Research Article
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Indigenous knowledge in agroforestry promotion: a case from Bandegaun, Indrawati Rural Municipality, Sindhupalchok District, Nepal

Abstract

This research presents the role of indigenous traditional knowledge on agroforestry promotion in Bandegaun of Sindhupalchok district. Both primary and secondary information was collected through a household survey, key informant discussion, focus group discussion, direct observation, and review of agroforestry-related literature, papers, and reports.

Agriculture was the main occupation of the respondents with the majority (62%) of the total respondents having a small landholding of less than 0.75 ha. However, about 91% of the total had practiced both agri-silviculture and home gardening, 55% of the total respondents had a Silvi-pastoral system and 27% of the total respondents had a small wood lot of trees. The main indigenous traditional knowledge used by the respondents for the promotion of these agroforestry practices in their farms were knowledge on the palatability of fodder species, knowledge on timber quality, knowledge on propagation by cutting, knowledge on NTFP value, knowledge on cash earning, and knowledge on religious value of tree species.

A total of 39 tree species were included in the agroforestry practices of the study areas. Among them were 10 fodder species, 12 timber and fuelwood species, 6 NTFPs, and 11 fruit trees. Each study household on average have grown 4 fruit trees, 47 fodder tree, 19 fuelwood, and timber trees, and an NTFP in their farmlands, which have provided a great contribution to fodder, fuelwood, and timber supply for household use reported by 91% of the total respondents and some respondents (76%) had also generated income from the sale of timber, fuelwood, and NTFPs.

Finally, it is recommended that indigenous knowledge-based agroforestry awareness and training programs along with preferred seedlings of good quality should be provided to promote agroforestry in study areas.

Keywords: agroforestry, agri-silviculture, home garden, indigenous knowledge, silvi-pasture

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Introduction

Nepal is largely a mountainous and hilly country, which is geologically unstable, ecologically fragile, and environmentally vulnerable.[1–3] It is rich in traditional indigenous knowledge due to its ethnic composition and geographical diversities, where farmers practice agroforestry in their private lands for livelihood.[4] Nepal is now also considered one of the most progressive countries in the world in terms of community-based forest management.[5] Agroforestry systems with an integrated approach to sustainable land use are considered contributors to climate change adaptation and mitigation.[6–8]

Two types of agroforestry practices exist in Nepal on the same piece of land, i.e. traditional type (subsistence, low management, less care to crops and trees, etc.) and improved type (commercial, enterprise, intensive management, etc.). With the integration and management of livestock, crop, and forestry agroforestry practice has exceptionally contributed to the food security and livelihood of farmers in the mid-hills of Nepal.[9–11] Many communities use traditional indigenous knowledge specific to biodiversity conservation, agricultural & animal husbandry, NRM (Natural Resource Management), ethnobotany, etc.[12–15] The agroforestry systems supply multiple ecosystem services and are a potential contributor to improving rural livelihood and enhancing farm yield and income.[16]

Though Nepal is rich in traditional indigenous knowledge due to geographical diversity and ethnic composition and it is seen that such knowledge is passed on from one generation to another and is farmer-friendly, socially acceptable, economic, environmentally sound, and suitable for local environmental conditions.[17] There is a treasure of indigenous knowledge in Nepal regarding agroforestry practices in private lands for livelihood improvement, despite these benefits, such indigenous knowledge and practices are neglected in Nepal. Thus this study will emphasize the general objective of the study to understand the role of indigenous traditional knowledge in the promotion of agroforestry practices in study areas of the Sindhupalchok district. Also, the specific objectives of the study were: To understand the trend of existing agroforestry practices adopted in the community and their contribution to the livelihood of farmers, to quantify the contribution of indigenous/traditional knowledge in agroforestry promotion in study areas, and to identify major issues, constraints, and opportunities of agroforestry intervention in study areas.

