Status, opportunities, and challenges of agroforestry practices: perspectives from Terhathum district, Nepal

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Tree cultivation in agricultural and public spaces serves as an alternative to fulfill the rural population's demand for forest products. However, agroforestry practices in Nepal, categorized by agro-ecological areas, lack sufficient documentation and improvement. The current investigation, undertaken in the Myaglung Municipality of Terhathum district in Nepal, aimed to examine the current practices and preferences related to agroforestry. The study also sought to uncover potential opportunities and challenges inherent in agroforestry while gauging the local community's perceptions regarding agroforestry. The primary data collection employed household interviews, key informant interviews, focus group discussions, and direct field observations while the secondary data were gathered from various public and unpublished sources. The farmers' preferences were evaluated using a five-point Likert Scale. In the study region, seven agroforestry systems, mainly employed for subsistence, were identified. The popular timber species in agroforestry included *Alnus nepalensis, Schima wallichii, Castanopsis hystrix, C. tribuloides*, and *Pinus roxburghii*. The favored fodder species were *Ficus roxburghii, F. nemoralis, Artocarpus lakoochaa, Litsea monopetala,* and *Morus alba*. On the other hand, the top fruit choices were *Citrus reticulata, C. limon, Musa paradisica, Mangifera indica*, and *Litchi chinensis*. The key barrier for agroforestry growth was the lack of technical knowledge in cultivating, managing, and harvesting agroforestry species, requiring attention for future agroforestry development in the region.

Keywords: Agroforestry, farmland, fodder, preference, fruit, timber

Agroforestry is defined by the International Centre for Research on Agroforestry (ICRAF) as "a land-use system that integrates trees with crops and/or animals, simultaneously or sequentially, to achieve higher productivity, higher economic returns, and better social and ecological benefits on a sustained yield basis than is attainable from monoculture on the same unit of land, particularly under conditions of low levels of technological inputs and on marginal sites". Agroforestry is a deliberate endeavor to mix and manage forest and agricultural resources on the same land. This intermediate land use system is essential for long-term forestry and agriculture (Kiyani *et al.*, 2017). Farmers may combine productivity and profitability with environmental care using agroforestry practices, resulting in healthy, long-term agricultural systems that can be passed down to future generations.

Pressure to fulfill rising demand for food, fodder, fuel, and other commodities, as well as global challenges such as climate change, are putting strain on agricultural and other land natural resources. This has resulted in a "perfect storm" of poverty and food insecurity throughout the

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world. Nair (1979) characterizes agroforestry as a method of land management integrating trees, crops, and animals in a manner that adheres to scientific principles, promotes environmental health, ensures economic feasibility, and meets the social preferences of farmers. Integrating trees onto agricultural land has been practiced for millennia by cultures throughout the world (Regmi & Garforth, 2010).

Nepal has a wide range of physiographic and biological characteristics within a span of around 200 kilometers from south to north and 885 kilometers from east to west. Nepal's diverse biodiversity reflects its unique geographical position, shifting elevation, and temperature. Nepal is positioned in a biogeographic transition zone, sandwiched between two biogeographic realms: the Palaearctic on the north and the Palaeotropics on the south (Udvardy, 1975). Forests cover 45.31% of Nepal's land area (FRTC, 2022). Aside from trees in forest environments, many tree species are protected on farms as part of subsistence farming systems. These trees play an important role in ensuring the sustainability of agricultural output, and the value of traditional farming practices for crop diversification has been recognized since time immemorial. The promotion of agroforestry species in private agricultural lands in Nepal's hills has been one of the primary causes of the recent rise in forest cover (Pandit & Kumar, 2010). The Nepalese economy is strongly reliant on natural resources, notably farmland, forests, marshes, and rangelands, with forestry and agriculture still employing more than 70% of the population and contributing to over 35% of the total GDP (CBS, 2011). The land is still a crucial resource in underdeveloped nations like Nepal, where more than 90% of the population relies on it to meet basic needs such as food, fodder, fuel, fiber, and timber (LRMP, 1986).

Buffers made of trees work as a transition zone, allowing agriculture and communities to "reconnect", resulting in a more functioning and sustainable environment. The act of planting trees on agricultural land can contribute to forest preservation by enhancing farmer access to forest resources such as firewood and fodder. Additionally, it aids in the restoration of soil fertility by mitigating soil erosion, enriching the soil through the decomposition of leaf litter and nitrogen fixation, recycling nutrients leached into the soil, and facilitating the breakdown of subsoil nutrients through extensive root systems (Shrestha, 2002).

