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2023-01-01

Neupane, B, Gautam, N, Miya, M S, Upadhyaya, A, Timilsina, Y P, Gautam, D, Kandel, S & Dhami, B 2023, 'Socio-Economic Contribution of *Zanthoxylum armatum* (Timur) in the Rural Household Income of Myagdi District, Nepal', *Warasan Singwaetlom lae Sappayakon Tammachat*, vol. 21, no. 1, pp. 58-66. <https://doi.org/10.32526/ennrj/21/202200175>

<http://hdl.handle.net/10138/571459>
[10.32526/ennrj/21/202200175](https://doi.org/10.32526/ennrj/21/202200175)

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Socio-Economic Contribution of *Zanthoxylum armatum* (Timur) in the Rural Household Income of Myagdi District, Nepal

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ARTICLE INFO

Received: 28 Apr 2022
 Received in revised: 22 Sep 2022
 Accepted: 26 Sep 2022
 Published online: 25 Nov 2022
 DOI: 10.32526/enrj/21/202200175

Keywords:

Dependency/ Households/ Income/
 Livelihood/ Medicinal plant/
 Regression

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ABSTRACT

Non-timber forest products (NTFPs) contribute to livelihood of rural communities which is influenced by numerous socio-economic variables. This study assessed the financial contribution of *Zanthoxylum armatum* and the influence of respondents' various socio-economic characteristics on such contribution in Ghatan of Beni Municipality, Myagdi District, Nepal. For this study, we used semi-structured questionnaires to 80 purposively selected households, followed by 10 key informant interviews, four focus group discussions, and direct field observations. A Pearson correlation matrix was used to determine the dependence of several socio-economic variables on average annual household income from the sale of *Z. armatum*. The average annual income per household from the sale of *Z. armatum* was found to be the highest (494 USD) in Brahmin/Chhetri households and the lowest (372 USD) in Dalit households. Among five variables used in the regression model, only three of them: land holding size (khet), time taken to harvest (days), and wealth ranking (rich) were found positively significant with p-values of 0.042, 0.000, and 0.064 respectively. Whereas, the education status of the respondents (literate) and the main income source (agriculture) were found negatively significant with p-values of 0.046 and 0.064, respectively. Furthermore, we believe that this result will help to promote the conservation of *Z. armatum* and other valuable medicinal plants as well as their sustainable management in the study area and similar areas.

1. INTRODUCTION

Non-timber forest products (NTFPs) are those forest resources other than timbers that originate from plants, animals, and minerals; and also include forest services that can be marketed, or have scenic, social, cultural, and religious significance (Ahenkan and Boon, 2011). They comprise Medicinal and Aromatic Plants (MAPs), fruits, bamboo and rattan, wild vegetables, tannin, gums, dyes, resins, and others (Hammet, 2004). NTFPs are well-known in the local and international markets for their multiple uses, as an ingredient, for example in herbal medicines, cosmetics, tea, food, etc. (Banjade and Paudel, 2008). They are one of the possible alternatives for the enhancement of the local economy and sustainable forest management (Wiersum and Ros-Tonen, 2005;

Mukul et al., 2010; Kar and Jacobson, 2012). Additionally, NTFPs are considered important for their potential for socio-cultural value, poverty alleviation, and biodiversity conservation (Shackleton and Pullanikkatil, 2019; Reta et al., 2020; Sahoo et al., 2020).

Among the NTFPs of Nepal, *Zanthoxylum armatum* (Nepali name: Timur) is one of the prioritized species for cultivation and economic development (DPR, 2006; Phuyal et al., 2019). *Z. armatum* is a shrub or small tree which reaches up to 6 m in height. It has glabrous branches with reddish brown stipular spines, imparipinnate leaves, minute and polygamous flowers, and a small drupe, reddish, ovoid, and glandular warted fruits (enclosing single rounded and shining black seeds) (Grierson and Long,

Citation: Neupane B, Gautam N, Miya MS, Upadhyaya A, Timilsina YP, Gautam D, Kandel S, Dhami B. Socio-economic contribution of *Zanthoxylum armatum* (Timur) in the rural household income of Myagdi District, Nepal. Environ. Nat. Resour. J. 2023;21(1):58-66. (<https://doi.org/10.32526/enrj/21/202200175>)

1991; Nair and Nayar, 1997). The species grows well in moist areas with deep soils exposed to sun, degraded slopes, open pastures, wastelands, shrub lands, and forests (natural as well as secondary scrub with adequate rainfall) (Phuyal et al., 2019). According to the IUCN (2022), it is under the least concerned species category. *Z. armatum* is distributed from hot valleys of subtropical to the temperate region of several Asian countries (Nair and Nayar, 1997). In Nepal, it is distributed at an elevation range of 1,100-2,900 m from east to west (Shrestha et al., 2022).