Materials and methodology

Study area description

This study was carried out in the Indrawati Rural Municipality (between longitudes 85°35'0" -85°39'0" E to latitudes 27°45'0" - 27°49'0" N with a total area of 105km²) of Sindhupalchok district, located in

Bagmati Province of Nepal (Figure 1). This rural municipality is surrounded by Pachpokhari Gaupalika in the North, western part with Melamchi Nagarpalika, Southern with Kavrepalanchok District, East with Jugal Gaupalika. As per the 2011 population census, Indrawati Rural Municipality had a total of 28,517 population with 13,376 males and 15,141 females. Out of total wards, ward number 4 had the largest population of 3,471, while ward number 3 had the least population with 3,471. Concerning the number of households, Indrawati Rural Municipality had a total of 6,211 households. Ward number 4 had the most households with a total of 797, while ward number 8 had the least number of households with a total 361 number of households. The research was conducted in two wards of IRM i.e. ward-5 (Area: 11.43 km^2) and ward-6 (Area: 08.66 km^2) also known as Bandegaun with 955 households.

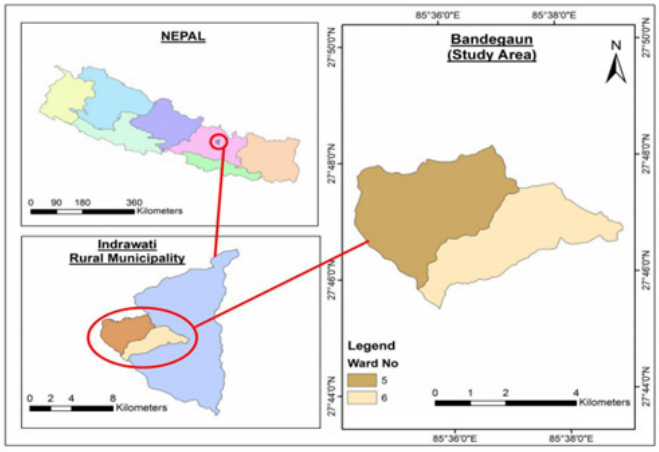

Figure 1 Study area.

Data collection

Qualitative research methods focus on discovering and understanding the experiences, perspectives, and thoughts of participants – that is qualitative research explores the meaning, and proposes, a reality.[18] Participatory Rural Appraisal (PRA) tools were used for primary data collection during the research period (Figure 2). Indigenous/Traditional knowledge practices were collected through a qualitative research approach by employing a participatory approach. Sampling frame: The households containing indigenous communities in the wards of Rural Municipal were sampling sites. Inclusion criteria: The households out of the total within the wards of the Rural Municipality which contains indigenous people involved in agroforestry were included. Sampling method: A simple random sampling from the total household was done to select the households to be surveyed because the population was homogenous. The Cochran formula was used for determining sample size.[19]

$$Sample\ Size(n) = \frac{N * z^2 * P(1-P)}{N * d^2 * + z^2 * P(1-P)}$$

The number of the household for the survey was calculated as follow:

Total number of households = 955 in Ward 5 and 728 in Ward 6

Degree of accuracy (d) =10% = 0.1

Confidence level = 95% i.e., z = 1.96

Expected incidence (p) = 50% = 0.5

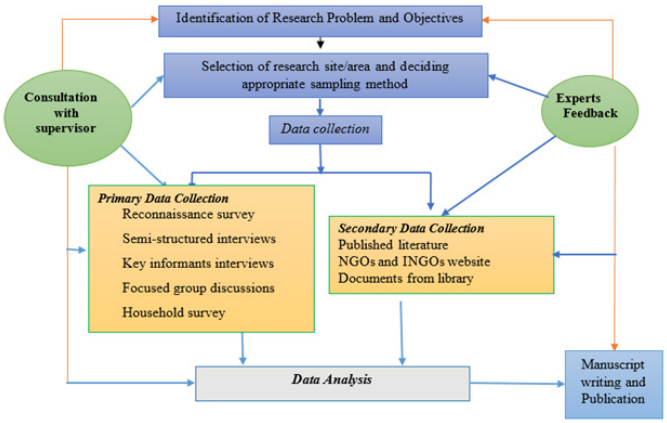

Figure 2 Framework of the study

Based on the Cochran formula, the households selected for Indrawati Rural Municipality-5 and 6 were 88 HHs and 85 HHs respectively. The inventory technique by Transect walk survey was used for species identification by their local names and parts used, based on key informant's knowledge.[20–22] The NTFPs were also identified with the help of Taxonomists and by standard literature.[23–31]

Secondary data on the socio-economic and biological status of farmers, income, and employment generated from agroforestry management activities were collected to supplement primary data. The main sources of secondary data were Rural Municipality data, farmer's records Divisional Forest Office and District Agriculture Learning Centre, District Livestock Service Office, and other line agencies supporting farmers to deal with agroforestry practices, Federation of Community Forest Users, Nepal (FECOFUN, Sindhupalchok), and local NGOs profiles and reports, and reports of other line agencies and agroforestry related published and unpublished documents and pieces of literature and journals. Furthermore, essential information was also being downloaded from related websites.