Agroforestry systems are supposed to be more profitable than forestry or agriculture alone (Lehmann *et al*., 2020; Liu *et al*., 2018). While numerous environmentally and economically beneficial agroforestry methods exist, comprehensive documentation of these techniques for dissemination to potential beneficiaries is still lacking (Atreya *et al*., 2021). Despite the presence of various legislative frameworks, policy statements, and strategic plans—such as the Master Plan for the Forestry Sector (1989), Agriculture Development Strategy (2015–2035), Agriculture Policy (2004), Forest Act (2019), Forest Regulation (2022), Forest Strategy (2016), Forest Policy (2019), National Agroforestry Policy (2019), and periodic plans—that emphasize rural development through sustainable natural resource management, agroforestry, and other agricultural practices, the current initiatives fail to prioritize the interests of local farmers and other stakeholders. There has been very little effort put into creating programs that promote and reproduce effective agroforestry methods (Atreya *et al*., 2021).

Most agroforestry systems in Nepal are traditional, and despite tremendous socioeconomic and ecological benefits, little progress has been made in the deliberate management of trees, crops, and cattle as an integrated and dynamic agro-ecosystem. This study tried to find out the status, opportunities, and challenges of agroforestry initiatives in the mid-hill range of eastern Nepal. Specifically, this study tried to document different types of agroforestry practices, determine people's tree preferences, and investigate people's perceptions toward agroforestry at the study site.

Materials and methods

Study area

The study was carried out in the Myanglung Municipality of Terhathum district from January to April 2022. Myanglung, the district headquarters of Terhathum district, is located between 26°66' – 27°30' N latitudes and 87°15' – 87°45' E longitudes. The location of the terrain ranges from 322m to 2,200m above the mean sea level, and covers an area of 100.21 km^2 (38.69 sq. miles). The municipality borders with Phedap Rural Municipality on the east, Laligurans Urban Municipality on the west, Chhathar Rural Municipality and Paanchthar district on the south, and Menchhyayem Rural Municipality and Sankhuwasabha district on the north. Subtropical to temperate climate predominate in this municipality. Most of the land has a slope ranging from 15 degrees to 30 degrees. The municipality's average lowest temperature is 15° C, with a high temperature of 30° C and a minimum temperature of 4.70° C. It has a population of 19,078 people with 9,347 men and 9,731 women and with a population density of 200 people per square kilometer and a total household population of 4,163 (CBS, 2021).