The rural people of Nepal, as a source of their household income, have been trading *Z. armatum* since the early 80s (Manandhar, 1986; Malla et al., 1993; Kunwar et al., 2018). Due to its increasing demand and market price, rural people have started to cultivate the plant commercially (Phuyal et al., 2019). According to the DoF (2014), Nepal exports roughly 90% of *Z. armatum* in raw form to India. It is also exported to China (He et al., 2018), and a small quantity to European countries (Phuyal et al., 2019). In Nepal, many herbal and ayurvedic medicine companies use *Z. armatum* in various products. A total of 2,990.71 USD royalty was collected from the trade of 418,179 kg of *Z. armatum* from Nepal in 2015 only. It was 2,448.41 USD for 17,896 kg in 2011 and 16,709.98 USD for 240,206 kg in 2013 (DoF, 2013; DoF, 2015). The Salyan District (which includes pocket areas of *Z. armatum*) alone contributed 16,658.73 USD to 272,200 kg in 2015 (DFO, 2015). According to Lamichhane et al. (2021), it covered 28% of the total traded volume of NTFPs in the fiscal year 2019-2020 in the Jajarkot District. *Z. armatum* has played an important role in uplifting the economic status of rural communities (Phuyal et al., 2019). The species could be promoted as an alternative cash crop to increase the income of rural farmers, which may improve their livelihoods and contribute to rural poverty alleviation.

The Myagdi District of Nepal has favorable environment and climate for diverse MAPs (such as *Paris polyphylla*, *Bergenia ciliata*, *Acorus calamus*, *Asparagus racemosus*, *Swertia chirayita*, and *Nardostachys grandiflora*). Hence, Ghatan village of ward No. 9 of Beni Municipality was allocated as the *Z. armatum* pocket area of the district, and the people of this area have been regularly involved in its cultivation. But despite being selected as a pocket area, there has been limited research on the linkage of the species to the household's income. Since proper

attention has not been paid to the value and conservation of *Z. armatum* and its contribution to livelihood at a local level. This study was conducted to document the economic potential and contribution of *Z. armatum* to the household income of rural people. Furthermore, this study may contribute to the conservation of *Z. armatum* and other valuable medicinal plants, as well as their long-term management in the study area and similar other areas.

2. METHODOLOGY

2.1 Study area

The study was carried out in the Ghatan Village of Beni Municipality, Myagdi District, Nepal. The district has a total area of 2,297 km², an elevation range of 792 m to 8,167 m, and is located between 83°20'10.28'E and 28°36'10.42'N. The temperature ranges from 3°C to 36°C. Beni Municipality lies in the headquarter of the district and comprises 10 wards. Ghatan lies in ward No. 9 of the municipality, about 7 km north of Beni Bazar (district headquarter). This ward combines the former Ghatan and Toripani Villages, and its altitude ranges from 1,400 m to 2,500 m (Figure 1). According to data provided by the municipality office, the ward has 800 households and a population of 4,132 people. Due to its exceptionally suitable cultivating conditions in ward No. 9, the village of Ghatan was assigned as a pocket area for *Z. armatum* production by the Division Forest Office (DFO), Myagdi. The people of the village are involved in agriculture, cultivation of *Z. armatum*, foreign employment, government jobs, and livestock rearing. No research activities about *Z. armatum* as well as other medicinal plants have been conducted in this area to date. So, this area was selected for conducting our research after a discussion with the DFO, Myagdi.

2.2 Data collection

2.2.1 Household survey

Among the total 800 households of the study area, 80 households were purposively selected that were directly involved in cultivation and collection of *Z. armatum* for the questionnaire survey. We interviewed the selected households by using the semi-structured questionnaire (Iponga et al., 2018). The questionnaire mainly consisted of the household information related to the household and commercial uses of *Z. armatum*, whether cultivated or not in the private farmland, yearly contribution to the household income, quantities harvested or collected annually, etc. The total annual

income of each respondent's household was the variable used for determining the wealth rankings of

households. The questionnaires were pre-tested and finalized before conducting the household survey.

