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Research Article

Harvesting and marketing potentiality of Chiraito *(Swertia chirayita)*, Amriso *(Thysanolaena maxima)*, and Timur *(Zanthoxylum armatum)* in western mid hills of Nepal

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ABSTRACT

This study carried out in April, 2016 assesses the market potentiality and different factors affecting the collection of non-timber forest products (NTFPs), mainly Chiraito (*Swertia chirayita*), Amriso (*Thysanolaena maxima*), and Timur (*Zanthoxylum armatum*) (CAT) found in the Panchase region of western Nepal. Three communities Bagefadke (Syangja), Ramjha (Parbat), and Bhadaure Tamagi (Kaski) of Panchase region were selected as the study site. Data were collected using a structured schedule interview with 105 randomly selected households (HHs) and included information collected from key informants (KIIs) and focus group discussions (FGDs). Collection of CAT varied across the HHs; on average they collected 0.38 kg of Chiraito, 7.28 Bhari Amriso, and 0.62 kg Timur seasonally. The findings revealed that age, large family size, illiterate peoples, and near users were more likely to collect CAT. Similarly, sex was found to significantly reduce the activity of collection and trade of NTFPs. Walking distance to the resource significantly increases the favor of collection indicating that the valuable CAT collected are from near locations. While the positive relationship between family size, distance from home, and collection ($p<0.1$) implies that large family size and users near to the forest are more likely to collect CAT than other variables. Market potentiality of CAT is seen high (55%, 67%, and 68%, respectively), Amriso and Timur have seen more market potentiality compared to Chiraito. It may be due to the high availability of Amriso and Timur in the area.

Keywords: Non Timber Forest Products, Utilization, Market, Village, Nepal

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INTRODUCTION

Non-Timber Forest Products (NTFPs) have an important role in supporting rural livelihoods, poverty reduction, and economic growth of rural communities worldwide. In Nepal, Non timber forest products (NTFPs) help to sustain the livelihood of about 80% of the rural people (Shrestha *et al.*, 2020). NTFPs contribute to five percent national GDP out of the 15% contribution from the forestry sector (Pyakurel & Baniya, 2011). Reta *et al.* (2020) and Shrestha *et al.* (2020) stated that Nepal alone has traded about 150 NTFPs on the international market. Every year, thousands of tons of NTFPs are collected in the Middle Hills of Nepal and traded with India, including Timur (*Zanthoxylum armatum*) and Chiraito *(Swertia chirayita)* (Malla *et al.*, 1993; Sinha *et al.*, 1993; Edwards, 1996; Den Hertog, 1997;

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Olsen 1997). Annually, Nepal has been able to earn US$ 8.6 million per year by trading about 10,000-15,000 tons of NTFPs (>100 species) with India and other countries (Edward, 1996). Using the UN COMTRADE data, Ghimire *et al.* (2015) estimated the export of 10770 tons of MAPs worth US$ 60.09 million from Nepal in 2014.

NTFPs can also create job opportunities and income generating activities for the local people resulting in the reduction of youth migration for jobs (Karki & Bhattarai, 2012). In the year 2021, Nepal has exported 248,600 kg of Amriso worth of NRs 6,137,704 to Bangladesh (GON, 2021). Chiraito (*Swertia chirayita*), Amriso (*Thysanolaena maxima),* and Timur (*Zanthoxylum armatum*) are the three selected NTFPs in this research (referred to as CAT hereafter). Two species among CAT (Chiraito and Timur) have also been listed under 12 Commercially Cultivatable NTFPs by Government of Nepal for livelihood upliftment purpose of rural people in Nepal (MFSC, 2012). Master Plan for Forestry Sector (1988) has given priority to revenue generation through NTFPs. The Forest Sector Policy (2015) also focuses on NTFPs to contribute to the rural livelihood and emphasized their research and study (MFSC, 2015).

