local breeds of cattle, sheep and goats are also reared in some rural areas but maintained by grazing and browsing system. During rainy season (June-September) the stall feeding crossbred cattle are fed mostly with green grasses as they are rich in nutrients along with the usual concentrates. But during lean period (October-May) the cereal straw and dry grasses perhaps being very poor in protein content are supplemented with other green fodder of high nutrient value and this is generally met by the use of fodders lopped from a large number of tree species. Some specialized grasses like broom grass (*Thysanolaena agrotis*) were also fed along with some tree fodders and crop residue (paddy, straw, etc) were also used as roughages. Tree fodders are another type of rescue biomass in the region for feed scarcity. Collection of tree fodders or grasses either from private land or unclassified forest is very difficult due to hilly terrains. The practice is beneficial in two ways; it would reduce the level of anti nutritional factors in the diet and increase the level of crude protein content of the diet.

The communities are dependent on forest to meet their needs for fodder, fuel-wood, timber and medicinal plants to meet their primary healthcare as well as of their domestic animals. The Garo tribes have their own traditional system of medicine for treating various ailments in humans as well as in their livestock. The

sources of these medicinal plant species could be cultivated plants from homesteads, farm lands, cultivation fields or wild plants from forest lands. The plant parts used varies greatly -leaves, fruits, roots or stems and most of these are collected fresh and used. Sometimes the plant parts are collected and stored for future use, particularly when the plant is not available. Over-exploitation by the local people has pushed many of the medicinal plants into threatened categories (Barik et al., 2007). There are very few healthcare centers for humans and Veterinary hospitals for animals.

Vegetation

The vegetation of Garo Hills can be broadly classified into tropical and sub-tropical zones based on altitude. Tropical vegetation covers areas upto an elevation of about 1000 m. The majority of the forests viz. Dilma, Dhima, Chimabangsi, Rajasimla Ildek, Darugre, Rongrengre, Songsak, Siju, Rewak, Emangre, Baghmara, Phulbari, Rongmatchokgre, Rongchugre, Singimari etc. fall in this zone. Due to excessive 'Jhum' practice most of the forest areas are cleared and secondary monoculture forests of *Shorea robusta* was established.

The sub-tropical vegetation occurs at elevations above 1200 m from sea level and this type of forest is restricted in Tura peak, Nokrek peak etc. These are mainly evergreen forests but a few elements of deciduous forest are also seen. There are significant gaps in the existing information on the flora of the state because numerous social and political constraints and roughness of terrain have prevented thorough surveys of the North-Eastern region (Khan et al., 1997). There is no comprehensive study so far available for medicinal plants of Meghalaya analyzing the endemism, species distribution pattern, threat status, availability and quantity consumed (Barik et al., 2007). Some of the ethnobotanical studies perform in Meghalaya state are those by (Rao, 1981), (Kumar et al., 1980) (Sajem and Gosai, 2006), (Sharma et al., 2013), (Laloo et al., 2006), (Laloo and Hemalatha, 2011) etc. mostly to document the medicinal value and taxonomic aspect of the species. The present study was conducted to document and conserve the indigenous knowledge of the tribal people associated with fodder plants and maintenance of livestock and to assess the current status of conservation plant species used as fodder by the people of Garo Hills.

Materials and methods

Methodology

Field surveys were carried out during the month of February to March 2013 in selected villages of West Garo Hills district of Meghalaya, India. Before undertaking the study prior informed consent was taken from the community and village headman to conduct surveys in Villages and Community Reserve Forests. Primary and secondary data were used in this study. The primary data were collected using semi structured questionnaire and personal observation. The secondary data was mainly from library and internet. The study was carried out in four randomly selected villages namely, Agalgre, Rongpotgre, Kimdegre and Manwapara. Ten livestock keeping households from each village were purposively selected for the study. A semi-structured questionnaire was administered to the farmers. Data were collected from male heads or other important respondents. From each family, information on their social and economic status, especially family size and composition, level of education, land holding, occupation, annual income, method of cultivation, monthly consumption, housing pattern and materials used in housing, land holding, number of cattle owned, materials (food, non-food, housing and marketable items) collected from the neighboring forests have been gathered. Also the researcher has taken note of the nature of degradation of forests in all those four villages. The palatability and lopping cycle were noted by interviewing the breeders. Aged farmers and local healers were interviewed from each village for gathering information on plant used to treat different diseases of animals. Farmers and local healers were inquired for the tree and shrub names in their local language, and the samples were collected and preserved for subsequent botanical identification. Herbariums were deposited in Department of Forestry, Mizoram University, Aizawl. The surveyed questionnaire was processed through a database program.