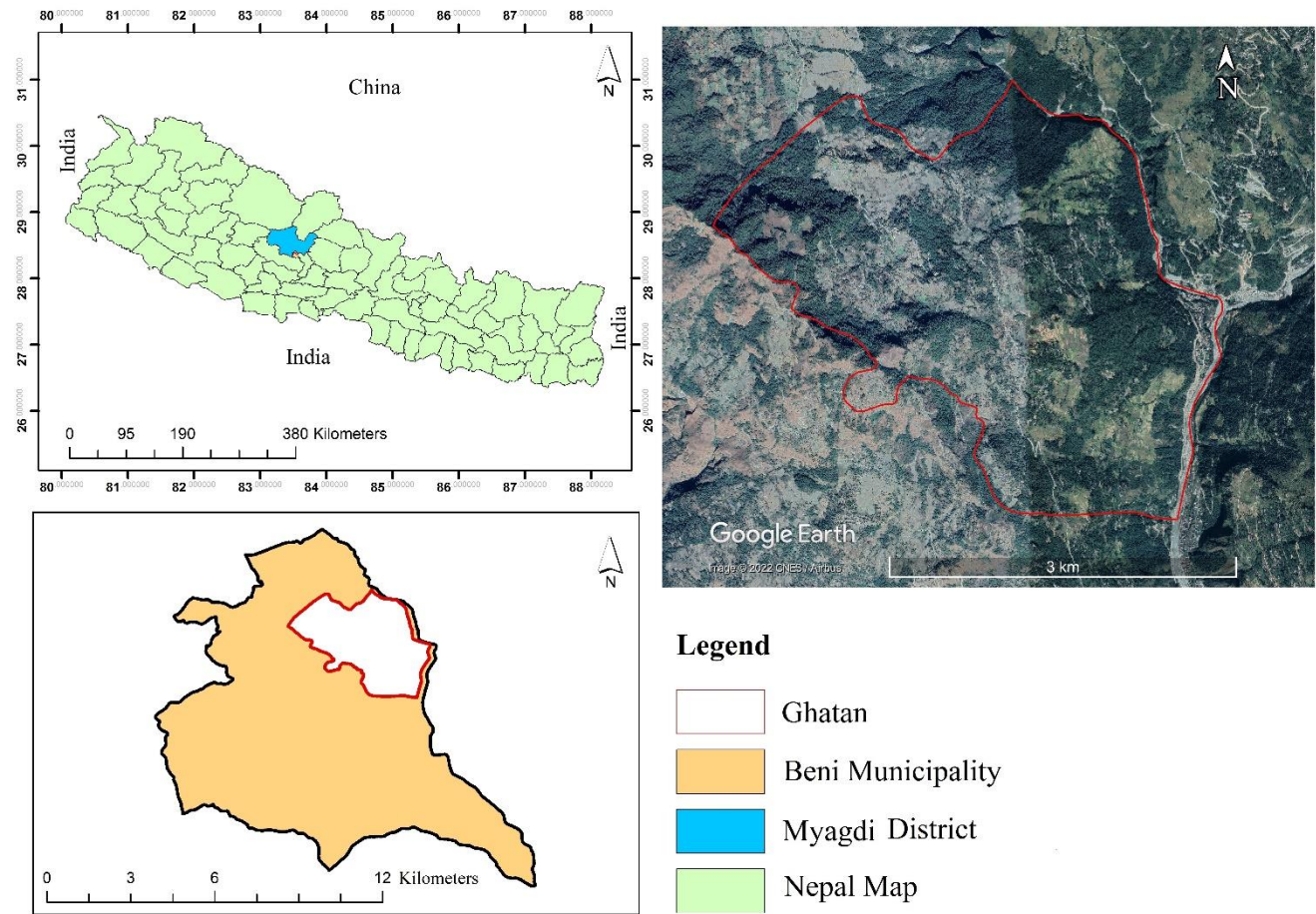


Figure 1. Map of the study area showing Ghatan Village

2.2.2 Key informant interview

A total of five key informants including local leader, teacher, local *Z. armatum* trader, elderly person, and local *Z. armatum* nursery (seedling production place) caretaker were interviewed purposively to collect information on *Z. armatum* and its status, market condition, dependency of people, mechanism involved in the sale of *Z. armatum*, threats prevalent and measures that could be taken to minimize them. Similarly, five domestic market retailers were interviewed about the collection system and market price of *Z. armatum*.

2.2.3 Focus group discussion

A total of four focus group discussion each consisting of eight to ten participants including Community Forest Users Groups (CFUGs) member, women, local NTFPs collectors, local leaders, teachers, etc. were performed to inform them about the

type of study that was being carried out there. Participatory resource mapping was carried out in the group discussions to assess the trend of availability of *Z. armatum* and distribution ranges in the study area. Various information about *Z. armatum* cultivation, such as from when they started to cultivate it commercially, average quantity of annual production, market availability etc. were also collected.