Previous researches suggest that number of internal factors that vary depending on the economic and cultural contexts have been identified as having an impact on the usage of NTFPs for household use in developing countries (Suleiman *et al*., 2017). The size of households dependent on NTFP is the most common factor. For instance, larger families require additional forest resources than smaller families, so they gather more NTFPs to meet the need, leading to higher income from NTFPs (Adhikari *et al*., 2004; Appiah *et al*., 2009; Sunderland *et al*., 2014). The age, gender, and makeup of the household are more significant factors than the number of family members. According to studies, young individuals may be more dependent on NTFPs than senior people because collecting NTFPs requires a lot of labor and is hazardous work (Cavendish, 2000; Mamo *et al*., 2007; McElwee, 2008). Additionally, the presence of more females in a home indicates a greater reliance on NTFPs because they are more likely to be involved in NTFP collection (Heltberg *et al*., 2000; Adhikari *et al*., 2004; Adhikari, 2005; Paumgarten and Shackleton, 2011; Dash *et al*., 2016; Mushi *et al*., 2020). Also, compared to wealthy or prosperous households, poor households generally show a stronger dependence on NTFPs (Cavendish, 2000; Escobal & Aldana, 2003; Paumgarten & Shackleton, 2011; Nerfa *et al*., 2020). Furthermore, external factors, including living closer to forests and having easier access to markets, frequently accelerate NTFP extraction and encourage people to sell NTFPs in their local markets in order to increase their income (Suleiman *et al*., 2017; Mushi *et al*., 2020; Bista & Webb, 2006).

The western mid hill region of Nepal is home to high-value non-timber forest products (NTFPs) such as Chiraito (*Swertia chirayita*), Amriso (*Thysanolaena maxima*), and Timur (*Zanthoxylum armatum*), which have significant medicinal, economic, and ecological importance (Adhikari *et al*., 2004; Bista & Webb, 2006). Despite their potential, the exploitation of these resources is hindered by unsustainable harvesting practices, inefficient market structures, and limited knowledge of sustainable utilization, leading to overharvesting and reduced economic returns for local communities (Adhikari *et al*., 2004; Frey *et al*., 2019). There are very limited studies in Nepal concerning the market potential and factors affecting the collection of NTFPs (Adhikari *et al*., 2004; Bista & Webb, 2006; Frey *et al*., 2019). In this context, this study critically examines the harvesting practices, market opportunities for these species, aiming to provide insights for sustainable resource management and enhanced livelihood outcomes in the region.

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METHODOLOGY

Study Area

This study was conducted in Panchase Protected Forest, located at the junction of Kaski, Parbat, and Syangja districts of western Nepal, comprising 57.76 sq. km. the forest area was decleared as protected forest in 2012 considering its significance for biodiversity, culture and ecotourism. It represents a vital Middle Mountain ecological zone, serving as a biodiversity-rich corridor linking the lowlands of Chitwan–Nawalparasi with the Annapurna Himalaya range. With altitudes ranging from 900 to 2,517 meters, the area features tropical to temperate vegetation and includes the culturally significant Panchase Lake at 2,250 meters. The research was conducted on three sites viz, Bhadaure Tamagi, Bagefadke, and Ramja villages of Kaski, Syangja and Parbat district of Nepal respectively (Figure 1).