Results

In sample villages majority of the families have their own land for settled cultivation and other purposes. There is no community land in the villages. The average land holding of the farmers ranged between 0.5 to

3.75 ha in all the villages. The majority of the farmers belong to marginal category (Rongpotgre 100%, Agalgre 90%, Kimdegre 60% and Manwapara 60%). The livestock holding in poultry was found to be highest (47.4%), next stands cattle with 28.1% of the farmers keeping the latter for domestic consumption (Table 3). Whereas other livestock animals viz., rabbit, pig and goat were kept by few numbers of livestock rearers. Bullocks and cows are used primarily as draught animals. Few pig rearers are keeping their animals in pucca housing. Majority had their animals housed in kutcha type of shed while in Agalgre (60%), in Rongpotgre (30%), Manwapara (30%) and in Kimdegre (10%) constructed mixed type of dwelling for their animals (Table 4). The farmers were able to identify which tree and shrub species and which vegetative part the livestock favored. In total, 43 species of fodder trees under 32 genera belonging to 22 families have been identified and documented. Moraceae has appeared to be the dominant family with 12 species of fodder trees, followed by Fabaceae with 4 species and Lauraceae with 2 species (Table 5). Tree fodders are generally collected from nearby forest. Fodder from 22 tree are found to be highly palatable, whereas from 13 species are moderately palatable and from 3 species the fodder is having low palatability. So, far the lopping cycle is concerned; it varies from species to species. Thirteen fodder species have the lopping cycle throughout the lean period (Oct.-May), eleven species from April-May, seven species from March-May, three species from Oct.-Dec., two species from Oct.-Jan., two species from Dec.-April, two species from Jan.-May and one species from Dec.-March. Majority of the species have longer lopping cycle and higher palatability, which are taken as positive attributes of the fodder trees by the breeders. The main impact of feeding such fodder during lean period as supplementary item has been observed to have maintained the sustainable production of cattle milk in West Garo Hills district. *Artocarpus heterophyllus* was the most known tree species as indicated by 77.50% (Table 5) of the respondents. Some farmers collect the leaves (Table 6) of this tree species and use them to feed their livestock. Apart from *Artocarpus heterophyllus*, *Macaranga* spp. was reported to be known and used by 70% of the respondents; because of their palatability, availability and easy to propagate (Table 5). *Phanera vareigata* was the third most preferred species in all categories of farmers because naturally grown was available both in homestead and roadside in the study area and the palatability is also high. Other high ranking species were *Shorea robusta*,