2.2.4 *Z. armatum* nurseries and plantation sites observation

After completing the household questionnaire survey, we also visited the two nurseries within the study site that were regularly producing and supplying the *Z. armatum* seedlings to the cultivators in Myagdi and its neighboring districts of Nepal. During the visit to those nurseries, we collected detailed information on how and at what season and months of the year the seedlings were produced. In addition, we observed the

plantation sites or farmlands of the local people and captured the field evidence regarding the *Z. armatum* species.

2.3 Data analysis

Qualitative data analysis was done through descriptive measures including mean, percentage, and pie chart in Microsoft Excel 10. Pearson correlation matrix was used on SPSS 22 to identify whether the various pre-determined socio-economic variables of respondents: caste, gender, literacy, wealth ranking, family size, land holding size, and distance from the forest are dependent or not with the average annual household income from the sale of *Z. armatum*. To classify respondents into various wealth ranking classes, three wealth ranking classes were selected: rich, middle-class, and poor households. The households having a total annual income less than 1,709.53 USD were considered poor households, households having a total annual income between 1,709.53 to 4,273.82 USD were considered as middle-class households, and households having a total annual income more than 4,273.82 USD were considered rich households. [Gauli and Hauser \(2011\)](#) had previously applied a similar technique to classify wealth ranking based on their field scenario. We also applied this ranking method based on field observation and consultation with DFO officials. All these socio-economic variables of respondents were considered independent variables and the average annual income from the sale of *Z. armatum* was a dependent variable. With the help of the Pearson correlation matrix, we were able to determine which independent variables

played a significant role with our pre-defined dependent variable.

3. RESULTS

3.1 Socio-economic characteristics of the respondents

Out of the total respondents, 66% (n=53) were male and 34% (n=27) were female. Regarding the education level of the respondents, 75% were literate and 25% were illiterate. Among them, 39% have completed their primary level education, 24% have completed secondary level, and only 12% have completed higher secondary level. Concerning to caste or ethnic groups, 69% were Brahmin/Chhetri, followed by 20% Dalit and 11% indigenous. Among the total respondents, 37% (n=30) were from the rich class, 44% (n=35) were from the middle class and 19% (n=15) were from households that fell under the poor class. The result shows that the number of respondents was highest from the middle class ([Table 1](#)).

3.2 Sources of income

Among the respondents, cultivation and collection of *Z. armatum* was the chief source of household income for 37% of the respondents. While, 32% of the respondents were involved in other income sources such as private jobs, business, and government jobs for the primary source of income, though they were cultivating *Z. armatum* in small quantity. In addition, 31% of the respondents were engaged in agriculture and livestock husbandry primarily, being less involved in *Z. armatum* cultivation ([Figure 2](#)).

Table 1. Socio-economic characteristics of the respondents

Variable	Category	Frequency	Percentage (%)
Sex	Male	53	66
	Female	27	34
Education	Illiterate	20	25
	Literate	60	75
Ethnic group	Brahmin/Chhetri	55	69
	Indigenous	9	11
	Dalit	16	20
Wealth ranking	Poor	15	19
	Middle	35	44
	Rich	30	37
Occupation	Farmer	51	64
	Non farmer	29	36

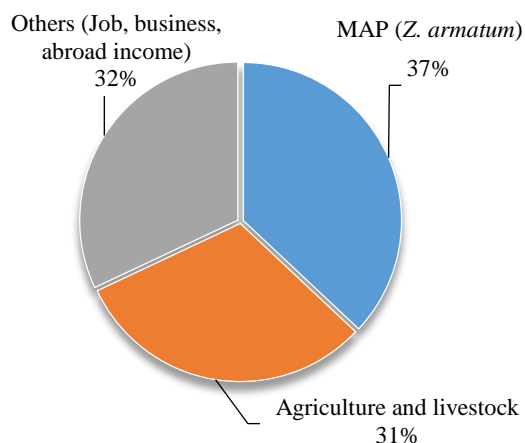


Figure 2. Sources of income of respondents

3.3 Contribution of *Z. armatum* for commercial and household use

Among the various medicinal plants found in the study area, only *Z. armatum* was cultivated and collected from the forest and private lands for commercial use as well as household use. About 90% of the collected *Z. armatum* was used for commercial purposes and 10% for household use. But some other high-value NTFPs such as *Paris polyphylla*, *Bergenia ciliata*, *Acorus calamus*, *Asparagus racemosus*, *Swertia chirayita*, and *Nardostachys grandiflora* were collected from the forest in very few amounts and for household use only.