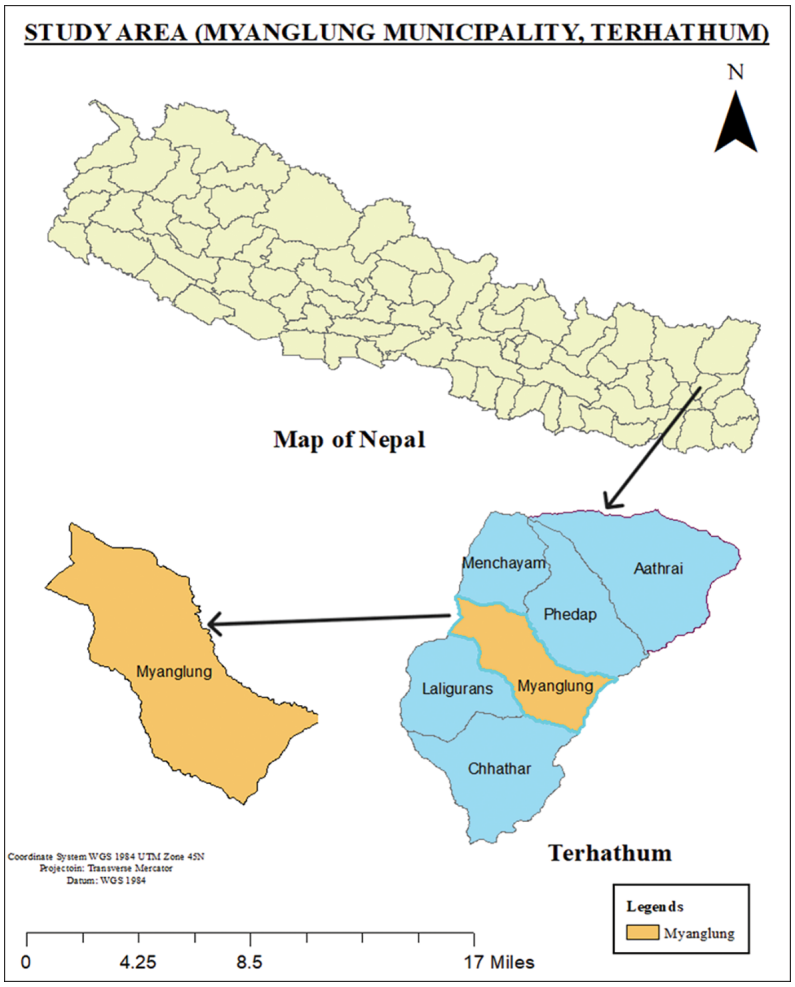

Figure 1: Location of the study area in the map of Nepal

Data collection

Reconnaissance surveys, key informant interviews, questionnaire surveys, formal and informal conversations, focus group discussions, and direct observation were used to collect the primary data. To conduct household interviews, the questionnaires underwent a pre-testing phase in select households during the preliminary survey. They were then refined based on feedback received from the relevant forest officials before finalization. Household interviews were conducted in 121 households. The authors visited all the households for the purpose of data collection. A simple random sampling method was used to select the sample population. At least 10 households from each ward were selected from the 10 wards of the municipality. Altogether 136 respondents (121 from household interviews and 15 from key informants' interview) were questioned for acquiring the desired information for the purpose of the study, out of which 57% were female. Questions related to demographics, livestock, landholdings, adopted agroforestry systems, energy sources, forest products' demand and supply, NTFP availability, cultivation practices, sale of forest products, market availability, market accessibility, problems/challenges faced in agroforestry practices, preferred timber, fodder & fruit species, and farmers' perception towards agroforestry practices were asked to the respondents.

Agriculture was found to be the most common employment among the respondents, followed by service, and small enterprises. Open and close-ended questions related to family composition, land and livestock holding, cropping pattern, preferred tree species, source of energy, source of income, ways of selling their products, services, and facilities received from the government institutions, and future perspective were asked to the respondents.

Key informant interviews were conducted separately with the concerned divisional forest officer, sub-divisional forest officers; chief of the district-level (Terhathum) unit of the federation of community forest users Nepal, model farmers, community school teachers, village elders, and social workers. Open-ended questions related to demography, institutions involved in agroforestry promotion, role of social organization in agroforestry development, services provided by the Division Forest Office (DFO) and the Agriculture Knowledge Centre, Terhathum, and so on were asked. Further, problems faced by the farmers in implementing agroforestry practices, and measures to improve and develop agroforestry production and productivity were also sought from the key informants.

Focus group discussions were held for three separate interest groups: model farmers, women's groups, and disadvantaged groups. Besides, on-farm observation was conducted in the households interviewed for the survey. All the tree species and their numbers were counted with the help of the local farmers on their farmlands or private lands. Main emphasis was given to counting and identifying tree species and their distribution on farmlands/private lands. Secondary data were collected from a variety of sources and records, including reports published by the Division Forest Office, Agriculture Knowledge Centre Dhankuta (Branch Office, Terhathum), municipal office, NGOs/INGOs, libraries, journals, magazines, internet, etc. Previous research papers, dissertations, journals, both published and unpublished articles, as well as other literature released by the Ministry of Forests and Environment (MoFE), Ministry of Agriculture and Livestock Development (MoALD), United States Development Agency (USDA), International Centre for Research in Agroforestry (ICRAF), DFO Terhathum, Nepal Agroforestry Foundation, etc. were also reviewed to collect relevant information on the status, issues, policies, and priorities of agroforestry development.

Data analysis

The collected data were transferred into MS-Excel. Descriptive statistics were used to summarize and analyze the socioeconomic traits of the respondents. The information collected/ obtained from the field survey were presented in bar-diagrams and tables. Chi-square test was done to determine the associations between economic class and household's perception towards agroforestry at 5% level of significance. The opinions/attitudes of the respondents towards agroforestry practices were analyzed using a Likert Scale which is a type of scale used to measure people's perceptions (Bryman, 2016). Mathematically, it is expressed as:

$$WM = \frac{\sum wi \times xi}{\sum wi},$$

Where, WM = Weighted Mean; w_i = no. of respondents; and x_i = value of strongly agree to strongly disagree.

Similarly, for the preference of tree species, preference value ranking (Chhetri, 2018) was used. Mathematically, it is expressed as:

$$PV = \frac{\sum_1^5 (6 - x) f}{n},$$

Where, PV = Preference Value, x = choice of species in order (1–5), f = frequency of respondents, and n = total no. of respondents.