Tetrameles nudiflora and *Azadirachta indica.* The study revealed that *Terminalia arjuna* was the least known species as indicated by 12.50% of the respondents. It was gathered from the study that farmers will choose a particular tree for feeding depending on its availability in the community and preference by animal. Most of these trees produced green leaves and some fruits throughout the dry season and could therefore serve as a reliable source of feed supplement for livestock in the dry season. Majority of the fodder tree species belong to Moraceae family (27.9%) followed by Fabaceae (9.3%) (Table 6). Fodders are collected mainly for leaves and in few cases for fruits and flowers. Apart from fodder trees species farmers of Garo Hills have some Knowledge on utilizing locally available plants for treating common ailments of their livestock's. Locally available and easily accessible ethnoveterinary medicinal plants provide a cheaper treatment as compared to Western drugs. The only limitation is the seasonal availability of certain plants, for which Garo tribe have acquired different ways to preserve them. Most common way of preserving is sun drying. From the livestock owners of West Garo Hills district a total of 11 plant species belonging to 8 families used as ethnoveterinary medicines have been reported (Table 7). In the study, two remedies were reported to cure indigestion in cattle. One remedy each was reported to cure diseases like fever, diarrhoea, skin disease and sores. Farmers used different tree parts as medication for animals. The leaves of *Ficus hispida* is ground into paste and is used to treat sores or ulcers. The leaves of *Careya arborea* is given to cattle suffering from indigestion. The bark of *Cassia fistula* is pounded and juice is fed to treat dysentery in cattle. Table 2 below presents some of the tree and shrub species identified by farmers in the study area used as medicinal plants for livestock. They were able to identify the nature of disease, the part of trees or shrub species used, the form it is used and specific animal treated. During rainy season fodder availability is in abundance. Weeds, herbs, stovers and agricultural by products would continue to be major input as livestock feed for ruminants (Table 8). Most of the tree and shrub species used for feeding and attending to the health needs of the animals were said to be available in the locality as indicated by 75% of the respondents. However 25% of the respondents indicated that they have to walk about 2 km before they can have access to the browse species for their animals. Even though most of the trees and shrubs identified by the farmers are available in the locality, the farmers have problems accessing them. The farmers assigned

various regions for their inability to access the trees and shrub. The height of the trees, bulkiness and falling from the tree were the major hindrances to accessing the trees (Table 9). Out of 40 respondents, 37.5% established some local trees and shrubs for animal feeding and for other purposes (Table 10). Some farmers keep a few stands of trees near their homes or in their fields especially the *Artocarpus heterophyllus* and *Phanera variegata* although they did not plant them. These trees are kept purposely for their shades and fruits. Among the trees and shrub established for fodder and for any other purpose, *Mangifera indica* was the most species established by the farmers in the surveyed area as indicated by 50%. This could be due to its multipurpose nature such as fruits, shade, firewood, windbreaks and fodder. However, 5% of the farmers do not established any tree species. They gave reasons such as, unavailability of seedlings, water problem, superstition, and slow growth of trees.

Discussion

The interaction with the farmers had helped produce and throw enormous light into the study conducted in accordance with its formulated objectives. The study revealed information which would have been impossible without personal interview of the respondents. The majority of the families are headed by male and few by female unless there is absence of an elderly male in the family. The state and the society following a matrilineal system, the ownership rights of fixed assets are entitled to female. The dominant family structure is composed of nuclear type as per the traditional concept. A major component of the population is dependent on agriculture as the main occupation for livelihood and next to it comes the service holders and then farm labor. Livestock production serves a subsidiary occupation providing some sort of financial security to them. Lack of awareness among the people and high cost has resulted in less adoption of modern technologies and machineries.

The livelihood pattern of the people living in and around the forest areas is highly shaped by the available forest resources that in turn affect the quality of forest. The best way to preserve forest and improve condition of the people is by improving economic condition of the people through education and

technological development, sustainable cultivation and also to follow a judicious land use pattern so as to maintain the forest resource. The constraint to livestock production is mainly due to feed and fodder scarcity. Forestry is the major source of leaf fodder and bedding material for livestock in the hills. Therefore, stall feeding practices for livestock should be encouraged. Farmers should be educated on the benefits of Agroforestry to encourage private plantation of fodder tree species. The multiple uses of the local tree and shrub species in different farming systems have led to negative and positive effects. As a result many areas are bare and susceptible to wind and water erosion. The exploitation of this knowledge from farmers and incorporation in research and development systems will benefit the present and future generations. It is therefore important for all parties (research-extension-farmers) to work collectively for the purpose of building a sustainable livestock production system through efficient utilization of fodder trees and shrubs.

Conservation measures

The practice of agri-silvi-pastoral system helps in conservation and sustainable utilization of fodder resources outside the forest areas.