3.4 Contribution with respect to education status

With concern to respondents’ education status, the mean annual income from the sale of *Z. armatum* was slightly higher in illiterate households with an average income of 477 USD per household followed by literate households with an average income of 461 USD per household (Table 2).

3.5 Contribution with respect to caste/ethnicity

Regarding respondents’ caste/ethnicity, the mean annual income from the sale of *Z. armatum* was highest in Brahmin/Chhetri households, with an average annual income of 494 USD per household. This was followed by indigenous households with an average annual income of 460 USD, showing that *Z. armatum*’s sales made income to all caste/ethnicity homes. Dalit households showed the lowest average yearly income, with 372 USD (Table 3).

3.6 Contribution with respect to wealth class

For the respondents’ wealth ranking category, the mean annual income from the sale of *Z. armatum* was highest in the rich households with an average annual income of 613 USD, indicating that all the households of this class were making income from the sale of *Z. armatum*. Middle-class households with an average annual income of 460 USD followed this. The mean annual income was lowest in poor households with an average annual income of 184 USD (Table 4).

Table 2. Education-wise average annual contribution of *Z. armatum* (USD)

	Education category	Mean	Std. deviation	Std. error mean
Average annual household income from sale of <i>Z. armatum</i>	Illiterate	477	341	76
	Literate	461	504	65

Table 3. Caste-wise average annual contribution of *Z. armatum* (USD)

	Caste	Mean	Std. deviation	Std. error	Minimum	Maximum
Average annual household income from sale of <i>Z. armatum</i>	Dalit	372	3,323	81	0	1,043
	Indigenous	460	190	63	174	696
	Brahmin/Chhetri	494	530	71	0	3,478
	Total	466	467	52	0	3,478

Table 4. Wealth ranking-wise average annual contribution of *Z. armatum* (USD)

	Wealth rank	Mean	Std. deviation	Std. error	Minimum	Maximum
Average annual household income from sale of <i>Z. armatum</i>	Poor	184	146	38	0	391
	Middle	460	336	57	0	1,304
	Rich	613	622	114	70	3,478
	Total	465	467	52	0	3,478

3.7 Socio-economic variables influencing the household income from *Z. armatum*

Multiple linear regressions indicated that the three variables: land holding size (khet), time taken to harvest (days), and wealth ranking (rich) were positively significant with average annual household revenue from the sale of *Z. armatum* with p-values of

0.042, 0.000, and 0.064 respectively. While two variables: education status of respondents (literate) and main income source (agriculture) were negatively significant with average annual income from the sale of *Z. armatum* with p-values 0.046 and 0.064, respectively (Table 5). The correlation matrix is shown in Table 6.

Table 5. Factors influencing the annual income from sale of *Z. armatum*

Independent variables	Coefficients		T	Sig.
	B	Std. error		
Constant	9.935	0.449	22.121	0.000
ln khet1	0.258	0.124	2.075	0.042**
ln bari1	-0.195	0.129	-1.505	0.138
Time taken to harvest (days)	0.037	0.005	7.063	0.000***
Ln family size (no.)	0.040	0.154	0.259	0.797
Sex (Dummy, Male=1)	0.040	0.128	0.315	0.754
Education (Dummy, Literate=1)	-0.260	0.127	-2.040	0.046**
Ethnicity (Dummy, Non- Dalit=1)	-0.033	0.166	-0.198	0.844
Wealth (Dummy, Rich=1)	0.339	0.179	1.890	0.064*
Main income (Dummy, agriculture=1)	-0.235	0.125	-1.883	0.064*

*Significant at p<0.1, **significant at p<0.05, ***significant at p<0.01; Over all model significant, F=10.216 (p<0.01); Adjusted Coefficient of determination (R²) =0.54; Results of social data has level of significant up to 10%

Table 6. Correlations matrix

		Age of respondent	Total annual income of respondent	Average annual household income from sale of <i>Z. armatum</i>	Family size of respondent	Land holding of respondent -Bari	Land holding of respondent-khet	Distance from the forest
Age of respondent	Pearson	1.000	0.112	0.163	0.531**	0.146	0.233*	0.088
	Correlation p-value		0.325	0.148	0.000	0.195	0.038	0.440
Total annual income of respondent	Pearson		1.000	0.477**	0.383**	0.342**	0.256**	0.146
	Correlation p-value			0.000	0.000	0.002	0.022	0.197
Average annual household income from sale of <i>Z. armatum</i>	Pearson			1.000	0.210	0.373**	0.038	0.437**
	Correlation p-value				0.062	0.001	0.738	0.000
Family size of respondent	Pearson				1.000	0.261*	0.280*	0.001
	Correlation p-value					0.019	0.012	0.994
Land holding of respondent-Bari	Pearson					1.000	0.623**	0.069
	Correlation p-value						0.000	0.541
Land holding of respondent-khet	Pearson						1.000	-0.089
	Correlation p-value							0.432
Distance from the forest	Pearson							1.000
	Correlation p-value							