Results

Types of agroforestry *systems practiced in the study area*

Traditional agroforestry systems have been consistently practiced over an extended period

without significant modifications in the study area. A thorough overview of the most preferred agroforestry systems practiced by the respondents' households in the study area are presented in Figure 2 and Table 1 below:

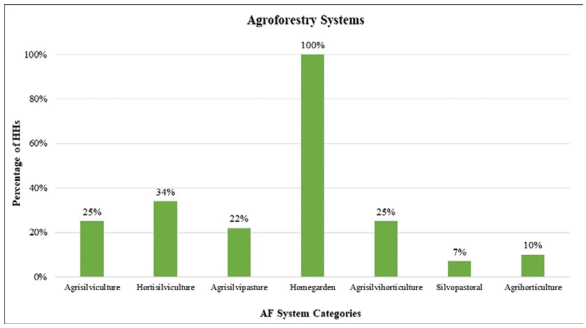

Figure 2: Agroforestry systems practiced in the study area

Table 1: Agroforestry systems practiced in the study area

Agroforestry systems	Major agroforestry practices
Agrisilviculture	• Cardamom under Alder (*Alnus nepalensis*) and Rudrakshya (*Elaeocarpus sphaericus*); • Ginger, Turmeric, Nepali broom-grass (*Thysanolaena maxima*), etc. under Chilaune (*Schima wallichii*), *A. nepalensis*, and fodder species; • Maize, millet, and seasonal vegetables under multipurpose fodder species.
Hortisilvipastoral	• Fruit, fodder, and timber species along with livestock; • Grasses planted in terrace along with fruit and fodder species.
Agrisilvipastoral	- *T. maxima* and grasses along with fodder trees and livestock.
Homegarden	• Seasonal vegetables along with fodder and fruit species.
Agrisilvihorticulture	• NTFPs along with fodder and fruit species, e.g. cardamom, cinnamon along with *E. sphaericus* and *Musa paradisiaca.*
Silvopastoral	• Fodder and grasses along with livestock.
Agrihorticulture	• Maize, millet and seasonal vegetables under mango, orange, litchi, etc. trees and banana plants; • Cardamom, ginger, turmeric, and so on under mango, orange, litchi, etc. trees.

Preference ranking of agroforestry tree species in the study area

While choosing the preferred tree species for timber, fodder, and fruits, the respondents assigned the values of 5, 4, 3, 2, and 1 as per their choices of order: I, II, III, IV, and V in their agroforestry practices. Table 2 below highlights the rankings of the ten preferred tree species for timber, in agroforestry, on the basis of their preference values. The five most preferred timber species were found to be Uttis (*Alnus nepalensis*) followed by Chilaune (*Schima wallichii*), Patle Katus (*Castanopsis hystrix*), Khote Salla (*Pinus roxburghii*), Katus (*C. tribuloides*), and Asna (*Terminalia alata*) in order of priority.

Table 2: Preference of timber in agroforestry

S. N.	Species	Local/ Common name	No. of respondents choosing the order of choices					Preference value	Ranking
			I	II	III	IV	V		
1.	*Alnus nepalensis*	Uttis/ Nepalese Alder	33	37	3	4	4	2.76	I
2.	*Schima wallichii*	Chilaune	21	31	11	8	5	2.34	II
3.	*Castanopsis hystrix*	Patle Katus/ Chinkapin	11	9	27	13	8	1.70	III
4.	*Pinus roxburghii*	Khote Salla/ Chir Pine	14	6	21	19	6	1.66	IV
5.	*C. tribuloides*	Katus/ Chinkapin	9	2	20	12	9	1.21	V
6.	*Terminalia alata*	Asna, Saj/ Indian Laurel	5	8	6	15	17	1.01	VI
7.	*Michelia champaca*	Champ/ Champak	11	3	5	13	12	0.99	VII
8.	*Rhododendron* spp.	Gurans	5	6	8	5	19	0.84	VIII
9.	*Prunus cerasoides*	Painu/ Himalayan Wild Cherry	6	5	7	7	9	0.78	IX
10.	*Melia azedarach*	Bakaino/ Chinaberry	4	4	6	9	17	0.74	X

Similarly, the ten preferred agroforestry tree species for fodder, in agroforestry, based on their preference values are presented in Table 3. Nimaro (*Ficus roxburghii*), Badhar (*Artocarpus lakoocha*), Kutmiro (*Litsea monopetala)*, Dudhilo (*F. nemoralis*), and *Kimbu* (*Morus alba*) were the most preferred five fodder tree species in order of priority.