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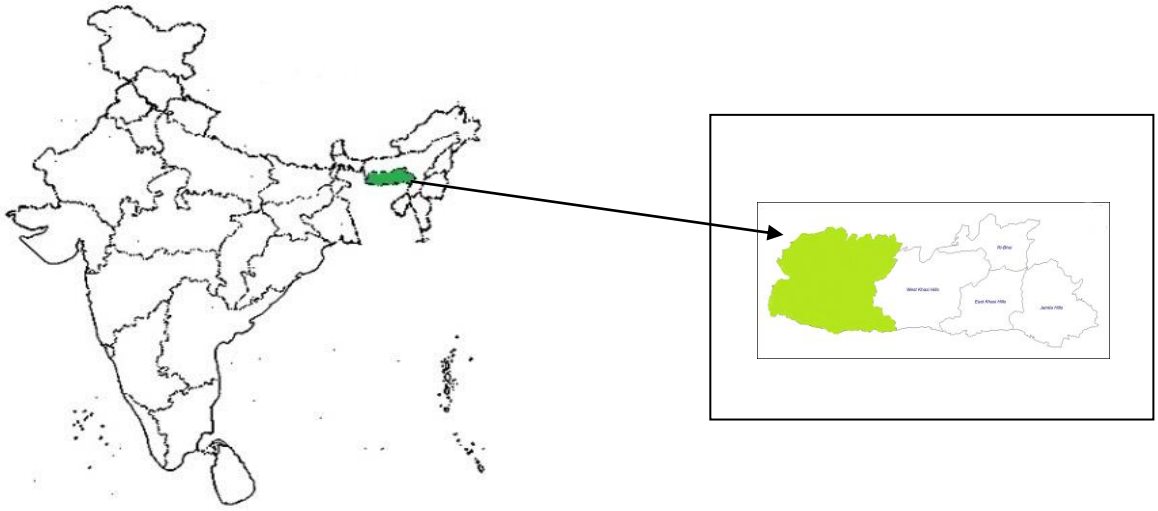

Fig. 1. Map of the study area, Garo Hills district of Meghalaya

Table 1: Livestock Population in West Garo Hills

Sl No	Name of Livestock	In numbers (2012)		
		Male	Female	Total
1	Cattle	1,00,705	1,62,638	2,63,343
2	Buffaloes	6,135	11,133	17,268
3	Sheep	2,458	7,141	9,599
4	Goats	43,618	94,850	1,38,468
5	Horses & Ponies	40	17	57
6	Pigs	62,744	65,602	1,28,346
7	Other livestock (Dog)	30,301	24,332	54,633
8	Total livestock	2,46,001	3,65,713	6,11,714
9	Total poultry	2,96,322	3,32,714	6,29,036

Source: (District Animal Husbandry and Veterinary Office, West Garo Hills, Tura)

Table 2. Dairy and poultry production in Garo Hills district (Estimation of production milk, egg and meat, Government of Meghalaya, 2013-2014)

Cow's milk (Tonnes)		Buffaloes (Tonnes)	Eggs-fowls (Lakhs No.)	Eggs-ducks (Lakhs No.)
Indigenous	Cross-breed			
17.38	3.13	0.95	411.13	20.55

Table 3. Livestock and poultry population in sample villages

Sl. No.	Livestock and poultry	Villages									
		Agalgre n=10		Rongpotgre n=10		Kimdegre n=10		Manwapara n=10		Overall n=40	
		N	%	N	%	N	%	N	%	N	%
1	Cattle	22	25	24	30.7	22	32.3	21	25.6	89	28.1
2	Goat	12	13.6	5	6.4	14	20.5	16	19.5	47	14.8
3	Poultry	49	55.6	39	50	26	38.2	36	43.9	150	47.4
4	Pigs	5	5.6	10	12.8	6	8.8	10	12.1	31	9.8