** : Correlation is significant at the 0.01 level (2-tailed)

* : Correlation is significant at the 0.05 level (2-tailed)

4. DISCUSSION

Only *Z. armatum* was cultivated and collected for commercial purposes among the various medicinal plants found in this area, while the rest were only used for household purposes. Figure 2 shows how dependency on agriculture and livestock husbandry has been reduced since more household members have been involved in the production of *Z. armatum* and other jobs, including foreign employment. The culture of collection and sale of *Z. armatum* in Nepal has a long history and can be dated back to the early 80s when the trade started with India. Before trading in India, local people utilized it for their household uses only (Malla et al., 1993). The NTFPs collection predominately for household consumption (43% out of collected NTFPs) was also reported by Maharjan and Dangal (2020) in their study in Dolakha District. Similarly, the majority of the NTFPs were used for household purposes (55%) in the study in Bajhang District (Singh et al., 2021).

The households earned an average of 465 USD annually from the sale of *Z. armatum*, which comprises about 8% of the total annual income of households. This demonstrates that it has played an important role in the rural economy and contributed to the household income of the locals in the study area. Shrestha et al. (2020) revealed that the local people of Nepal draw between 15-50% of their household income from the NTFP sub-sector. Likewise, in the Baitadi District of Nepal, MAPs, including *Z. armatum*, have contributed to up to 9.5% of the total annual household income (Pyakurel et al., 2017). In Darchula, Baitadi, and Dadeldhura Districts, the contribution from the NTFPs sub-sector was 20% of the annual household income (Kunwar et al., 2013) and Olsen and Larsen (2003) estimated 12% in the higher region of Nepal. All of these studies include the contribution made by various NTFPs, but we only include the contribution made by *Z. armatum*. That's why the average annual household contribution in our study is slightly less than in those studies. In the past, rural people started to trade different medicinal plants, including *Z. armatum*, as a source of income (Manandhar, 1986; Kunwar et al., 2018). Similarly, according to the focus group discussion, commercial cultivation of *Z. armatum* in Ghatan village started in 2011 after the implementation of one village, one product program for *Z. armatum* cultivation supported by the Federation of Nepal Chambers of Commerce and Industry and DFO of Myagdi.

The participation of the poor in the collection of *Z. armatum* was lower than that of the middle and upper classes. It can be further clarified that the average annual income from the sale of *Z. armatum* for poor households is USD 184, whereas rich households receive 613 USD annually. Gauli and Hauser (2011) also found that the economic contribution of NTFPs is higher in rich households than in poor households. Though rich people were not directly involved in the collection of *Z. armatum*, they did work as middlemen and/or intermediate contractors and thus earned more money than the poor and middle-class people. Another important reason for rich people contributing more than poor people is that most of the *Z. armatum* collection was done on their private land rather than in community forests (CF), and rich people have larger land holding sizes (11.62 Ropani land per household) than poor people (4.2 Ropani land per household). Likewise, while analyzing the financial contribution of *Z. armatum* among literate and illiterate households, the contribution among illiterate people was found greater than that of literate households. This is because most literate people were found to be involved in various other professions such as government jobs, and business rather than the cultivation and collection of *Z. armatum*. Our finding was quite similar to the result shown by Piya et al. (2011).

While analyzing socio-economic factors affecting the income earned from the sale of *Z. armatum* by a household using a multiple linear regression model, we found that land holding size (khet), time taken to harvest (days), and wealth ranking (rich) were positively significant in the average annual household income respectively. Whereas, the education status of respondents (literate) and main income source (agriculture) were negatively significant. This result shows that people having greater land holding size are getting more income from the sale of *Z. armatum* than people having less land holding size. Other research studies have also demonstrated that dependence on NTFPs is influenced by various socioeconomic characteristics, including distance from the market (Lacuna-Richman, 2004), income (Heubes et al., 2012), and possession of livestock and age of household head (Melaku et al., 2014). The other factors that also influence household dependence include labor availability, involvement in non-agriculture activities (which are similar to our findings), and incorporation into markets (Hasan et al., 2013).