Results

The participation of men in the study was very high compared with the participation of women. The population of Brahmin (32%) in the study was higher followed by Tamang (27%), Chettri (20%), Dalit (12%), Newar (6%), and Majhi (3%), this is because Brahmins were more involved in agroforestry practices with relatively bigger landholding size compared with other ethnic groups. The landholding of farmers ranged from 0.2 ha to 2.2 ha where the majority (88.41%) of the total respondents had landholding bigger than 0.5 ha (Table 1). This result shows that more trees can be included in farming systems to improve the livelihood of farmers. Income sources of surveyed households were categorized into 5 categories which are agroforestry products, business, service or job, remittance, and wage labor. The income sources and gross income of the respondent households, were higher from agroforestry products (Figure 3). Out of the total study households, more than 91% of the total farmers had both trees in and around agricultural field systems, and home gardens, 55% of total farmers had marginal lands with Silvi-pastoral system and 27% of the total farmers had a small wood lot of trees in marginal farmlands. In agroforestry, there were multiple income sources such as income from crops such as vegetables and fruits, etc. (57%), income from livestock and their products (25%), income from timber (10%), and NTFPs (8%).

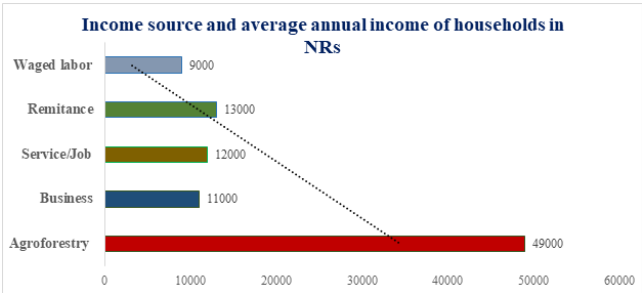

Figure 3 Income source and average annual income.

Table 1 Landholdings of the respondents

Category of land	Number of respondents
0.1-0.25 ha	5
0.3-0.5 ha	14
0.55-0.75 ha	88
0.8- 1 ha	41
1-1.5 ha	20
> 2 ha	5
Total	173

Agroforestry in study areas found traditional practices with mostly indigenous species. This practice was mostly applied in Bari land and Kharbari (marginal lands). In Bari land, most of the tree species were fodder and fuelwood species. Trees in Bari land were planted on terrace bunds, borders, and slopes. In marginal lands, timber species with local grasses and wood lots of trees were recorded. Out of the total study households, more than 91% of the total farmers had both an Agri-silviculture system (158) and a home garden (159), 55% of total farmers had marginal lands with the Silvi-pastoral system (96) and 27% of the total farmers had a small woodlot (46) of trees in marginal farmlands. Major species found in the home garden were Mango (*Mangifera indica* L.), Litchi (*Litchi chinensis*), Jackfruit (*Artocarpus heterophyllus* Lam.), Lemon (*Citrus limon* (L.) Burm. f.), Guava (*Psidium guajava* L.), Anar (*Punica granatum* L.), and Nashpati (*Pyrus communis* L.), Lapsi (*Choerospondias axillaris* (Roxb.) B.L. Burtt & A.W. Hill). Most of the species found in the home garden were fruits and some are NTFPs such as Rudraksha (*Elaeocarpus ganitrus* F.), Amala (*Phyllanthus emblica* L.), Harro (*Terminalia chebula* Retz.), Barro (*Terminalia bellerica* Roxb.), Buddhachitta (*Ziziphus budhensis* B.), and Tejpat (*Cinnamomum tamal*a (Buch.-Ham.) Th. G. G. Nees). Major species found in the Agri-silviculture system were fodder species such as Kutmiro (*Litsea polyantha* Juss.), Kimbu (*Morus alba* L.), Koiralo (*Bauhinia variegata* L.), Khanayo (*Ficus cunica* Buch.), Gayo (*Bridelia retusa* (L.) A.Juss.), Bakaino (*Melia azedarach* L.), Ipil (*Leucaena leucocephala* (Lam.)de Wit), Badahar (*Artocarpus lakoocha* Roxb.), Kabro (*Ficus lacor* Buch.-Ham.), Khasreto (*Ficus hispida* L. f.) and Chilaune (*Schima wallichii* (DC.) Korth) and Paiyu (*Prunus cerasoides* D. Don). But in Kharbari and other marginal lands with silvopastoral systems and wood lots, Chilaune (*Schima wallichii* (DC.) Korth), Champ (*Michelia champaca* L. *)*, Salla (*Pinus roxburghii* Sarg.), and other species like Sal (*Shorea robusta* Gaertn), and Bamboos (Tama bans-*Dendrocalamus hamiltonii* Nees & Arn. ex Munro, Taru bans-*Bambusa nutans* Wall. ex Munro, Bhalu bans-*Dendrocalamus hookeri* Munro*, and* Nigalo- *Himalayacalamus asper*) were found. Very few people reported that they had Pipal (*Ficus religiosa* L.), Dumri (*Ficus racemosa* L.), Bar (*Ficus benghalensis* L.), Swami (*Prosopis cineraria* (L.)Druce), Bel (*Aegle marmelos* (L.) Correa*)* in their marginal lands. The major grasses of Kharbari were Siru (*Imperata cylindrica*) and khargarss (*Eulaliopsis binata*). Very few trees were seen in Khet lands (Agricultural land) majority were chilaune (*Schima wallichii* (DC.) Korth) and Utis (*Alnus nepalensis* D.(Don)). Almost all farmers had Kutmiro (*Litsea polyantha* Juss.) and Chilaune (*Schima wallichii* (DC.) Korth) in their private lands. Nearly 37% of the total respondents had grown sal (*Shorea robusta* Gaertn.) trees in their farmlands. Paulownia (*Paulownia tomentosa* Thunb) was also introduced in study areas.