Table 3: Preference of fodder species in agroforestry

S. N.	Species	Local/ Common name	No. of respondents choosing the order of choices					Preference value	Ranking
			I	II	III	IV	V		
1.	*Ficus roxburghii*	Nimaro	35	25	8	9	7	2.68	I
2.	*Artocarpus lakoocha*	Badhar	29	16	14	3	6	2.17	II
3.	*Litsea monopetala*	Kutmiro	20	18	19	9	5	2.08	III
4.	*F. nemoralis*	Dudhilo	9	13	13	9	13	1.38	IV
5.	*Morus alba*	Kimbu	9	10	14	11	15	1.36	V
6.	*Bauhinia purpurea*	Tanki	8	11	9	11	16	1.23	VI
7.	*Leucaena leucocephala*	Ipil-Ipil	4	7	12	20	8	1.09	VII
8.	*F. auriculata*	Khanyu	2	9	12	9	9	0.90	VIII
9.	*F. lacor*	Kabhro	1	5	9	14	13	0.77	IX
10.	*B. variegata*	Koiralo	4	3	5	12	7	0.64	X

Likewise, the ten preferred plants for fruits, in agroforestry, based on their preference values are presented in Table 4. Mandarin orange (*Citrus reticulata*) followed by Banana (*Musa paradisica*), Kagati (*Citrus limon*), Aamp (*Mangifera indica*), and Litchi (*Litchi chinensis*) were the five most desired fruit-yielding plants in order of priority.

Table 4: Preference of fruit species in agroforestry

S. N.	Species	Local/ Common name	No. of respondents choosing the order of choices					Preference value	Ranking
			I	II	III	IV	V		
1.	*Citrus reticulata*	Suntala/ Orange	31	13	15	11	6	2.31	I
2.	*Musa paradisiaca*	Kera/ Banana	19	16	14	19	13	2.08	II
3.	*C. limon*	Kagati/ Lemon	17	19	16	4	5	1.83	III
4.	*Mangifera indica*	Aamp/ Mango	12	17	15	12	13	1.74	IV
5.	*Litchi chinensis*	Litchi	9	12	16	12	11	1.45	V
6.	*Pyrus pyrifolia*	Naspati/ Asian Pear	11	12	9	14	12	1.40	VI
7.	*Actinidia* spp.	Thekifal/ Kiwifruit	7	9	12	13	6	1.15	VII
8.	*Psidium guajava*	Amba/ Guava	5	8	9	17	20	1.14	VIII
9.	*Carica papaya*	Mewa/ Papaya	5	8	10	7	9	0.91	IX
10.	*Prunus persica*	Aaru/ Peach	5	4	5	4	16	0.66	X

Perception of respondents towards agroforestry

Respondents assessed their attitude towards various aspects of agroforestry through seven statements, rating them on a Likert Scale, ranging from strongly agree to strongly disagree. The tabulated results are presented in Table 5. The "Statement 3" (Agroforestry conserves soil and water) is found to be in highest rank with the mean of 4.46. Similarly, the "Statement 7" (Agroforestry improves surrounding environment) came to be in second rank with the mean of 4.36. Likewise, the "Statement 6" had the third ranking with the mean of 4.34. The "Statement 4" (Trees in agroforestry reduces crop yield) had the lowest ranking with the mean of 2.54.

Table 5: Respondents' perception towards agroforestry

S. N.	Statement	No. of respondents choosing the order of choices					Preference value	Ranking	Attitude
		I	II	III	IV	V			
		SA	A	N	D	SD			
1.	Agroforestry is suitable for poor farmers	31	5	11	28	40	2.58	VI	Poor
2.	May not take long time to get outcome	42	12	16	22	25	3.09	IV	Good
3.	Agroforestry conserves soil and water	81	24	13	2	0	4.46	I	Excellent
4.	Trees in agroforestry reduces crop yield	30	5	21	17	43	2.54	VII	Poor
5.	Agroforestry increases the income of HH	40	10	7	25	38	2.87	V	Good
6.	Agroforestry supplies substantial need for HH consumption	81	22	7	5	3	4.34	III	Excellent
7.	Agroforestry improves surrounding environment	78	26	8	5	0	4.36	II	Excellent

Note: SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree and SD = Strongly Disagree; HH = Household.

Chi-square test

A significant association exists between economic class and the perception on "Agroforestry is suitable for poor farmers" at 5% significance level (x^2=28.62; *df*=6; & *p*=0.000004). Additionally, there is a statistically significant association between the scale of agroforestry and the perception that "Trees in agroforestry reduces crop yield" at 5% significance level (x^2=9.98; *df*=4, & p=0.04), specifically indicating that subsistence-scale agroforestry practices have a significant impact on crop-yield.