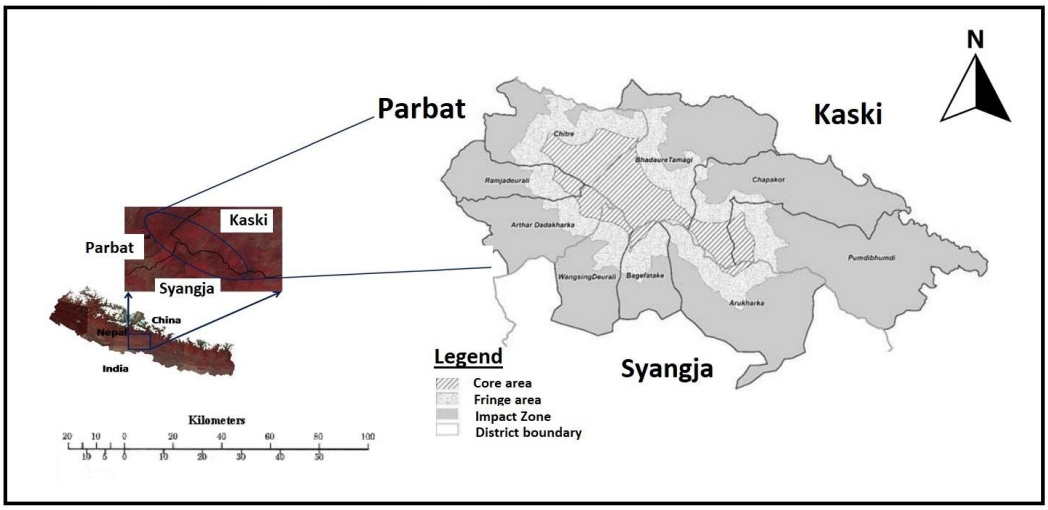

Figure 1: Map of the Study Area

Sampling and Data Collection

These sites were purposively selected as they are the key areas for producing CAT. A total of 105 households (HHs), 35 from each site were selected randomly for household survey by using pretested questionnaire. Information was further collected from Key Informant Interview (KII) and Focus Group Discussion (FGD). Secondary data was obtained from scientific publications and publications from the related offices.

Statistical analysis

The factors affecting the collection of CAT were analyzed using the logistic regression model. The probability of the respondents to whether collect and trade CAT or not depends on a set of variables X such that,

$$\text{Prob}\,(Y=1) = f\,(\beta x) \text{ ----------1}$$

$$\text{Prob}\,(Y=0) = 1-(\beta x) \text{ ----------2}$$

Using the logistic distribution, we have,

$$\text{Prob}\,(Y=1) = e^{\beta x} / 1+e^{\beta x} \text{----------3}$$

$$= A\,(\beta x) \text{ ----------4}$$

Where A is the logistic cumulative distribution function

Then the probability model of the regression:

$$E(Y/Xi) = 0[1-F\,(\beta x)] +1[f\,(\beta x)] = F\,(\beta x) \text{ ---------- 5}$$

Where Xi is defined as the set of variables including:

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$$Y=\beta_o+\beta_1X_1+\beta_2X_2+\beta_3X_3+\text{----------}+\beta_7X_7$$

Where,

Y= dependent variable taking values of 0 and 1,
1= if the respondents collect /sell NTFPS and
0 = otherwise; and

The X variables are:

X_1 = age; X_2 = gender (1 = M, 0 = F); X_3 = Marital status (1= married, 0= otherwise); X_4 =family size; X_5 = Education; X_6 = Distance of NTFPs from home

RESULTS

Collection and Use of CAT

Out of the total HHs interviewed, 56% were found collecting CAT (Figure 2). 36% HHs collected CAT for own use in the house and 20% of them collected for sale. Figure (3) shows the different uses of CAT as reported by the local people such as for food, medicine, household use, and sales. The frequency of HHs collecting CAT was: Amriso>Timur>Chiraito. That means more households collected Amriso than Timur and Chiraito. More households collected Timur than Chiraito (Figure 3).

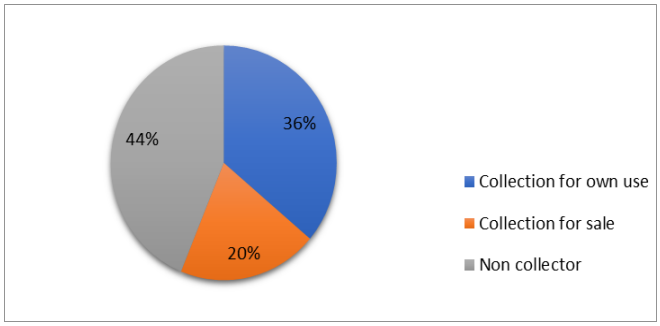

Figure 2: HHs involved in CAT collection and use

Most of HHs collects CAT for medicine, food, and HH use purposes. Their preference for CAT for HH use is Amriso which was found in nearby forest and easy to collect. The second largest purpose of collection was for food/spices from Timur. 20% of the HHs collected Chiraito for medicinal purpose, which shows that the dependency on Chiraito for medicinal use is very low, it may be because of the easily available of health posts near the area (Figure 2).