Table 4. Type of animal shed

Sl. No.	Type of animal shed	Villages							
		Agalgre n=10		Rongpotgre n=10		Kimdegre n=10		Manwapara n=10	
		N	%	N	%	N	%	N	%
1	Pucca	2	20	3	30	2	20	2	20
2	Mixed	6	60	3	30	1	10	3	30
3	Kutcha	2	20	4	40	7	70	5	50

N= number of respondents

Table 5. Tree and shrub species used for feeding livestock in the West Garo Hills district

Sl. No.	Scientific name	Local name	Family	Palatability	Percentage of utilization (%)	Lopping cycle	Part utilized
1	*Albizzia chinensis* (Osbeck) Merrill	Bolpu	Fabaceae	Moderate	15.00	Dec-April	Leaves
2	*Albizzia procera* (Roxb.) Benth.	Kelwi	Fabaceae	High	12.50	Oct-Dec	Leaves
3	*Albizzia odoratisima* (L.f.) Benth	Siso	Fabaceae	High	35.00	Oct-May	Leaves
4	*Alstonia scholaris* (L.) R.Br.	Sokchon	Apocynaceae	Low	7.50	Dec-April	Leaves
5	*Artocarpus chaplasha* J.R. Forster & G.Forster	Bolsram	Moraceae	High	40.00	April-May	Leaves, fruits
6	*Artocarpus heterophyllus* Lam.	Te,brong	Moraceae	High	95.00	Jan.-Oct.	Leaves, fruits

7	*Artocarphus lacucha* Buch.-Ham.	Arimu	Moraceae	Moderate	17.50	Jan-May	Leaves, fruits
8	*Averrhoa carambola* L.	Amilenga	Oxalidaceae	High	5.00	Oct-May	Leaves
9	*Azadirachta indica* A.Juss.	Neem	Meliaceae	High	50.00	Oct-May	Leaves
10	*Bombax malabaricum* L.	Bochu	Malvaceae	Moderate	27.50	March-May	Leaves
11	*Butea monosperma* (Lam.) Taub.	Dak	Fabaceae	Moderate	17.50	April-May	Leaves, twigs
12	*Callicarpa arborea* Roxb.	Masanchi	Verbanaceae	Moderate	37.50	Dec-April	Leaves, flowers
13	*Dendrocalamus hamltonii* Gamble	Wa'nok	Poaceae	High	30.00	Oct-May	Leaves, twigs
14	*Dillenia indica* L.	Agatchi	Dilleniaceae	Moderate	30.00	April-May	Leaves, fruits

15	*Ficus auriculata* Lour.	Te'bil	Moraceae	High	27.50	Oct-Dec	Leaves
16	*Ficus benghalensis* L.	Giting	Moraceae	Moderate	22.50	April-May	Leaves, fruits
17	*Ficus elmeri* Merr.	Aminsep	Moraceae	Low	15.00	April-May	Leaves
18	*Ficus hispida* Linn.	Sakap	Moraceae	High	37.50	Oct-May	Leaves
19	*Ficus lamponga* Miq.	Bol-kan-tap	Moraceae	Moderate	15.00	March-May	Leaves
20	*Ficus religiosa* L. Forssk	Prap-te'brong	Moraceae	High	47.50	Feb-May	Leaves
21	*Ficus rumphi* Bl.	Prap rakseng	Moraceae	High	12.50	April-May	Leaves
22	*Ficus subulata* Bl.	Ti'wek	Moraceae	Moderate	25.00	March-June	Leaves
23	*Gmelina arborea* Roxb.	Gamare	Verbanaceae	Low	35.00	Dec-March	Leaves
24	*Hibiscus surratensis* L.	Me'kri	Malvaceae	Moderate	10.00	March-May	Leaves
25	*Hodgsonia heteroclita* (Roxb.) Hook. f.	Te'bi	Cucurbitaceae	High	17.50	March-May	Leaves