Challenges affecting agroforestry development in the study area

Respondents reported that the foremost challenge in agroforestry development in the study area was due to the lack of technical skills (86%, Figure 3). According to them, other barriers for agroforestry development in the study area included: insufficient capital (84%), lack of qualified seeds (77%), absence of irrigation facilities (72%), labor shortages (71%), and lack of accessible markets for selling products (68%).

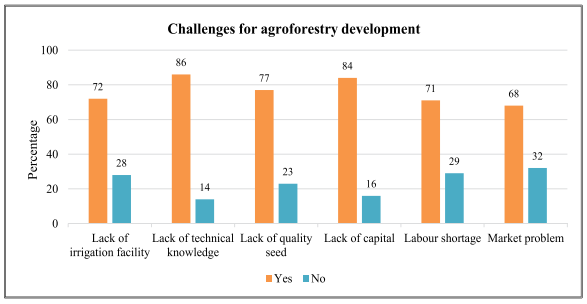

Figure 3: Challenges for agroforestry development in the study area

Discussion

Socio-economic characteristics of the respondents

The most prevalent type of farming in the study area is traditional agriculture which is centered on the production of cereals. The future of this farming, however, is in doubt given the labor shortage—a substantial portion of which is now seeking employment mainly in Gulf nations—which has significantly reduced farming activity in Nepal (Khanal, 2018). The average family size in the study area was 4.4 in 2012, which is comparable to Nepal's national average of 4.6 people (MoHP, 2012). A household's size affects the amount of labor that is available, and more working members increase the likelihood that agroforestry will be adopted, as noted by Ghadim (1999). Studies conducted in the past in western Kenya (Kindt *et al*., 2004) and Mexico (Blanckaert *et al*., 2004) further support the idea that having more family members may result in more labor being provided for home gardening, as well as a greater variety of plants and animals being grown. The average amount of agricultural land owned by each household in the study area was 18.06 Ropani (0.92 ha), which is comparable to Terhathum district's average of 19.26 Ropani (0.98 ha) (CBS, 2021).

Agroforestry systems practiced in the study area

The purpose of this study was to investigate the current agroforestry techniques used in the study area. Fifty seven percent of the local populace are mostly involved in agriculture. The study findings identified seven primary agroforestry systems operated by the local farmers, with home garden being found to be the most significant and widely used agroforestry system. This statement agrees with the findings of Amatya (1994) from the Terhathum district *kindly check*, where home garden was found to be the most popular and commonly practiced one among the other agroforestry systems practiced. However, the makeup of the home gardens varied according to the socioeconomic situations and ecological zones of the localities. Seasonal vegetables were often planted alongside horticultural crops like banana, orange, chilly, ginger, and turmeric in most household gardens in the mid-hills (Amatya *et al*., 2018). Intensive cultivation of cereals, vegetables, and spices, as well as fuel, fruit, and fodder species, was done within the home gardens in the study area. To fulfill their dietary needs and not for economic gain, these items were solely

meant for household consumption. The purpose of a home garden agroforestry system was to satisfy the owners' demands for sustenance as well as to provide aesthetic and ornamental advantages (Amatya *et al.*, 2018).

Preference of agroforestry species

Sixty agroforestry tree species were recorded from the farmer's fields. These trees ranged from fruit trees to fodder trees to fuelwood & timber trees to multipurpose trees. The trees were found to be grown on the homesteads as well as scattered on the farms. The trees were preferred for the purpose of fodder, shade, and medicinal use together with ornamental and religious values. The study concluded that the five most preferred timber species were Uttis (*A. nepalensis*) followed by Chilaune (*S. wallichii*), Patle Katus (*C. hystrix*), Khote Salla (*P. roxburghii*) and Musure Katus (*C. tribuloides*).

Farmers preferred *A. nepalensis* as it is a fast-growing plant with significant economic value. Similar to the findings of Osti (2016), Nimaro (*F. roxburghii*) was the most chosen species for fodder, followed by Badahar (*A. lakoochaa*), Kutmiro (*L. monopetala*), Dudhilo (*F. nemoralis*), and Kimbu (*M. alba*). Farmers favored these species because of their flavor, availability, and protein content. On the other hand, the five most popular fruit species were Orange (*C. reticulata*), Banana (*M. paradisica*), Lemon (*C. limon*), Mango (*M. indica*), and Litchi (*L. chinensis*), which were like those mentioned in the district profile of Terhathum (2016).