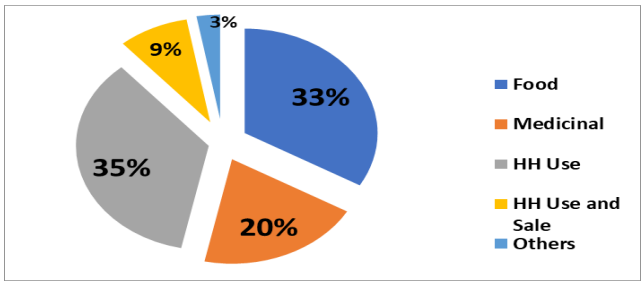

Figure 3: Purpose of Collecting CAT

Annual Collection of CAT and Market Price

On average, 0.38 kg of Chiraito was collected with 0.1 kg and 1 kg minimum and maximum, respectively, annually. The average market price of Chiraito according to them was NRs 350 per kg. Similarly, the average value 7.28 Bhari of Amriso followed by 0.62 kg of Timur was

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found to be collected annually in the research sites. Average market price of both items (Amriso per bhari and Timur per kg) is NRs 1,000 (Table 1).

Table 1: Descriptive of Average Annual Collection and Market Price

Name	Min	Max	Avg. Quantity Collected	SD	Avg. Market Price (NRs)/ unit
Chiraito (Kg)	0.1	1	0.38	0.04	350
Amriso (Bhari)	5	50	7.28	1.02	1000
Timur (Kg)	0.1	2	0.62	0.08	1000

Note: Bhari is a bundle to carry in the back of a person.

Resource Condition of CAT

Resource condition of CAT as compared before five years is found to be in an increasing trend. 24%, 68%, and 60% of the respondents said that the resource conditions of Chiraito, Amriso, and Timur are, respectively, increasing. On average, 21% says the resource condition is the same as compared before five years. Similarly, the largest (54%) of respondents was on a decreasing state in the case of Chiraito. Only a small percentage 11% and 18% was on decreasing condition of Amriso and Timur, respectively. Therefore, Resource Condition of CAT as compared before five years is seen increasing in the case of Amriso (68%) and Timur (60%), but 34% of the people argue that Resource Condition of Chiraito is Decreasing in the study area (Figure 4).

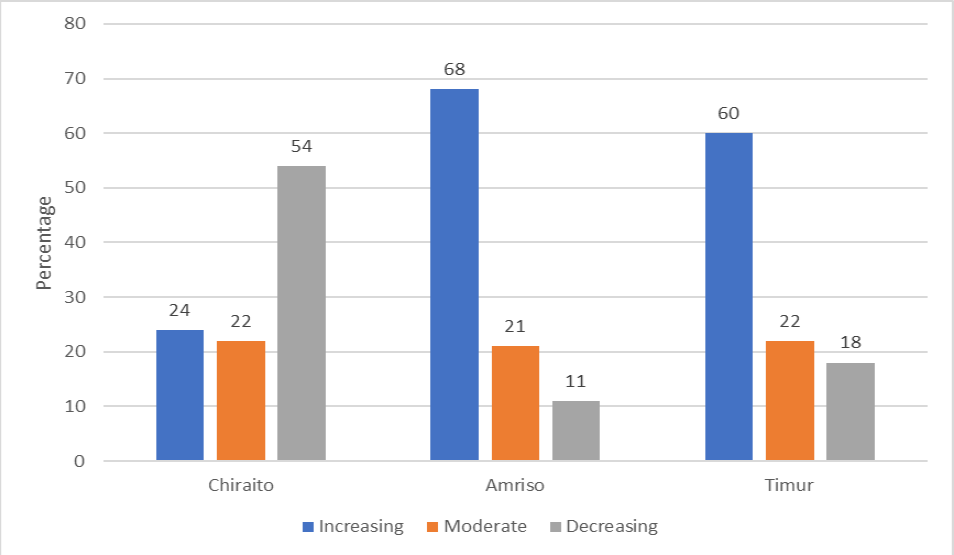

Figure 4: Resource Condition of CAT

Market Potentiality of CAT

All three NTFPs have high market potentiality, but very few collected quantities are traded in market.