All respondents during the study were requested for their experiences with the traditional indigenous knowledge used for the promotion of agroforestry practices in farming communities. Table 2 shows their response related to indigenous knowledge which was helpful for the promotion of agroforestry practices in study areas.

Table 2 Indigenous knowledge useful for agroforestry promotion in the study areas

Indigenous Knowledge	N	%	Major and common species promoted
Knowledge of the palatability of fodder species	158	91	*Litsea polyantha* Juss, *Morus alba* L., *Ficus cunia* Buch Ham. ex Roxb., *Artocarpus lakoocha* Roxb., *Leucaena leucocephala* (Lam.) de Wit.
Knowledge of timber quality	131	75	*Schima wallichii* (DC.) Korth., *Michelia champaca* L., *Pinus roxburghii* Sarg., *Alnus nepalensis* D.(Don), *Shorea robusta* Gaertn, *Paulownia tomentosa* Thunb.
Knowledge of propagation by cutting	50	29	*Ficus infectoria* var., *Morus alba* L., *Pyrus communis* L.
Knowledge of NTFP value	44	25	*Phyllanthus emblica* L., *Terminalia chebula* Retz., *Terminalia bellerica* Roxb., *Elaeocarpus ganitrus* F., *Ziziphus budhensis* B., *Cinnamomum tamal*a (Buch.-Ham.) Th. G. G. Nees, *Dendrocalamus hamiltonii* Nees & Arn. ex Munro, *Bambusa nutans* Wall. ex Munro, *Dendrocalamus hookeri* Munro, *Himalayacalamus asper*
Knowledge of cash earning by selling timber NTFPs and fruits	88	51	*Schima wallichii* (DC.) Korth, *Alnus nepalensis* D.(Don), *Toona ciliata* M. Roem., *Paulownia tomentosa* Thunb., *Elaeocarpus ganitrus* F., *Ziziphus budhensis* B., *Citrus limon* (L.) Burm. f.
Knowledge of the religious value of trees	115	65	*Ficus religiosa* L., *Michelia champaca* L., *Prunus cerasoides* D. (Don), *Ficus racemosa* L., *Ficus benghalensis* L., *Prosopis cineraria* (L.) Druce, *Aegle marmelos* (L.) Correa, *Dendrocalamus hamiltonii* Nees & Arn. ex Munro, *Dendrocalamus hookeri* Munro, *Himalayacalamus asper*
Knowledge of village development and shade trees in public places	10	17	*Ficus racemosa* L., *Ficus benghalensis* L., *Ficus religiosa* L.