5. CONCLUSION

The study showed that the financial contribution of *Z. armatum* was greatest in higher castes and in wealthy households. The wealth ranking of respondents, land holding size, and time taken to harvest *Z. armatum* were positively significant in the total annual income from its sale, whereas education status and main income source were negatively significant. The study concludes that *Z. armatum* contributes significantly to household income and that it varies significantly across households depending on the influence of various socioeconomic factors. This finding of the study will be useful for the long-term conservation and management of *Z. armatum* in the study area and similar other areas, focusing on its socio-economic contribution. *Z. armatum* should be prioritized for commercial cultivation and collection on community land, as opposed to cultivation on rich households' private land. The responsible authorities should provide technical and financial assistance to cultivators. Additionally, lower caste people should also be given more priority in *Z. armatum* cultivation in the study area.

ACKNOWLEDGEMENTS

We would like to acknowledge the University Grant Commission (UGC), Nepal for funding this research under the UGC's Small Research Development and Innovation Grant. We are grateful to Mr. Saroj Rijal and his team for assisting us during our field work, as well as Mr. Yiba Giri, a *Z. armatum* cultivator and farmer, for his continuous support and the field assistants for their help during the field survey. Likewise, we are thankful to the Division Forest Office, Myagdi team for their continuous motivation and support during our research. Similarly, we would like to express our heartfelt gratitude to the respondents for their time and hospitality in providing the information.

REFERENCES

- Ahenkan A, Boon E. Commercialization of non-timber forest products in Ghana: Processing, packaging and marketing. *Food Agriculture and Environment* 2011;8:962-9.
- Banjade MR, Paudel NS. Economic potential of non-timber forest products in Nepal: Myth or reality. *Journal of forest and Livelihood* 2008;7(1):36-48.
- Department of Forest (DoF). Hamro Ban, Annual Report of the Department of Forests for FY 2012/13. Kathmandu: Department of Forest; 2013.
- Department of Forest (DoF). Hamro Ban, Annual Report of the Department of Forests for FY 2013/14. Kathmandu: Department of Forest; 2014.
- Department of Forest (DoF). Hamro Ban, Annual Report of the Department of Forests for FY 2014/15. Kathmandu: Department of Forest; 2015.
- Department of Plant Resources (DPR). NTFPs Prioritized for Economic Development of Nepal (Nepal Ko Aarthik Bikaska Lagi Prathamikta Prapta Jadibutiharu). Kathmandu, Nepal: Department of Plant Resources; 2006.
- District Forest Office (DFO). Annual Progress Report. Salyan, Khalanga: District Forest Office; 2015.
- Gauli K, Hauser M. Commercial management of non-timber forest products in Nepal's community forest user's groups: Who benefits? *International Forestry Review* 2011;13(1):35-45.
- Grierson AJC, Long DG. *Flora of Bhutan, Volume 2, Part 1*. Edinburgh: Royal Botanic Garden; 1991.
- Hammet AL. Non-timber forest products: Profits and panacea. In: *A Synthesis Report on the Current Status of NTFPs in the Terai Region of Nepal*. Kathmandu, Nepal: Ministry of Forests and Soil Conservation; 2004.
- Hasan MK, Gatto P, Jha PK. Traditional uses of wild medicinal plants and their management practices in Nepal: A study in Makawanpur District. *International Journal of Medicinal and Aromatic Plants* 2013;3(1):102-12.
- He J, Yang B, Dong M, Wang Y. Crossing the roof of the world: Trade in medicinal plants from Nepal to China. *Journal of Ethnopharmacology* 2018;224:100-10.
- Heubes J, Heubach K, Schmidt M, Wittig R, Zizka G, Nuppenau EA, et al. Impact of future climate and land use change on non-timber forest product provision in Benin, West Africa: Linking niche-based modeling with ecosystem service values. *Economic Botany* 2012;66(4):383-97.
- Iponga DM, Mikolo-Yobo C, Lescuyer G, Assoumou FM, Levang P, Tieguhong JC, et al. The contribution of NTFP-gathering to rural people's livelihoods around two timber concessions in Gabon. *Agroforestry Systems* 2018;92(1):157-68.
- International Union for Conservation of Nature (IUCN). The IUCN red list of threatened species. Version 2022-1 [Internet]. 2022 [cited 2022 Oct 22]. Available from: <https://www.iucnredlist.org>.
- Kar SP, Jacobson MG. NTFP income contribution to household economy and related socioeconomic factors: Lessons from Bangladesh. *Forest Policy and Economics* 2012;14(1):136-42.
- Kunwar RM, Mahat L, Acharya RP, Bussmann RW. Medicinal plants, traditional medicine, markets and management in far-west Nepal. *Journal of Ethnobiology and Ethnomedicine* 2013;9:Article No. 24.
- Kunwar RM, Fadiman M, Cameron M, Bussmann RW, Thapa-Magar KB, Rimal B, et al. Cross-cultural comparison of plant use knowledge in Baitadi and Darchula Districts, Nepal Himalaya. *Journal of Ethnobiology and Ethnomedicine* 2018;14:Article No. 40.
- Lacuna-Richman C. Subsistence strategies of an indigenous minority in the Philippines: Nonwood forest product use by the Tagbanua of Narra, Palawan. *Economic Botany* 2004; 58:266-85.
- Lamichhane R, Gautam D, Miya MS, Chhetri HB, Timilsina S. Role of non-timber forest products in national economy: A case of Jajarkot District, Nepal. *Grassroots Journal of Natural Resources* 2021;4(1):94-105.
- Malla SB, Shakya PR, Rajbhandari KR, Bhattarai NK, Subedi MN. *Minor Forest Products of Nepal: General Status and Trade*. Kathmandu: Forest Resource Information System Project; 1993.