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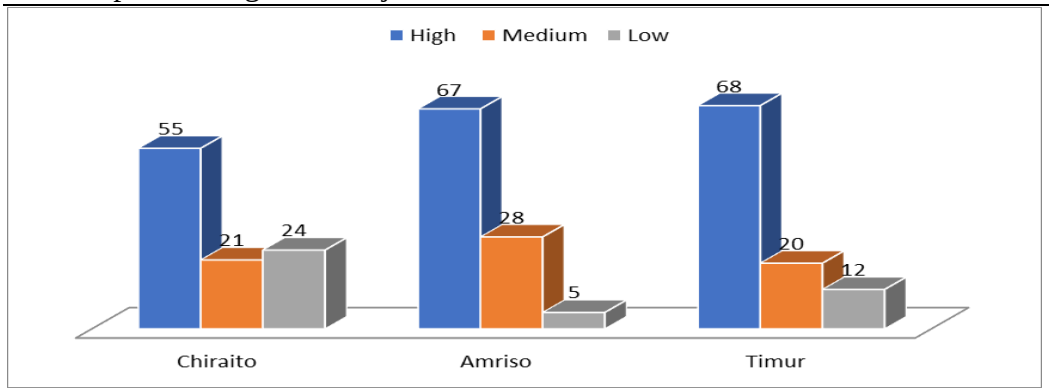

Figure 5: Market Potentiality on CAT

Out of the total respondents, 68%, 20%, and 12% of the HHs perception is high, medium, and low, respectively, in case of Timur. In the same way, 67% of the respondent's perception towards Amriso was found to be high, followed by 28% and 5% with medium and low accordingly. Similarly, 55% of the respondents argue for the high market potential of Chiraito (Figure 5).

As a result, Market Potentiality of CAT is Seen High (55%, 67%, and 68% resp.) Amriso and Timur in comparison to Chiraito are seen to have more market potentiality. It may be because of the high availability of Amriso and Timur in the study area.

Factors affecting the Collection of CAT

The significant variables that affect the collection were age, Large Family Size, illiterate peoples, and near users are more likely to collect CAT.

Table 2: Factors affecting the collection of CAT

Variables	Coefficient	S.E.	P value	Exp(B)
Age	0.115**	0.046	0.012	1.122
Sex (1= Male)	-1.028	1.007	0.307	0.357
Family size	0.539*	0.296	0.038	1.715
Education (1= Illiterate)	2.886***	0.962	0.002	17.93
Distance to reach forest	-0.182*	0.081	0.025	0.832
Marital status (1= Married)	-0.223	0.601	0.405	2.059
Constant	-3.985	2.819	0.157	0.018

*, **, *** means significant at 10 percent, 5 percent, and 1 percent respectively and Exp(B) represents the exponentiated coefficient of a predictor variable

The result of the logistic regression show that all independent variables jointly account for the variation in the dependent variables. Among the 6 variables used in logistic regression revealed that age, family size, education and distance to resources from their home are the more responsible factors for the collection of CAT. An increase or decrease in any of the said variables will lead to a corresponding increase or decrease in the CAT collection (Table 2).
The positive relationship between Family Size, distance from home and collection ($p<0.1$) implies that large family size and users near to the forest are more likely to collect CAT than other Variables. As the estimated coefficient of Age ($P< 0.05$) with positive values revealed that as the age increases, they are expected to be more likely in collecting CAT. It may be because of the involvement of young and old age people in the collection. It also makes obvious that the education status of the respondents is positively and significantly correlated with the collection of CAT which revealed that illiterate people are more interested in going to collect CAT in comparison to literate people. It may be because literate people are

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involved in other activities.

DISCUSSION

A small percentage of HHs perceives the decreasing condition of resources in the past five years (Figure 4). Qualitative results from the key informant interviews explored that intensive and market-based collection of Chiraito is damaging the resource site as well as its sustainability. Current harvesting pattern of Chiraito in the study area could be due to fast commercialization among CAT and destructive harvesting is a serious problem especially for Chiraito species whose whole parts and roots are traded. Respondents observed that presently the availability of commercially valuable Chiraito is scarce, and they are now scattered and sparse. Therefore, people had to spend more time to collect fewer amounts of Chiraito species, and it is labor intensive as well. The reasons behind the depletion of CAT were intensive over-collection and premature collection to make more money in short periods of time. Some NTFP related study shows that collectors under pressure from food sufficiency (Roy, 2010) and high market demand (Sundriyal *et al.,* 2012) lead to exploiting more resources to make money and could be due to high competition among collectors. Findings of Pandit et al.(2003) also showed that CAT species were being harvested even before they matured, partly because of the collector's fear that others would harvest those NTFPs before them.