Local farmers' perception towards agroforestry practices

The five-point Likert Scale was used to measure the perceptions/attitudes of the local farmers towards the agroforestry practices in the study area. The attitudes of different levels of respondents were measured from strongly agree (1–5) to strongly disagree (1–5). Altogether, six statements were drawn from the respondents and asked about their perception. From the Likert Scale analysis, the people's perception regarding the statements: "Agroforestry is suitable for poor farmers" and "Trees in agroforestry reduces crop yield" were found to be poor. In the contrary, the respondents strongly believed that trees in agroforestry reduced crop yield. They held the opinion that agroforestry was only appropriate for the people with substantial landholding capacities since it ensured food security and required the allocation of some land for agroforestry being a long-term investment. According to them, the farmers who had access to more acreage tend to be less risk-averse and more open to experimenting with new technology. The adoption of agroforestry, as claimed by (Dhakal & Rai, 2020), was found to be influenced by the farmers' land holding capacity, and the farmers who used the conventional agroforestry practices felt that trees lowered agricultural yields.

According to (Barakoti *et al*., 1999), alley cropping of mixed tree species (*A. lakoocha, B. purpurea, Eucalyptus camaldulensis, Leucaena latisiliqua,* and *Madhuca latifolia*) in the Terai region had a favorable impact on agriculture crop production. This indicated that the farmers in the present study area were not aware that the right crop combinations might boost instead of decreasing the agricultural productivity. However, the farmers had a positive outlook on the notion that agroforestry might not take long to provide results and might boost household income, which seemed desirable. Likewise, the farmers showed excellent attitude towards the statements: "Agroforestry conserve soil & water" and "Agroforestry supplies substantial needs (food, fuel, fodder, timber, and fruits) for household consumption". Most of the farmers strongly agreed on both of these statements. The farming system in the study area was found to be traditional, and they knew the purpose of growing species on the farm. They had good indigenous knowledge about species which conserved soil and water in a proper manner. Aryal *et al*. (2019) also argued that the agroforestry practice in rural areas had mostly supposed to produce fodder and fuelwood along with agricultural crops which coincided with the findings of our study. Nevertheless, the farmers were found to be completely unaware of the multiple benefits (social, ecological, and economic) of agroforestry.

Conclusion

The adoption of agroforestry systems stands out as a promising alternative to address pressing issues such as biodiversity loss, food security, and the scarcity of forest products. Seven different agroforestry practices, mostly concentrated for subsistence purposes, were observed within the study area. A total of 63 agroforestry tree species were recorded from the study area; the most preferred ones being *A. nepalensis, F. roxbourghi, and C. reticulata* for timber, fodder, and fruits, respectively. Lack of technical knowledge among the farmers was observes as the major challenge for agroforestry development in the study area. Gaps between policy makers, researchers, extension workers, and farmers should be reduced as far as possible. Some policy reforms and institutional strengthening are necessary to promote agroforestry in the study area. Furthermore, improvisation, commercialization, and modernization are necessary in agroforestry practices for its sustainability in the study area.

Author Contribution Statement

G. Regmi: Data collection, analysis, draft writing. LBT: Conception and design, manuscript revision. U. Thapa: Conception and design, manuscript, result interpretation, manuscript revision, supervision.

Data Availability

The data used in this study are accessible upon request to the corresponding author.

Conflict of Interest

The authors declare no conflict of interest.

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Annex 1: Respondents' preferences for timber species

S. N.	Timber species		Frequency of response					Preference value
	Scientific name	**Local name**	**I**	**II**	**III**	**IV**	**V**	
1.	*Alnus nepalensis*	Uttis/ Nepalese Alder	33	37	3	4	4	2.76
2.	*Schima wallichii*	Chilaune	21	31	11	8	5	2.34
3.	*Castanopsis hystrix*	Patle Katus/ Chinkapin	11	9	27	13	8	1.70
4.	*Pinus roxburghii*	Khote Salla/ Chir Pine	14	6	21	19	6	1.66
5.	*C. tribuloides*	Katus/ Chinkapin	9	2	20	12	9	1.21
6.	*Terminalia alata*	Asna, Saj/ Indian Laurel	5	8	6	15	17	1.01
7.	*Michelia champaca*	Champ/ Champak	11	3	5	13	12	0.99
8.	*Rhododendron* spp.	Gurans	5	6	8	5	19	0.84
9.	*Prunus cerasoides*	Painu/ Himalayan Wild Cherry	6	5	7	7	9	0.78
10.	*Melia azedarach*	Bakaino/ Chinaberry	4	4	6	9	17	0.74
11.	*Albizzia lebbeck*	Kalo Siris	1	2	3	3	5	0.27
12.	*Bombax ceiba*	Simal	1	1	1	3	3	0.17
13.	*Fraximus floribunda*	Lankuri	0	2	1	2	2	0.14
14.	*Pinus wallichiana*	Gobre Salla	0	1	0	3	2	0.10
15.	*P. patula*	Patle Salla	0	1	1	2	1	0.10
16.	*Engelhardia spicata*	Mauwa	0	1	0	2	2	0.08
17.	*Eucalyptus camaldulensis*	Masala	0	1	1	1	0	0.07
18.	*Semecarpus anacardium*	Bhalayo	0	1	0	0	0	0.03
Total			**121**	**121**	**121**	**121**	**121**	-