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Almost all respondents agreed that indigenous knowledge was part of their heritage and useful for species conservation and promotion in study areas. They further added that this knowledge should be the basis for local-level planning and decision-making processes and practices in agroforestry natural-resource development and management, and biodiversity conservation.

Discussion

Local agroforestry expertise has gathered over time in India, which is well recognized for its ethnoforestry methods and indigenous knowledge systems for cultivating a wide range of tree species. In recent years, efforts have been made to mobilize scientific information about agroforestry systems.[32] Home gardens, Agri-silviculture, and Silvopastoral systems were the main agroforestry practices of study areas. Home gardening is a more popular agroforestry model than other practices and is common in all localities in Nepal.[33] In total 39 tree species were included in agroforestry practices of study areas. Among them, were 10 fodder species, 12 timber and fuelwood species, 6 NTFPs, and 11 fruit trees. It is revealed that there was great diversity in species combination in study areas. Khanal[34] also recorded similar species in the mid-hills of Nepal. Each household on average has grown 71 trees in their farm lands. This figure is higher than the national data of 39 trees per household[35] and 65 trees per household in the Tanahun district of Nepal.[36] Extent of trees growing on farmland, the present study finds an average of 158 trees per hectare of farmland and 65 trees per household. Sharma et al.,[4] reported 5 different types of NTFPs are mainly extracted from the forest including plant species for Ethno botanical use, fuelwood, animal fodder, construction materials, and edible forest products in the Marwet Community, Ri-Bhoi District, Meghalaya.

The main indigenous knowledge used for the promotion of agroforestry in study areas where knowledge on the palatability of fodder species, knowledge on timber quality, knowledge on propagation by cutting, knowledge on NTFP value, knowledge on cash earning by selling timber and NTFPs and fruits, knowledge on religious value of trees, and knowledge on village development and shade tree in public places. Sharma et al.,[17] also reported that bamboo management, fodder tree plantation, and valuable NTFPs promotion are based on indigenous knowledge of farmers. The vast majority (91%) of the total respondents reported that indigenous knowledge on the palatability of fodder has contributed a lot to promoting fodder trees in agroforestry practices and about 78% of livestock feed obtained from fodder trees, grasses, and crops grown under agroforestry practices. Panging and Sharma[37] reported that 33 indigenous plant species belonging to 26 families were found to be used as traditional healthcare services by the Mising tribes of Desangmukh (GaonPanchayat), Sivasagar district, Assam. Griffin et al.,[38] also reported community forests in the hilly region of Nepal supply more than 20% of the total fodder demands of livestock enterprises, and the remaining fodder forage and feed were contributed by agroforestry practices. The application of indigenous knowledge has helped to increase the traditional agroforestry practices. It is now important to preserve this indigenous knowledge.[39] This supports agroforestry promotion. Tree species like Kutmiro (*Litsea polyantha* Juss), Chilaune (*Schima wallichii* (DC.) Korth), Sal (*Shorea robusta* Gaertn.), and Uttis (*Alnus nepalensis* D.(Don)) are found in high numbers in study areas. The Indigenous Traditional Knowledge has also played great roles in promoting NTFPs like Amala (*Phyllanthus emblica* L.), Harro (*Terminalia chebula* Retz.), Barro (*Terminalia bellerica* Roxb.), Bamboo (*Dendrocalamus hamiltonii* Nees & Arn. ex Munro, *Bambusa nutans* Wall. ex Munro, *Dendrocalamus hookeri* Munro), and Rudraksha (*Elaeocarpus ganitrus* F.).

Conclusion

Agroforestry practices in study areas were found more beneficial than mono-cropping of forestry and agriculture. Nepal has the National Agroforestry Policy 2019, which emphasizes developing agroforestry as an enterprise. Thus, there is a huge potentiality for developing agroforestry systems and improving the current practices in the study of Rural Municipality areas because there is better access to road and transport, and farmers and elected members of Rural Municipality were highly interested in promoting agroforestry plantation in their localities. Kathmandu Valley is near the study areas where agroforestry products can be sold easily if it is promoted commercially. There is local knowledge and if it is strengthened through a capacity-building awareness program with the availability of quality seedlings of desirable species, agroforestry can be promoted on a large scale throughout study areas as reported by almost all respondents.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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