26	*Holarrhena antidysenterica* (linn.) Wall.	Bolmatra	Apocynaceae	High	12.50	Oct-May	Leaves
27	*Lagerstroemia speciosa* L.	Bolasari	Lythraceae	High	15.00	Oct-May	Leaves
	Litsea monopetala Roxb.	Boldo-kaki	Lauraceae	High	42.50	March-May	Leaves
28	*Litsea polyantha* Juss.	Bolbit	Lauraceae	High	30.00	Oct-May	Leaves
29	*Macaranga peltata* Roxb. Mueller	Cha'gru	Euphorbiaceae	High	75.00	Oct-May	Leaves, twigs
30	*Morus alba* L.	Miskuri	Moraceae	Moderate	22.50	April-May	Leaves
31	*Phanera variegata* (L.) Benth	Me'gong	Caesalpinaceae	High	72.50	Oct-May	Leaves
33	*Phyllanthus emblica* L.	Ambare	Euphorbiaceae	Moderate	22.50	April-May	Leaves
34	*Rhus semialata* Mill.	Kitma	Anacardiaceae	Low	17.50	April-May	Leaves
35	*Schima wallichi* (DC.) Korth.	Boldak	Theaceae	Moderate	17.50	March-May	Leaves
36	*Shorea robusta* Roth	Bolsal	Dipterocarpaceae	High	52.50	Oct-May	Leaves

37	*Spondias indica* Wight & Arn.	Ambletong	Anacardiaceae	High	40.00	April-May	Leaves
38	*Stereospermum chelonoides* (L.fil.) DC.	Bolsil	Bignoniaceae	High	37.50	March-May	Leaves
39	*Terminalia arjuna* (Roxb.) Wight & Arn.	Arjun	Combretaceae	High	5.00	Oct-Jan	Leaves
40	*Tetrameles nudiflora* R.Br.	Bolbok	Tetramelaceae	High	67.50	Oct-May	Leaves
41	*Toona ciliata* M. Roem.	Bolbret	Meliaceae	Moderate	22.50	April-May	Leaves, flowers
42	*Trema orientalis* (L.) Blume	Pakram	Ulmaceae	High	30.00	Jan-May	leaves
43	*Vitex penducularis* Wall.	Rangre	Lamiaceae	High	12.50	Oct-Dec	Leaves

Table 6. Number of fodder species in each family

Sl. No.	Family	Percent usage	Overall parts used
1	Anacardiaceae	4.6%	Leaves-100%,
2	Apocynaceae	4.6%	fruits- 11.62% ,
3	Dilleniaceae	2.3%	flowers-2.32% ,
4	Dipterocarpaceae	2.3%	twigs-`6.9%
5	Euphorbiaceae	4.6%	
6	Fabaceae	9.3%	
7	Lauraceae	4.6%	
8	Malvaceae	4.6%	
9	Meliaceae	4.6%	

10	Moraceae	27.9%
11	Theaceae	2.3%
12	Verbanaceae	4.6%

Table 7. Medicinal uses of some tree and shrub species for livestock production

Scientific name	Local name	Family	Animal	Nature of disease	Usage form
Azadiractha indica A. Juss.	Neem	Meliaceae	Cattle	To increase lactation	Leaves are given to eat.
Bombax ceiba L.	Simul	Bombaceae	Cattle	Indigestion	Bark is crushed with water and is given orally to the animal as purgative.
Butea monosperma (Lam.) Taub.	Dak	Fabaceae	Cattle	Dysuria, paralysis	Flower decoction is given to the animal twice a day for 10 days to cure dysurea as well as paralysis.
Careya arborea Roxb.	Gimbil	Lecythidaceae	Cattle	Indigestion	Leaves are given to eat.
Cassia fistula L.	Snaru	Fabaceae	Cattle	Dysentery	Juice of the bark is used against dysentery of cattle.
Cinnamomum verum J.Presl.	Dalchini	Lauraceae	Goats	Mange	Leaves are pounded with root of *Mimosa pudica* and applied on the affected part.