- Maharjan S, Dangal MR. Economic contribution of non-timber forest products in rural livelihood of Dolakha, Nepal. *Open Journal for Research in Economics* 2020;3(2):55-66.
- Manandhar NP. Ethnobotany of Jumla District, Nepal. *International Journal of Crude Drug Research* 1986;24(2):81-9.
- Melaku E, Ewnetu Z, Teketay D. Non-timber forest products and household incomes in Bonga forest area, southwestern Ethiopia. *Journal of Forestry Research* 2014;25:215-23.
- Mukul SA, Uddin MB, Manzoor RAZM, Fox J. Integrating livelihoods and conservation in protected areas: Understanding the role and stakeholder views on prospects for nontimber forest products: A Bangladesh case study. *International Journal of Sustainable Development and World Ecology* 2010;17(2):180-8.
- Nair KN, Nayar MP. Rutaceae. In: Hajra PK, Nair VJ, Daniel P, editors. *Flora of India (Malpighiaceae - Dichapetalaceae) Vol. 4*. Calcutta, India: Botanical Survey of India; 1997. p. 259-408.
- Olsen CS, Larsen HO. Alpine medicinal plant trade and Himalayan mountain livelihood strategies. *Geographical Journal* 2003;169:243-54.
- Phuyal N, Jha PK, Raturi PP, Rajbhandary S. *Zanthoxylum armatum* DC.: Current knowledge, gaps and opportunities in Nepal. *Journal of Ethnopharmacology* 2019;229:326-41.
- Piya L, Maharjan KL, Joshi NP, Dangol DR. Collection and marketing of non-timber forest products by Chepang Community in Nepal. *Journal of Agriculture and Environment* 2011;12:10-21.
- Pyakurel D, Sharma IB, Ghimire SK. Trade and conservation of medicinal and aromatic plants in western Nepal. *Botanica Orientalis: Journal of Plant Science* 2017;11:27-37.
- Reta Z, Adgo Y, Girum T, Mekonnen N. Assessment of contribution of non-timber forest products in the socioeconomic status of peoples in Eastern Ethiopia. *Open Access Journal of Biogenetic Science and Research* 2020;4(4):1-8.
- Sahoo SR, Panda NK, Subudhi SN, Das HK. Contribution of non-timber forest products (NTFPs) in the socio-economic development of forest dwellers in Odisha. *Journal of Pharmacognosy and Phytochemistry* 2020;9(4):81-5.
- Shackleton CM, Pullanikkatil D. Considering the links between non-timber forest products and poverty alleviation. In: Pullanikkatil D, Shackleton C, editors. *Poverty Reduction Through Non-Timber Forest Products, Sustainable Development Goals Series*. Springer Cham; 2019. p. 15-28.
- Shrestha KK, Bhandari P, Bhattarai S. *Plants of Nepal (Gymnosperms and Angiosperms)*. Kathmandu, Nepal: Heritage Publishers and Distributors Pvt. Ltd; 2022.
- Shrestha S, Shrestha J, Shah KK. Non-timber forest products and their role in the livelihoods of people of Nepal: A critical review. *Grassroots Journal of Natural Resources* 2020; 3(2):42-56.
- Singh J, Miya MS, Adhikari A, Das LK. Potentiality of income generation through non-timber forest products: A case study from the Sallipatan Trishakti Community Forest, Bajhang district, Nepal. *International Research Journal of MMC* 2021;2(2):1-15.
- Wiersum KF, Ros-Tonen MAF. *The Role of Forests in Poverty Alleviation: Dealing with Multiple Millennium Development Goals*. Wageningen UR: North-South Policy Brief; 2005.