CAT is collected by the HHs either for subsistence or commercial purposes (Figure 2). There is high dependency of local people on CAT for livelihood and commercial purpose. From the study area, all three types of NTFPs were collected and sold by HHs either instantly after collection or to local traders. Which is very less in comparison to other studies in the country such as Subedi (2006) recorded 163 NTFPs harvested for commercial purpose, a study by Rijal *et al*. (2011) in lowland found 23 products and 63 species being traded and 76 species by Sundriyal *et al.* (2012), however this study covered large portion compared to this study. This study found that a large number of CAT was collected for food and HH purpose and few of them were traded (Figure 3). The difference between the numbers of collected CAT for medicinal purposes and traded is large, which indicates that the other NTFPs species have equal economic potential in the market, but they are not yet marketed by people as these are highly traded in other parts of country. The result also shows that more than 60% of the respondents perceived that the market potential of the generally collected CAT is high (Figure 5). Direct observation revealed that a few numbers of tradable products is another factor limiting cash income from the trade so that commercialization value addition could be a good options. Studies have reported that market saturation due to a limited number of markets also affects the amount of cash income received from the selected products (Pettenlla *et al.,* 2013). Similarly, direct observation also revealed that CAT market is demand-based; driven by larger NTFPs traders in the urban area. Gauli and Hauser (2011) concludes that commercialization of non-timber forest products does not automatically result in equitable income benefits for everyone, whereas, locally- crafted rules and norms do.

Several authors have analyzed and discussed the forest products including NTFPs and dependency of HHs on wealth and in terms of economic returns (Marasini *et al.,* 2006; Rijal, 2011; Adhikari, 2004; Arun, 2004). They are reported that households with low economic status rely heavily on forest resources. However, the HHs level, what factor motivates them to collect has not been discussed yet. Present findings substantiated with the outcome assumed by Coomes and Barham (1997). They suggested a more general relation between a family's wealth endowment, its resource use pattern, and income generation portfolio.

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Moreover, Coomes *et al*. (2004) suggest that a family's geographic location, factors such as age, gender, and skills influence natural resource use. The result of this study revealed that the collection of CAT is insignificant to sex of the respondents (Table 2). This implies that sex of the respondents did not have any significant value in the collection of CAT. Dangol *et al*. (2011) stated that HHs having better education, food sufficiency, and other sources of income are less involved in the collection and sale of NTFPs. Additionally, regression analysis demonstrated that the positive relationship between age, education and family size are the motivational factors to involve in the collection of CAT indicating this similar with the findings of Rijal (2011), Adhikari (2004), Angeleson *et al*. (2003).

Findings of this study revealed that the collection of CAT by HHs is significant and has a positive relationship with near resources (Table 2), which is in line with the findings of Opaluwa *et al.* (2011). This may be due to the fact that people of the study area prefer near areas where high valuable medicinal as well as commercially tradable NTFPs are found. The same author also points out that larger family size and education factors were significant to the collection of NTFPs.

CONCLUSION

CAT is becoming an increasingly important source of medicine, food, and HH use for rural households of Panchase. Majority of the local people are involved in the collection of CAT, with their support to livelihood and income generation. Amriso and Timur have increased in stock than before, but the case of Chiraito is reverse. There is high market potentiality of CAT indicating scope of further expansion of cultivation. The significant variables that affect the collection were age, large family size, illiteracy, and near users are more likely to collect CAT. Besides setting rules and regulations for sustainable harvesting of CAT, PPF and FUG can provide institutional backup for the community and lend a group voice to bargain for better prices by using an 'integrated approach' is recommendable.

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Authors' Contributions

Mr. Sandesh Bolakhe designed and conceptualized the research, collected and analyzed data and prepared the first draft of the manuscript. Mr. Pramod Ghimire reviewed and edited the manuscript. Dr. Gandhiv Kafle edited and enhanced the manuscript many times and managed the submission process to the journal as corresponding author.

Conflict of Interest

The authors declare that there is no conflict of interest.

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