Citrus aurantifolia (Christm). Swingle	Narang	Rutaceae	Cattle	During discharge of mucus in the faeces	About 10 gm fruit preserved in common salt is given.
Citrus indica Tanaka	Me'mang narang	Rutaceae	cattle	Diarrhoea	Fruit is ground with bamboo leaves and mixed with drinking water of animal.
Ficus hispida L.f.	Sa'kap	Moraceae	Cattle	Sore	Leaves are mixed with common salt and rubbed on tongue.
Ficus religiosa L. Forssk.	Prap	Moraceae	Buffalo	Dysuria, haematuria	Leaf extract is given orally to the buffalo.
Zanthoxylum rhetsa (Roxb.) DC.	Me'cheng	Rutaceae	Cattle	Fever	Unripe fruits are pounded and mixed with water which is given to the cattle.

Table 8. Other type of fodder resources used by the farmers

Scientific name	Local name	Common name	Family	Parts used
Areca catechu L.	Gue	Areca nut	Arecaceae	Leaves
Brachiaria decumbens (Trin.) Griseb.	Sauri	Signal grass	Poaceae	Leaves
Brassica oleracea L.	Kobi	Cabbage	Brassicaceae	Leaves
Cajanus cajan (L.) Millsp.	Mendu	Pigeon pea	Fabaceae	Leaves
Cocos nucifera L.	Narikel	Coconut	Arecaceae	Leaves
Coix lacryma-jobi L.	Me'garu	Job's-tears	Poaceae	Leaves
Cymbopogon citrates (DC.) Stapf	Mipanat	Lemon grass	Poaceae	Leaves
Digitaria sanguinalis (L.) Scop.	Samsiriting	Crab grass	Rubiaceae	Leaves
Eleusine coracana Gaertn.	Mi'si	Millet	Poaceae	Leaves
Hibiscus calyces L.	Galda	Sorrel	Malvaceae	Leaves
Hyparrhenia hirta (L.) Stapf	Am'pang	Coolatai grass	Poaceae	Leaves
Hyparrhenia rufa (Nees) Stapf	Pangpangsi		Poaceae	Leaves
Mikkenia micrantha Kunth	Meghalaya bu'du	Bitter vine	Asteraceae	Leaves
Millettia pulchra Kurz	Culmerong	Millettia	Leguminosae	Leaves

Mucuna bracteata DC.	Wakme	Red jade vine	Fabaceae	Leaves
Musa paradisiaca L.	Te'rik	Banana	Musaceae	Leaves
Oryza sativa L.	Mi	Rice	Poaceae	Leaves
Osbeckia crinita L.	Kaku	Osbeckia	Melastomataceae	Leaves
Paederia foetida L.	Pasim	Skunkvine	Rubiaceae	Leaves
Phragmites autralis (Cav.) Trin. Ex Steud.	Me'ga	Common reed	Poaceae	Leaves
Sparganium erectum L.	Kabera	Burr-reed	Typhaceae	Leaves
Thysanolaena agrotis Nees	Simu	Broom grass	Poaceae	Leaves
Tragus berteronianus (L.) All.	Samsok	Burr	Poaceae	Leaves
Zea mays L.	Me'rakku	Maize	Poaceae	Leaves

Table 9. Problems of accessing the trees and shrubs

Sl. No.	Problem	No. of respondents	Percentage (%)
1	Falling from tree	29	72.5
2	Bulkiness	21	52.5
3	Tree height	20	50
4	Snake bite	12	30
5	Distance of trees	3	7.5

6	Skin irritation	1	2.5
7	Scarcity of trees	0	0
8	Old age	7	17.5

Table 10. Trees and shrubs grown by farmers for fodder and other purposes

Sl. No.	Tree species	No. of farmers	Percentage (%)
1	*Artocarpus heterophyllus* Lam.	10	100
2	*Azadirachta indica* A.Juss.	4	40
3	*Carica papaya* L.	2	20
4	*Citrus indica* Tanaka	4	40
5	*Leucaena leucocephala* (Lam.) de Wit	2	20
6	*Mangifera indica* L.	5	50
7	*Phanera variegata* (L.) Benth.	4	40
8	*Phyllanthus emblica* L.	5	50
9	*Tamarindus indica* L.	3	30