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Annex 2: Respondents' preferences for fodder species

S. N.	Fodder species		Frequency of response					Preference value
	Scientific name	Local name	I	II	III	IV	V	
1.	*Ficus roxburghii*	Nimaro	35	25	8	9	7	2.68
2.	*Artocarpus lakoocha*	Badahar	29	16	14	3	6	2.17
3.	*Litsea monopetala*	Kutmiro	20	18	19	9	5	2.08
4.	*F. nemoralis*	Dudhilo	9	13	13	9	13	1.38
5.	*Morus alba*	Kimbu	9	10	14	11	15	1.36
6.	*Bauhinia purpurea*	Tanki	8	11	9	11	16	1.23
7.	*Leucaena leucocephala*	Ipil-Ipil	4	7	12	20	8	1.09
8.	*F. auriculata*	Khanyu	2	9	12	9	9	0.90
9.	*F. lacor*	Kabhro	1	5	9	14	13	0.77
10.	*B. variegata*	Koiralo	4	3	5	12	7	0.64
11.	*Melia azedarach*	Bakaino	0	0	3	6	3	0.20
12.	*Albizia lebbeck*	Kalo Siris	0	1	0	2	9	0.14
13.	*Brassaiopsis hainla*	Chuletro	0	0	2	3	4	0.13
14.	*Saurauia napaulensis*	Gogan	0	1	0	3	4	0.12
15.	*Prunus cerasoides*	Paiyu	0	1	1	0	2	0.07
16.	*Senegalia catechu*	Khari	0	1	0	0	0	0.03
Total			**121**	**121**	**121**	**121**	**121**	-

Annex 3: Respondents' preferences for fruit species

S. N.	Fruit species		Frequency of response					Preference value
	Scientific name	**Local name**	**I**	**II**	**III**	**IV**	**V**	
1.	*Citrus reticulata*	Suntala/ Orange	31	13	15	11	6	2.31
2.	*Musa paradisiaca*	Kera/ Banana	19	16	14	19	13	2.08
3.	*C. limon*	Kagati/ Lemon	17	19	16	4	5	1.83
4.	*Mangifera indica*	Aamp/ Mango	12	17	15	12	13	1.74
5.	*Litchi chinensis*	Litchi	9	12	16	12	11	1.45
6.	*Pyrus pyrifolia*	Naspati/ Asian Pear	11	12	9	14	12	1.40
7.	*Actinidia* spp.	Thekifal/ Kiwifruit	7	9	12	13	6	1.15
8.	*Psidium guajava*	Amba/ Guava	5	8	9	17	20	1.14
9.	*Carica papaya*	Mewa/ Papaya	5	8	10	7	9	0.91
10.	*Prunus persica*	Aaru/ Peach	5	4	5	4	16	0.66
11.	*Citrus sinensis*	Junar/ Sweet Orange	0	3	0	0	0	0.10
12.	*Persea americana*	Ghiuphal/ Avocado	0	0	0	3	3	0.07
13.	*Malus* spp.	Syau/ Apple	0	0	0	1	4	0.05
14.	*Vitis* spp.	Angur/ Grapes	0	0	0	1	0	0.02
15.	*Choerospondias axillaris*	Lapsi	0	0	0	0	3	0.02
16.	*Punica granatum*	Anar/ Pomegranate	0	0	0	1	0	0.02
17.	*Juglans* spp.	Dante Okhar	0	0	0	1	0	0.02
18.	*Diospyros kaki*	Haluwaved/ Persimmon	0	0	0	1	0	0.02
	Total		**121**	**121**	**121**	**121**	**121**	-